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Understanding Hypothyroidism: A Clear Look at Current Research and Treatment

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KEYWORDS

Oral Submucous Fibrosis, Buccal Fat Pad, Collagen Membrane, Split-Thickness Skin Graft, Reconstruction, Trismus.

ABSTRACT:

Introduction: This narrative review aims to provide a comprehensive overview of current research trends and treatment strategies in hypothyroidism.

Objectives: To provide a comprehensive narrative review of the recent advances in diagnosis and management of hypothyroidism by synthesizing current research evidence.

Methods: A systematic literature search was performed across databases including PubMed, Google Scholar, and Cochrane, using relevant keywords related to hypothyroidism, research trends, and therapeutic strategies. A total of 267 records were identified. After removing 21 duplicates, 246 articles were screened for relevance. Of these, 114 were excluded based on titles and abstracts. Sixty-three full-text articles were sought, with 4 unavailable for retrieval. Fifty-nine reports were assessed for eligibility, and 5 were excluded (3 focusing on thyroid cancer, 2 lacking sufficient information). Finally, 54 studies published up to June 2023 were included in this review.

Results: From 267 records, 54 studies were included. Research trends highlight genetic variants identified through GWAS, advancing precision medicine and early detection. Environmental factors, particularly endocrine disruptors, influence thyroid dysfunction. Novel biomarkers like reverse T3 and deiodinase enzymes improve diagnostics. Besides levothyroxine, therapies under study include combinations of T4 and T3, controlled-release T3, TSH analogs and stem cell therapy. Lifestyle strategies—diet, exercise, stress management and complementary medicine—support care, while systemic effects span cardiology, neurocognition, fertility and mental health.

Conclusions: Thyroid hormone replacement remains central to hypothyroidism management, yet challenges including persistent symptoms, variable response, and diagnostic limitations endure. Advances in genetics, biomarkers, and novel formulations are paving the way for personalized and precise care. Lifestyle and nutritional interventions may complement standard therapy to improve outcomes. Future directions include immunotherapies, stem cell–based approaches, and precision medicine strategies. Collectively, evidence supports a multidimensional framework integrating optimized pharmacological treatment with complementary and emerging therapies to enhance long-term patient quality of life.

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1. Introduction

Hypothyroidism is a common endocrine disorder where the thyroid gland remains underactive, resulting in decreased production of thyroid hormones [1]. The thyroid hormones have a very important role to play in energy production, regulating metabolism and also to control the functioning of various organs and tissues in the body. When the thyroid gland fails to produce sufficient hormones, it leads to a wide range of symptoms and health complications [2,3].

Hypothyroidism is very prevalent now a days and it spreads across different populations[4,5]. Even though hypothyroidism can affect any individual it is more common in women [6]. Many factors favor the development of hypothyroidism like Hashimoto's disease, thyroid surgeries done in the past, certain medications and congenital anomalies[5].

Certain factors, can increase the likelihood of developing hypothyroidism such as a family history of thyroid disorders or autoimmune diseases, iodine deficiency etc[5].

Early diagnosis and timely management of hypothyroidism are very important to improve quality of life and prevent complications. Regular screening and follow ups including measurement of thyroid-stimulating hormone (TSH) and free thyroxine (T4) levels, helps to identify individuals with hypothyroidism and treat them appropriately [7,8].

2. Objectives

To provide a comprehensive overview of recent advances in the diagnosis and management of hypothyroidism by synthesizing current research evidence.

3. Methods

A systematic search was conducted across various electronic databases, including PubMed, Google Scholar and Cochrane. The search strategy involved a combination of keywords and controlled vocabulary terms related to hypothyroidism, research trends and treatment strategies. The search was limited to studies published in English until June 2023.

The titles and abstracts of the retrieved articles to identify potentially relevant studies. Full-text articles were collected for more detailed evaluation. Selection criteria included studies focusing on hypothyroidism, current research patterns and treatment strategies. The selection process is depicted in Figure 1.

Data were summarized and explained in a narrative, descriptive fashion. The results of individual studies were summed up and consolidated on the basis of developing trends of research and common treatment modalities of hypothyroidism.

As the review examined previously published literature alone, ethical clearance was not required.

