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Review Article

Interactions Between Autoimmune Diseases and Micronutrient Deficiencies The Case of Hashimoto's Thyroiditis

Kostiukow A[1], Romanowski MW[1], Ignaszak E[2], Poniewierski P[1], Jajor J[1*] and Samborski W[1]

[1]*Department of Rheumatology and Rehabilitation, Poznan University of Medical Sciences, Poland*

[2]*State University of Applied Sciences, Poland*

[*]**Corresponding author:** Julia Jajor, Department of Rheumatology and Rehabilitation, Poznan University of Medical Sciences, Poland, Tel: +793 389 071; E-mail: julia.jajor@gmail.com

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Abstract

One of the most common autoimmune diseases is autoimmune thyroiditis. There are currently few publications describing the role of vitamins in the prevention and treatment of these diseases. In patients with autoimmune thyroiditis, with special attention to Hashimoto thyroiditis, deficiencies of many vitamins are observed. These include antioxidant vitamins, such as A, C and E. There are also deficiencies of vitamin D. The proper diet demand for the vitamins above is an essential element supporting the adequate functioning of the thyroid gland. Medical data suggest the beneficial role of vitamin deficiencies, particularly vitamin D, in the development of autoimmune thyroid diseases and supplementation. Literature review indicates the need for further research in this area.

This article is a review of the medical literature on the subject of autoimmune diseases and vitamin deficiencies in autoimmune thyroiditis. For this purpose, a scientific database was searched for the following keywords: autoimmune diseases, immune system, hypersensitivity, vitamins, vitamin deficiencies, autoimmune thyroiditis, Hashimoto thyroiditis.

Keywords: Autoimmune diseases; Immune system; Hypersensitivity; Vitamins; Vitamin deficiencies; Autoimmune thyroiditis; Hashimoto thyroiditis

Introduction

Autoimmune diseases are now an increasingly common problem affecting modern society [1]. Epidemiological studies conducted over the last few years prove that 3-8% of people from the entire population develop autoimmune disorders [2] and in this group the most common diseases (about 94%) are: Hashimoto's thyroiditis, Graves' disease, Diabetes mellitus type 1, Pernicious anaemia, Rheumatoid arthritis, Acquired vitiligo, Systemic lupus erythematosus and Multiple sclerosis [3]. Ue list of diseases is very long and according to various sources can contain from 80 [4] to even more than 150 disease entities [5].

Functioning of the Immune System

Understanding the functioning of the immune system is the basis for understanding the autoimmune processes. Uis system consists of various types of cells, tissues and organs. Most of these cells are located in lymph organs (thymus, spleen, lymph nodes) or glands. Ue immune system is designed to protect the body against attacks by bacteria and parasites. Specialized organs filter bacteria that enter the tissues, while cells and molecules of the circulatory system respond to pathogen attacks [3]. Uis system helps in maintaining the integrity of the internal environment of the body by participating in removing what is foreign to it. It may also cause necrosis of their structures recognizing them as foreign under certain conditions [6]. Ue structures that induce an immune response are called antigens. Ue antigen molecule may contain many different or the same antigenic determinants that can lead to antibody synthesis in the human body or the formation of effector cells. Antibodies also are known as immunoglobulins and glycoproteins which can bind antigens with high affinity and specificity. In the human body are five classes of antibodies which can be distinguished: IgA, IgD, IgE, IgG, IgM. Uey can neutralize toxins or viruses and block such fragments that are dangerous for the biological activity of antibodies, and they can induce programmed cell death (apoptosis) [3]. Ue immune response is composed of 4 elements: an early, innate (non-specific) response to the penetration of structures recognized as foreign, a specific response to a specific antigen and the strengthening of the unspecific response [7]. Innate immunity is the first line of defense against infections. It can develop within a few hours of stimulation leading to acute inflammation. It shows certain specificity for bacterial antigens, but it has no memory. Acquired immunity response is the second line of defense, and it develops slowly. It is highly specific, aimed precisely at specific antigens unlike innate immunity. Uis response can remember [8]. Two types of lymphocytes are involved in this type of immunity: B and T. B lymphocytes mature in the bone marrow. During antigen stimulation antibodies develop and begin to be secreted [7]. Uey take part in the humoral response producing soluble immunoglobulins. T-lymphocytes mature in the thymus and represent a cell-mediated response. Ue development of the immune response requires cooperation between B and T lymphocytes and antigen which is presenting in cells [3]. Among the antibodies and receptors produced by lymphocytes are also those that can identify their antigens. Ue cells which produce them are called cells with autoreactive potential. In the case of recognizing own antigens a set of mechanisms maintaining the state of autotolerance is started (no humoral and cellular response to own antigen). Disruption of this state leads to initiation of an immune

