

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Epidemiology of Thyroid Disorders

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- ❑ Thyroid hormones act on almost all nucleated cells and are essential for **normal growth** and **energy metabolism**
 - ❑ Thyroid dysfunction is **common**, **readily identifiable** and **easily treatable**, but if undiagnosed or untreated, it can have **profound adverse effects**
 - ❑ **Iodine nutrition** remains a **key determinant of thyroid function worldwide**
 - ❑ In iodine-replete populations, thyroid dysfunction is most commonly due to **thyroid autoimmunity**

The prevalence and incidence of thyroid dysfunction are difficult to compare across countries owing to differences in:

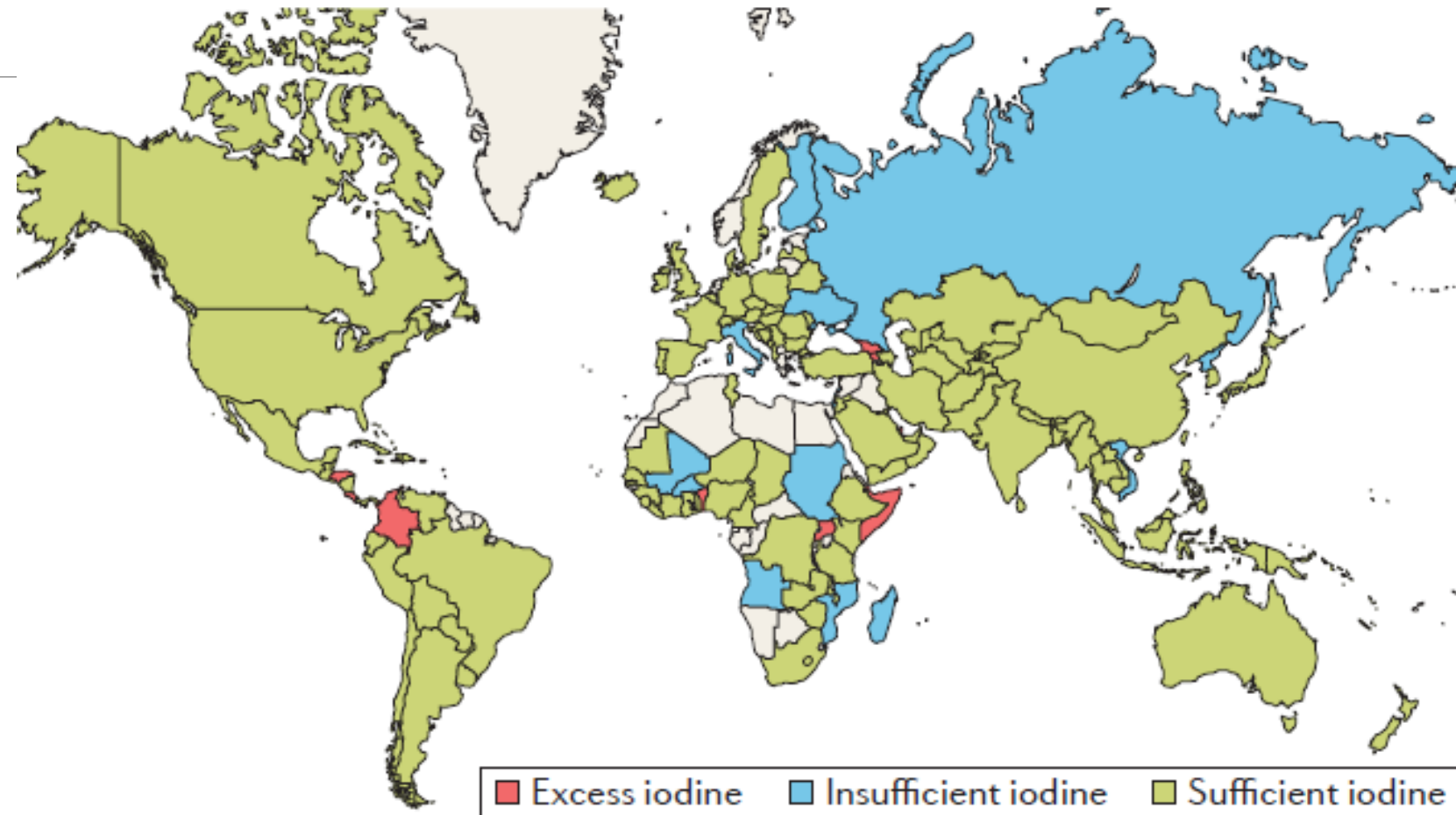
- ❑ *diagnostic thresholds*
- ❑ *assay sensitivities*
- ❑ *population selection*
- ❑ *iodine nutrition*