4. Results

Current Research Trends

There has been considerable research done recently that has added to our understanding of hypothyroidism, including of mechanisms, diagnostics and management. A summary of recent advances in hypothyroidism research is provided in this section.

One well-established area of research is identifying genetic factors of hypothyroidism. The genetic mechanisms of hypothyroidism can be clarified through genetic sequencing and genome-wide association studies (GWAS), which have identified many variants associated with hypothyroidism [9,10]. This research paves way for personalized treatment, establishment of early detection methods and risk prediction[11].

Research findings related to pathophysiology of hypothyroidism and associated environmental factors, including chemical exposure that disrupt thyroid hormones [12,13]. Environmental factors that can influence the endocrine system and activity of thyroid hormones are also referred to as endocrine-disrupting chemicals [14].

Novel diagnostic methods and trending hypothyroid biomarkers-

The investigation of novel diagnostic methods and biomarkers for hypothyroidism is another field for studies in this knowledge area. To facilitate accurate diagnosis and treatment of patients, researchers are examining the utility of a variety of thyroid markers such as reverse T3, thyroid autoantibodies and peripheral deiodinase enzymes[15-18].

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Furthermore, recent literature on hypothyroid reveal advances in treatment approaches. For example, research seeks to ascertain the therapeutic efficacy and safety of various treatments (such as new medications or combination therapies) [19-21]. The intent is to enhance the hormone replacement while reducing adverse effects to maintain ideal thyroid function and symptom management.

Additionally, researchers are keen on studying the effects of hypothyroidism on different health sectors such as cardiology [22], neurocognitive functioning [23], fertility [24] and mental health [25,26]. The ongoing studies in these fields attempt to understand the relationship between hypothyroidism and these conditions, which is aimed towards better management and an improved life for the patients.

Novel treatment strategies and therapeutic advancements-

As you might be aware, hypothyroidism—or an underactive thyroid—is a condition marked by insufficient thyroid hormone levels. Fortunately, this condition is typically addressed using thyroid hormone replacement therapy. Even though most patients respond well to this form of treatment, newer research is aimed at tackling the therapeutic deficiencies of hypothyroidism to ensure better treatment results.

Personalized Thyroid Hormone Treatment: The standard protocol in hormone replacement therapy is the administration of levothyroxine (T4), which the body then converts to the active hormone triiodothyronine (T3). Nevertheless, a number of patients experience persistent symptoms, which is an indication that there is inadequate conversion of T4 to T3 in their bodies. The novel treatments attempt to tailor therapy to each patient's needs by using a combination of T4 and T3 in different proportions or by employing desiccated thyroid extract, which comprises both hormones. Such tailored treatments have the potential to provide more effective alleviation of symptoms and enhance the quality of life of patients [27,28].

Controlled-Release T3 Formulations: Recently, attention has been given to the use of T3 in controlled-release formulations designed to gradually release the hormone. This method attempts to replicate the natural circadian rhythm of thyroid hormone secretion, thus potentially enhancing symptom control and reducing side effects related to sudden changes in hormone levels[29].

Combination Therapy: The combining of synthetic T4 and T3 at fixed ratios has been proposed as treatment for patients that continue to have symptoms despite having an optimized T4 therapy. Combination therapy has been shown to help with patient satisfaction and has an impact on the patient's quality of life. Nonetheless, there needs to be more research conducted on the optimal T4-T3 ratio as well as the identification of patients who stand to benefit most from this treatment[19].

Thyroid-Stimulating Hormone Analogs: There is ongoing research regarding the use of thyroid-stimulating hormone (TSH) analogs, like recombinant human TSH, due to their potential benefits over standard thyroid hormone therapy. The use of TSH analogs may reduce the dependence on exogenous hormone therapy through the direct stimulation of the thyroid gland and the possible improvement of thyroid hormone synthesis[30, 31].

Immunomodulatory Treatments: For hypothyroidism resulting from autoimmune thyroiditis like Hashimoto's disease, immunomodulatory treatments are under consideration. Such treatments seek to modulate the immune system's activity and, as a result, may slow the progression of the autoimmune disease, which in the long term, is beneficial in lowering the dependency for hormone replacement[32].

Stem Cell Therapy: Stem cell research holds promise for regenerating damaged or malfunctioning thyroid tissue. Preliminary studies have shown successful differentiation of stem cells into functional thyroid cells in animal models, opening up possibilities for future therapeutic applications in humans [33,34].