response against own tissues which is the essence of autoimmune phenomena [9].

Factors Causing Autoimmune Diseases

Autoimmunity can be defined as an immune response of the body directed against its antigen or group of antigens. However, autoimmune disorders are the inability of the immune system to distinguish between foreign and own antigens where human system destroys own tissues [10]. Genetic and environmental factors play a decisive role in the development of autoimmune diseases [7]. Ue factors include genetic inheritance of certain HLA haplotype which increases the risk of the disease. Ue proof occurrence of numerous autoimmune diseases in the genetically burdened family are more oIen than in other families. Polymorphisms or mutations play an important role in the activation and suppression of lymphocyte [3].

On the other hand, environmental factors may influence the formation of autoimmune processes, for example: hormones, drugs, infections and other factors (e.g. ultraviolet radiation). Hormones play a special role in increasing morbidity which confirms the fact that women suffer more oIen than men. Ue peak of incidence falls on reproductive age which is a confirmation that oestrogens can be a triggering factor. Also, the administration of certain drugs may be associated with the development of idiosyncratic side effects in case of autoimmune disorders. However, it is usually a reversible process aIer drug withdrawal [7]. Also, infectious agents (EBV, Streptococci, Klebsiella, Mycoplasma, Malaria urticaria, etc.) can influence the development of autoimmune diseases [3]. All mentioned factors are dependent on the phenomenon of the so-called molecular mimicry. Ue similarities that exist between antigens of microorganisms and antigens (autoantigens) in the human body is a homology which may lead to the generation of autoantibodies and then to the cross-development reaction which consequently triggers an autoimmune disease by targeting the immune system against its tissues. However, these similarities between antigens do not always result in autoimmune disorders [4]. Other factors include psychological stress and dietary aspect [7]. Ue development mechanisms of autoimmune diseases and in addition to the aforementioned molecular mimicry also include modification of self-antigens by microorganisms, polyclonal activation by antigens of microorganisms, incorrect regulation of responses by U1 and U2 cells and changes in the access of own antigen [3]. Research over the last few years has also shown that the composition of the intestinal flora exerts a significant influence on the regulation of the immune response, which may contribute to disorders. Ue evidence was a change in the intestinal flora profile, i.e. dysbiosis in many people with autoimmune diseases. However, it has not been explained yet how the microbiota can regulate the immune system [11].

Types of Hypersensitivity

An autoimmune disease can cause tissue damage or a physiological dysfunction due to an autoimmune response [7]. Ue development of the disease is caused by the self-antigen tolerance disorders (Table 1) [3]. Ue essence is the impairment of own tissue tolerance caused by the disorder of T lymphocytes which is leading to the production of antibodies against particular tissue elements [1]. Ue autoimmune process correlates to the phenomenon of "hypersensitivity". Tissue damage (immunopathology) is a result of the excessive activity of the immune system on inactive antigens or microorganisms that cause infections. Uese reactions are antigen-specific and occur aIer prior contact of the immune system with a specific antigen. Depending on the time and place of the reaction of immune mechanisms there are five types of hypersensitivity [3]. In the case of autoimmune diseases, tissue damage is mediated by antibodies (type II and III of hypersensitivity) or activation of macrophages or cytotoxic T lymphocytes (type IV of hypersensitivity). Many diseases are characterized by the predominance of any hypersensitivity. However, overlapping lesions resulting from the actions of both antibodies and T lymphocytes can oIen be observed. Autoantibodies can also cause autoimmune disease by binding to functional sites of their antigens: hormone receptors, receptors for neurotransmitters and serum proteins. Uey can mimic or block the action of an endogenous ligand for its proteins, which causes failures, not necessarily resulting in inflammation and tissue damage. Such situations can be observed in endocrine autoimmune processes in which autoantibodies block or mimic the action of hormones such as thyrotropin inducing hypothyroidism or hyperthyroidism [7].