Risk factors for developing hypothyroidism and hyperthyroidism

| Risk factor | Hypothyroidism | Hyperthyroidism | Comment |
|--|----------------|-----------------|--|
| Female sex | + | + | Sex hormones and the skewed inactivation of the X chromosome are suspected to be triggers for hypothyroidism and hyperthyroidism ²⁶ |
| Iodine deficiency | + | + | Severe iodine deficiency can cause hypothyroidism and hyperthyroidism ¹⁷⁰ |
| Iodine excess | + | + | Excess iodine status can trigger hyperthyroidism, typically in elderly individuals with long-standing thyroid nodules and hyperthyroidism ¹⁷⁰ |
| Transition from iodine deficiency to sufficiency | + | + | Transition from iodine deficiency to sufficiency was associated with an increase in thyroperoxidase antibodies; one study reported an increase from 14.3% to 23.8% ¹⁴⁵ . As a result, the incidence of overt hypothyroidism increased almost 20% from 38.3 per 100,000 per year at baseline to 47.2 per 100,000 per year ¹⁴⁶ |
| Other autoimmune conditions | + | + | One study reported that another autoimmune disease was present in almost 10% of patients with Graves disease and in 15% of patients with Hashimoto's thyroiditis, with rheumatoid arthritis being the most common ¹⁹ |
| Genetic risk factors | n/a | NA | Both Graves disease and Hashimoto thyroiditis have genetic predispositions. Genome-wide association data have identified regions associated with thyroperoxidase antibody positivity ¹⁷¹ and thyroid disease ^{171,172} . Whole-genome sequencing might reveal novel insights ¹⁶⁰ |
| Smoking | - | + | Current smoking increases the odds of Graves hyperthyroidism almost twofold and increases the risk of Graves ophthalmopathy almost eightfold ¹⁷³ . Smokers also have a slower response during antithyroid drug treatment ¹⁷⁴ . Smoking might protect against hypothyroidism as smokers have a 30–45% reduction in the odds of being thyroperoxidase antibody positive ^{175,176} . Current smokers had a 50% lower prevalence of subclinical hypothyroidism and a 40% lower prevalence of overt hypothyroidism than non-smokers ¹⁷⁷ |

