Factors That Affect Thyroid Function

Nutritional, lifestyle, and environmental factors can affect thyroid function (positively or negatively) at various sites, including the thyroid gland and the body's cells. The factors listed below include human, animal, and in vitro study results.

Factors associated with lower thyroid antibodies:

- Vitamin D[1,2,3] (TPO, TG, and TRA antibodies)
- Selenium[4,5] (TPO and TRA antibodies)
- Myoinositol with selenium[6] (TG antibodies)

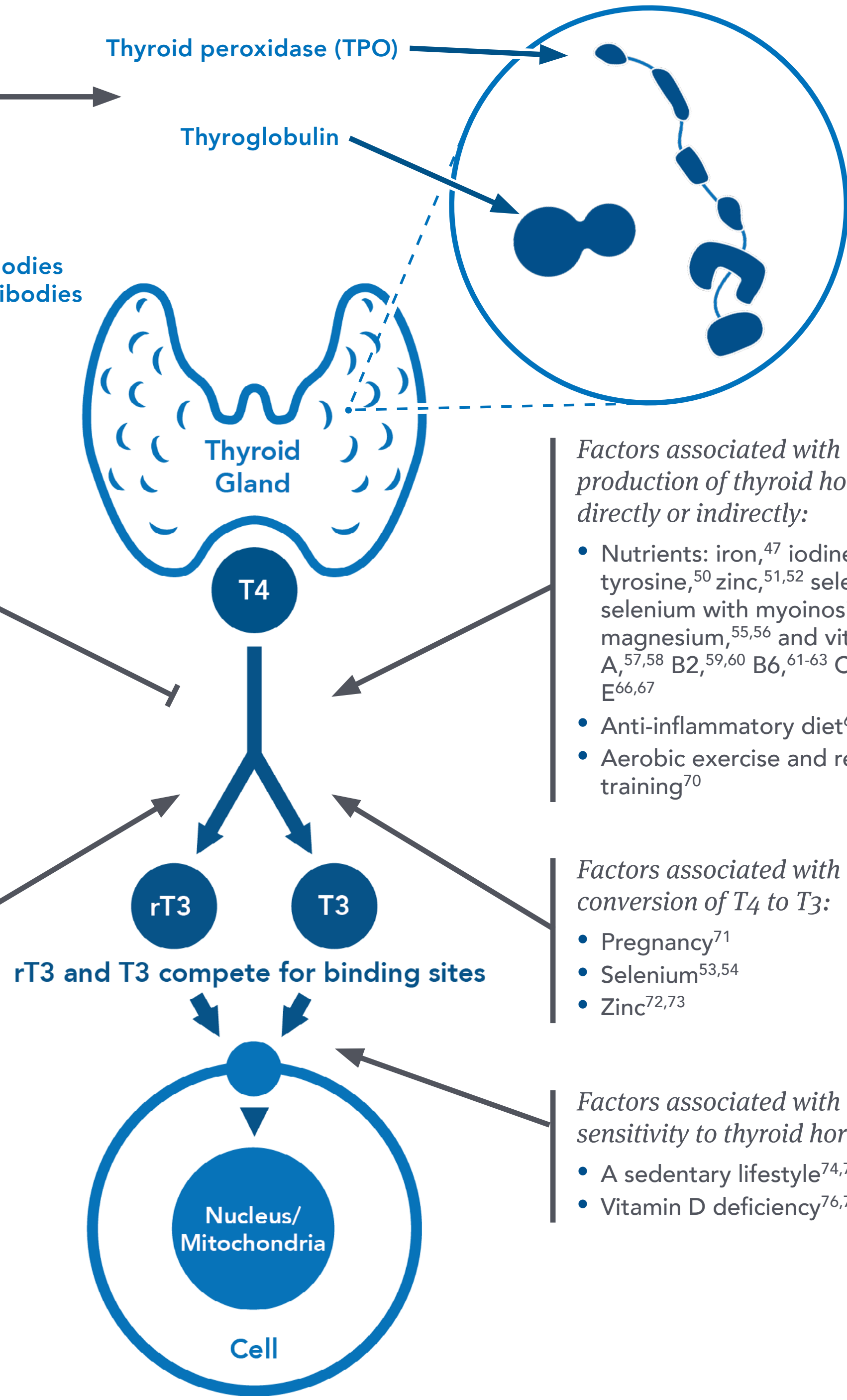
Thyroglobulin (TG) antibodies
Thyroid peroxidase (TPO) antibodies
Thyrotropin receptor (TRA) antibodies

