Hypothyroidism in Children & Adolescents

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1. Definition

Hypothyroidism is a state of inadequate thyroid hormone action caused by insufficient production of thyroid hormones or, less commonly, impaired hypothalamic–pituitary stimulation.

In children, it is particularly important because untreated hypothyroidism can cause **growth failure, delayed puberty, and impaired neurodevelopment**, especially when congenital hypothyroidism is not treated promptly.

Two clinically important types

Type	Problem	Typical laboratory pattern
Primary hypothyroidism	Thyroid gland failure	↑ TSH + ↓ FT4
Central hypothyroidism	Pituitary/hypothalamic disease	↓ FT4 + low/normal/inappropriately mildly ↑ TSH

2. Clinical Presentation

A. Common symptoms

Think of hypothyroidism when several of the following occur together:

- Fatigue, lethargy
- Cold intolerance
- Constipation
- Dry/coarse skin
- Weight gain or difficulty losing weight
- Poor concentration
- Excessive sleepiness
- Muscle weakness or cramps
- Menstrual irregularities in adolescents
- Reduced school performance

In children, two particularly important clues:

↓ Growth velocity + delayed bone maturation

and

Delayed puberty

Pitfall: Weight gain alone is a poor reason to diagnose hypothyroidism. Severe obesity is usually **not** caused by hypothyroidism.

B. Physical examination

Look for:

- **Poor linear growth / short stature**
- Bradycardia
- Dry, coarse skin
- Cool skin
- Delayed deep tendon reflex relaxation
- Goiter
- Puffy face/periorbital edema
- Brittle hair/hair loss
- Constipation
- Muscle weakness
- Delayed puberty
- Hypothermia in severe disease

Hashimoto thyroiditis may present with:

- Firm, diffusely enlarged thyroid
- Sometimes a normal-sized or atrophic thyroid
- Positive thyroid autoantibodies

Hashimoto thyroiditis is the **most common cause of acquired hypothyroidism in children and adolescents**. (American Thyroid Association)

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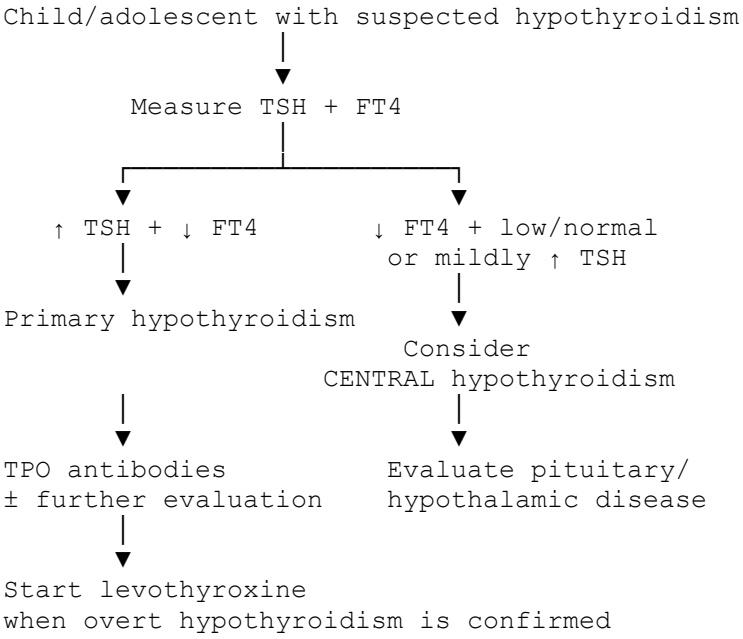
3. Diagnostic Approach

Practical diagnostic algorithm



For children and adolescents, **TSH and FT4 should generally be measured together** rather than relying on TSH alone. (Nice)

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4. Differential Diagnosis

If TSH is elevated:

Consider:

1. **Primary hypothyroidism**
    - Hashimoto thyroiditis
    - Congenital thyroid dysgenesis
    - Post-thyroid surgery/radiation
    - Iodine deficiency/excess
    - Drug-induced hypothyroidism
2. **Subclinical hypothyroidism**
    - ↑ TSH + normal FT4
3. **Transient TSH elevation**
    - Recent illness

    - Some medications
    - Obesity
    - Laboratory variation
4. **Poor adherence to levothyroxine** in a previously treated patient

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If FT4 is low but TSH is not elevated:

Think **central hypothyroidism**.

Important causes include:

- Pituitary tumor
- Hypothalamic disease
- Congenital pituitary disorders
- Previous cranial irradiation
- Traumatic brain injury
- Other pituitary hormone deficiencies

Must not miss: A low FT4 with a "normal" TSH does **not** exclude hypothyroidism. In central hypothyroidism, TSH may be low, normal, or mildly elevated but biologically inappropriate.