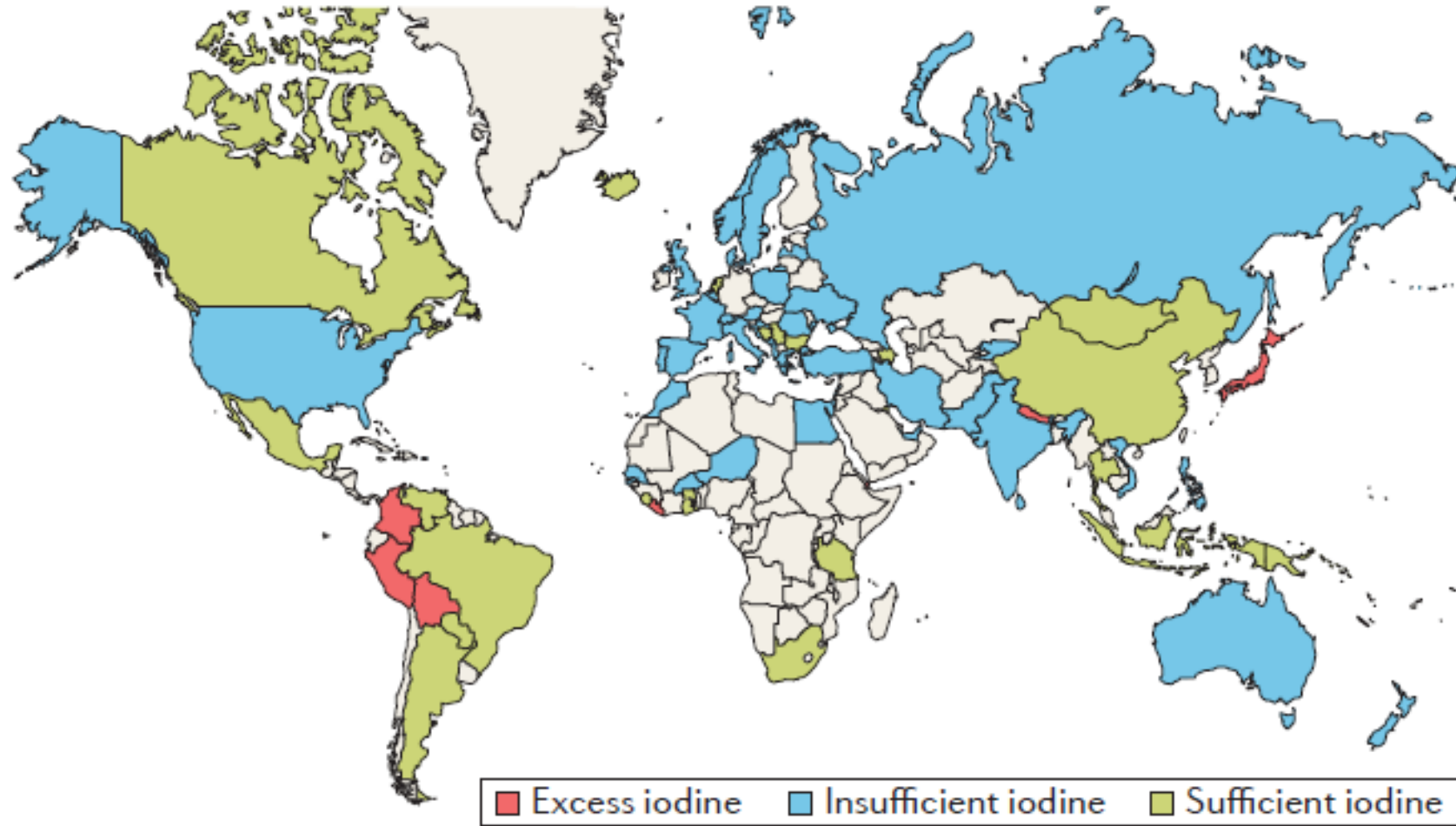
| Risk factor | Hypothyroidism | Hyperthyroidism | Comment |
|----------------------|----------------|-----------------|---|
| Selenium deficiency | + | + | One study reported that patients with newly diagnosed Graves disease and hypothyroidism had lower selenium levels than the normal population. This finding was most pronounced in patients with Graves disease ¹⁸ |
| Drugs | + | + | Examples of drugs that can cause hyperthyroidism and hypothyroidism include amiodarone ²¹ , lithium ²² and IFN- γ |
| Infections | NA | NA | Infectious agents have been associated with both autoimmune diseases and Graves disease ¹⁷⁹ . The most well studied is <i>Yersinia enterocolitica</i> , although retroviruses have also been identified as a possible cause ^{16,179} |
| Syndromic conditions | + | NA | Almost 25% of patients in a large registry of patients with Down syndrome had thyroid disease, the most common being primary hypothyroidism ²⁰ . The prevalence of hypothyroidism in Turner syndrome is approximately 13% ¹⁷² , but the incidence increases substantially by the third decade of life |

a Iodine status – general population



Taylor, P., Albrecht, D., Scholz, A. *et al.* Global epidemiology of hyperthyroidism and hypothyroidism. *Nat Rev Endocrinol* 14, 301–316 (2018).

