

## **Thyroid Disease and Diet — Nutrition Plays a Part in Maintaining Thyroid Health** **By Cheryl Harris, MPH, RD**

*Suggested CDR Learning Codes: 3000, 3020, 3090, 4000, 4040, 4050, 5000, 5110, 5120, 5160, 5190, 5290; Level 2*

“I have a tough time losing weight because of my thyroid.”

You’ve probably heard this complaint time and again from clients who have thyroid disease—and with good reason. To the great frustration of many of the 27 million Americans with thyroid gland issues, the thyroid has a profound impact on metabolism. Unintended weight gain and weight loss are common, and both can be a daunting challenge to rectify. Although weight may be the most common complaint, clients are at an increased risk of cardiovascular disease and diabetes, underscoring the need to eat a balanced diet and adopt a healthful lifestyle. But since one-half of all people with thyroid disease are undiagnosed and weight changes are a common symptom,<sup>1</sup> RDs are in a prime position to spot potential thyroid conditions, make appropriate referrals, and help clients get a timely diagnosis and the treatment they need.

This continuing education activity will provide an overview of thyroid disease, its relationship with cardiovascular disease and diabetes, and the role nutrition plays in maintaining thyroid health.

### **Thyroid 101**

The thyroid gland is a 2-inch butterfly-shaped organ located at the front of the neck. Though the thyroid is small, it’s a major gland in the endocrine system and affects nearly every organ in the body. It regulates fat and carbohydrate metabolism, respiration, body temperature, brain development, cholesterol levels, the heart and nervous system, blood calcium levels, menstrual cycles, skin integrity, and more.<sup>1</sup>

The most common thyroid condition is hypothyroidism, or underactive thyroid. In the United States, hypothyroidism usually is caused by an autoimmune response known as Hashimoto’s disease or autoimmune thyroiditis. As with all autoimmune diseases, the body mistakenly identifies its own tissues as an invader and attacks them until the organ is destroyed. This chronic attack eventually prevents the thyroid from releasing adequate levels of the hormones T3 and T4, which are necessary to keep the body functioning properly. The lack of these hormones can slow down metabolism and cause weight gain, fatigue, dry skin and hair, and difficulty concentrating (see table below).<sup>2</sup> Hashimoto’s affects approximately 5% of the US population, is seven times more prevalent in women than men, and generally occurs during middle age.<sup>3</sup>

Hyperthyroidism, or overactive thyroid gland, is another common thyroid condition. The most prevalent form is Graves' disease in which the body's autoimmune response causes the thyroid gland to produce too much T3 and T4. Symptoms of hyperthyroidism can include weight loss, high blood pressure, diarrhea, and a rapid heartbeat. Graves' disease also disproportionately affects women and typically presents before the age of 40.<sup>4</sup>

Hashimoto's is more common than Graves' disease, but both are referred to as autoimmune thyroid disease (ATD), which has a strong genetic link and is associated with other autoimmune disorders, such as type 1 diabetes, rheumatoid arthritis, lupus, and celiac disease.<sup>2</sup>

A goiter, or enlargement of the thyroid gland, can be caused by hypothyroidism, hyperthyroidism, excessive or inadequate intake of iodine in the diet, or thyroid cancer—the most common endocrine cancer whose incidence studies indicate is increasing.<sup>5</sup>

### **Treatment**

The disease process for Hashimoto's is a spectrum, and not all patients require treatment. Some patients have autoimmune antibodies but retain enough thyroid function without the need for intervention for years. Generally, once the body can no longer produce an adequate amount of thyroid hormone for necessary physiological functions, thyroid replacement medication is necessary to correct the hormonal imbalances associated with hypothyroidism.

Hyperthyroidism usually is treated with medications, surgery, or oral radioactive iodine. However, these treatments are imprecise and may cause the thyroid to secrete inadequate amounts of T3 and T4 and function insufficiently after treatment. Seventy percent to 90% of patients with Graves' or thyroid cancer eventually need treatment for hypothyroidism as a result of treatment.<sup>6</sup>

### **Cardiovascular Risk and Diabetes**

Patients with hypothyroidism have a greater risk of cardiovascular disease than the risks associated with weight gain alone. Low levels of thyroid hormones lead to a higher blood lipid profile, increased blood pressure, and elevated levels of the amino acid homocysteine and the inflammatory marker C-reactive protein.<sup>6</sup>