Factors associated with the inhibition of proper thyroid hormone production:

- Stress and trauma[7-10]
- Infection,[11-16] radiation,[17,18] medications[19-22]
- Fluoride (antagonist to iodine)[23]
- Environmental toxins: pesticides,[24] plastics,[25,26] mercury,[27] cadmium,[28] lead[29,30]
- Autoimmune disease: celiac[31,32]
- Perimenopause and menopause[33]

Factors associated with increased conversion of T4 to rT3:

- Stress and trauma, including significant illness[34,35]
- Dieting and insufficient food intake[36,37]
- Inflammation (e.g., cytokines)[38,39]
- Environmental toxins[40,41]
- Infections[42,43]
- Liver dysfunction[44]
- Certain medications[45,46]



Factors associated with the proper production of thyroid hormones, directly or indirectly:

- Nutrients: iron,[47] iodine,[48,49] tyrosine,[50] zinc,[51,52] selenium,[53,54] selenium with myoinositol,[6] magnesium,[55,56] and vitamins A,[57,58] B2,[59,60] B6,[61-63] C,[64,65] D,[1] E[66,67]
- Anti-inflammatory diet[68,69]
- Aerobic exercise and resistance training[70]

Factors associated with increased conversion of T4 to T3:

- Pregnancy[71]
- Selenium[53,54]
- Zinc[72,73]

Factors associated with reduced sensitivity to thyroid hormones:

- A sedentary lifestyle[74,75]
- Vitamin D deficiency[76,77]