Recent lifestyle modifications and complementary therapies in hypothyroidism-

In addition to traditional medical management, recent research has focused on exploring the role of lifestyle modifications and complementary therapies in the management of hypothyroidism. These approaches

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aim to complement conventional treatment and potentially improve symptoms, overall well-being and quality of life for individuals with hypothyroidism. This section highlights some of the recent developments in this area.

Diet and Nutrition: Research suggests that certain dietary modifications may support thyroid health. For example, adequate intake of iodine, selenium and zinc is essential for thyroid hormone synthesis. (35) Moreover, some research suggests that following a gluten-free diet could be advantageous for people with autoimmune thyroiditis[36,37].

Exercise and Physical Activity: Regular exercise and physical activity have been shown to have positive effects on thyroid function and overall metabolism. Engaging in aerobic and resistance training exercises can help improve cardiovascular health, maintain a healthy weight and promote overall well-being. However, it is important to tailor exercise regimens to individual needs and capabilities[38-40].

Stress Management: Chronic stress can negatively impact thyroid function [41]. Thus, stress management, such as mindfulness, meditation, yoga, deep breathing, or relaxation exercises, may be advantageous [42]. These behaviors may help to alleviate stress and improve quality of life.

Herbal and Nutritional Supplements: Many herbal and nutritional supplements have been used for their benefits in hypothyroidism. For example, guggul, ashwagandha and selenium supplements have shown very good results in supporting thyroid health [43-45].

Acupuncture and Traditional Chinese medicine (TCM): The use of acupuncture and TCM, along with other practices such as herbal medicine and certain diets, has shown potential for improving thyroid function and managing symptoms of hypothyroidism. These alternative practices may be integrated with other therapies for complementary holistic care [46,47].

The potential benefits of lifestyle changes and adjunct therapies do not justify the absence of traditional medical treatment. Diet and nutrition, physical activity, stress control, herbal and nutritional supplements, acupuncture and TCM support thyroid health, overall well-being and symptom management. Their effectiveness, safety and long-term consequences remain uncleared. Practitioners can guide their patients in the integrated care for hypothyroidism to make these approaches more accessible.

5. Discussion

Challenges and limitations

While hypothyroidism is a well-researched and very commonly treated condition, there are many challenges and limitations that healthcare professionals and patients with hypothyroidism face in the management of the disorder.

One significant challenge is achieving optimal thyroid hormone replacement therapy. Finding the right dosage of thyroid hormone medication, typically levothyroxine (T4), can be challenging, as individual requirements vary. The ideal dosage should effectively alleviate symptoms while avoiding overmedication, which can lead to hyperthyroidism. Frequent monitoring of thyroid function and dosage adjustments are necessary to achieve optimal outcomes [48].

Another challenge is the persistence of symptoms despite treatment. Some individuals continue to experience symptoms like fatigue, weight gain and cognitive difficulties, even with adequate thyroid hormone replacement. This phenomenon, often referred to as "persistent hypothyroid symptoms," is not fully understood and can significantly impact a patient's quality of life[49, 50].

Additionally, there are limitations in the available treatment options. Current therapies focus on hormone replacement, but they may not address the underlying causes of hypothyroidism, especially in cases of autoimmune thyroiditis. Novel treatment approaches targeting specific molecular pathways or immune dysregulation are still in the early stages of research and development [51].

Lastly, the interpretation of thyroid function tests can be complex. The reference ranges for thyroid-stimulating hormone (TSH) and thyroid hormones can vary, leading to potential discrepancies in diagnosis and treatment decisions. Consistency in reference ranges and interpretation guidelines is necessary to ensure standardized care[52].

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Future directions in hypothyroidism research

Advancing studies on hypothyroidism indicate new insights and approaches continually reshaping our understanding of the disorder and its management. These developments are not only enhancing diagnostic accuracy but also paving the way for more effective therapeutic and comprehensive care strategies. Several emerging research avenues hold particular promise and may significantly influence the future of hypothyroidism management.