Thyroid hormones regulate cholesterol synthesis, cholesterol receptors, and the rate of cholesterol degradation. Hypothyroidism increases LDL levels, and increased cholesterol levels have been shown to induce hypothyroidism, leading to a harmful feedback loop that has been illustrated most clearly in animal models. In humans, normalization of thyroid hormone levels has a beneficial effect on cholesterol, which may be worth noting especially for clients who choose not to take prescribed thyroid medications.<sup>7</sup>

Moreover, a strong relationship exists between thyroid disorders, impaired glucose control, and diabetes. Thirty percent of people with type 1 diabetes have ATD, and 12.5% of those with type 2 diabetes have thyroid disease compared with a 6.6% prevalence of thyroid disease in the general public. Both hypothyroidism and hyperthyroidism affect carbohydrate metabolism

and have a profound effect on glucose control, making close coordination with an endocrinologist vital.<sup>8</sup>

## **Weight**

It's imperative dietitians have a good understanding of the metabolic changes associated with thyroid disease so they can set realistic goals and expectations for clients. Most people with hypothyroidism tend to experience abnormal weight gain and difficulty losing weight until hormone levels stabilize. Moreover, it's common for patients with Graves' disease to experience periods of high and low thyroid hormone levels, so it may take several months to achieve a balance. During this time, it's essential clients focus on healthful behaviors such as eating nutritious foods, exercising regularly, managing stress, and sleeping adequately rather than focus on the numbers on the scale.

Clara Schneider, MS, RD, RN, CDE, LDN, of Outer Banks Nutrition and author of numerous books, including *The Everything Thyroid Diet Book*, says, "The No. 1 priority is to get the thyroid disease under control. Clients need to have labs and medications addressed first. Weight changes are just not going to happen before all of that is under control." She notes that Hashimoto's typically occurs around menopause, which compounds the weight gain issue that many women experience during that time.

"The biggest factors that help with weight loss are calorie- and carbohydrate-controlled meal plans," says Sheila Dean, DSc, RD, LD, CCN, CDE, of the Palm Harbor Center for Health & Healing in Florida. "Naturally I try to ensure [clients are] eating a whole foods-based, minimally processed diet with at least 2 L of water daily." Schneider agrees that a heart-healthy eating plan is fundamental. "The diet should emphasize more vegetables, leaner meats, more beans, fiber, and fluids. We need to look at intake of sugars, added fats, fast food, and meals out."

Emphasizing lean proteins, vegetables, fruits, heart-healthy fats and omega 3s, high-fiber foods, and appropriate portions can help manage or prevent illnesses associated with thyroid disease. As Schneider notes, "It's eating for prevention of all these diseases that accompany thyroid disease: heart disease, diabetes, cancer, and more." As an added bonus, fiber can relieve constipation that people with hypothyroidism often experience.

## **Key Nutrients**

Many nutritional factors play a role in optimizing thyroid function. However, both nutrient deficiencies and excesses can trigger or exacerbate symptoms. Working in collaboration with a physician is ideal to determine nutritional status for optimal thyroid health.

**Iodine:** Iodine is a vital nutrient in the body and essential to thyroid function; thyroid hormones are comprised of iodine. While autoimmune disease is the primary cause of thyroid dysfunction in the United States, iodine deficiency is the main cause worldwide.<sup>9</sup>

Iodine deficiency has been considered rare in the United States since the 1920s, largely due to the widespread use of iodized salt. This, along with fish, dairy, and grains, is a major source of iodine in the standard American diet.

However, iodine intake has dropped during the past few decades. Americans get approximately 70% of their salt intake from processed foods that, in the United States and Canada, generally don't contain iodine. A 2012 Centers for Disease Control and Prevention report indicates that, on average, Americans are getting adequate amounts of iodine, with the potential exception of women of childbearing age<sup>10</sup> (see "Thyroid Disease and Pregnancy" sidebar below).

Both iodine deficiency and excess have significant risks; therefore, supplementation should be approached with caution. Supplemental iodine may cause symptom flare-ups in people with Hashimoto's disease because it stimulates autoimmune antibodies.<sup>11</sup>

Iodine intake often isn't readily apparent on a dietary recall since the amount in foods is largely dependent on levels in the soil and added salt. However, Schneider says, "Clients taking iodine tablets are a red flag. Frequent intake of foods such as seaweed, which is high in iodine, or an avoidance of all iodized salt may serve as signs that further exploration is needed."