Image courtesy of 123RF

Version 4; updated 2026

REFERENCES

1. Tang J, Shan S, Li F, Yun P. Effects of vitamin D supplementation on autoantibodies and thyroid function in patients with Hashimoto's thyroiditis: a systematic review and meta-analysis. *Medicine (Baltimore)*. 2023;102(52):e36759. doi:10.1097/MD.0000000000036759
2. Chen X, Zhang Y, Lin L, et al. A beneficial levels of 25-hydroxyvitamin D for a decrease in thyrotropin receptor antibody (TRAB) in patients with Graves' disease: a real-world study. *BMC Endocr Disord*. 2025;25(1):14. doi:10.1186/s12902-024-01823-x
3. Płazińska MT, Czarnywojtek A, Sawicka-Gutaj N, et al. Vitamin D deficiency and thyroid autoantibody fluctuations in patients with Graves' disease - a mere coincidence or a real relationship?. *Adv Med Sci*. 2020;65(1):39-45. doi:10.1016/j.advms.2019.11.001
4. Huwiler VV, Maissen-Abgottspon S, Stanga Z, et al. Selenium supplementation in patients with Hashimoto Thyroiditis: a systematic review and meta-analysis of randomized clinical trials. *Thyroid*. 2024;34(3):295-313. doi:10.1089/thy.2023.0556
5. Zheng H, Wei J, Wang L, et al. Effects of selenium supplementation on Graves' Disease: a systematic review and meta-analysis. *Evid Based Complement Alternat Med*. 2018;2018:3763565. doi:10.1155/2018/3763565
6. Zuhair V, Sheikh AT, Shafi N, et al. Role of supplementation with selenium and myo-inositol versus selenium alone in patients of autoimmune thyroiditis: a systematic review and meta-analysis. *Clin Med Insights Endocrinol Diabetes*. 2024;17:11795514241300998. doi:10.1177/11795514241300998
7. Wang J, Chen Z, Carru C, Capobianco G, Sedda S, Li Z. What is the impact of stress on the onset and anti-thyroid drug therapy in patients with graves' disease: a systematic review and meta-analysis. *BMC Endocr Disord*. 2023;23(1):194. doi:10.1186/s12902-023-01450-y
8. Singh M, Narayan J, Thakur R, Bhattacharya S, Sonkar SK, Ali W. Association of stress and primary hypothyroidism. *J Family Med Prim Care*. 2024;13(3):1073-1078. doi:10.4103/jfmpc.jfmpc_845_23
9. Corso A, Engel H, Müller F, et al. Early life stress in women with autoimmune thyroid disorders. *Sci Rep*. 2023;13(1):22341. doi:10.1038/s41598-023-49993-3
10. Chen Z, Yu Y, Yao J, et al. Causal effects of post-traumatic stress disorder on autoimmune thyroid disease: insights from mendelian randomization. *Front Psychiatry*. 2024;15:1417302. doi:10.3389/fpsyt.2024.1417302
11. Wang H, Liu Y, Zhao Y. The association of hepatitis C virus infection and thyroid disease: a systematic review and meta-analysis. *Int J Biol Markers*. 2021;36(4):3-9. doi:10.1177/17246008211056959
12. Zangiabadian M, Mirsaeidi M, Pooyafar MH, Goudarzi M, Nasiri MJ. Associations of Yersinia Enterocolitica infection with autoimmune thyroid diseases: a systematic review and meta-analysis. *Endocr Metab Immune Disord Drug Targets*. 2021;21(4):682-687. doi:10.2174/1871530320666200621180515
13. Rossini A, Cassibba S, Perticone F, et al. Increased prevalence of autoimmune thyroid disease after COVID-19: a single-center, prospective study. *Front Endocrinol (Lausanne)*. 2023;14:1126683. doi:10.3389/fendo.2023.1126683
14. Yanachkova, V., Stankova, T., & Staynova, R. Thyroid dysfunction as a long-term post-COVID-19 complication in mild-to-moderate COVID-19. *Biotechnol Biotechnol Equip*. 2023;37(1):194–202. https://doi.org/10.1080/13102818.2023.2170829
15. Zhang J, Hai X, Wang S, et al. Helicobacter pylori infection increase the risk of subclinical hyperthyroidism in middle-aged and elderly women independent of dietary factors: results from the Tianjin chronic low-grade systemic inflammation and health cohort study in China. *Front Nutr*. 2023;10:1002359. doi:10.3389/fnut.2023.1002359