Precision medicine represents one such direction, aiming to tailor treatment plans to an individual's genetic and molecular profile. Precision medicine in thyroid disorders emphasizes the need for integration of genetic susceptibility, environmental exposures and clinical variability among individuals to optimize management. Autoimmune thyroid diseases such as Hashimoto's thyroiditis and Graves' disease, result from immune dysregulation influenced by loci such as HLA, CTLA4 and TSH receptor, in association with external factors including iodine intake, smoking, and infections. Heterogeneity in autoantibody profiles and levothyroxine absorption necessitates individualized approaches. Advances in drug formulations, micronutrient supplementation and malignancy risk stratification exemplify precision-based therapeutic strategies [53].

Another area of interest is personalized hormone replacement therapy. Future work in this domain may concentrate on refining replacement strategies to better mimic physiological hormone secretion. This could involve the development of innovative delivery systems or optimizing the T4-to-T3 ratio in combination therapy to maximize therapeutic benefit[54].

The role of immunotherapies is also being explored, particularly in autoimmune thyroid disorders such as Hashimoto's thyroiditis. Conventional treatment relies on levothyroxine replacement but does not address the underlying immune dysregulation. Novel approaches, including monoclonal antibodies targeting B cells (e.g., rituximab), immune checkpoint modulators and cytokine-directed therapies which aim to decrease autoantibody production and inflammatory signaling. Additionally, clinical trials have explored the use of myoinositol with selenium for their immune-modulatory effects, demonstrating reductions in thyroid autoantibodies and chemokine levels. Although still experimental, immunotherapies may not only preserve thyroid function but also slow or halt disease progression [54].

Finally, the management of persistent hypothyroid symptoms remains an unmet clinical need. Some patients on levothyroxine (L-T4) monotherapy continue to experience fatigue, weight issues, and cognitive or mood disturbances, even with adequate dosing. While guidelines recommend ruling out lifestyle and comorbid factors first, combination L-T4/L-T3 therapy is cautiously considered, especially in thyroidectomized patients with low serum T3 or in those with DIO2 and MCT10 polymorphisms. Although patient preference for combination therapy is increasing, evidence for clear clinical benefit remains limited, and treatment must ensure normal thyroid function[54].

CONCLUSION

Recent advances in hypothyroidism research have significantly expanded our understanding of its genetic, environmental, and pathophysiological underpinnings while also shaping novel diagnostic and therapeutic approaches. Precision and personalized medicine are emerging as central themes, integrating genomics, biomarkers, and individual variability to improve treatment efficacy. Innovative therapies, including controlled-release T3 formulations, thyroid-stimulating hormone analogs, immunomodulators, and even stem cell–based strategies, highlight the shift toward targeted interventions beyond traditional levothyroxine replacement. Complementary lifestyle modifications further reinforce holistic care. Nonetheless, challenges such as persistent symptoms, variability in hormone requirements, and limitations in current treatments remain unresolved. Future directions will likely focus on refining individualized therapy, validating novel immunotherapies, and translating experimental advances into clinical practice, ultimately striving to improve outcomes and quality of life for patients with hypothyroidism.