b Iodine status – pregnancy



Hypothyroidism

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- ❑ Hypothyroidism is approximately **ten times more** prevalent **in women** than men
 - ❑ **Iodine deficiency** and **autoimmune disease** (known as Hashimoto thyroiditis) account for the vast majority of cases of primary hypothyroidism

Isfahan Thyroid Cohort Study (ITCS)

- ❑ This cohort is located in Isfahan, Iran
- ❑ The study had two phases (2006 and 2011) and its third stage is planned for 2020–2021
- ❑ The first phase was initiated in 2006 with 2523 participants (1275 males, 1248 females)



In iodine-sufficient countries, the prevalence of overt **hypothyroidism** ranges from **1% to 2%**, rising to **7%** in individuals aged **between 85 and 89 years**

Subclinical hypothyroidism: 4 to 10 %

□ The prevalence of **overt hypothyroidism** in the general population ranges

❖ in Europe from between **0.2% and 5.3%**

❖ in the USA **0.3% and 3.7%**

IRAN

Tehran Thyroid Study & Isfahan Thyroid Cohort Study (ITCS)

overt hypothyroidism : 2.4% & 2.8%

subclinical hypothyroidism: 5% & 5.8%

- *Nat Rev Endocrinol* 14, 301–316 (2018).
- *Iranian Journal of Endocrinology and Metabolism*. 2016; 18 (3) :165-172
- *Arch Iran Med*. 2021 Nov 1;24(11):788-795.

Hyperthyroidism

□ The prevalence of **overt hyperthyroidism** ranges from 0.2% to 1.3% in **iodine-sufficient** parts of the world

□ **IRAN**

□ The prevalence of hyperthyroidism :

Overt hyperthyroidism: 0.69% & 0.8%

□ **subclinical hyperthyroidism: 1.52% & 0.99**

- *Nat Rev Endocrinol* 14, 301–316 (2018).
- Journal of Diabetes and Metabolic Disorders. 2018 Dec;17(2):345-355
- Arch Iran Med. 2021 Nov 1;24(11):788-795.

Pregnancy

Hypothyroidism in pregnancy

□ In iodine-sufficient areas, the prevalence of hypothyroidism in pregnancy is **~2%⁸³**

□ IRAN

The prevalence of hypothyroidism in Iranian pregnant women

❖ **clinical hypothyroidism : 1.35%**

❖ **subclinical hypothyroidism: 11.90%**

- *Nat Rev Endocrinol* 14, 301–316 (2018)
- *BMC Pregnancy Childbirth* 20, 405 (2020)

Hyperthyroidism in pregnancy

Thyrotoxicosis in pregnancy :

❖ overt thyrotoxicosis :0.2%

❖ subclinical thyrotoxicosis: 2.5%

IRAN

The prevalence of hyperthyroidism, in Iranian pregnant women is **3.31%**

❖ clinical hyperthyroidism :1.06%

❖ subclinical hyperthyroidism : 2.56%

- *Nat Rev Endocrinol* 14, 301–316 (2018)
- *BMC Pregnancy Childbirth* 20, 405 (2020)

Thyroid nodule

And

AntiTPO Ab positive

Thyroid nodule in general population: 6.4% in women ,1.5 % in men

Autopsy surveys: 37-57%

IRAN

□ Palpable thyroid nodules were observed in **2.5%** (**3.6% women, 1.3% men**)

□ the prevalence of thyroid nodules that were undetectable by physical examination, was 13.2%

Anti Tpo Ab positive in general population in world : 5% of adult and 15 % older women