16. Wang K, Zhang Q, Zhang P, Yang Q, Pan F, Zha B. Use of bidirectional Mendelian randomization to unveil the association of Helicobacter pylori infection and autoimmune thyroid diseases. *Sci Adv*. 2024;10(31):eadi8646. doi:10.1126/sciadv.adi8646
17. Solmunde E, Falstie-Jensen AM, Lorenzen EL, et al. Breast cancer, breast cancer-directed radiation therapy and risk of hypothyroidism: a systematic review and meta-analysis. *Breast*. 2023;68:216-224. doi:10.1016/j.breast.2023.02.008
18. Rooney MK, Andring LM, Corrigan KL, et al. Hypothyroidism following radiotherapy for head and neck cancer: a systematic review of the literature and opportunities to improve the therapeutic ratio. *Cancers (Basel)*. 2023;15(17):4321. doi:10.3390/cancers15174321
19. Chou SM, Yeh HJ, Lin TM, et al. Association of interferon-based therapy with risk of autoimmune diseases in patients with chronic hepatitis C virus infection: a population-based Taiwanese cohort study. *Front Immunol*. 2022;13:992819. doi:10.3389/fimmu.2022.992819
20. Rodia, R., Pani, F., Caocci, G. et al. Thyroid autoimmunity and hypothyroidism are associated with deep molecular response in patients with chronic myeloid leukemia on tyrosine kinase inhibitors. *J Endocrinol Invest*. 2022;45:291–300. https://doi.org/10.1007/s40618-021-01613-5
21. Joseph B, Nunez NA, Pazdernik V, et al. Long-term lithium therapy and thyroid disorders in bipolar disorder: a historical cohort study. *Brain Sci*. 2023;13(1):133. doi:10.3390/brainsci13010133
22. Chan JKN, Solmi M, Correll CU, et al. Lithium for bipolar disorder and risk of thyroid dysfunction and chronic kidney disease. *JAMA Netw Open*. 2025;8(2):e2458608. doi:10.1001/jamanetworkopen.2024.58608
23. Iamandii I, De Pasquale L, Giannone ME, et al. Does fluoride exposure affect thyroid function? a systematic review and dose-response meta-analysis. *Environ Res*. 2024;242:117759. doi:10.1016/j.envres.2023.117759
24. Sirikul W, Sapbamrer R. Exposure to pesticides and the risk of hypothyroidism: a systematic review and meta-analysis. *BMC Public Health*. 2023;23(1):1867. doi:10.1186/s12889-023-16721-5
25. Pei Z, Zhang L, Bao Y, Li J, Zhuo Q. The negative impacts of bisphenols on thyroid function in adults with bisphenol A exposure level exceeding the tolerable daily intake. *Ecotoxicol Environ Saf*. 2025;290:117790. doi:10.1016/j.ecoenv.2025.117790
26. Milczarek-Banach J, Rachoń D, Bednarczuk T, Myśliwiec-Czajka K, Wasik A, Miśkiewicz P. Exposure to Bisphenol A analogs and the thyroid function and volume in women of reproductive age-cross-sectional study. *Front Endocrinol (Lausanne)*. 2021;11:587252. doi:10.3389/fendo.2020.587252
27. Hu Q, Han X, Dong G, et al. Association between mercury exposure and thyroid hormones levels: a meta-analysis. *Environ Res*. 2021;196:110928. doi:10.1016/j.envres.2021.110928
28. Shao R, Su L, Wang P, et al. Cadmium exposure was associated with sex-specific thyroid dysfunction: consistent evidence from two independent cross-sectional studies based on urinary and blood cadmium measurements. *Biol Trace Elem Res*. 2025;203(1):88-97. doi:10.1007/s12011-024-04176-7
29. Chen Y, Xiang Q, Wang N, et al. Are ethnic differences, urinary iodine status, lead and cadmium exposure associated with thyroid autoimmunity and hypothyroid status? a cross-sectional study. *BMJ Open*. 2022;12(2):e056909. doi:10.1136/bmjopen-2021-056909
30. Moradnia M, Broberg K, Lozano M, et al. Association between urinary heavy metal concentrations, thyroid hormones, and birth outcomes among pregnant women in Isfahan City. *Sci Rep*. 2025;15:24264. https://doi.org/10.1038/s41598-025-10137-4
31. Dore MP, Fanciulli G, Rouatbi M, Mereu S, Pes GM. Autoimmune thyroid disorders are more prevalent in patients with Celiac disease: a retrospective case-control study. *J Clin Med*. 2022;11(20):6027. doi:10.3390/jcm11206027