**Vitamin D:** Vitamin D deficiency is linked to Hashimoto's, according to one study showing that more than 90% of patients studied were deficient. However, it's unclear whether the low vitamin D levels were the direct cause of Hashimoto's or the result of the disease process itself.<sup>12</sup>

Hyperthyroidism, particularly Graves' disease, is known to cause bone loss, which is compounded by the vitamin D deficiency commonly found in people with hyperthyroidism. This bone mass can be regained with treatment for hyperthyroidism, and experts suggest that adequate bone-building nutrients, such as vitamin D, are particularly important during and after treatment.<sup>13</sup>

Foods that contain some vitamin D include fatty fish, milk, dairy, eggs, and mushrooms. Sunlight also is a potential source, but the amount of vitamin production depends on the season and latitude. If clients have low vitamin D levels, supplemental D3 may be necessary, and the client's physician should monitor progress to ensure the individual's levels stay within an appropriate range.

**Selenium:** The highest concentration of selenium is found in the thyroid gland, and it's been shown to be a necessary component of enzymes integral to thyroid function.<sup>14</sup> Selenium is an essential trace mineral and has been shown to have a profound effect on the immune system, cognitive function, fertility in both men and women, and mortality rate.

A meta-analysis of randomized, placebo-controlled studies has shown benefits of selenium on both thyroid antibody titers and mood in patients with Hashimoto's, but this effect seems more pronounced in people with a selenium deficiency or insufficiency at the outset.<sup>15</sup> Conversely, an excessive intake of selenium can cause gastrointestinal distress or even raise the risk of type 2 diabetes and cancer. So clients will benefit from having their selenium levels tested and incorporating healthful, selenium-rich foods in to their diets, such as Brazil nuts, tuna, crab, and lobster.<sup>15</sup>

**Vitamin B12:** Studies have shown that about 30% of people with ATD experience a vitamin B12 deficiency. Food sources of B12 include mollusks, sardines, salmon, organ meats such as liver, muscle meat, and dairy. Vegan sources include fortified cereals and nutritional yeast. Severe B12 deficiency can be irreversible, so it's important for dietitians to suggest clients with thyroid disease have their levels tested.<sup>16</sup>

### **Goitrogens**

Cruciferous vegetables such as broccoli, cauliflower, and cabbage naturally release a compound called goitrin when they're hydrolyzed, or broken down. Goitrin can interfere with the synthesis of thyroid hormones. However, this is usually a concern only when coupled with an iodine deficiency.<sup>17</sup> Heating cruciferous vegetables denatures much or all of this potential goitrogenic effect.<sup>18</sup> "If you're eating three to four servings per week of cooked or even lightly steamed crucifers, generally it shouldn't have a negative effect on thyroid health and particularly if iodine consumption and tissue levels are adequate," Dean says.

Soy is another potential goitrogen. The isoflavones in soy can lower thyroid hormone synthesis, but numerous studies have found that consuming soy doesn't cause hypothyroidism in people with adequate iodine stores.<sup>19</sup> While moderate soy intake (ie, levels found in food) gets a green light, concern remains for high-dose soy supplementation, specifically in people with preexisting compromised thyroid function. In addition to biological plausibility for thyroid suppression with soy consumption, a randomized, double-blinded study showed a threefold increase in the development of clinical hypothyroidism among women with subclinical hypothyroid levels when supplemented with high doses of soy. Iodine levels did not appear to be a factor.<sup>20</sup>

Clearly, given the prevalence of subclinical and overt thyroid disease and frequent supplemental soy intake, especially among postmenopausal women, more research is needed. However, Dean cautions clients to eat soy in moderation: "Certainly, I'm not encouraging soy-based supplements."

While a typical intake of cooked crucifers and soy are generally considered safe in people with adequate iodine, the potential exception is millet, a nutritious gluten-free grain, which may suppress thyroid function even in people with adequate iodine intake.<sup>21</sup> If a dietary recall indicates frequent millet consumption in patients with hypothyroidism, it may be wise to suggest they choose a different grain.

### **What About a Gluten-Free Diet?**

Gluten sensitivity and gluten intolerance continue to be topics of discussion in the dietetics community, with speculation that a gluten-free diet may help relieve symptoms of various autoimmune conditions, including ATD. The two aspects of this theory involve the relationship between ATD and a gluten-free diet in people with celiac disease and the effect of a gluten-free diet in people with ATD without celiac disease.

