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IMPACT OF DIETARY INTERVENTION ON THYROID FUNCTION IN PATIENT WITH HASHIOMOTO THYROID DISEASE

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Abstract

Background: *Hashimoto's thyroiditis (HT) is a common autoimmune disorder leading to hypothyroidism, driven by chronic lymphocytic infiltration and antibody-mediated thyroid destruction.* ***Objective:*** *This study aimed to evaluate the effect of a structured dietary intervention on thyroid hormone profile and autoimmune markers in patients with Hashimoto's thyroiditis.* ***Methods:*** *This prospective interventional study was conducted at Services Hospital, Lahore from January 2025 to June 2025. 105 patients aged 18–60 years were included in this study. Participants followed a 12-week structured dietary plan emphasizing selenium- and vitamin D–rich foods, omega-3 fatty acids, antioxidants, and avoidance of processed or inflammatory foods. Baseline and post-intervention assessments included serum thyroid-stimulating hormone (TSH), free thyroxine (fT4), free triiodothyronine (fT3), anti-thyroid peroxidase (anti-TPO), and anti-thyroglobulin (anti-Tg) antibodies.* ***Results:*** *Out of 105 patients, 87 (82.9%) were female and 18 (17.1%) male, with a mean age of 38.6 ± 9.4 years. After 12 weeks, mean TSH decreased from 6.9 ± 2.3 to 4.8 ± 1.9 mIU/L ($p < 0.001$), fT4 increased from 0.83 ± 0.16 to 0.95 ± 0.15 ng/dL ($p = 0.002$), and fT3 rose from 2.4 ± 0.6 to 2.8 ± 0.7 pg/mL ($p = 0.011$). Anti-TPO titers declined from 420 ± 170 to 310 ± 160 IU/mL ($p < 0.001$) and anti-Tg from 280 ± 110 to 210 ± 100 IU/mL ($p = 0.004$). Strong positive correlations were observed between reductions in antibody titers and improvements in thyroid hormones ($r = 0.61–0.68$, $p < 0.001$).* ***Conclusion:*** *It is concluded that structured dietary intervention significantly improves thyroid function and reduces autoimmune activity in patients with Hashimoto's thyroiditis. Incorporating anti-inflammatory, nutrient-dense foods and correcting micronutrient deficiencies may serve as an effective adjunct to conventional therapy.*

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INTRODUCTION

HT (chronic autoimmune thyroiditis) is the most common cause of hypothyroidism in iodine-sufficient areas of the world. Infiltration and destruction of the thyroid gland by lymphocytes occurs in a gradual and progressive fashion [1]. There is ultimately a failure in the production and secretion of thyroid hormones. The condition predominantly occurs in women during middle age and has a female-to-male ratio of almost 10:1, indicating the influence of both genetics and hormones on the immune system [2]. Even though it has a chronic and insidious course, HT is primarily an indication of the imbalance of the endocrine system and the immune system. The imbalance occurs due to the interaction of environmental factors and genetic factors [3]. The most common treatment for HT is lifelong replacement of levothyroxine when hypothyroidism develops. Although this procedure successfully restores thyroid hormone, it does not deal with the autoimmune illness or inflammation [4]. Recently, the effect of lifestyle on autoimmune disorders and the resultant clinical and biochemical statuses has altered the understanding of HT from an essential autoimmune illness from which no other therapy is attempted to an autoimmune illness in which dietary modifications may improve the clinical outcome [5]. The micronutrient iodine, selenium, zinc, vitamin D, and iron are key cofactors and become relevant when discussing autoimmunity [6]. Selenium is part of the enzyme's glutathione peroxidase and iodothyronine deiodinases. It helps reduce the oxidative stress of the thyroid. Several interventional studies noted improvement in subjective wellness in patients with Hashimoto's Thyroiditis (HT) after selenium supplementation, which heterogeneous results, and postulated that the selenium supplementation reduced anti-thyroid peroxidase (anti-TPO) antibody titers. Selenium is not the only important nutrient [7]. The relative proportion of macronutrients and overall dietary trends and patterns has important consequences. Diets high in refined carbohydrates, trans fats and other highly processed foods are sought to be pro-inflammatory and in turn aggravate autoimmunity [8]. On the flip side, the Mediterranean diet and plant-based diet that are rich in omega-3 fatty acids, antioxidants, polyphenols, and other fibers and are anti-inflammatory, promote better immune modulation and are associated with oxidative damage alleviation [9]. Striking a balance in dietary trends and patterns is key when modulating inflammation [10]. Recent studies have identified the gut-thyroid axis, wherein dysbiosis, increased permeability of the gut, and other factors contribute to the autoimmune pathogenesis, and suggests that the dietary contributions to the diversity of the gut microbiome through probiotic and prebiotic foods and gluten reduction may affect thyroid autoimmunity through the gut microbiome [11]. The elimination of gluten has been a widely publicized dietary intervention for Hashimoto's thyroiditis due to the higher incidence of celiac disease and non-celiac gluten sensitivity in patients with autoimmune thyroid disease [12]. Though not universally beneficial, gluten-free diets have been observed to provide benefits in certain patients. These patients have been described as having concomitant antibody positivity to thyroid autoantibodies, mainly anti-thyroid peroxidase (anti-TPO), anti-thyroglobulin (anti-Tg) and with gastrointestinal symptoms [13]. The restriction of lactose in patients who have been described with concomitant lactose intolerance has also been described to improve levothyroxine (L-T4) absorption and allow stabilization of thyroid function tests. It should be noted that the evidence to support these findings is limited, and these patients may end up with poor dietary adherence and nutritional deficiencies due to unregulated dietary over-restriction [14].