32. Baharvand P, Hormozi M, Aaliehpour A. Comparison of thyroid disease prevalence in patients with celiac disease and controls. *Gastroenterol Hepatol Bed Bench*. 2020;13(1):44-49.
33. Mintziori G, Veneti S, Poppe K, et al. EMAS position statement: thyroid disease and menopause. *Maturitas*. 2024;185:107991. doi:10.1016/j.maturitas.2024.107991
34. da Silveira CD, de Vasconcelos FP, Moura EB, et al. Thyroid function, reverse triiodothyronine, and mortality in critically ill clinical patients. *Indian J Crit Care Med*. 2021;25(10):1161-1166. doi:10.5005/jp-journals-10071-24001
35. Vidart J, Axelrud L, Braun AC, Marschner RA, Wajner SM. Relationship among low T3 levels, type 3 deiodinase, oxidative stress, and mortality in sepsis and septic shock: defining patient outcomes. *Int J Mol Sci*. 2023;24(4):3935. doi:10.3390/ijms24043935
36. Loucks AB, Heath EM. Induction of low-T3 syndrome in exercising women occurs at a threshold of energy availability. *Am J Physiol*. 1994;266(3 Pt 2):R817-R823. doi:10.1152/ajpregu.1994.266.3.R817
37. Sloot YJE, Janssen MJR, van Herwaarden AE, Peeters RP, Netea-Maier RT, Smit JWA. The influence of energy depletion by Metformin or hypocaloric diet on thyroid iodine uptake in healthy volunteers: a randomized trial. *Sci Rep*. 2019;9(1):5396. doi:10.1038/s41598-019-41997-2
38. Zhai Y, Wang B, Han W, Yu B, Ci J, An F. Correlation between systemic inflammatory response index and thyroid function: 2009-2012 NHANES results. *Front Endocrinol (Lausanne)*. 2024;14:1305386. doi:10.3389/fendo.2023.1305386
39. Munteanu AI, Jugănaru I, Nicoară DM, et al. Evaluating the role of CBC-derived indices in children with Hashimoto's Thyroiditis. *Diagnostics (Basel)*. 2024;14(24):2834. doi:10.3390/diagnostics14242834
40. Peng FJ, Palazzi P, Mezzache S, et al. Cross-sectional examination of thyroid hormones and environmental exposure to multiclass pesticides in women of reproductive age in China. *Environ Health Perspect*. 2024;132(10):107005. doi:10.1289/EHP14378
41. Turyk ME, Persky VW, Imm P, Knobeloch L, Chatterton R, Anderson HA. Hormone disruption by PBDEs in adult male sport fish consumers. *Environ Health Perspect*. 2008;116(12):1635-1641. doi:10.1289/ehp.11707
42. van der Spek AH, Jim KK, Karaczyn A, et al. The thyroid hormone inactivating type 3 deiodinase is essential for optimal neutrophil function: observations from three species. *Endocrinology*. 2018;159(2):826-835. doi:10.1210/en.2017-00666
43. Mehdi SF, Qureshi MH, Pervaiz S, et al. Endocrine and metabolic alterations in response to systemic inflammation and sepsis: a review article. *Mol Med*. 2025;31(16): https://doi.org/10.1186/s10020-025-01074-z
44. Bruinstroop E, van der Spek AH, Boelen A. Role of hepatic deiodinases in thyroid hormone homeostasis and liver metabolism, inflammation, and fibrosis. *Eur Thyroid J*. 2023;12(3):e220211. doi:10.1530/ETJ-22-0211
45. Mazori AY, Skamagas M. Increased Thyroid-hormone requirements consistent with type 3 deiodinase induction related to Ibrutinib in a thyroidectomized woman. *AACE Clin Case Rep*. 2020;7(2):121-123. doi:10.1016/j.aace.2020.11.025
46. Medić F, Bakula M, Alfirević M, Bakula M, Mucić K, Marić N. Amiodarone and thyroid dysfunction. *Acta Clin Croat*. 2022;61(2):327-341. doi:10.20471/acc.2022.61.02.20
47. Garofalo V, Condorelli RA, Cannarella R, Aversa A, Calogero AE, La Vignera S. Relationship between iron deficiency and thyroid function: a systematic review and meta-analysis. *Nutrients*. 2023;15(22):4790. doi:10.3390/nu15224790
48. Lisco G, De Tullio A, Triggiani D, et al. Iodine deficiency and iodine prophylaxis: an overview and update. *Nutrients*. 2023;15(4):1004. doi:10.3390/nu15041004