The rate of celiac disease is significantly higher among people with ATD than the general population. Studies have shown that 2% to 4.8% of US adults with ATD have celiac disease and 7.8% of children with ATD have celiac disease vs. 1% of the general population.<sup>22</sup> Celiac

disease testing is recommended for anyone who has ATD and celiac disease symptoms. However, appropriate and timely identification is often delayed because the typical symptoms of ATD overlap greatly with the symptoms for celiac disease, such as diarrhea, constipation, weight changes, fatigue, anemia, and infertility.

Studies have found that people with undiagnosed celiac disease commonly have antithyroid antibodies and show reductions in thyroid antibody titers, indicating a lesser autoimmune response, after six months of consuming a gluten-free diet.<sup>23,24</sup> Moreover, when people with celiac disease and hypothyroidism go on a gluten-free diet and start experiencing increased absorption of both food and medications due to intestinal healing, often they need lower doses of thyroid medication.<sup>25</sup> So a gluten-free diet may benefit both conditions in those with ATD and celiac disease.

To date, no studies have evaluated the effects of a gluten-free diet in people who have ATD but not celiac disease. This remains an area of controversy, although some experts report observing benefits in clients.

So what should RDs do in practice? If clients are interested and motivated to try a gluten-free diet, they should be tested for celiac disease first before going gluten free, even in the absence of gastrointestinal symptoms. Once someone with celiac disease adopts a gluten-free diet, the autoimmune markers for the disease disappear, so it is critical that the testing precedes dietary changes to insure accuracy. If the test is negative, a trial gluten-free diet emphasizing naturally gluten-free foods (eg, fruits, vegetables, beans, nuts, seeds, fish, poultry) for several months will allow clients and RDs to observe any potential effects.

### **Foods, Supplements, and Medication Interactions**

When it comes to thyroid medications, it's important for RDs to know which medications can interact with common nutritional supplements. Calcium supplements have the potential to interfere with proper absorption of thyroid medications, so patients must consider the timing when taking both. Studies recommend spacing calcium supplements and thyroid medications by at least four hours.<sup>26</sup> Coffee and fiber supplements lower the absorption of thyroid medication, so patients should take them one hour apart.<sup>27</sup> Dietitians should confirm whether clients have received and are adhering to these guidelines for optimal health.

Chromium picolinate, which is marketed for blood sugar control and weight loss, also impairs the absorption of thyroid medications. If clients decide to take chromium picolinate, they should take it three to four hours apart from thyroid medications.<sup>28</sup> Flavonoids in fruits, vegetables, and tea have been shown to have potential cardiovascular benefits. However, high-dose flavonoid supplements may suppress thyroid function.<sup>29</sup> The Natural Standards Database provides an extensive list of supplements that have a potential impact on thyroid function, so taking precautions and coordinating patient care with a knowledgeable practitioner is prudent.

### **Exercise**

A discussion on thyroid disease and good health isn't complete without stressing the importance of physical activity. Lisa Lilienfield, MD, a thyroid disease specialist at the Kaplan Center for Integrative Medicine in McLean, Virginia, and a certified yoga instructor, is a firm

believer in the importance of exercise, particularly for clients with a thyroid disorder. “With hypothyroid patients, certainly exercise can help with weight gain, fatigue, and depression. With hyperthyroidism, anxiety and sleep disturbances are so common, and exercise can help regulate both.”

In addition to the obvious impact exercise has on weight and metabolism, a study of patients with Graves’ disease found that a structured exercise program showed dramatic improvements in fatigue levels, and significantly more patients were able to successfully stop taking antithyroid medications without a relapse.<sup>30</sup>

Since fatigue can be a barrier to exercise, starting off slowly and gently is paramount. Lilienfield and Schneider recommend patients use a pedometer as a tool for a tangible source of structure and motivation. Lilienfield also suggests clients attend a gentle yoga class as a place to get started.

### Typing It Altogether

Thyroid disease presents unique challenges due to undesired weight changes, significant cardiovascular risks, and symptoms such as fatigue, mood changes, and gastrointestinal upset, which can hinder the development of healthful behaviors. It’s vital that dietitians focus on setting realistic goals for heart-healthy changes and regular exercise when counseling clients. With so many potential nutrient deficiencies and interactions with medications and supplements, it will be important for dietitians to coordinate with the rest of the clients’ healthcare team for optimal health outcomes.