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References

1. Almandoz JP, Gharib H. Hypothyroidism: etiology, diagnosis, and management. Medical Clinics. 2012 Mar 1;96(2):203-21.
2. Zhang J, Lazar MA. The mechanism of action of thyroid hormones. Annual review of physiology. 2000 Mar;62(1):439-66.
3. Gomberg-Maitland M, Frishman WH. Thyroid hormone and cardiovascular disease. American heart journal. 1998 Feb 1;135(2):187-96.
4. Taylor PN, Albrecht D, Scholz A, Gutierrez-Buey G, Lazarus JH, Dayan CM, Okosieme OE. Global epidemiology of hyperthyroidism and hypothyroidism. Nature Reviews Endocrinology. 2018 May;14(5):301-16.
5. Chiovato L, Magri F, Carlé A. Hypothyroidism in context: where we've been and where we're going. Advances in therapy. 2019 Sep;36:47-58.
6. Vanderpump MP, Tunbridge WM. Epidemiology and prevention of clinical and subclinical hypothyroidism. Thyroid. 2002 Oct 1;12(10):839-47.
7. Razvi S, McMillan CV, Weaver JU. Instruments used in measuring symptoms, health status and quality of life in hypothyroidism: a systematic qualitative review. Clinical Endocrinology. 2005 Dec;63(6):617-24.
8. Wilson SA, Stem LA, Bruehlman RD. Hypothyroidism: Diagnosis and treatment. American family physician. 2021 May 15;103(10):605-13
9. Narumi S. Genome-wide association studies for thyroid physiology and diseases. Endocrine journal. 2023;70(1):9-17.
10. Rawal R, Teumer A, Völzke H, Wallaschofski H, Ittermann T, Åsvold BO, Bjøro T, Greiser KH, Tiller D, Werdan K, Meyer zuSchwabedissen HE. Meta-analysis of two genome-wide association studies identifies four genetic loci associated with thyroid function. Human molecular genetics. 2012 Jul 15;21(14):3275-82.
11. Tam V, Patel N, Turcotte M, Bossé Y, Paré G, Meyre D. Benefits and limitations of genome-wide association studies. Nature Reviews Genetics. 2019 Aug;20(8):467-84.
12. Sur U, Erkekoglu P, Bulus AD, Andiran N, Kocer-Gumusel B. Oxidative stress markers, trace elements, and endocrine disrupting chemicals in children with Hashimoto's thyroiditis. Toxicology mechanisms and methods. 2019 Nov 22;29(9):633-43.
13. Boas M, Feldt-Rasmussen U, Main KM. Thyroid effects of endocrine disrupting chemicals. Molecular and cellular endocrinology. 2012 May 22;355(2):240-8.
14. McLachlan JA. Environmental signaling: what embryos and evolution teach us about endocrine disrupting chemicals. Endocrine reviews. 2001 Jun 1;22(3):319-41.
15. Gomes-Lima C, Wartofsky L, Burman K. Can reverse T3 assay be employed to guide T4 vs. T4/T3 therapy in hypothyroidism?. Frontiers in Endocrinology. 2019 Dec 11;10:856.
16. KLEIN AH, FOLEY TP, BERNARD B, HO RS, FISHER DA. Cord blood reverse T3 in congenital hypothyroidism. The Journal of Clinical Endocrinology & Metabolism. 1978 Feb 1;46(2):336-8.
17. Fröhlich E, Wahl R. Thyroid autoimmunity: role of anti-thyroid antibodies in thyroid and extra-thyroidal diseases. Frontiers in immunology. 2017 May 9;8:521.
18. Gereben B, McAninch EA, Ribeiro MO, Bianco AC. Scope and limitations of iodothyronine deiodinases in hypothyroidism. Nature Reviews Endocrinology. 2015 Nov;11(11):642-52.
19. Biondi B, Wartofsky L. Combination treatment with T4 and T3: toward personalized replacement therapy in hypothyroidism?. The Journal of Clinical Endocrinology & Metabolism. 2012 Jul 1;97(7):2256-71.
20. Fallahi P, Ferrari SM, Ruffilli I, Ragusa F, Biricotti M, Materazzi G, Miccoli P, Antonelli A. Advancements in the treatment of hypothyroidism with L-T4 liquid formulation or soft gel capsule: an update. Expert opinion on drug delivery. 2017 May 4;14(5):647-55.
21. Eligar V, Taylor PN, Okosieme OE, Leese GP, Dayan CM. Thyroxine replacement: a clinical endocrinologist's viewpoint. Annals of clinical biochemistry. 2016 Jul;53(4):421-33.
22. Inoue K, Ritz B, Brent GA, Ebrahimi R, Rhee CM, Leung AM. Association of subclinical hypothyroidism and cardiovascular disease with

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(5), 958-965 | ISSN:2251-6727

mortality. JAMA Network Open. 2020 Feb 5;3(2):e1920745-.

