

Iron deficiency anemia in children

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What is Anemia?

- Reduction of the red blood cell (RBC) volume or hemoglobin concentration below reference level for the age and sex of the individual (1).
- Hb < - 2SD or 95th centile for age and sex (1).

Anemia

All anemias are either due to: (2)

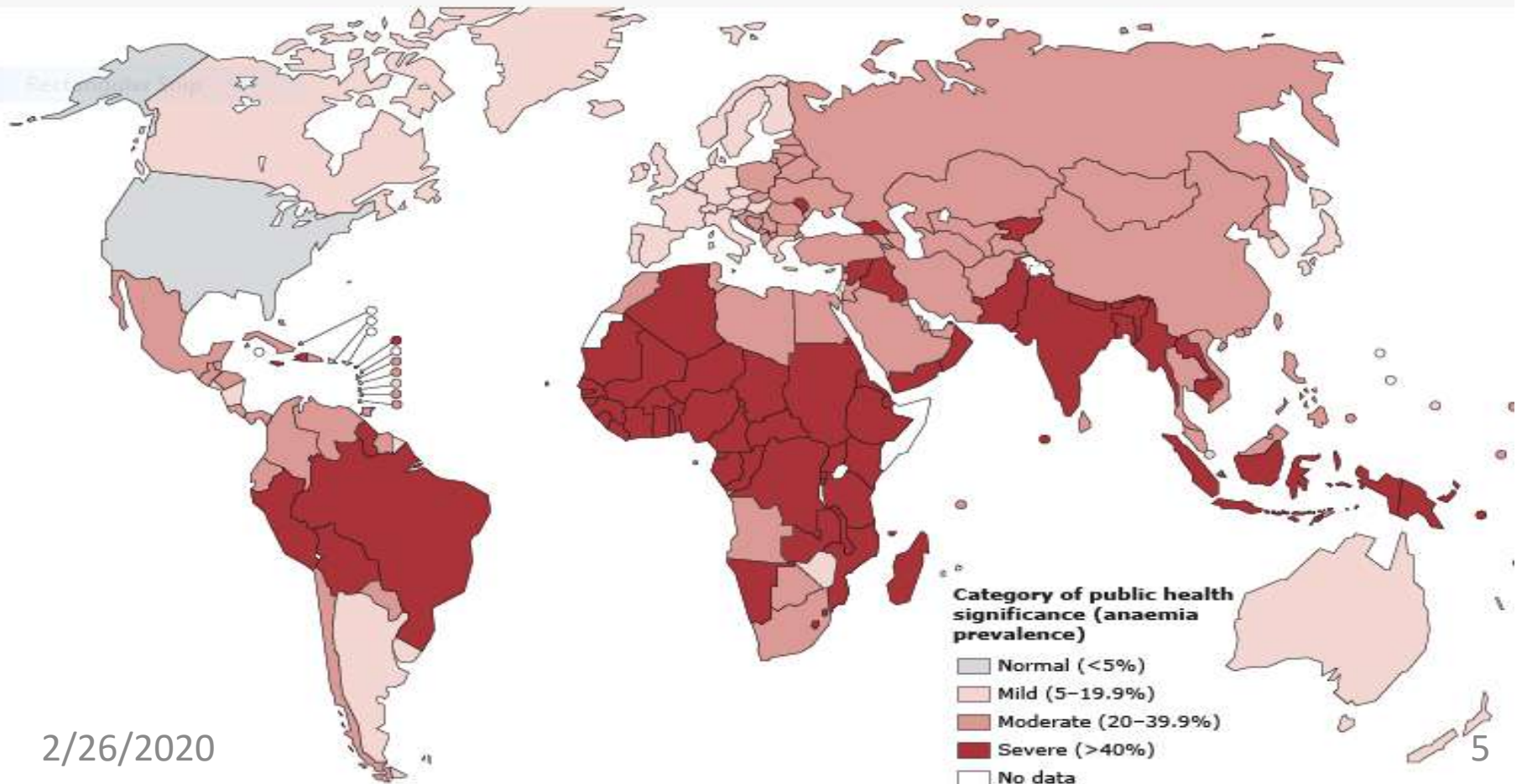
1. Ineffective RBC production
2. Accelerated destruction of the RBC
3. Blood loss