— *Written by Cheryl Harris, MPH, RD, a dietitian in private practice in Fairfax and Alexandria, Virginia. She’s also a speaker, writer, and health coach.*

Hypothyroidism	Hyperthyroidism
Weight gain	Weight loss
Constipation	Diarrhea
Fatigue	Fatigue
Hair loss	N/A
Depression, “brain fog,” or difficulty concentrating	Anxiety, difficulty concentrating, nervousness
Joint pain	Muscle weakness
Infertility, missed periods	Infertility, missed periods
Miscarriage	Miscarriage

— *Author compiled table from several sources.*

## Thyroid Disease and Pregnancy

According to the American Thyroid Association, “Pregnancy is a stress test for the thyroid.” Thyroid disorders often first become apparent during this time and are quite common during the postpartum period. They have a huge impact on mom and baby. Hypothyroidism and hyperthyroidism can cause preeclampsia, low birth weight, miscarriage, and a variety of other serious complications, even at subclinical levels.

Many clients seek RDs when experiencing infertility, planning for a baby, or early in their pregnancy. Those who have other autoimmune diseases, a goiter, a family history of thyroid disease, thyroid antibodies, or a history of miscarriage or preterm birth are considered high risk of developing thyroid complications during or after pregnancy. Confirming whether or not these clients have had thyroid screening will lessen the risk of preventable complications.<sup>1</sup>

Pregnant women with existing thyroid disease should be proactive about their health, as the first six weeks of pregnancy are particularly critical. “Getting good control before conception is key, and women should have their thyroid function tested monthly during pregnancy because requirements are increased,” says Lisa Lilienfield, MD, a thyroid disease specialist at the Kaplan Center for Integrative Medicine in McLean, Virginia.

Pregnant clients need up to 50% more iodine than nonpregnant patients. Iodine deficiency in pregnancy can cause severe consequences in the developing fetus, such as mental retardation and stunted growth.<sup>2</sup> However, there also are dangers with excess intake, with symptoms similar to those seen in iodine deficiency. The American Thyroid Association recommends pregnant women take a prenatal vitamin containing 150 mcg of potassium iodide, which more than one-half of prenatal vitamins don’t contain.

Postpartum thyroiditis is a form of Hashimoto’s and affects 4% to 10% of women in the year following childbirth. Symptoms may be subtle but diagnosis is important for the health of subsequent pregnancies. Women who have experienced postpartum thyroiditis are at increased risk for developing hypothyroidism later in life.<sup>1</sup>

## References

1. Ogunyemi DA. Autoimmune thyroid disease and pregnancy. eMedicine website. <http://www.emedicine.medscape.com/article/261913-overview>. Updated March 8, 2012.
2. Dietary supplement fact sheet: iodine. Office of Dietary Supplements website. <http://ods.od.nih.gov/factsheets/Iodine-QuickFacts>. Reviewed June 24, 2011. Accessed January 17, 2012.

## Recommended Reading

### *For Professionals*

- “Medical Nutrition Therapy for Thyroid and Related Disorders” in *Krause’s Food, Nutrition, & Diet Therapy*, 13th edition



### **For Clients**

- ***The Everything Thyroid Diet*** Book by Clara Schneider
- ***The Thyroid Diet Revolution*** by Mary Shoman

### **Take-Home Pearls**

- Thyroid disease is common, particularly among women and people with other autoimmune diseases.
- Weight loss is particularly challenging for thyroid disease patients unless hormone levels are stabilized. The initial focus should be on healthful eating, physical activity, and adequate sleep.
- Many people with thyroid disease are at higher risk of cardiovascular disease and diabetes.
- A heart-healthy diet that includes vegetables, fruits, lean proteins, fiber, and omega-3s is paramount.
- Both nutrient deficiencies and excesses worsen thyroid function and symptoms. Communication and coordination with the client's healthcare team is vital.
- Supplements can affect thyroid function and interfere with the efficacy of thyroid medication.
- Physical exercise is crucial. Encourage clients to start with walking and beginner's yoga.

