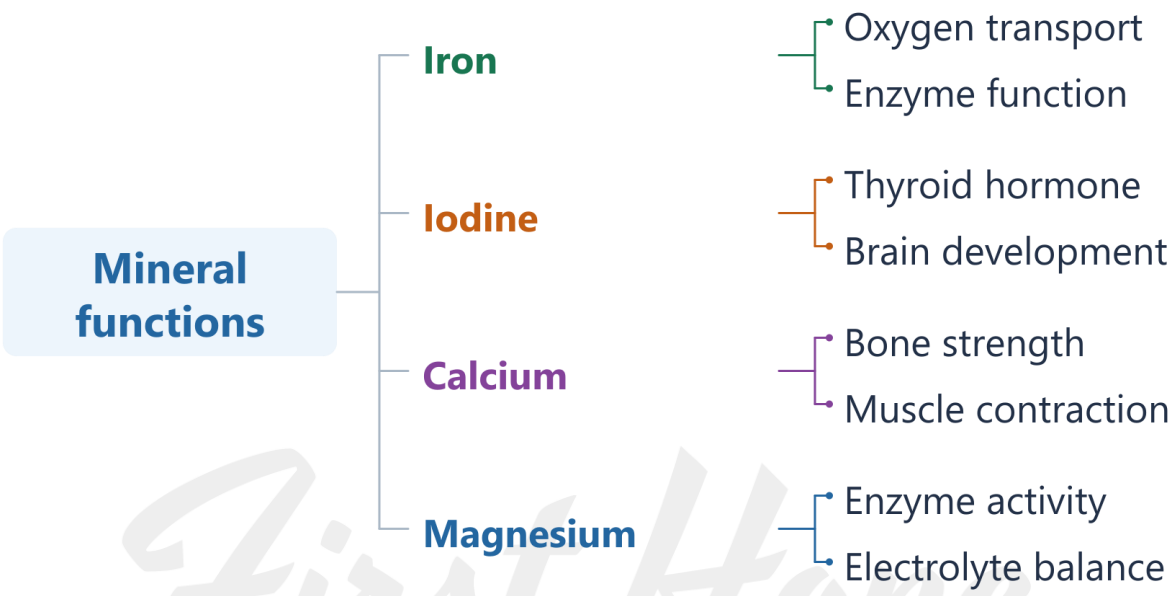
Pediatrics - Topic 13 - Micronutrients in Health and disease -2: Iron, Iodine, Calcium, Magnesium

Minerals in Child Health

- Minerals support oxygen transport, bone formation, thyroid function, muscle activity and many enzyme reactions.

Requirements and Food Sources



- A daily dietary requirement differs from a preventive programme dose and from the dose used to treat a deficiency.
- The following selected Indian dietary allowances apply to healthy children and must be interpreted with the child's age and diet.

Age	Iron (mg/day)	Iodine (micrograms/day)	Calcium / magnesium (mg/day)
1–3 years	8	90	500 / 90
4–6 years	11	90	550 / 125
7–9 years	15	90	650 / 175
Boys 13–15 years	22	140	1000 / 345
Girls 13–15 years	30	140	1000 / 340