Iron Deficiency Anemia

- Most common cause of anemia worldwide (3)
- USA: 7-9% of toddlers have anemia, & 2-3% IDA
- Resource poor settings around 40 % have anemia (4)
- May have severe complications on health and neurodevelopment

Iron deficiency Anemia

Anemia as a public health problem in preschool-aged children, by country



Iron deficiency anemia

- ▶ Iron acquirement is in 3rd trimester
- ▶ A diet containing 8–10mg of iron daily is necessary for optimal nutrition
- ▶ 1mg of iron must be absorbed each day - Absorbed in the proximal small intestine
- ▶ Absorbed 2-3 times more efficiently from human milk than from cow's milk (5,6).

Iron sources

- Meat
 - Liver
 - Kidney
 - Egg-yolk
 - Green vegetables
 - Fruits (5,7)
- **** Cow's milk- poor source of iron

Iron absorption

➤ Depends upon

- Body stores of iron
- Rate of erythropoiesis
- Iron needs of the body

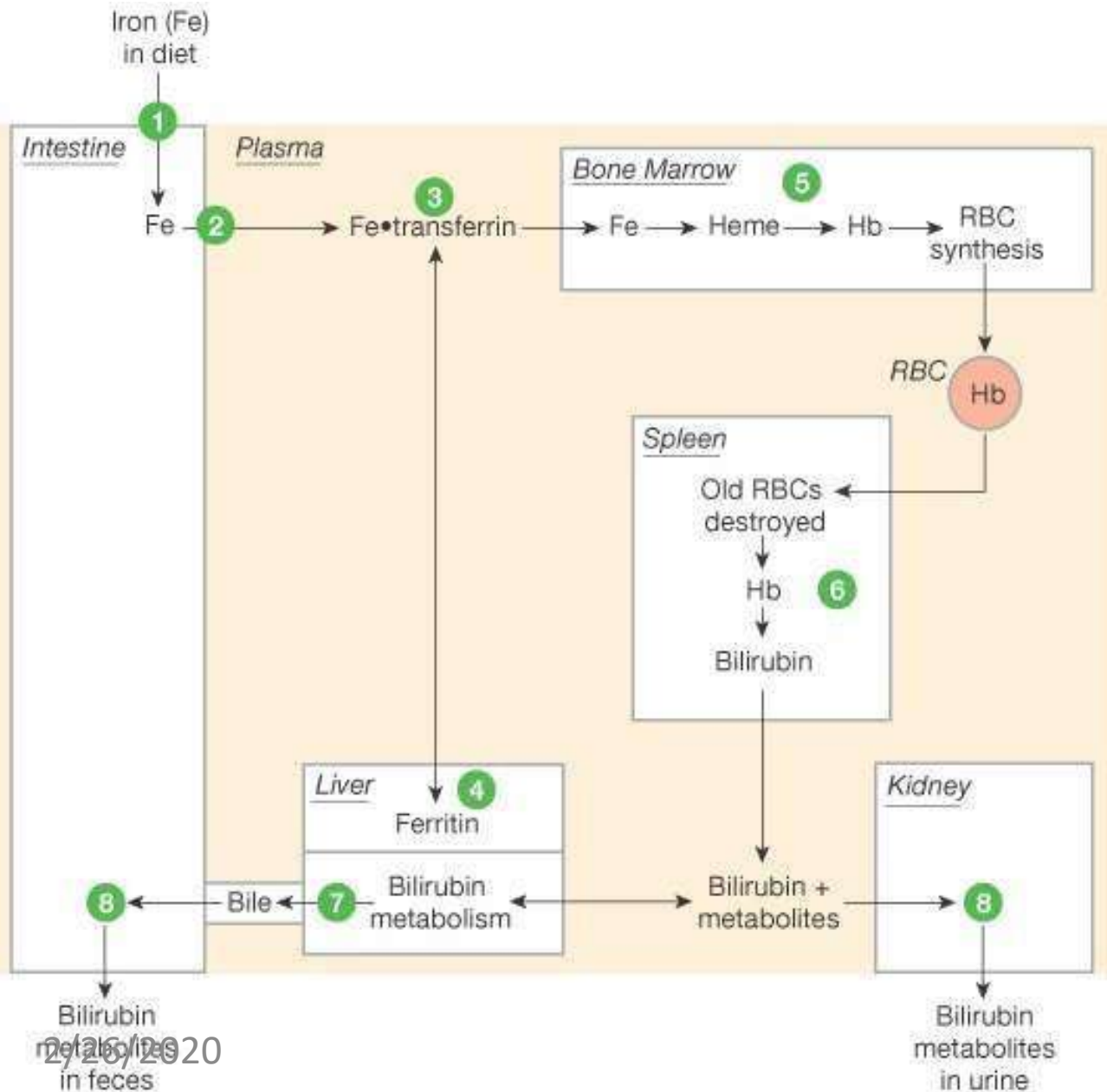
➤ Increased absorption in presence of:

- vitamin C, fruit juices, Lactose, amino acids- cystine, lysine, Histidine, gastric Hcl

➤ Decreased absorption :

- Phytates, tannic acid, calcium salts, phosphates (7,8)

Iron Metabolism



- 1 Iron comes from the diet.
- 2 Fe absorbed by active transport.
- 3 Transferrin protein transports Fe in plasma.
- 4 Liver stores excess Fe as ferritin.
- 5 Bone marrow uses Fe to make hemoglobin (Hb).
- 6 Spleen converts Hb to bilirubin.
- 7 Liver metabolizes bilirubin and excretes it in bile.
- 8 Bilirubin metabolites are excreted in urine and feces.

Pathogenesis of IDA

▶ Increased physiological demand:

- growing children (6-24 months)
- adolescence
- women during reproductive ages

▶ Pathological blood loss:

- chronic loss

▶ Inadequate intake of diets rich in iron:

- nutritional deficiency
- decreased absorption- gastroenterostomy
tropical sprue/ coeliac disease (1, 8)

ETIOLOGY

- The most important cause world-wide is **infestation with parasitic worms** (**hookworms**- suck 0.03- 0.2 ml of blood per worm /day),**whipworms, roundworms**
- Dietary insufficiency
- !!!! Unmodified Cows and goat
- Malabsorption



ETIOLOGY

- Chronic blood loss - occult bleeding : peptic ulcer, Meckel diverticulum, polyp, hemangioma, inflammatory bowel disease, Intravascular hemolysis and hemoglobinuria
- Chronic diarrhea

(4,8)

Risk factors for IDA

- Demographic – Eldery, Teenager, Female
- Fetal maternal bleeding, TTTS, Maternal iron deficiency
- Prematurity
- Insufficient intake at infancy
- Dietary:
 - low oral Iron intake,
 - insufficient absorption (low bioavailability)
 - Unmodified cow milk
 - Occult blood loss
 - Obesity

CLINICAL FEATURES

- **Pallor is the most important sign**
- Pagophagia (pica for ice) / pica
- Anxiety , Poor appetite
- Below 5g/dL: irritability and anorexia are prominent
- Tachycardia and systolic murmurs- dyspnea , Palpitations