IRAN

12.8%

higher prevalence among women than in men: 16.0 vs. 8.5%

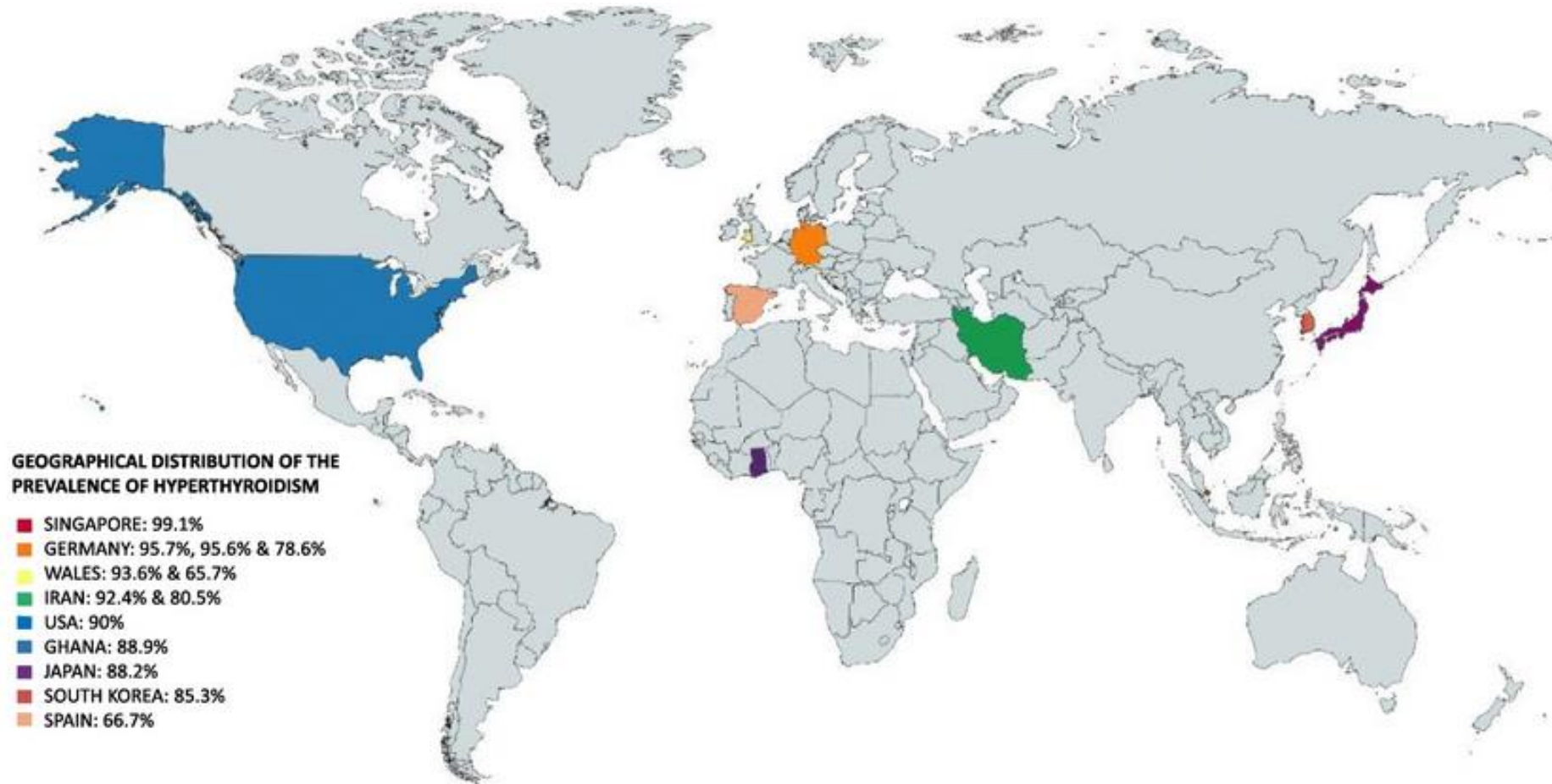
Thyroid Eye disease

Table 2 Characteristics of included studies

| Author | Study period | Country | Number of patients with TED | Prevalence (%) hyperthyroidism in TED | Prevalence (%) hypothyroidism in TED | Prevalence (%) euthyroidism in TED |
|---------------------------|--------------|-------------|-----------------------------|---------------------------------------|--------------------------------------|------------------------------------|
| Ackuaku-Dogbe et al. [24] | 2014–2016 | Ghana | 117 | 104 (88.9) | 5 (4.3) | 8 (6.8) |
| Expósito et al. [25] | 2007–2011 | Spain | 18 | 12 (66.7) | 6 (33.3) | – |
| Bartley et al. [14] | 1976–1990 | USA | 120 | 108 (90) | 5 (4.2) | 7 (5.8) |