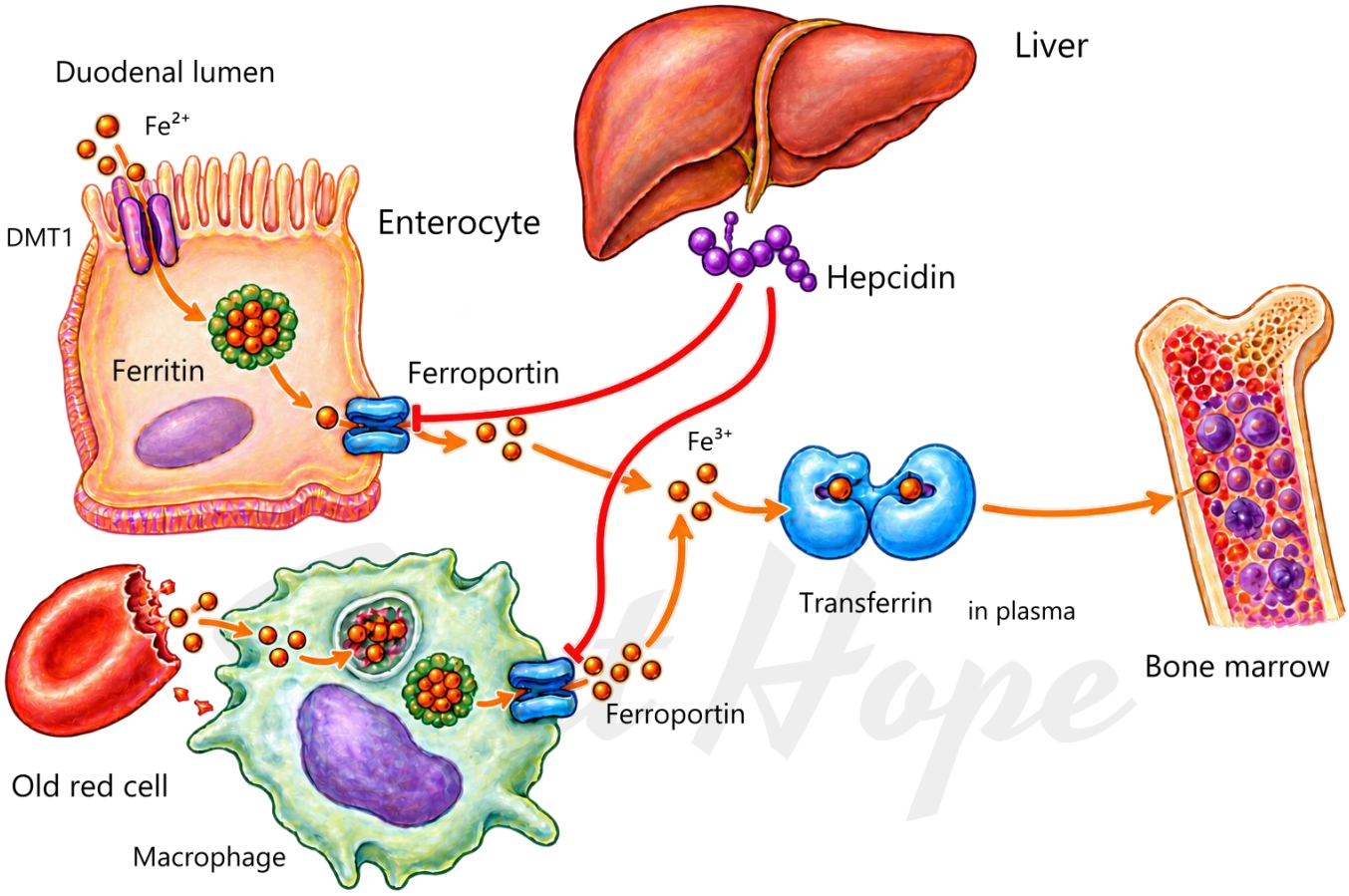
- Milk, curd, calcium-set foods and selected leafy vegetables provide calcium, while nuts, pulses and whole grains provide magnesium.
- Meat and fish provide readily absorbed heme iron, while pulses, leafy vegetables and fortified foods provide non-heme iron.

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- Iodized salt is the main population strategy for ensuring adequate iodine intake without increasing total salt consumption.

Iron Deficiency

Iron Metabolism and Causes



Hepcidin limits iron release from intestinal cells and macrophages, while transferrin carries circulating iron

Iron Functions, Transport and Regulation

- Iron forms part of hemoglobin, myoglobin and enzymes involved in energy metabolism.
- The intestine regulates absorption, transferrin transports circulating iron and ferritin stores it.
- Hepcidin reduces iron release through ferroportin, so inflammation can restrict iron availability even when stores are present.

Causes of Deficiency

- Prematurity, rapid growth, low iron intake and delayed iron-rich complementary feeding increase deficiency risk.
- Excess milk intake can displace iron-rich foods, while intestinal blood loss and heavy menstrual bleeding cause ongoing iron loss.
- Malabsorption, parasites and chronic disease should be considered when the history or treatment response suggests them.

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Stages of Iron Depletion

Stage	Typical change
Depleted stores	Ferritin falls before anemia necessarily develops.
Iron-restricted red-cell production	Less iron is available to the marrow and red-cell indices begin to change.
Iron deficiency anemia	Hemoglobin falls below the appropriate age-specific threshold.

Clinical Features

- Iron deficiency may cause tiredness, irritability, poor attention, pica and reduced exercise tolerance before marked pallor develops.
- Iron deficiency anemia can produce pallor, tachycardia and, when severe, cardiovascular compromise.
- Angular mouth lesions, a smooth tongue and spoon-shaped nails may occur, but their absence does not exclude deficiency.
- Assess growth, dietary quality and developmental or school concerns without assuming that every learning difficulty is caused by anemia.

Investigations and Interpretation

- A complete blood count often shows low hemoglobin with small, pale red cells and an increased red-cell distribution width.
- A low ferritin supports depleted iron stores, but a normal or raised ferritin during inflammation does not exclude deficiency.
- Interpret hemoglobin with age-specific thresholds and consider inflammation when interpreting iron studies.