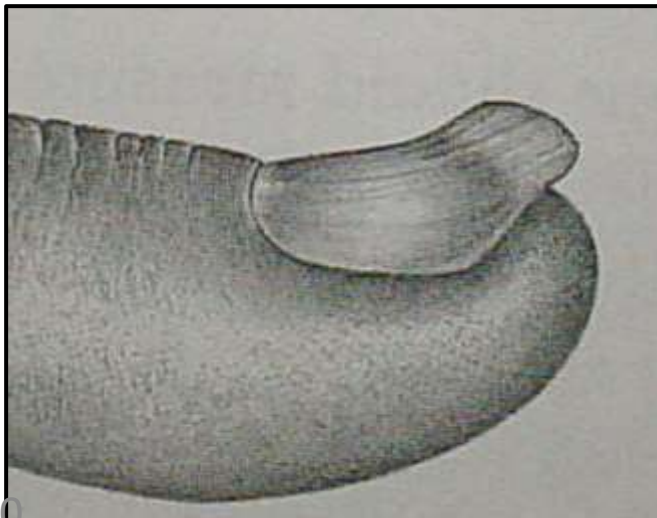
CLINICAL FEATURES

- Hair loss and lightheadedness
- Fainting
- Sleepiness, Tinnitus
- Mouth ulcers, Glossitis ,Angular cheilitis
- Constipation
- Depression, Twitching
muscles, Tingling, numbness or burning
sensations

CLINICAL FEATURES

- Koilonychia (spoon-shaped nails) ,
- Platynychia
- Weak, brittle nails
- Pruritus & Dysphagia
- Decreased immunity
- Febrile seizures : no causal relationship
- Thrombosis risk : unclear cause

Koilonychia - spoon shaped nail



CLINICAL FEATURES

- Neurologic and intellectual function
- Affects attention span, alertness,
- Verbal learning and memory
- **Monoamine oxidase (MAO)**, an iron dependent enzyme, has a crucial role in neurochemical reactions in the CNS
- breath-holding spells

LABORATORY INVESTIGATIONS

1. complete blood count (CBC)

- High RBC distribution width (RDW) - reflecting an increased variability in the size of red blood cells (RBCs).

- A low MCV, MCH and MCHC

2. Hemoglobin (Hb) & hematocrit (Hct) value – low

3. Reticulocyte - normal or moderately decreased

LABORATORY INVESTIGATIONS

3. Peripheral blood smear – microcytic hypochromic anemia, target cells, hypochromic pencil-shaped cells, and occasionally small numbers of nucleated RBC
- Thrombocytosis -activate thrombopoietin receptors in precursor cells which make platelets

LABORATORY INVESTIGATIONS

- Diagnostic tests
 - Serum ferritin- low
 - Serum iron - low
 - Serum transferrin -elevated
 - Total iron binding capacity (TIBC) - high
- Stool for occult blood
- Stool : hookworm and whipworm