### **References (for main article)**

1. Canaris GJ, Manowitz NR, Mayor G, Ridgway EC. The Colorado thyroid disease prevalence study. ***Arch Intern Med.*** 2000;160(4):526-534.
2. Hypothyroidism. Bethesda, MD: National Endocrine and Metabolic Diseases Information Service, US Dept of Health and Human Services; 2012. NIH Publication No. 12-6180.
3. Golden SH, Robinson KA, Saldanha I, Anton B, Ladenson PW. Clinical review: prevalence and incidence of endocrine and metabolic disorders in the United States: a comprehensive review. ***J Clin Endocr Metab.*** 2009;94(6):1853-1878.
4. Graves' Disease. Bethesda, MD: National Endocrine and Metabolic Diseases Information Service, US Dept of Health and Human Services; 2008. NIH Publication No. 08-6217.
5. Aschebrook-Kilfoy B, Ward MH, Sabra MM, Devesa SS. Thyroid cancer incidence patterns in the United States by histologic type, 1992-2006. ***Thyroid.*** 2011;21(2):125-134.

6. Biondi B, Klein I. Hypothyroidism as a risk factor for cardiovascular disease. *Endocrine*. 2004;24(1):1-13.
7. Duntas LH, Brenta G. The effect of thyroid disorders on lipid levels and metabolism. *Med Clin North Am*. 2012;96(2):269-281.
8. Johnson JL. Diabetes control in thyroid disease. *Diabetes Spectrum*. 2006;19(3):148-153.
9. Dietary supplement fact sheet: iodine. Office of Dietary Supplements website. <http://ods.od.nih.gov/factsheets/Iodine-QuickFacts>. Reviewed June 24, 2011. Accessed January 17, 2012.
10. Centers for Disease Control and Prevention. **Second National Report on Biochemical Indicators of Diet and Nutrition in the U.S. Population**. Atlanta, GA: Centers for Disease Control and Prevention, US Dept of Health and Human Services; 2012.
11. Dean S. Medical nutrition therapy for thyroid and related disorders. In: Mahan KL, Escott-Stump S, eds. **Krause's Food, Nutrition, & Diet Therapy**. 13th ed. Philadelphia, PA: Saunders; 2008: 711-724.
12. Tamer G, Arik S, Tamer I, Coksert D. Relative vitamin D insufficiency in Hashimoto's thyroiditis. *Thyroid*. 2011;21(8):891-896.
13. Jyotsna VP, Sahoo A, Ksh SA, Sreenivas V, Gupta N. Bone mineral density in patients of Graves disease pre- & post-treatment in a predominantly vitamin D deficient population. *Indian J Med Res*. 2012;135(1):36-41.
14. Rayman MP. Selenium and human health. *Lancet*. 2012;379(9822):1256-1268.
15. Toulis KA, Anastasilakis AD, Tzellos TG, Goulis DG, Kouvelas D. Selenium supplementation in the treatment of Hashimoto's thyroiditis: a systematic review and a meta-analysis. *Thyroid*. 2010;20(10):1163-1173.
16. Sworczak K, Wisniewski P. The role of vitamins in the prevention and treatment of thyroid disorders. *Endokrynol Pol*. 2011;62(4):340-344.
17. Institute of Medicine Food and Nutrition Board. **Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc**. Washington, DC: National Academies Press; 2001.
18. Rungapamestry V, Duncan AJ, Fuller Z, Ratcliffe B. Effect of cooking brassica vegetables on the subsequent hydrolysis and metabolic fate of glucosinolates. *Proc Nutr Soc*. 2007;66(1):69-81.