Antigens	Diseases
Insulin receptor	Hypo- or hyperglycemia
Receptor for TSH	Graves' disease
Keratinocytes of the epidermis	Pemphigus
Acetylcholine receptor	Myasthenia gravis
Platelets	Thrombocytopenic purpura
Membrane antigens of erythrocytes	Haemolytic anaemia
Factor VIII (serum proteins)	Haemophilia acquired
Thyroglobulin / T4	Thyroiditis (Hashimoto)
Thyroid peroxidase	
GAD, tyrosine phosphatase (pancreatic β cells)	Diabetes mellitus
21 - steroidal hydroxylase (adrenal cortex cells)	Addison's disease
Lysosomal enzymes	Systemic vasculitis
Histones Double-stranded DNA	Systemic lupus erythematosus
Exocrine glands, liver, kidney, thyroid	Sjögrena syndrome
IgG connective tissue	Rheumatoid arthritis
Protein myelin (brain)	Multiple sclerosis

Table 1: Examples of antigens in autoimmune diseases [7].

Organ-Specific and Systemic Disorders

Autoimmune diseases may affect each organ in the body, but some of the systems are particularly sensitive (e.g. endocrine glands). Uey can be divided into organ-specific and systemic disorders. Ue first ones usually affect a single organ. Ue autoimmune response is directed against multiple antigens of one organ. Most of these diseases are related to one of the endocrine glands [7]. Antigens of autoimmune processes may be surface molecules of living cells [2] (especially hormone receptors) or intracellular molecules, mainly intracellular enzymes [7]. Ue characteristic feature is the presence in the

circulation of antibodies specific for a specific organ and the presence of an inflammatory mass in target tissues which mainly consists of lymphocytes with an admixture of monocytes [12]. Organ-specific diseases include, among others: Uyroiditis (Hashimoto), Graves' disease, Addison's disease, Hemolytic anaemia, Pernicious anaemia, Diabetes mellitus, Myasthenia gravis, Guillain- Barré syndrome, Pemphigus. Systemic diseases in contrast to organ-specific relate to many organs and are usually associated with an autoimmune response directed against their molecules distributed throughout the body [7]. Most oIen intracellular molecules are involved in the transcription and translation of the genetic code. Uese diseases include, among others: Systemic lupus erythematosus, Scleroderma, Multiple sclerosis, Rheumatoid arthritis, Sjögren's syndrome, Chronic/acute hepatitis, Wegener's granulomatous disease [3]. Autoaggressive diseases can also co-exist with each other creating the so-called autoimmune polyglandular syndromes. More frequent than in the general population can be observed the presence of antithyroid antibodies exist in patients with pernicious anaemia in which autoimmune processes occur in the gastric mucosa. As well patients with autoimmune thyroid disease oIen have antibodies against gastric mucosa [13]. A second example may be patients with type 1 diabetes in whom oIen are detectable antibodies directed against thyroid or antibodies characteristic for celiac disease [2]. Ue occurrence of one of the autoimmune diseases also increases the risk of another parallel disease. Uerefore special attention should be paid to the appropriate diagnosis of the patient [1].

Diet as a Part of Treatment in Autoimmune Uyroi6 Diseases

Autoimmune diseases have a clinically chronic course with periods of exacerbation and remission which can lead to disability or even death of the patient [2]. It is important to choose a proper treatment that restores immune tolerance to self-antigens which is difficult to achieve. Ue treatment is currently based mainly on reducing the inflammatory process [3]. Also, pharmacological methods are very oIen necessary as well as to use a proper diet contributing to the patient's health and well-being.

