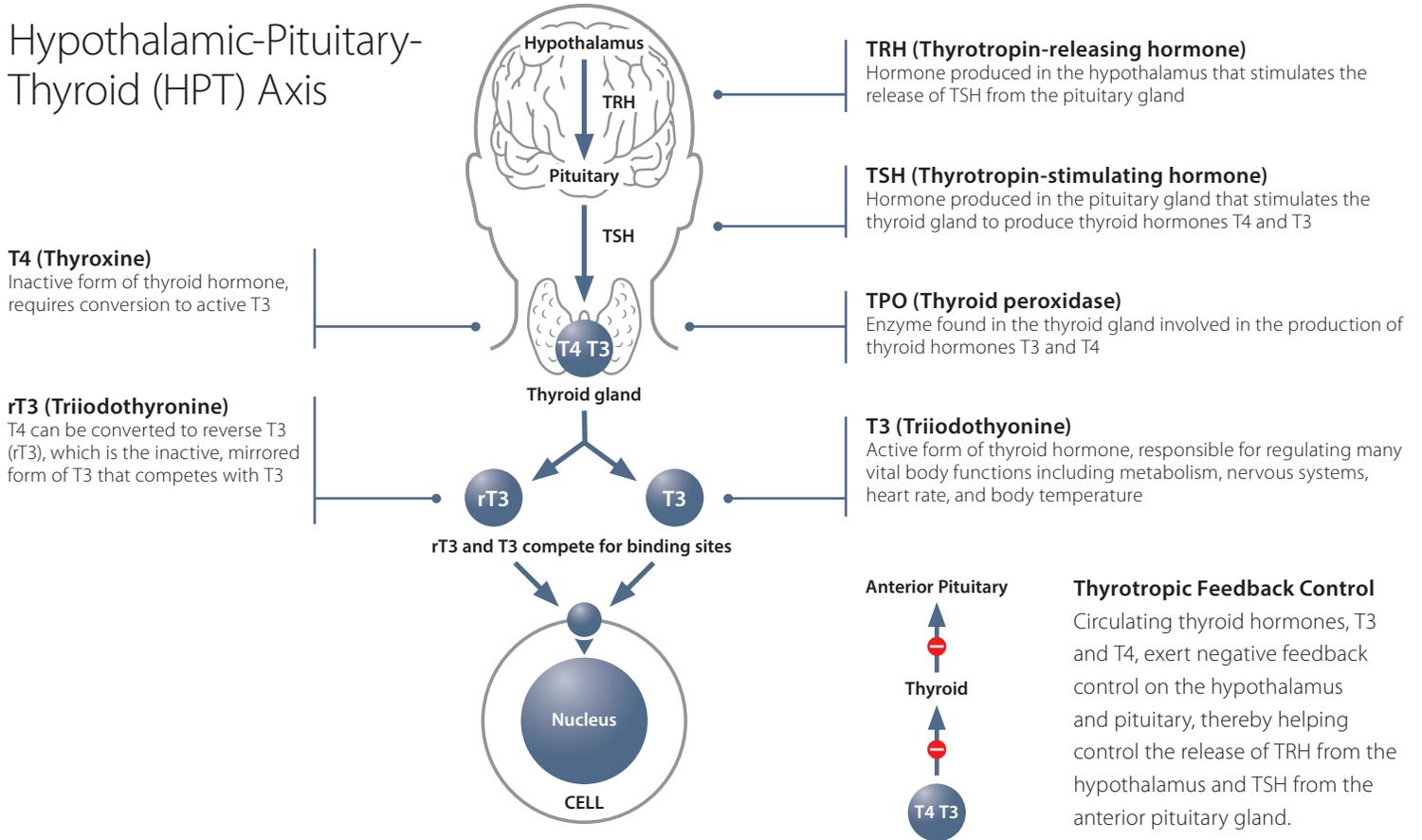


# Thyroid Function and Hypothyroidism

Thyroid hormone (TH) is essential for life and has a myriad of functions in the body. TH regulates our metabolism and is associated with changes in body weight and energy levels. TH is involved in regulating most all vital body functions including breathing, heart rate, nervous systems,

musculoskeletal health, reproductive health, body temperature, appetite, digestive functions, cholesterol, triglyceride and carbohydrate metabolism, and normal physical growth and mental development in children.

## Hypothalamic-Pituitary-Thyroid (HPT) Axis



### Thyroid Function Labs

#### TSH

4 - 10 mIU/L

0.5-1 mIU/L



> 10 mIU/L

Test	Reference Range*
TSH	0.3-4.2 mIU/L
Free T4	0.9-1.7 ng/dL
Free T3	2.8-4.4 pg/mL
Serum rT3	10-24 ng/dL

\*Reference values for TSH and T4 are age-specific; adult reference range presented here  
\*Thyroid panel lab fine-tuning depends on the individual and their symptoms, however, a TSH ~ 1.0 mIU/L is considered ideal by many clinicians

#### Other test results which may indicate hypothyroidism:

- High cholesterol, especially LDL-C
- Anemia
- Hyponatremia
- Elevated lactate dehydrogenase
- Elevated creatine phosphokinase
- Hyperprolactinemia

### Thyroid Function Tests: Considerations

- Mild, subclinical hypothyroidism is defined by raised TSH with normal free T4 levels
- Overt hypothyroidism involves a high TSH level (usually > 10 mIU/L) with a subnormal free T4
- The majority (99%) of T4 in the blood is bound to thyroxine-binding globulin, so free T4 measures how much unbound T4 is in the blood and available to cells
- Free T3 is typically used to diagnose hyperthyroidism and is seldom used in hypothyroidism assessments
- Serum rT3 levels tend to follow T4 (low in hypothyroidism; high in hyperthyroidism)
- TPO antibodies may also be measured. Elevated TPO antibodies indicate a potential autoimmune disease such as Hashimoto's thyroiditis