19. Messina M, Redmond G. Effects of soy protein and soybean isoflavones on thyroid function in healthy adults and hypothyroid patients: a review of the relevant literature. ***Thyroid***. 2006;16(3):249-258.
20. Sathyapalan T, Manuchehri AM, Thatcher NJ, et al. The effect of soy phytoestrogen supplementation on thyroid status and cardiovascular risk markers in patients with subclinical hypothyroidism: a randomized, double-blind, crossover study. ***J Clin Endocrinol Metab***. 2011;96(5):1442-1449.
21. Elnour A, Hambraeus L, Eltom M, Dramaix M, Bourdoux P. Endemic goiter with iodine sufficiency: a possible role for the consumption of pearl millet in the etiology of endemic goiter. ***Am J Clin Nutr***. 2000;71(1):59-66.
22. Ch'ng CL, Jones MK, Kingham JG. Celiac disease and autoimmune thyroid disease. ***Clin Med Res***. 2007;5(3):184-192.
23. Ventura A, Neri E, Ughi C, Leopaldi A, Citta A, Not T. Gluten-dependent diabetes-related and thyroid-related autoantibodies in patients with celiac disease. ***J Pediatr***. 2000;137(2):263-265.
24. Naiyer AJ, Shah J, Hernandez L, et al. Tissue transglutaminase antibodies in individuals with celiac disease bind to thyroid follicles and extracellular matrix and may contribute to thyroid dysfunction. ***Thyroid***. 2008;18(11):1171-1178.
25. Jiskra J, Limanova Z, Vanickova Z, Kocna P. IgA and IgG antigliadin, IgA anti-tissue transglutaminase and antiendomysial antibodies in patients with autoimmune thyroid diseases and their relationship to thyroidal replacement therapy. ***Physiol Res***. 2003;52(1):79-88.
26. Mazokopakis EE, Giannakopoulos TG, Starakis IK. Interaction between levothyroxine and calcium carbonate. ***Can Fam Physician***. 2008;54(1):39.
27. Benvenga S, Bartolone L, Pappalardo MA, et al. Altered intestinal absorption of L-thyroxine caused by coffee. ***Thyroid***. 2008;18(3):293-301.
28. John-Kalarickal J, Pearlman G, Carlson HE. New medications which decrease levothyroxine absorption. ***Thyroid***. 2007;17(8):763-765.
29. Egert S, Rimbach G. Which sources of flavonoids: complex diets or dietary supplements? ***Adv Nutr***. 2011;2(1):8-14.
30. Cutovic M, Konstantinovic L, Stankovic Z, Vesovic-Potic V. Structured exercise program improves functional capacity and delays relapse in euthyroid patients with Graves' disease. ***Disabil Rehabil***. 2012;Epub ahead of print.

## Examination

### 1. Which of the following are symptoms of thyroid disease?

- A. Weight gain
- B. Weight loss
- C. Heart palpitations
- D. Symptoms depend on the type of thyroid disease an individual has.

### 2. Which of the following statements regarding thyroid disease in the United States is true?

- A. It is predominantly found in women.
- B. It is predominantly an autoimmune condition.
- C. It is predominantly related to a lack of iodine.
- D. A and B

### 3. Why do clients with untreated hypothyroidism have an increased risk of cardiovascular issues?

- A. Effects of the weight gain typically associated with hypothyroidism
- B. Increased C-reactive protein levels
- C. Change in lipid metabolism
- D. All of the above

### 4. Which of the following statements about iodine is false?

- A. Iodine is necessary for thyroid function.
- B. Iodine is found in table salt but rarely in processed foods.
- C. Iodine deficiency is the main cause of thyroid disease in the United States.
- D. Iodine deficiency and excess causes harm.

### 5. Which of the following statements about goitrogenic foods is true?

- A. Clients should avoid soy because it suppresses thyroid function.
- B. Clients should avoid all cruciferous vegetables because they suppress thyroid function.
- C. Cooked cruciferous vegetables shouldn't be problematic if iodine intake is sufficient.
- D. Millet won't suppress thyroid function as long as it's cooked.

### 6. Which nutrients are of particular concern for clients with thyroid disease?

- A. Iodine
- B. Vitamin D
- C. Selenium
- D. Vitamin B12
- E. All of the above

**7. Which of the following statements regarding a gluten-free diet in relation to thyroid disease is true?**

- A. It is advisable for all clients with thyroid disease.
- B. It should be tried and if the client benefits, they should be tested for celiac disease.
- C. It may benefit some clients with thyroid disease.
- D. It will help clients lose the weight associated with hypothyroidism.

**8. Foods or supplements that may influence the absorption of thyroid medication include which of the following?**

- A. Coffee
- B. Fiber
- C. Calcium supplements
- D. B and C
- E. A, B, and C

**9. The initial recommendations for thyroid disease and exercise include which of the following?**

- A. Adding gentle exercise, such as walking and yoga
- B. Waiting until thyroid function is considered stable before exercising
- C. Exercising for at least 30 minutes five to six times per week due to cardiovascular disease risks associated with thyroid disease
- D. Following only a trainer-designed fitness plan

**10. It is vital that pregnant clients with thyroid disease do which of the following?**

- A. Coordinate closely with a physician and have thyroid labs monitored every month during pregnancy.
- B. Take a multivitamin including iodine from potassium iodide.
- C. Monitor thyroid levels closely postpartum.
- D. All of the above