Incorrect balancing of a low-nutritional diet is considered as one of the factors that increase the risk of many diseases, including hypothyroidism (not all autoimmune thyroid diseases result in hypothyroidism because Graves' disease is characterized by autoantibodies directed to the TSH receptor and presents with hyperthyroidism) [14]. Uerefore, maintaining the proper functioning of the thyroid requires supplying food with the right amount of nutrients, including vitamins [15]. Among those which deficiency may favour dysfunctions of the thyroid are: vitamin D, vitamin A and vitamins from the group B [14]. Uey can interact directly or indirectly with thyroid [15]. Ue holistic approach to thyroid diseases treatment, in addition to pharmacological treatment, should also apply a properly balanced diet and lifestyle [14].

Antioxidant vitamins

In patients with autoimmune thyroiditis deficiencies of many vitamins are observed, among which antioxidant vitamins are mentioned. Many researchers point the important role of increased oxidative stress in the pathogenesis of autoimmune thyroiditis. Antioxidant vitamin deficiencies lead to the development of oxidative stress and disruption of homeostasis, which can cause structural and functional damage to cells. Consequently, the reactive oxygen species which are called free radicals contribute to the damage of the function of the thyroid [16]. Research carried out by Markiewicz- Zukowska et al. [15] regarding vitamin content in the diets of women suffering from Hashimoto indicate significant deficiencies of the discussed vitamins (Figure 1).

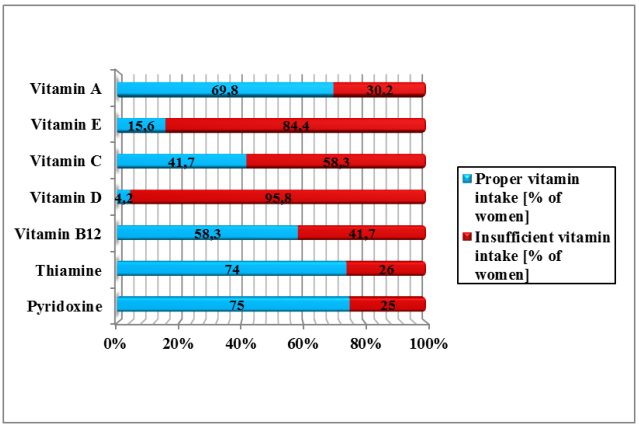

Figure 1: Ue content of vitamins in the diets of women suffering from Hashimoto [15].

Ue diet of people suffering from autoimmune thyroiditis should cover the need for vitamins belonging to antioxidants, such as vitamin A, C and E. Uey counteract free radicals, alleviating the oxidative stress that contributes to the destruction of thyroid tissue cells [17]. Also, it has been shown that vitamin C may increase the absorption of oral levothyroxine (levothyroxine is an iodine-containing levodine synthetic analogue of natural thyroxine, it affects similar to thyroid hormones and is administered orally) [15]. Ue occurrence of vitamin A deficiencies in autoimmune thyroiditis may be associated with decreased iodine absorption by the thyroid gland and limited synthesis and secretion of thyroid hormones [16]. Metabolism of vitamin A is closely related to the activity of the hypothalamus-pituitary axis – thyroid. Ue diet low in this vitamin has an impact on the functioning of the pituitary axis - thyroid and thus effects the regulation of thyroid hormone metabolism and inhibition of secretion of TSH [14,16,18]. It has been proven that a diet with a reduced content of both vitamin A and iodine may contribute increased risk of hypothyroidism compared to a poor iodine diet [16,17]. Studies carried out in children with a severe deficiency of iodine and vitamin A have proven that this deficiency may increase the secretion of TSH and effect of thyroid enlargement [16]. A strong correlation was found between the size of the thyroid and the severity of vitamin A deficiency [18]. Only a few studies have been carried out assessing the effect of vitamin A supplementation on thyroid function and treatment of Hashimoto's disease [19]. Uat supplementation with this vitamin may affect the activity of TSH. Leading to a decrease in its concentration and reducing the risk of appearance or reduction of the size of the thyroid [18,16]. Uat is evidenced from a 4-month, randomised, double-blind study conducted by Farthang et al. on 84 pre-menopausal women who showed the supplementation with vitamin A. Ue results are shown in a significant reduction in the serum of TSH levels and may, therefore, reduce the risk of subclinical hypothyroidism [19].