23. Zhou Q, Wang C, Xu H, Li X. Impact of preconception treatment initiation for hypothyroidism on neurocognitive function in children. The Journal of Clinical Endocrinology & Metabolism. 2020 Nov;105(11):e3919-28.
24. Dosiou C. Thyroid and fertility: recent advances. Thyroid. 2020 Apr 1;30(4):479-86.
25. Ghamri R, Babaker R, Ezzat S, Alsaedi H, Alkhamisi M, Arbaein R, Alyahya R, Fayraq S, Alamri S, Alyahya II RA. Assessment of quality of life among patients with primary hypothyroidism: a case-control study. Cureus. 2022 Oct 5;14(10).
26. Yang R, Du X, Li Z, Zhao X, Lyu X, Ye G, Lu X, Zhang G, Li C, Yue Y, Wu Y. Association of subclinical hypothyroidism with anxiety symptom in young first-episode and drug-naïve patients with major depressive disorder. Frontiers in psychiatry. 2022 Jun 24;13:920723.
27. Ettleson MD, Bianco AC. Individualized therapy for hypothyroidism: is T4 enough for everyone?. The Journal of Clinical Endocrinology & Metabolism. 2020 Sep;105(9):e3090-104.
28. Magri F, Chiovato L, Croce L, Rotondi M. Thyroid hormone therapy for subclinical hypothyroidism. Endocrine. 2019 Oct;66:27-34.
29. Idrees T, Price JD, Piccariello T, Bianco AC. Sustained release T3 therapy: animal models and translational applications. Frontiers in Endocrinology. 2019 Aug 13;10:544.
30. Szkudlinski MW. Past, presence and future of thyroid-stimulating hormone (TSH) superactiveanalogs. Molecular Basis of Thyroid Cancer. 2004 Jan 1:345-56.
31. Hong YT, Lim ST, Hong KH. Voice outcome of total thyroidectomy in comparison with administration of recombinant human TSH. Journal of Voice. 2021 Mar 1;35(2):317-22.
32. Raterman HG, Jamnitski A, Lems WF, et al.: Improvement of thyroid function in hypothyroid patients with rheumatoid arthritis after 6 months of adalimumab treatment: a pilot study. J Rheumatol. 2011;38(2):247–51. 10.3899/jrheum.100488
33. Thomas D, Friedman S, Lin RY. Thyroid stem cells: lessons from normal development and thyroid cancer. Endocrine-related cancer. 2008 Mar;15(1):51.
34. Posabella A, Alber AB, Undeutsch HJ, Droeser RA, Hollenberg AN, Ikonomou L, Kotton DN. Derivation of thyroid follicular cells from pluripotent stem cells: insights from development and implications for regenerative medicine. Frontiers in Endocrinology. 2021 Apr 20;12:666565.
35. Mezzomo TR, Nadal J. Effect of nutrients and dietary substances on thyroid function and hypothyroidism. Demetra: Food, Nutrition & Health. 2016 Jun 1;11(2):427-44.
36. Krysiak R, Szkróbka W, Okopień B. The effect of gluten-free diet on thyroid autoimmunity in drug-naïve women with Hashimoto's thyroiditis: a pilot study. Experimental and Clinical Endocrinology & Diabetes. 2019 Jul;127(07):417-22.
37. Malandrini S, Trimboli P, Guzzaloni G, Virili C, Lucchini B. What about TSH and Anti-Thyroid Antibodies in Patients with Autoimmune Thyroiditis and Celiac Disease Using a Gluten-Free Diet? A Systematic Review. Nutrients. 2022 Apr 18;14(8):1681.
38. Lankhaar JA, Kemler E, Hofstetter H, Collard DC, Zelissen PM, Stubbe JH, Backx FJ. Physical activity, sports participation and exercise-related constraints in adult women with primary hypothyroidism treated with thyroid hormone replacement therapy. Journal of sports sciences. 2021 Nov 2;39(21):2493-502.
39. Masaki M, Koide K, Goda A, Miyazaki A, Masuyama T, Koshiba M. Effect of acute aerobic exercise on arterial stiffness and thyroid-stimulating hormone in subclinical hypothyroidism. Heart and vessels. 2019 Aug 1;34:1309-16.
40. Yadav P, Verma R. Impact of Aerobic and Resistance Training on Thyroid-Stimulating Hormone in Hypothyroidism. Journal of Pharmaceutical Negative Results. 2022 Oct 12:1751-62.
41. Chaudhuri A, Koner S. A study of correlation of perceived stress and thyroid function among females in a rural population of reproductive age group. Medical Journal of Dr. DY Patil University. 2020 Jan 1;13(1):30-6.
42. Nilkantham S, Majumdar V, Singh A. Scientific yoga module for hypothyroidism: A study protocol