49. Vargas-Uricoechea H, Castellanos-Pinedo A, Meza-Cabrera IA, Pinzón-Fernández MV, Urrego-Noguera K, Vargas-Sierra H. Iodine intake from universal salt iodization programs and Hashimoto's Thyroiditis: a systematic review. *Diseases*. 2025;13(6):166. doi:10.3390/diseases13060166
50. Shahid MA, Ashraf MA, Sharma S. Physiology, Thyroid hormone. [Updated 2023 Jun 5]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK500006/
51. Wróblewski M, Wróblewska J, Nuszkiewicz J, Pawłowska M, Wesołowski R, Woźniak A. The role of selected trace elements in oxidoreductive homeostasis in patients with thyroid diseases. *Int J Mol Sci*. 2023;24(5):4840. doi:10.3390/ijms24054840
52. Ye Y, Li Y, Ma Q, et al. Association of multiple blood metals with thyroid function in general adults: a cross-sectional study. *Front Endocrinol (Lausanne)*. 2023;14:1134208. doi:10.3389/fendo.2023.1134208
53. Kobayashi R, Hasegawa M, Kawaguchi C, et al. Thyroid function in patients with selenium deficiency exhibits high free T4 to T3 ratio. *Clin Pediatr Endocrinol*. 2021;30(1):19-26. doi:10.1297/cpe.30.19
54. Liu F, Wang K, Nie J, et al. Relationship between dietary selenium intake and serum thyroid function measures in U.S. adults: Data from NHANES 2007-2012. *Front Nutr*. 2022;9:1002489. doi:10.3389/fnut.2022.1002489
55. Wang K, Wei H, Zhang W, et al. Severely low serum magnesium is associated with increased risks of positive anti-thyroglobulin antibody and hypothyroidism: a cross-sectional study. *Sci Rep*. 2018;8(1):9904. doi:10.1038/s41598-018-28362-5
56. Kolanu BR, Vadakedath S, Boddula V, Kandi V. Activities of serum magnesium and thyroid hormones in pre-, peri-, and post-menopausal women. *Cureus*. 2020 Jan 3;12(1):e6554. doi: 10.7759/cureus.6554.
57. Mikulska-Sauermann AA, Resztak M, Karaźniewicz-Łada M, Filipowicz D, Ruchała M, Główka FK. Assessment of vitamin concentrations in patients with Hashimoto's thyroiditis and their relationships with thyroid function, biochemical status, and anthropometric parameters-a preliminary study. *Nutrients*. 2024;16(11):1694. doi:10.3390/nu16111694
58. Zhang W, Liu E, Que H. Association of circulating vitamin levels with thyroid diseases: a Mendelian randomization study. *Front Endocrinol (Lausanne)*. 2024;15:1360851. doi:10.3389/fendo.2024.1360851
59. Song L, Zhou H, Yang Q, et al. Association between the oxidative balance score and thyroid function: Results from the NHANES 2007-2012 and Mendelian randomization study. *PLoS One*. 2024;19(3):e0298860. doi:10.1371/journal.pone.0298860
60. Krishnamurthy HK, Reddy S, Jayaraman V, et al. Effect of micronutrients on thyroid parameters. *J Thyroid Res*. 2021. 2021:1865483. doi: 10.1155/2021/1865483. eCollection 2021
61. Li L, Wang J, Chen J. Relationship between vitamin B6 intake and thyroid function in US adults: NHANES 2007-2012 results. *PLoS One*. 2025;20(4):e0321688. doi:10.1371/journal.pone.0321688
62. Zhang SF, Li LZ, Zhang W, et al. Association between plasma homocysteine levels and subclinical hypothyroidism in adult subjects: a meta-analysis. *Horm Metab Res*. 2020;52(9):625-638. doi:10.1055/a-1199-2633
63. Vitamin B6. Linus Pauling Institute. Updated May 2024. Accessed October 2025. https://lpi.oregonstate.edu/mic/vitamins/vitamin-B6
64. Farasati Far B, Behnoush AH, Ghondaghsaz E, Habibi MA, Khalaji A. The interplay between vitamin C and thyroid. *Endocrinol Diabetes Metab*. 2023;6(4):e432. doi:10.1002/edm2.432
65. Wu J, Jia C, Wang Q, Li X. Association between vitamin C intake and thyroid function among U.S. adults: a population-based study. *Front Endocrinol (Lausanne)*. 2024;15:1462251. doi:10.3389/fendo.2024.1462251
66. Liu S, Lu C, He L, et al. Vitamin E intake and prevalence rates of thyroid dysfunction and autoimmune thyroiditis: a cross-sectional analysis of NHANES data. *Thyroid*. 2024;34(6):753-763. doi:10.1089/thy.2023.0561