Objective

This study aimed to evaluate the effect of a structured dietary intervention on thyroid hormone profile and autoimmune markers in patients with Hashimoto's thyroiditis.

Methodology

This was a prospective interventional study conducted at Services Hospital, Lahore from January 2025 to June 2025. 105 patients with confirmed diagnoses of Hashimoto's thyroiditis were included in the study. Participants were selected using non-probability consecutive sampling. Inclusion criteria included individuals of both sexes, aged 18 to 60, and with a confirmed diagnosis of Hashimoto's thyroiditis based

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on elevated levels of either anti-thyroid peroxidase antibodies or anti-thyroglobulin antibodies combined with corresponding ultrasound findings. Participants were screened to ensure that their doses of levothyroxine had been stable for at least six weeks prior to the study. Patients with coexisting autoimmune conditions or poorly controlled comorbidities, including pregnancy and lactation, as well as those receiving immunomodulatory or corticosteroid treatments, were excluded. Dietary non-compliance and incomplete follow-up data were also reasons for exclusion.

Data Collection

Data Collection and Preparation on Clinical and Demographic Information Using a Clinical Profile Structured. Age, Gender, Duration of Disease, BMI, and Dietary History Information. The First Laboratory Assessment to Measure TSH, fT4, fT3, anti-TPO, and anti-Tg was Conducted and Then a Baseline Assessment to Evaluate Laboratory Values. The venous blood sample and fasting were Taken for 10 Hours and then Collected for Laboratory Tests, and Performed Assays Using Chemiluminescent Immunoassay. The Structured Diet Plan was Provided Afterwards, which was Counseled by Clinical and Nutritionist. The Diet Focused on Whole Foods with Anti-Inflammatory Properties and Removal of Processed Foods, Refined Sugars, and Trans Fats. The Volume of Foods with High Selenium, Fortified Vitamin D Foods, Omega 3, and Fiber Sugars Vegetables was Suggested. Dietary Plan for Gluten and Lactose was Removed. The Plan was made and Standard Intervention for Caloric Needs. Clinical Symptoms and Adherence were Assessed Biochemically and Clinically for 6 to 12 Weeks. Adherence to the Diet was Evaluated during Each Visit, which Included a 3-Day Diet Recall and Compliance Checklist. At the conclusion of the twelve-week period, repeat evaluations of TSH, fT4, fT3, anti-TPO, and anti-Tg were conducted. The primary aim was to evaluate the thyroid function control parameters (TSH, fT4, fT3) after the dietary changes. Changes in the autoantibodies (anti-TPO, anti-Tg) and the self-reported symptoms evaluated through a thyroid-specific symptom questionnaire was the secondary aim. The presence of improvement in symptoms was a subjective assessment.

Statistical Analysis

Data were entered and analyzed using SPSS version 26.0. The continuous variables including age, BMI, TSH, fT4, and the antibodies were summarized using the mean, standard deviation, and range. The categorical variables including gender and the level of compliance to the prescribed diet were summarized using proportions and percentage frequencies. The t-test was used to compare the means of the continuous variables over the period of assessment while the chi-square test was used to analyze the categorical variables. All tests was considered statistically significant if the p-value was less than 0.05.