B vitamins

It has also been noted an increased incidence of deficiency of vitamin B in patients with autoimmune thyroiditis which is necessary for the proper functioning of the body [15,16]. Vitamin B6 contributes to the conversion of iodine into thyroid hormone, and its lack can significantly worsen the hypothyroidism of this gland [15]. Animal studies regarding the activity of the hypothalamic-pituitary-thyroid axis in relation to the deficiency of vitamin B6 confirmed that the deficiency might lead to hypothyroidism which results are shown in decreased TSH synthesis in the hypothalamus. Supplementing this vitamin deficiency caused normalisation of thyroid hormone levels. Excessive supply, in both human and animal studies, led to a decrease in TSH levels. On the other hand, there are reports of possible negative effects of using higher than physiological doses of vitamin B6 [18]. In patients with Hashimoto, the lack of or low levels of hydrochloric acid is oIen noticed. Uiamine which participates in the conversion of carbohydrates into energy is necessary for the process of assimilation of proteins and fats. It is involved in the release of hydrochloric acid in the stomach, indispensable in the digestion of proteins (not only thiamine but all B-vitamins have carrier functions in the pathways leading from carbohydrates, fats, or proteins to AcCoA and via citric acid cycle and oxidative phosphorylation to ATP replenishment). Ue main symptom of its deficiency is chronic fatigue in Hashimoto [20]. Costantini and Pala [21] in their research put forward the hypothesis that chronic fatigue that accompanies autoimmune diseases may be the result of a moderate deficiency of vitamin B1. A research which been conducted among three women with Hashimoto who were treated with an oral dose of thiamine or in injections showed that treatment with vitamin B1 may lead to partial or complete regression of fatigue. It has been concluded that mild deficiency of this vitamin and related fatigue and other disorders may be caused by dysfunction in the intracellular transport of thiamine or enzymatic abnormalities most likely associated with the autoimmune process in the course of the disease. However, there are no studies confirming this hypothesis. It is suggested that patients with autoimmune thyroiditis should also periodically check a deficiency of another B vitamin, which is vitamin B12 [18]. Ue deficiency of this vitamin in people with Hashimoto was noticed by Ness - Abramof et al. [22]. In a study of 115 patients with autoimmune thyroiditis, they found a decreased level of vitamin B12 in 28% of patients [22]. Periodic tests in this field seem to be justified, due to the frequent coexistence with Hashimoto of other auto-aggressive ailments, including atrophic gastritis and megaloblastic (pernicious) anaemia. It is one of the components of the autoimmune polyglandular syndrome where the most important role is played by vitamin B12 [15,17,18]. Uis correlation is confirmed by many researchers including Centanni et al. [23] whose atrophied gastritis found in 35% of subjects with autoimmune thyroid disease [23]. Other scientists also note a significant correlation between autoimmune thyroiditis and vitamin B12 deficiency. Jaya Kumari et al. [24] noted in their study a deficiency of this vitamin in 45.5% of 350 patients, but they did not notice any significant relationship between the level of vitamin B12 and the concentration of anti-TPO antibodies [24]. In turn, Wentz [25] in her study on the impact of individual interventions on the course of Hashimoto's disease among 2232 people, pointed out the low level of B12 in 33% of respondents. She also noted that these people in 88% declared better mood and reduction of fatigue as a result of taking supplements of this vitamin [25]. Uerefore, the authors emphasise the necessity of routine tests of vitamin B12 concentration in patients at risk due to the non-specificity of deficiency symptoms. Hypothyroidism can potentially mask deficiency due to the coherence of the occurrence of symptoms such as weakness, drowsiness or memory disorders [26]. Ue supply of vitamin B12 in the diet should, therefore, pay special attention to monitor its level in the body [17].