67. Buczyńska A, Sidorkiewicz I, Kościuszko M, et al. Parallel investigation of oxidative stress and nutritional profile in women with Hashimoto's thyroiditis. *Clin Nutr*. 2025;53:177-187. doi:10.1016/j.clnu.2025.08.017

68. Klobucar S, Jovanovic GK, Kryczyk-Koziol J, et al. Association of Dietary Inflammatory Index and thyroid function in patients with Hashimoto's thyroiditis: an observational cross–sectional multicenter study. *Medicina*. 2024;60(9):1454. https://doi.org/10.3390/medicina60091454

69. Alijani S, Ghadir M, Gargari BP. The association between dietary inflammatory index and dietary total antioxidant capacity and Hashimoto's thyroiditis: a case-control study. *BMC Endocr Disord*. 2024;24(1):177. doi:10.1186/s12902-024-01708-z

70. Sundus H, Khan SA, Zaidi S, Chhabra C, Ahmad I, Khan H. Effect of long-term exercise-based interventions on thyroid function in hypothyroidism: a systematic review and meta-analysis of randomized controlled trials. *Complement Ther Med*. 2025;92:103196. doi:10.1016/j.ctim.2025.103196

71. Rosenberger KD, Parker N. Updates on thyroid disorders in pregnancy and the postpartum period. *Nurse Pract*. 2024;49(2):31-37. doi:10.1097/01.NPR.0000000000000130

72. Nishiyama S, Futagoishi-Suginohara Y, Matsukura M, et al. Zinc supplementation alters thyroid hormone metabolism in disabled patients with zinc deficiency. J Am Coll Nutr. 1994;13(1):62-67. doi:10.1080/07315724.1994.10718373

73. Severo JS, Morais JBS, de Freitas TEC, et al. The role of zinc in thyroid hormones metab-olism. Int J Vitam Nutr Res. 2019 Jul;89(1-2):80-88. doi: 10.1024/0300-9831/a000262.

74. Yang H, Kang J, Dong L, Lin Z, Lin Q, Wu B. Association between impaired sensitivity to thyroid hormones and sedentary behavior: a cross-sectional study. *Front Med (Lausanne)*. 2025;12:1596669. Published 2025 Jun 6. doi:10.3389/fmed.2025.1596669

75. Zhang SY, Hu XQ, Xiang C, et al. Physical activity affects dysthyreosis by thyroid hormones sensitivity: a population-based study. *Front Endocrinol (Lausanne)*. 2024;15:1418766. Published 2024 Oct 28. doi:10.3389/fendo.2024.1418766

76. Zhou L, Wang Y, Su J, An Y, Liu J, Wang G. Vitamin D deficiency is associated with impaired sensitivity to thyroid hormones in euthyroid adults. *Nutrients*. 2023;15(17):3697. doi:10.3390/nu15173697

77. Li Y, Sun J, Jiao Y, Li N, Zhao W. Impaired sensitivity to thyroid hormones is associated with decreased vitamin D levels in the euthyroid population. *J Clin Endocrinol Metab*. 2024;109(3):691-700. doi:10.1210/clinem/dgad607