## Causes



### Stress & Inflammation

Elevated acute or chronic stress can impair thyroid function, and hypothyroidism is associated with higher levels of CRP, ESR, and IL-6



### Nutrient Insufficiency or Excess

Inadequate iodine, selenium, zinc, iron and vitamin A may impair thyroid function, while excess fluoride and iodine can damage thyroid cells



### Autoimmune Conditions

Including Hashimoto's disease and other autoimmune etiologies



### Congenital or Pituitary Disorder

Defective or no thyroid at birth, or failure of pituitary gland to produce sufficient TSH



### Toxins

Endocrine-disrupting chemicals such as BPA have been implicated in hypothyroidism



### Pregnancy & Menopause

Some women produce thyroid antibodies during/after pregnancy. Estradiol reduces iodine uptake and increases thyroid-binding globulin, reducing free thyroid hormones



### Medications

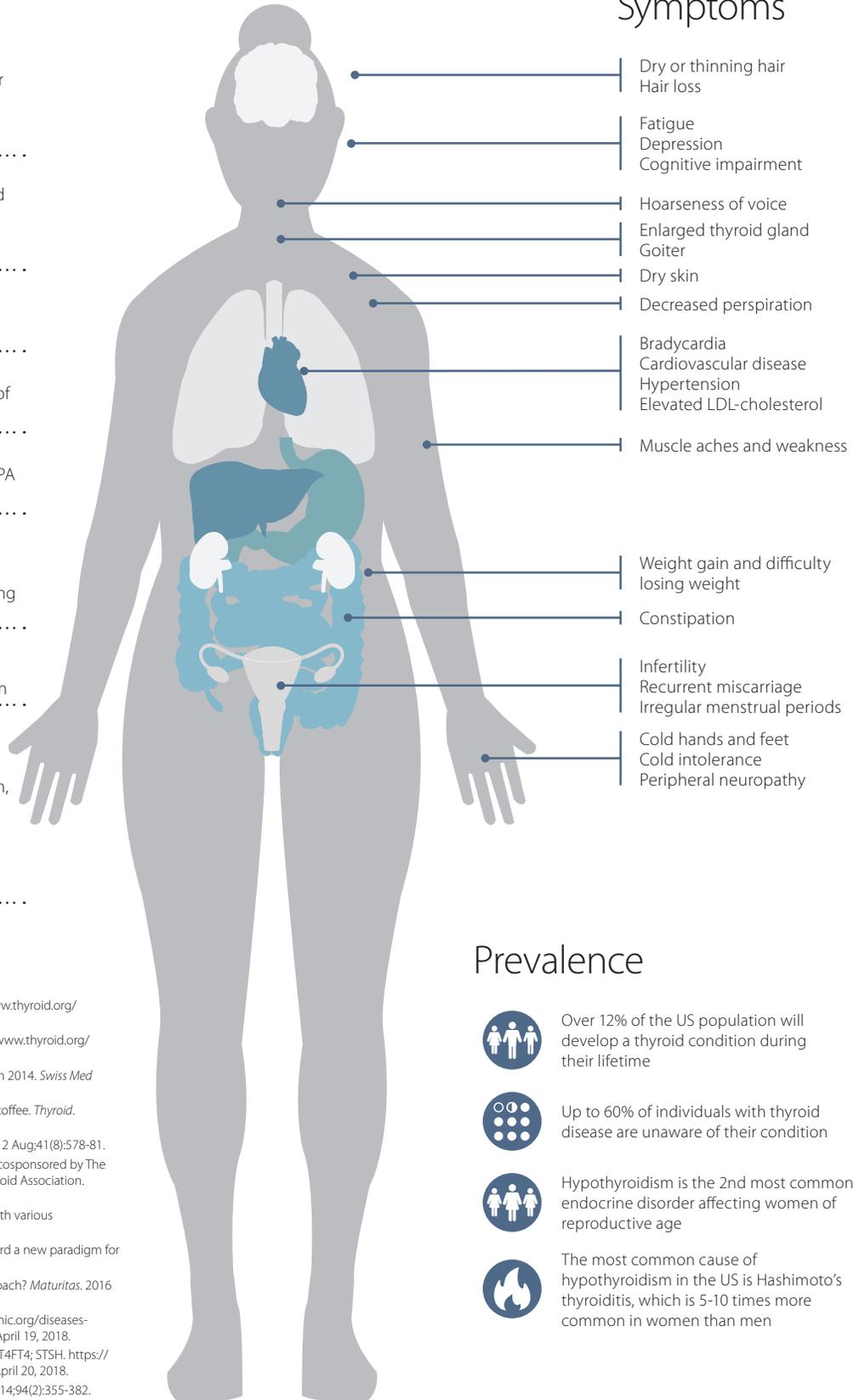
Amiodarone, lithium, IFN- $\alpha$ , and IL-2 can interfere with thyroid hormone production



### Reduced Absorption of Thyroid Hormone Replacement:

Certain medications (e.g. PPIs, cholestyramine, colesvelam, ciprofloxacin, sevelamer, aluminum hydroxide from antacids, etc.), supplements (e.g. iron, calcium) and coffee reduce the intestinal absorption of thyroid hormone replacement

## Symptoms



## Prevalence



Over 12% of the US population will develop a thyroid condition during their lifetime



Up to 60% of individuals with thyroid disease are unaware of their condition



Hypothyroidism is the 2nd most common endocrine disorder affecting women of reproductive age



The most common cause of hypothyroidism in the US is Hashimoto's thyroiditis, which is 5-10 times more common in women than men

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