| Eckstein et al. [15] | 2000 | Germany | 182 | 143 (78.6) | 11 (6) | 28 (15.4) |
| Jang et al. [26] | 2008–2010 | South Korea | 163 | 139 (85.3) | – | 24 (14.7) |
| Kashkouli et al. [22] | 2003–2006 | Iran | 303 | 280 (92.4) | 23 (7.5) | – |
| Khoo et al. [27] | 1996–1999 | Singapore | 1020 | 1011 (99.1) | 2 (0.2) | 7 (0.7) |
| McKeag et al. [28] | 2006–2007 | Wales | 47 | 44 (93.6) | 3 (6.4) | – |
| Medghalchi et al. [29] | 2012–2014 | Iran | 103 | 83 (80.5) | 19 (18.4) | 1 (0.9) |
| Mukasa et al. [30] | 2010–2010 | Japan | 238 | 210 (88.2) | – | 28 (11.8) |
| Ponto et al. [31] | 1999–2012 | Germany | 610 | 584 (95.7) | – | – |
| Ponto et al. [32] | 2005–2012 | Germany | 461 | 441 (95.6) | 12 (2.6) | 8 (1.7) |
| Cozma et al. [33] | 1997–2005 | Wales | 140 | 92 (65.7) | 29 (20.7) | 19 (13.6) |