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5. Investigations

Essential investigations

First-line

TSH + FT4

These are the key diagnostic tests.

If primary hypothyroidism is suspected:

Anti-TPO antibodies

Useful for identifying autoimmune thyroiditis. NICE recommends measuring TPO antibodies in children and young people with elevated TSH. (Nice)

Additional investigations when indicated

Investigation	When useful
Anti-TPO ± anti-thyroglobulin antibodies	Suspected Hashimoto
Thyroid ultrasound	Significant goiter, nodule, asymmetry, or structural concern
CBC, electrolytes, glucose, lipids	Selected patients/severe disease
Morning cortisol	Suspected central hypothyroidism/pituitary disease
Other pituitary hormones	Suspected central hypothyroidism
MRI brain/pituitary	Suspected pituitary/hypothalamic disease

Important laboratory pitfall: Biotin

High-dose **biotin supplements can interfere with thyroid function assays** and produce misleading results. Always ask about supplements when the clinical picture and laboratory results do not match. (Nice)

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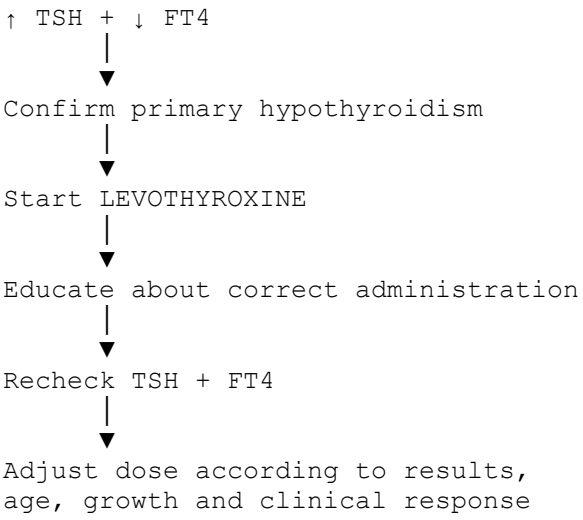
6. Management Algorithm

A. Overt primary hypothyroidism



Levothyroxine (LT4) is first-line treatment. (Nice)

B. Subclinical hypothyroidism

↑ TSH + normal FT4

Do **not automatically start treatment** in every child.

Consider:

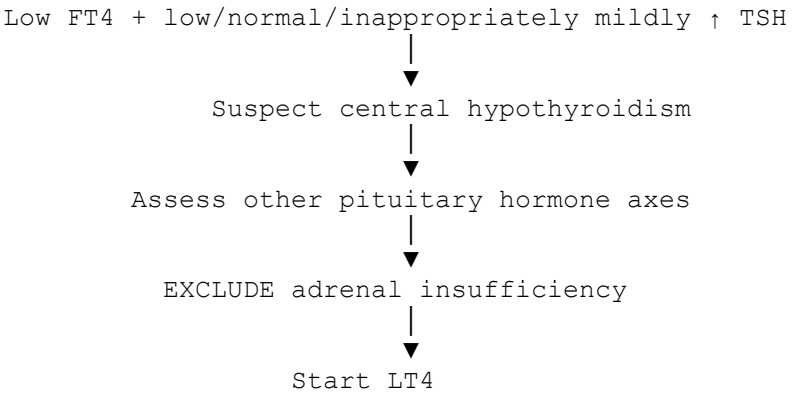
- Degree of TSH elevation
- Symptoms
- Goiter
- Positive thyroid antibodies
- Age
- Underlying thyroid disease
- Whether abnormality persists

For children ≥2 years, NICE suggests considering levothyroxine when:

- TSH **≥20 mIU/L**, or
- TSH **10–20 mIU/L persists**, or
- TSH **5–10 mIU/L persists** with thyroid dysgenesis or clinical symptoms/signs. (Nice)

Mild unexplained TSH elevation with normal FT4 can often be **rechecked rather than immediately treated**. (Nice)

C. Central hypothyroidism



Critical point

If central hypothyroidism is suspected, **do not start levothyroxine blindly before considering adrenal insufficiency**.

If central adrenal insufficiency cannot be excluded, glucocorticoid treatment should precede LT4 to avoid precipitating adrenal crisis. (PubMed Central (PMC))

D. Congenital hypothyroidism

A newborn with an abnormal screening result requires **rapid confirmatory serum TSH + FT4**.

If congenital hypothyroidism is confirmed:

Start levothyroxine promptly—ideally within the first 2 weeks of life.