Age-Specific Hemoglobin Thresholds

Age	WHO 2024 anemia threshold
6–23 months	Hemoglobin is below 10.5 g/dL.
24–59 months	Hemoglobin is below 11 g/dL.
5–11 years	Hemoglobin is below 11.5 g/dL.
12–14 years	Hemoglobin is below 12 g/dL.

➢ These thresholds establish anemia, not its cause, and measurement quality and relevant altitude adjustments must be considered.

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Other Laboratory Clues

- A blood film may show hypochromia and pencil cells, while reticulocyte indices can help assess marrow iron supply.
- Do not use serum iron alone to diagnose iron deficiency because it changes with meals, time and inflammation.
- Marked microcytosis with a relatively preserved red-cell count or poor response to iron suggests alternatives such as thalassemia trait.

Dose, Administration and Counselling

Elemental-Iron Dose and Product Concentration

- Treat the dietary or bleeding cause and prescribe oral iron according to its **elemental iron** content.
- A common treatment range is 3–6 mg/kg/day of elemental iron, selected according to severity and the pediatric protocol.
    - For example, a 10 kg child prescribed 3 mg/kg/day needs 30 mg of elemental iron daily, not 30 mg of the iron salt.
- Check the product concentration before converting milligrams to milliliters, and write the dose clearly for the caregiver.

Administration and Expected Adverse Effects

- Iron is absorbed better away from inhibitors, but taking it with a small amount of food can improve tolerance when needed.
- Explain that dark stools and mild constipation can occur, and keep the bottle locked away because overdose is dangerous.

Response, Duration and Escalation

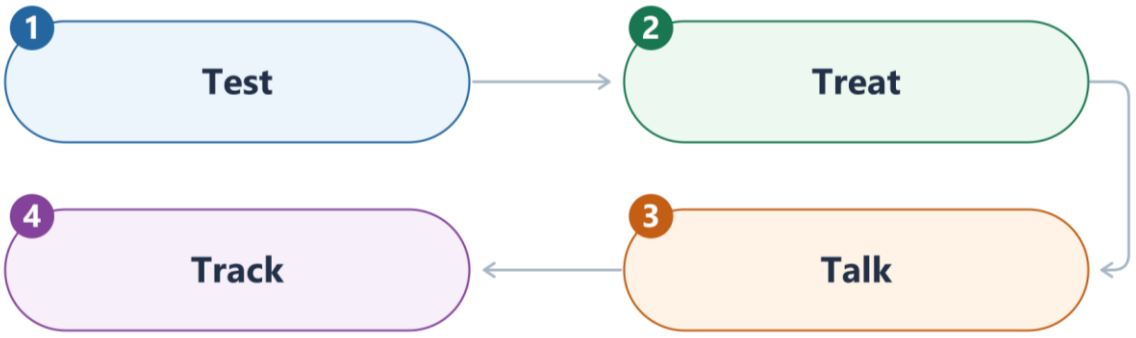
- Check an early response in severe disease and reassess hemoglobin after a few weeks in a stable child.
- Continue treatment for at least three months after correction of anemia to replenish stores, then reassess the need for further supplementation.
- If response is poor, check adherence, dose, ongoing loss, malabsorption and the original diagnosis before escalating treatment.
- Intravenous iron is reserved for selected indications such as significant malabsorption or failure of adequate oral therapy under specialist care.
- An unstable child or a child with severe symptomatic anemia needs urgent hospital assessment rather than routine outpatient iron alone.

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National Anemia Prevention and Control

Anemia Mukt Bharat Abhiyaan

- The 2026 programme uses a **7 × 7 × 7** approach covering seven beneficiary groups, seven interventions and seven institutional mechanisms.
- The beneficiary groups include children, adolescents, pregnant women, lactating women, women of reproductive age and low-birth-weight babies aged 0–6 months.
- Children aged 6–59 months and children aged 5–9 years form separate beneficiary groups because their preventive schedules differ.



Programme Implementation

Main Interventions

- Provide prophylactic iron–folic acid, test for anemia and arrange treatment according to the result and clinical condition.
- Promote deworming, appropriate delayed cord clamping, community participation and communication about anemia.
- Address non-nutritional causes such as infection and inherited blood disorders rather than attributing all anemia to diet.
- Promote affordable iron-rich foods and dietary diversity, with digital tracking to support follow-up and treatment completion.

Child and Adolescent Prophylaxis

Age	Preventive schedule	Content of each dose
6–59 months	Give 1 mL syrup twice weekly.	Each 1 mL provides 20 mg elemental iron and 100 micrograms folic acid.
5–9 years	Give one pink tablet weekly.	Each tablet provides 45 mg elemental iron and 400 micrograms folic acid.
10–19 years	Give one blue tablet weekly.	Each tablet provides 60 mg elemental iron and 500 micrograms folic acid.

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