Thyroid eye disease and hyperthyroidism

The global prevalence **86.2%**

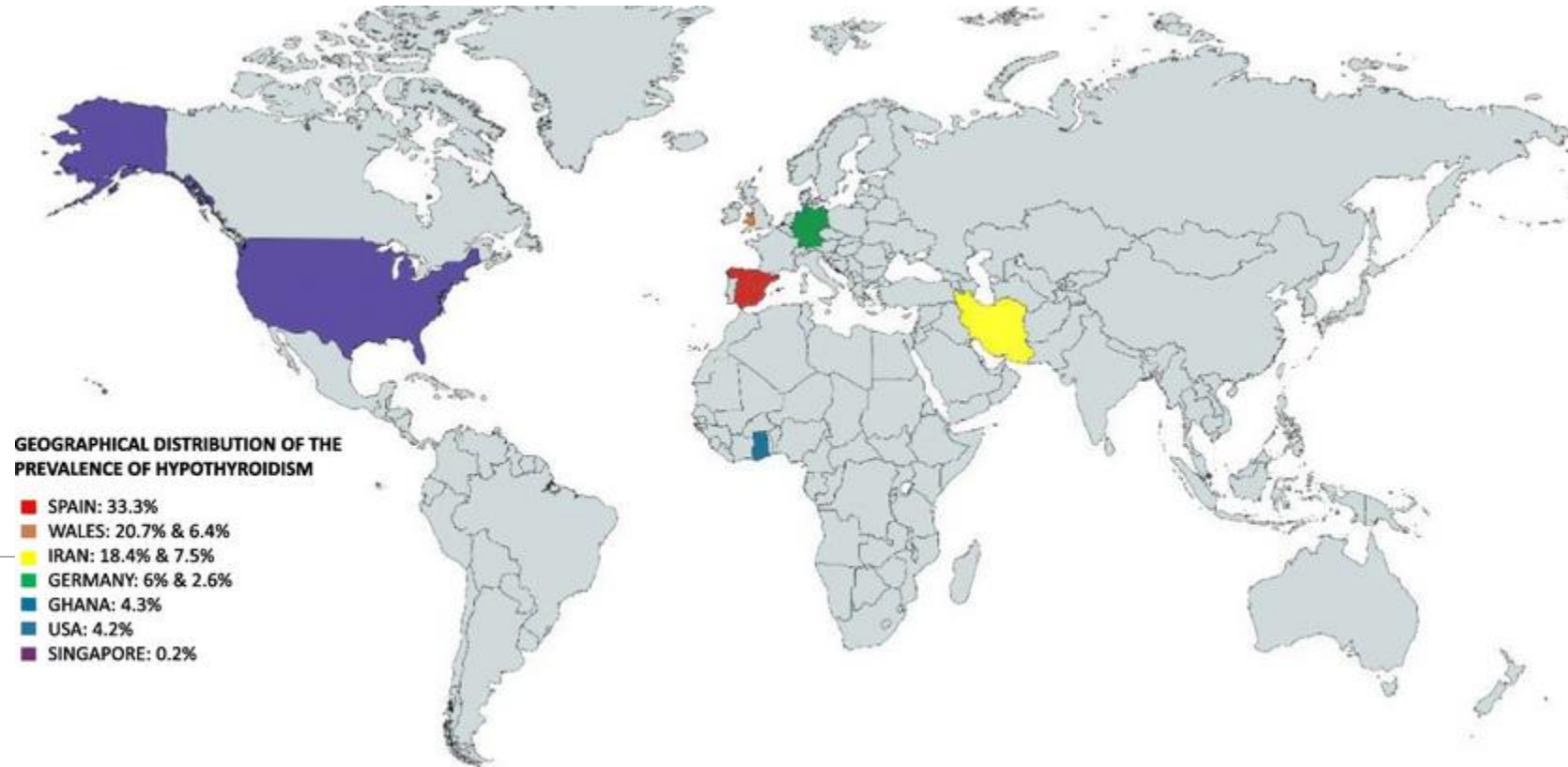


Geographical distribution of prevalence of hyperthyroidism (Singapore, Germany, Wales, Iran, USA, Ghana, Japan, South Korea, and Spain)

Muñoz-Ortiz, J., Sierra-Cote, M.C., Zapata-Bravo, E. et al. Prevalence of hyperthyroidism, hypothyroidism, and euthyroidism in thyroid eye disease: a systematic review of the literature. *Syst Rev* 9, 201 (2020).