For severe congenital hypothyroidism, the recommended starting dose is generally **10–15 µg/kg/day**. (PubMed Central (PMC))

Exam point: Congenital hypothyroidism is a pediatric endocrine emergency in terms of **preventing permanent neurodevelopmental consequences**, even though the child may initially appear clinically well.

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7. Drug Summary Table

Drug	Indication	Practical dose/approach	Important point
Levothyroxine (LT4)	Primary hypothyroidism	Dose is **age- and severity-dependent**	First-line treatment
LT4 in congenital hypothyroidism	Confirmed CH	Usually up to **10–15 µg/kg/day** in severe disease	Start as early as possible
Liothyronine (T3)	Routine hypothyroidism	**Not recommended routinely**	LT4 monotherapy preferred

NICE recommends levothyroxine as first-line treatment and advises against routine liothyronine or natural thyroid extract because there is insufficient evidence of benefit over LT4 monotherapy. (Nice)

How to take levothyroxine

Best practice:

- Once daily
- Ideally on an empty stomach
- Take consistently at the same time each day

- Avoid simultaneous administration with **iron or calcium**, which can reduce absorption. (American Thyroid Association)

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8. Admission Criteria

Most children with uncomplicated hypothyroidism are managed **outpatient**.

Consider admission for:

Severe hypothyroidism / suspected myxedema coma

Red flags:

- Altered mental status
- Hypothermia
- Marked bradycardia
- Hypotension
- Hypoventilation
- Hypoglycemia
- Hyponatremia
- Severe weakness
- Multisystem decompensation

This is a **medical emergency requiring ICU-level management**.

Also consider admission if:

- Severe electrolyte/metabolic abnormalities
- Significant altered consciousness
- Severe hypoglycemia
- Suspected adrenal crisis
- Acute neurologic compromise from pituitary disease

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9. Referral Criteria

Refer to pediatric endocrinology when:

- Congenital hypothyroidism
- Suspected central hypothyroidism
- Severe overt hypothyroidism

- Persistent unexplained TSH elevation
- Significant goiter
- Thyroid nodule
- Abnormal thyroid function with pituitary symptoms
- Difficult-to-control hypothyroidism
- Poor growth despite biochemical treatment
- Persistent symptoms despite normalized thyroid tests
- Uncertainty about stopping treatment in possible transient hypothyroidism

Urgent referral

- Low FT4 with non-elevated TSH
- Suspected pituitary disease
- Hypothyroidism associated with multiple pituitary hormone deficiencies
- Severe clinical hypothyroidism

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10. Follow-up

After starting or changing LT4

Check:

TSH + FT4 after approximately 4–8 weeks

The American Thyroid Association advises checking thyroid function approximately 4–8 weeks after starting or changing LT4 in children. (American Thyroid Association)

NICE recommends FT4 and TSH every **6–12 weeks** in children ≥2 years until TSH stabilizes. (Nice)

Once stable

Monitoring becomes less frequent.

For children ≥2 years, NICE suggests:

- Every **4–6 months until after puberty**
- Then approximately **annually**. (Nice)

For congenital hypothyroidism, monitoring is substantially more frequent during infancy because adequate thyroid hormone replacement is critical for neurodevelopment and growth. (PubMed Central (PMC))

Treatment target

Primary hypothyroidism

TSH within the age-appropriate reference range, with FT4 appropriate for age.

Central hypothyroidism

Do NOT use TSH as the main treatment target.

Follow **FT4**, generally aiming for an appropriate level in the upper part of the age-specific reference range. (PubMed Central (PMC))

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11. Clinical Pearls

⭐ Pearl 1

TSH ↑ + FT4 ↓ = Primary hypothyroidism

⭐ Pearl 2

FT4 ↓ + TSH low/normal = Central hypothyroidism until proven otherwise.

⭐ Pearl 3

A normal TSH does **not** exclude central hypothyroidism.

⭐ Pearl 4

In a child, **poor growth velocity** is often more useful than weight gain as a clue to hypothyroidism.

⭐ Pearl 5

Hashimoto thyroiditis is the most common cause of **acquired** hypothyroidism in children.

⭐ Pearl 6

Levothyroxine is the treatment of choice.

⭐ Pearl 7

Do not diagnose hypothyroidism from symptoms alone—**confirm with thyroid function tests.**

⭐ Pearl 8

Before treating central hypothyroidism, think about **adrenal insufficiency**.

⭐ Pearl 9

Do not treat every mildly elevated TSH with levothyroxine.

⭐ Pearl 10

In congenital hypothyroidism, **early treatment matters for neurodevelopment**.