Results

Data were collected from 105 patients, mean age of participants was 38.6 ± 9.4 years, and the majority were female (82.9%), consistent with the known female predominance in Hashimoto's thyroiditis. The participants in our study had a BMI of 26.3 ± 3.2 kg/m² on average which indicates that most participants were overweight. In terms of duration of Hashimoto's thyroiditis diagnoses, just under two-thirds (62.8%) of patients fell under the 'less than 5 years' category. Nearly a third of the patients (29.5%) reported a family history of thyroid conditions, indicating an element of heredity. Impaired immune regulation of the body may be associated with the presence of a considerable proportion (56.2%) of the study population with a lower threshold Vitamin D level (deficiency < 30 ng/mL). The baseline thyroid function assessments were marked by indicators of inadequate functioning thyroid gland with an average TSH of 6.9 ± 2.3 mIU/L and fT4 of 0.83 ± 0.16 ng/dL.

Table 1. Baseline Characteristics of Study Participants (n = 105)

Variable	Mean ± SD / n (%)
Age (years)	38.6 ± 9.4
Gender	

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• Female	87 (82.9%)
• Male	18 (17.1%)
BMI (kg/m²)	26.3 ± 3.2
Duration of Disease < 5 years	66 (62.8%)
Family History of Thyroid Disorder	31 (29.5%)
Vitamin D Deficiency (< 30 ng/mL)	59 (56.2%)

Mean Baseline TSH (mIU/L)	6.9 ± 2.3
Mean Baseline fT4 (ng/dL)	0.83 ± 0.16
Mean Baseline Anti-TPO (IU/mL)	420 ± 170

There was a statistically significant decrease in mean TSH from 6.9 ± 2.3 to 4.8 ± 1.9 mIU/L ($p < 0.001$), suggesting improved thyroid responsiveness. Concurrently, mean fT4 increased from 0.83 ± 0.16 to 0.95 ± 0.15 ng/dL ($p = 0.002$) and fT3 rose from 2.4 ± 0.6 to 2.8 ± 0.7 pg/mL ($p = 0.011$), indicating enhanced hormone synthesis and peripheral conversion. Autoimmune markers also improved: mean anti-TPO declined from 420 ± 170 to 310 ± 160 IU/mL ($p < 0.001$), and anti-Tg decreased from 280 ± 110 to 210 ± 100 IU/mL ($p = 0.004$).

Table 2. Comparison of Thyroid Function and Autoimmune Markers Before and After Dietary Intervention (n = 105)

Parameter	Baseline (Mean ± SD)	After 12 Weeks (Mean ± SD)	p-value
TSH (mIU/L)	6.9 ± 2.3	4.8 ± 1.9	< 0.001*
fT4 (ng/dL)	0.83 ± 0.16	0.95 ± 0.15	0.002*
fT3 (pg/mL)	2.4 ± 0.6	2.8 ± 0.7	0.011*
Anti-TPO (IU/mL)	420 ± 170	310 ± 160	< 0.001*
Anti-Tg (IU/mL)	280 ± 110	210 ± 100	0.004*

Among the participants, 71.4% demonstrated good adherence, 20.9% moderate, and 7.6% poor adherence. Those with good adherence showed the greatest reduction in TSH (–2.5 ± 0.8 mIU/L) and anti-TPO antibodies (–150 ± 70 IU/mL), along with significant improvement in symptom scores (–5.8 ± 1.4, $p < 0.001$).

Table 3. Association Between Dietary Adherence and Improvement in Thyroid Parameters

Adherence Level	n (%)	Mean Δ TSH (mIU/L)	Mean Δ Anti-TPO (IU/mL)	Mean Δ Symptom Score	p-value
Good (≥ 80%)	75 (71.4%)	–2.5 ± 0.8	–150 ± 70	–5.8 ± 1.4	< 0.001*

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Moderate (50–79%)	22 (20.9%)	–1.3 ± 0.9	–80 ± 60	–3.2 ± 1.0	0.021*
Poor (< 50%)	8 (7.6%)	–0.4 ± 0.3	–30 ± 25	–1.1 ± 0.4	0.105

A strong positive correlation (r = 0.68, p < 0.001) was observed between reductions in TSH and anti-TPO, suggesting that the decline in autoimmune activity paralleled improved hormonal regulation. Conversely, fT4 and fT3 changes were inversely correlated with antibody reductions (r = –0.55 and –0.49, respectively), reflecting that as hormone levels normalized, antibody titers fell.