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 958-965 | ISSN:2251-6727

for tele-yoga RCT. Contemporary Clinical Trials Communications. 2023 Jun 10:101157.
43. Namdev N, Rai G, Mahobiya P. Protective role of ashwagandha and quercetin over cypermethrin induced hypothyroidism: A hematological study in mice. Advances in zoology and botany. 2023;11(2):103-11.
44. Kombe P, Kuchewar V. Evaluation of effect of Kanchanar Guggul in sub-clinical hypothyroidism with respect to Agnimandya. International journal of ayurvedic medicine. 2019;10(4):310-16.
45. Kryczyk-Kozioł J, Zagrodzki P, Prochownik E, Błażewska-Gruszczyk A, Słowiaczek M, Sun Q, Schomburg L, Ochab E, Bartyzel M. Positive effects of selenium supplementation in women with newly diagnosed Hashimoto's thyroiditis in an area with low selenium status. International Journal of Clinical Practice. 2021 Sep;75(9):e14484.
46. Tao YX, Li Q, Li CC, Huo JJ. Efficacy of Chinese medicine in the adjuvant treatment of Hashimoto's thyroiditis with hypothyroidism: a systematic review and meta-analysis. Biotechnology and Genetic Engineering Reviews. 2023 Mar 23:1-27.
47. Simpson J. Syndrome Differentiation and Acupuncture Treatment for Hypothyroidism. The Journal of Chinese Medicine And Acupuncture. 2019 Apr 30:6.
48. Nagy EV, Perros P, Papini E, Katko M, Hegedüs L. New formulations of levothyroxine in the treatment of hypothyroidism: trick or treat?. Thyroid. 2021 Feb 1;31(2):193-201.
49. Perros P, Van Der Feltz-Cornelis C, Papini E, Nagy EV, Weetman AP, Hegedüs L. The enigma of persistent symptoms in hypothyroid patients treated with levothyroxine: A narrative review. Clinical endocrinology. 2023 Apr;98(4):461-8.
50. Ettleson MD, Bianco AC. Individualized therapy for hypothyroidism: is T4 enough for everyone?. The Journal of Clinical Endocrinology & Metabolism. 2020 Sep;105(9):e3090-104.
51. Ferrari SM, Fallahi P, Elia G, Ragusa F, Camastra S, Paparo SR, Giusti C, Gonnella D, Ruffilli I, Shoenfeld Y, Antonelli A. Novel therapies for thyroid autoimmune diseases: An update. Best Practice & Research Clinical Endocrinology & Metabolism. 2020 Jan 1;34(1):101366.
52. Razvi S, Bhana S, Mrabeti S. Challenges in interpreting thyroid stimulating hormone results in the diagnosis of thyroid dysfunction. Journal of thyroid research. 2019 Sep 22;2019.
53. Ferrari SM, Ragusa F, Elia G, Paparo SR, Mazzi V, Baldini E, Benvenga S, Antonelli A, Fallahi P. Precision medicine in autoimmune thyroiditis and hypothyroidism. Frontiers in pharmacology. 2021 Nov 17; 12:750380.
54. Biondi B, Cooper DS. Thyroid hormone therapy for hypothyroidism. Endocrine. 2019 Oct;66(1):18-26.

Figure

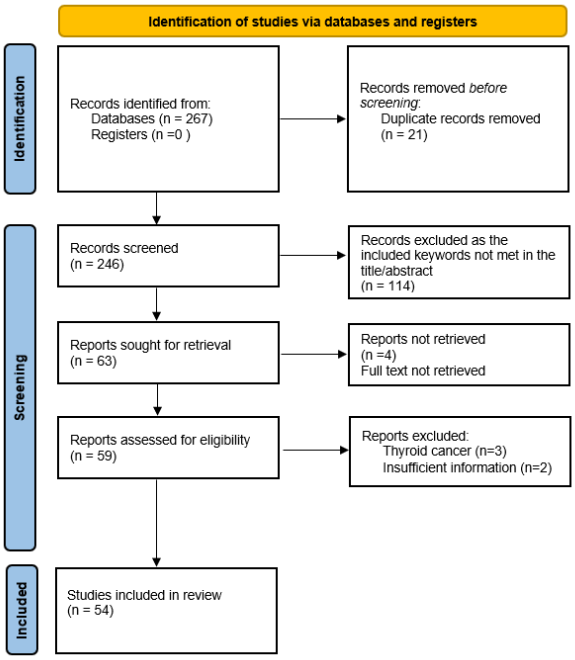

Figure 1: Selection process for the review