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12. Common Mistakes in Exams and Practice

Mistake	Correct approach
Diagnosing hypothyroidism from weight gain alone	Check TSH + FT4
Ordering TSH alone in a child	Usually obtain **TSH + FT4**
Assuming normal TSH excludes hypothyroidism	Consider **central hypothyroidism**
Treating every mildly elevated TSH	Consider repeat testing and clinical context
Using T3 routinely	LT4 is standard treatment
Starting LT4 in suspected central disease without considering cortisol	**Exclude/treat adrenal insufficiency first**
Checking thyroid tests too soon after changing LT4	Usually wait several weeks
Ignoring adherence	Always assess compliance before repeatedly increasing LT4
Giving LT4 together with iron/calcium	Separate administration
Forgetting biotin interference	Ask about supplements
Using adult reference ranges in children	Use **age-specific laboratory ranges**
Reducing LT4 because of one isolated mildly high FT4	Interpret with TSH, timing of dose, and clinical status

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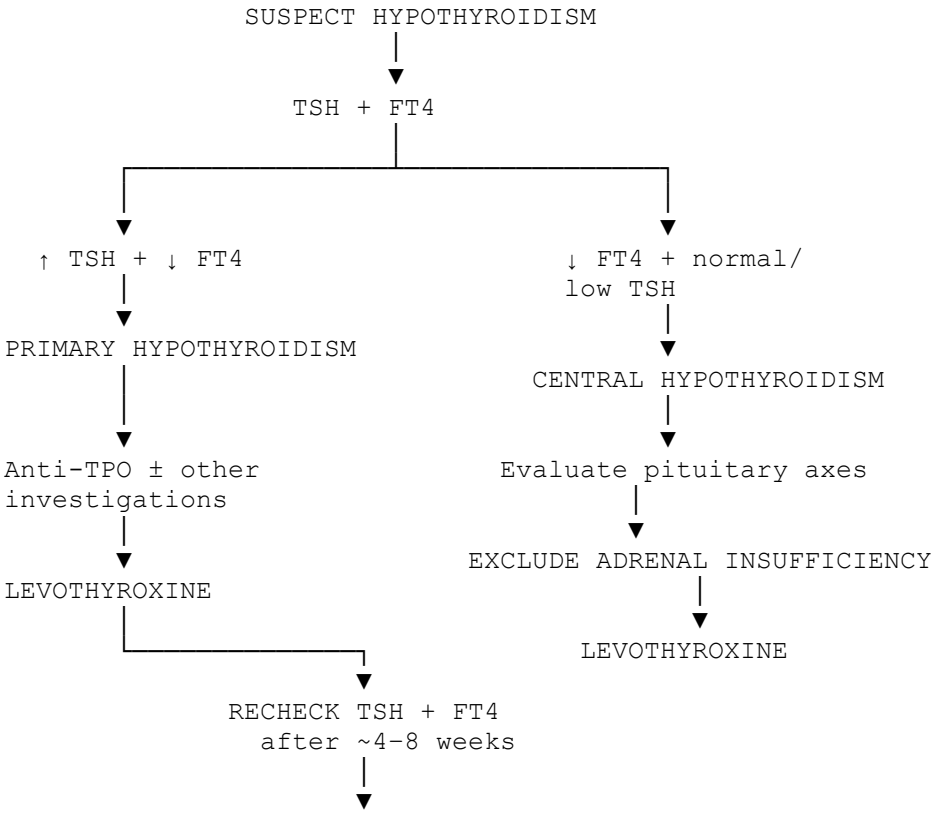
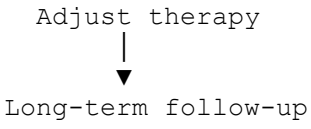
13. Key Take-Home Messages

1. **Think of hypothyroidism in a child with poor growth, fatigue, constipation, cold intolerance, dry skin, bradycardia, goiter, or delayed puberty.**
2. The basic diagnostic tests are **TSH + FT4**.
3. **High TSH + low FT4 → primary hypothyroidism.**
4. **Low FT4 + low/normal/inappropriately mildly elevated TSH → central hypothyroidism.**
5. **Hashimoto thyroiditis is the commonest acquired cause** in children and adolescents. (American Thyroid Association)
6. **Levothyroxine is first-line treatment.** (Nice)
7. Mild subclinical hypothyroidism does **not always require immediate treatment**.
8. Before treating suspected central hypothyroidism, consider **adrenal insufficiency**. (PubMed Central (PMC))
9. Monitor TSH/FT4 after starting or changing LT4 and adjust according to **age, laboratory results, growth, and clinical response**. (Nice)
10. **Congenital hypothyroidism must be treated promptly**, because early thyroid hormone replacement is critical for normal neurodevelopment. (PubMed Central (PMC))

One-Minute Clinical Algorithm




Adjust therapy
Long-term follow-up