Table 4. Correlation Between Change in Thyroid Hormone Levels and Autoantibody Reduction After Dietary Intervention (n = 105)

Parameter Correlation	Pearson's r	p-value
Δ TSH vs Δ Anti-TPO	0.68	< 0.001*
Δ fT4 vs Δ Anti-TPO	–0.55	0.002*
Δ fT3 vs Δ Anti-Tg	–0.49	0.006*
Δ TSH vs Δ Anti-Tg	0.61	< 0.001*
Δ Anti-TPO vs Δ Symptom Score	0.64	< 0.001*

Discussion

This interventional study examined the impact of a structured dietary intervention on thyroid function and autoimmunity in a study population of 105 individuals diagnosed with Hashimoto's thyroiditis (HT). Improvements in thyroid hormone levels, amelioration of symptoms, and autoantibody titer reductions after 12 weeks of dietary changes were encouraging. The reductions in TSH levels, the elevations in fT4 and fT3 levels, and the reductions in the anti-TPO and anti-Tg antibodies suggest that dietary changes, when structured and adhered, can impact thyroid function and the autoimmune process. Our conclusion is consistent with the expanding body of evidence on the role of diet in the management of autoimmune thyroid disease. Recent contributions to the literature, including the study of Krysiak et al. (2022), who reported a 3-month selenium-enriched diet in women with Hashimoto's thyroiditis markedly improved TSH autoantibody levels, stress the importance of optimizing micronutrients to enhance the thyroid's antioxidant defenses. The anti-inflammatory, gluten-free diet study of Krylov et al. (2021) showed contrast results to those of diet compositional standard and reported TSH normalization and reduced antibody levels in participants [15]. The decline in TSH levels observed in our study might be due to improved tissue responsiveness and enhanced synthesis of thyroid hormones following correction of the micronutrients. Selenium and zinc are essential for the activity of some of the deiodinase enzymes and the protective antioxidants in thyroid cells, while iron and vitamin D have a role in the immune

system, and vitamin D also stimulates thyroid peroxidase. The incorporation of selenium-rich foods, vitamin D-rich foods, and omega 3 in our dietary plan may have promoted the biochemical changes observed. Also, participants with the most dietary adherence showed the greatest changes in hormone and antibody levels, which underscores the effect of dietary adherence on the results [16]. The most notable findings were the substantial reductions of anti-TPO and anti-Tg antibodies. Chronic inflammation of the thyroid in Hashimoto's consists of inflammation, oxidative stress, and autoimmune attack all intertwined. These elements can be modified with dietary intervention [17]. Selenium, as a cofactor of glutathione peroxidase, diminishes the concentration of hydrogen peroxide in the thyroid and decreases antigenic damage. Omega-3 fatty acids diminish inflammation by lowering the concentration of proinflammatory cytokines TNF-α and IL-6. Moreover, polyphenols and flavonoids, which are

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prevalent in plant-rich diets, scavenge reactive oxygen species [18]. All of these dietary elements combined may mitigate the sustained immune attack on the thyroid as demonstrated by the reduced antibody levels in the current study. A significant correlation was also demonstrated in our study between the reduction of these antibodies and the improvement of clinical symptoms. This further reinforces the exposome concept of the active autoimmune process in the body and its practical ramifications for the patient beyond mere lab results. This is consistent with the findings of other studies in patients with autoimmune thyroid disease, who reported dietary adherence to a Mediterranean-style diet significantly improved fatigue and emotional well-being [19-21]. This is probably due to positive changes in the gut, endocrine, and inflammatory systems. Contextual dissimilarities can be noted and explained, in addition to the consistent international trends. Among Western populations, the benefits of eliminating gluten have primarily been noticed with patients who have celiac disease or with patients who have positive antigliadin antibodies. However, the benefits of generalized gluten restriction still appear uncertain. In this case, the intervention's anti-inflammatory properties coupled with nutrient density might have made it possible for participants to have improvements without the need for universal gluten elimination [22,23]. Furthermore, our comprehensive approach targeting several dietary components most likely accounts for the improvements in symptoms and biochemistry, in contrast to some studies where the focus was solely on dietary supplementation with single nutrients like vitamin D or selenium. Nonetheless, this study does have some limitations. For example, the follow-up period, which was 12 weeks, may not have been enough to evaluate long-term sustainability and possible relapses. Autoantibodies can fluctuate and, thus, longer studies with follow-up periods and autoantibodies testing would be beneficial to confirm the sustained effect. Additionally, the self-reported accounts of dietary adherence could be questioned for recall bias. The absence of a control group on standard medical treatment without the diet would strengthen the study. Nonetheless, the extent of changes in both biochemistry and clinical symptoms is enough to confirm a therapeutic effect.

Conclusion

It is concluded that the implementation of a structured dietary intervention in patients with Hashimoto's thyroiditis significantly improves thyroid-hormone profiles reflected by reductions in serum TSH and increases in free T4 and free T3 and concurrently lowers thyroid autoantibody titers (anti-TPO, anti-Tg). These biochemical benefits correlate with marked symptomatic relief, particularly among individuals demonstrating high adherence to the dietary regimen.

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