Low vitamin B12 levels may be present not only due to the lack of alimentary supply but also as a result of pernicious anaemia. It is very well known that these two diseases are associated oIen. In this case, B12 in the diet will be ineffective as intrinsic factor deficiency is present. Only parenteral B12 supplementation can be applied.

Vitamin D

In recent years, scientists have also been interested in vitamin D deficiency in Hashimoto patients [27,28]. Numerous studies indicate a low content of this vitamin in the blood serum of patients with lymphocytic thyroiditis. However, it is not entirely clear whether this level is a result of the autoimmune disease process or is one of its causes [29]. It is supposed that these mechanisms are associated with its anti-inflammatory and immunomodulatory effects [30]. Due to the immunomodulatory properties, vitamin D affects the proliferation and differentiation of immune cells as well as the inhibition and maturation of U1 lymphocytes, U2 cell induction and U17 lymphocyte regulation [31,20]. Mechanisms of functioning in the immune system of vitamin D suggest that its deficiency may be disrupting the immune balance and be one of the environmental factors important in the development of Hashimoto. Uere are also indications of the role of the VDR polymorphisms of disease aetiology, which may also be one of the genetic factors [32]. On the other hand, vitamin D is attributed to the properties that influence the inhibition of the inflammatory process by weakening the increased activity of the immune system cells involved in autoimmune reactions [33]. Most of the available studies indicated an increase in vitamin D deficiency and its decreased concentration in the group of people with Hashimoto compared to the control group. Ue differences relate to the correlation of vitamin D concentration in relation to the hormonal activity of the thyroid gland and the activity of the autoimmune process in the assessment of antithyroid antibodies (Table 2) [28,30,34-38].

		Kivity et al.	Bozkurt et al.	Unal et al.	Maciejewski et al.	Mazokopakis et al.	Kim
Year		2011	2013	2014	2015	2015	2016
The period in which the test was carried out		Mar-06	June - August	-	January - March	April - September	March 2005 - June 2009
Country		Hungary	Turkey	Turkey	Poland	Greece	South Korea
The number of people	Group with HT	28	360	254	62	218	221
	Control group	98	180	124	32	-	407

participating in the study							
The average age	Group with HT	-	42.5 ± 11	44.6 ± 13.5	49.15 ± 15.51	35.3 ± 8.5	45.4
	Control group	-			46.09 ± 14.32	-	
The extent of vitamin D deficiency		<10 ng/ml	<10 ng/ml	<20 ng/ml	<50 nmol/L	<30 ng/mL	<20 ng/ml
The average level of vitamin D of the subjects	Group with HT	-	12.2 ± 5.6 ng/mL	19.4 ± 10.1 ng/ml	20.09 ± 12.66 nmol/L	18.4 ± 6.3 ng/mL	36.9 ± 23.0 ng/mL
	Control group	-	15.4 ± 6.8 ng/mL	22.5 ± 15.4 ng/ml	30.31 ± 19.49 nmol/L	-	39.9 ± 21.5 ng/mL
Number of people with vitamin D deficiency (%)	Group with HT	79	41.5	63	98.4	85.3	48.9
	Control group	52	20.5	51	84.4	-	37.1
Medium level of TSH	Group with HT	-	Group I – 2.7 ± 1.5 mIU/mL Group II – 2.6 ± 1.4 mIU/mL	2.47 mIU/ml	1.2 mIU/L	2.3 ± 1.6 µIU/mL	-
	Control group	-	21 ± 0.1 mIU/mL	1.75 mIU/ml	-	-	-
Medium level anti TPO [IU / mL]	Group with HT	-	Group I – 630.4 Group II – 411	117.68	889	296.7 ± 115	-
	Control group	-	20,4	0.26	-	-	-
Medium level anti TG	Group with HT	-	Group I – 168 U/mL Group II – 137 U/mL	29.4 IU/ml	549 IU/mL	13.8 ± 8 IU/mL	-
	Control group	-	18 U/mL	1.43 IU/ml	-	-	-
Other		The study also included 22 patients with Graves' disease, who also had a deficiency of vitamin D (64% of the subjects) and 42 patients without autoimmune thyroid disease who had a significantly less prevalent vitamin D deficiency (52% of subjects).	180 people (in the state of euthyreosis) suffering from HT at least 6 months and treated with L-thyroxine and 180 people (in the euthyroid state) with newly diagnosed HT disease took part in the study.	The study was conducted on newly diagnosed patients. The study also involved 27 patients with Graves' disease whose also had a deficiency of vitamin D (85.2% of subjects).	All patients during the study were in euthyreosis. The duration of the disease ranged from several months to three years.	After administration of oral supplementation with vitamin D3 to patients with a deficiency for 4 months at a dose of 1200 - 4000 IU of cholecalciferol, there was a decrease in anti-TP (by 20.3%), antiTG (by 5.3%) and TSH (by 4%) .	Among patients with overt hypothyroidism, there was a significantly higher prevalence of vitamin D deficiency than those with subclinical hypothyroidism or euthyroidism. The study also included 148 patients diagnosed with Graves' disease, who also had a deficiency of vitamin D (41.9% of subjects).
* HT– Hashimoto							