Thyroid eye disease and hypothyroidism

The global prevalence **10.6%**

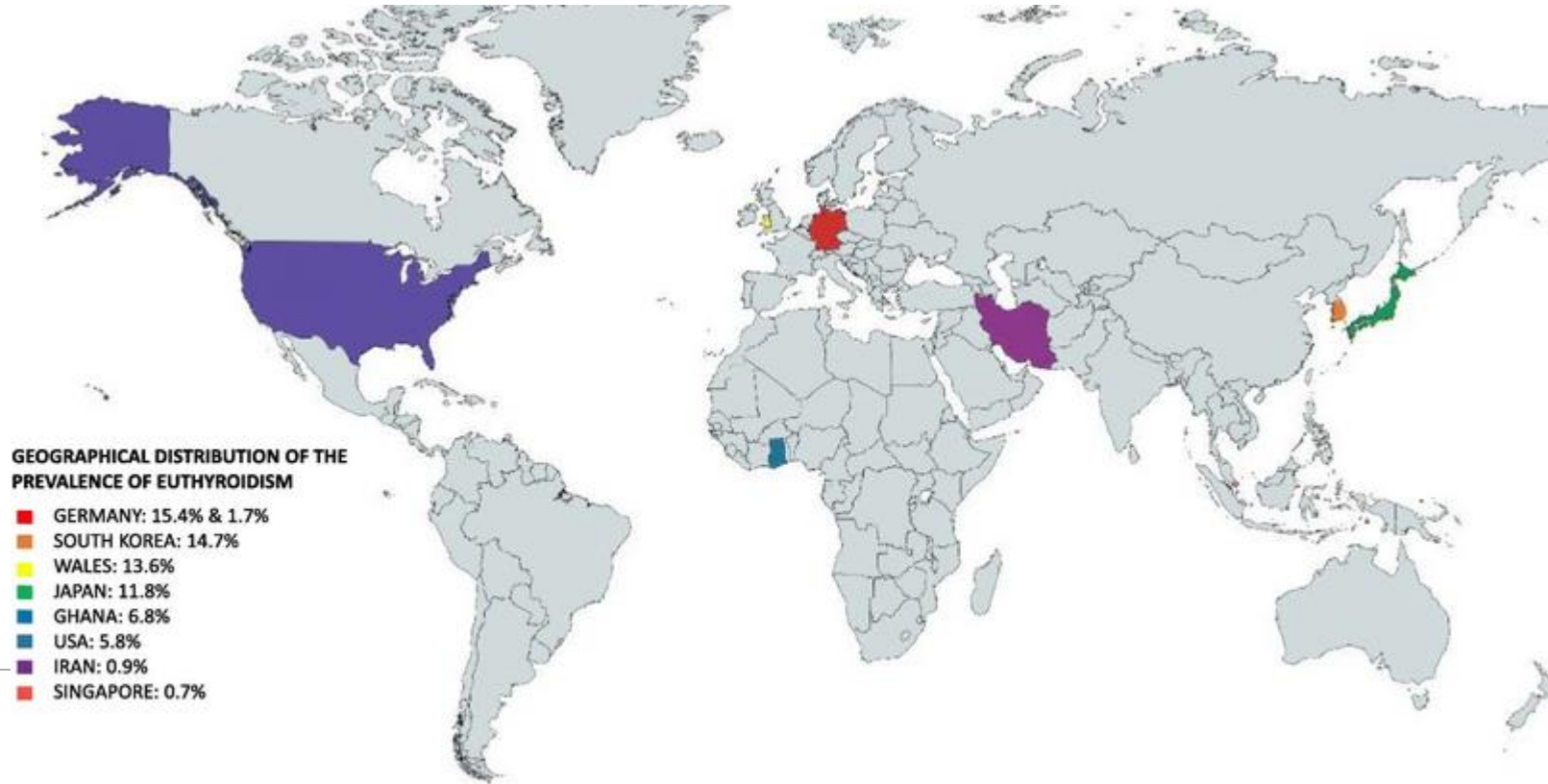


Geographical distribution of prevalence of hypothyroidism (Spain, Wales, Iran, Germany, Ghana, USA, and Singapore)

Muñoz-Ortiz, J., Sierra-Cote, M.C., Zapata-Bravo, E. et al. Prevalence of hyperthyroidism, hypothyroidism, and euthyroidism in thyroid eye disease: a systematic review of the literature. *Syst Rev* 9, 201 (2020).

Thyroid eye disease and Euthyroidism

The global prevalence **7.9%**



Geographical distribution of euthyroid prevalence (Germany, South Korea, Wales, Japan, Ghana, USA, Iran, and Singapore)

Muñoz-Ortiz, J., Sierra-Cote, M.C., Zapata-Bravo, E. et al. Prevalence of hyperthyroidism, hypothyroidism, and euthyroidism in thyroid eye disease: a systematic review of the literature. *Syst Rev* 9, 201 (2020).

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