Table 2: A review of studies assessing the relationship between vitamin D levels and Hashimoto's disease [27,28,30,34,35,38].

A study conducted by Kivity et al. [34] showed that the prevalence of vitamin D deficiency was significantly higher in patients with autoimmune thyroid disease (72%) than in healthy patients (30.6%) and in patients with Hashimoto (79%) compared to patients without autoimmune thyroid disease (52%). Also, there was an increase in TSH values with an increase in vitamin D deficiency and an inverse correlation between vitamin deficiency and the presence of positive antithyroid antibodies [34]. Ue analysis carried out by Bozkurt et al. [35] also showed a statistically significant lower concentration of vitamin D in the group of Hashimoto patients compared to the control group. Vitamin deficiency correlated with the duration of the disease, thyroid volume and the level of antithyroid antibodies. High vitamin D deficiency occurred mainly in Hashimoto patients treated with l-thyroxine (48.3%). A lower deficiency had patients in the euthyroid stage (35%) and in the control group it concerned much less (20.5%). Authors of this study suggest that the deficiency of vitamin D which

lasts for a longer period as a stimulant of the process of the autoimmune thyroid gland may contribute to its progression and destruction [35]. Other researchers, Mazokopakis et al. [30] also observed a decreased level of vitamin D in Hashimoto patients and a negative correlation between its serum concentration and the level of anti-TPO antibodies which was found in all subjects. Ue level of these antibodies was significantly higher in patients with vitamin D deficiency (186/218 subjects) compared to the patients with normal vitamin D (32/218 subjects). Interestingly, aler applying a 4-month supplementation, it has been dropped by 20.3%. Uese researchers suggest that vitamin D deficiency may be associated with the pathogenesis of Hashimoto and its supplementation may be useful in the treatment of patients with this disease [30]. On the other hand, in the medical literature are studies showing little or no relationship between low vitamin D level and autoimmune thyroid disease [29] and they are also demonstrating a weak correlation between the duration of Hashimoto. Because of only few analyses which are available in the medical literature there is no allow to confirm the influence of this factor on the concentration of vitamin D [39].

Most researchers agree that further large-scale randomised, controlled trials are needed to determine whether vitamin D deficiency plays a significant causative role in the pathogenesis of Hashimoto's disease or is its outcome and whether supplementing of vitamin D deficiencies affects, prevention or/and disease progression [30,35,38,40,41].

Conclusion

Ue proper diet demand for vitamins above is an essential element supporting the pharmacotherapy and supporting the proper functioning of the thyroid gland [17]. However, despite the widespread belief of the beneficial effects on health and common availability of vitamins, there are currently only few publications describing the role of vitamins in the prevention and treatment of thyroid diseases [18].

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