LABORATORY INVESTIGATIONS

BMA

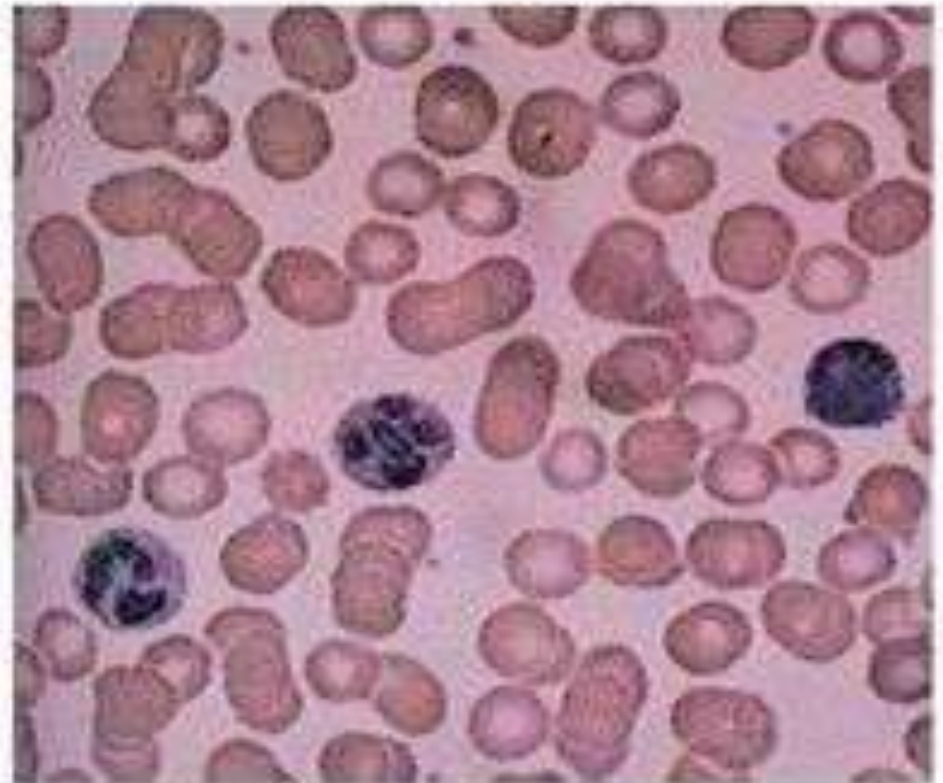
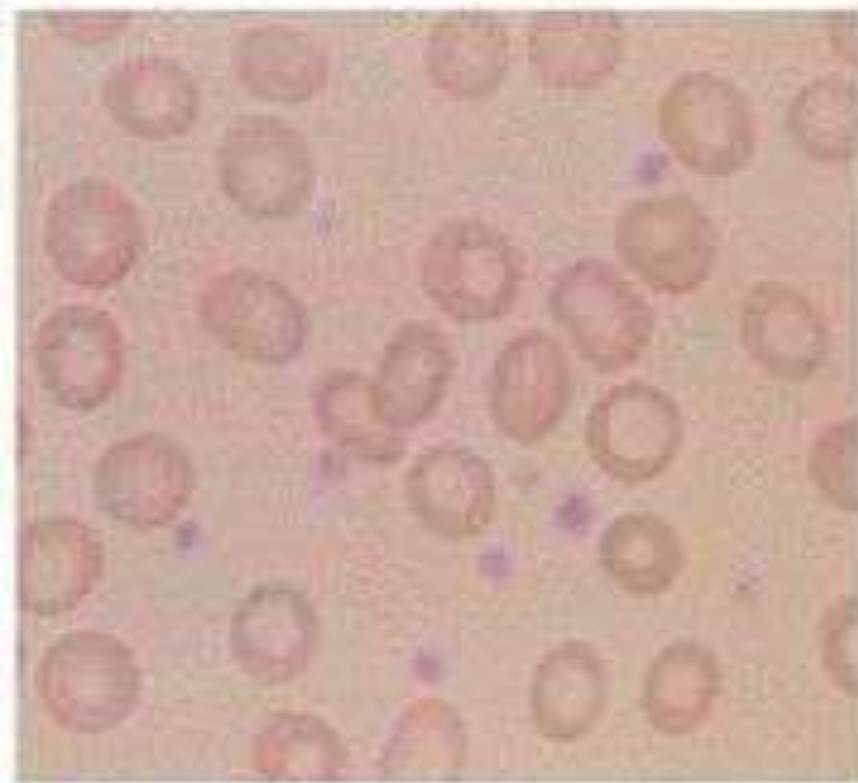
- Bone marrow aspiration, with the marrow stained for iron -Bone marrow is hypercellular, with erythroid hyperplasia
- Leukocytes and megakaryocytes are normal
- No stainable iron in marrow reticulum cells

LABORATORY WORKUP

| | Iron deficiency anemia | Anemia of inflammatory disease |
|--------------------------|------------------------|--------------------------------|
| Hematocrit | ↓ to ↓ ↓ ↓ | ↓ to ↓ ↓ |
| MCV | ↓ to ↓ ↓ ↓ | Normal to ↓ |
| MCHC | ↓ | Normal |
| Serum iron | ↓ to ↓ ↓ ↓ | Normal to ↓ ↓ |
| Serum TIBC | Normal to ↑ | Normal to ↓ |
| Serum ferritin | ↓ to ↓ ↓ | Normal to ↑ ↑ |
| Stainable iron in marrow | Absent | Normal to ↑ |
| Reticulocytes | Normal to ↓ | ↓ |

MCV — mean corpuscular volume, MCHC — mean corpuscular hemoglobin

Iron Deficiency Anemia



PREVENTION

- **Recommended intake :**
 - full term : 1mg/kg day
 - preterm: 2-4mg/kg/day
 - Child: 7-10 mg/day
- **Breastfeed infants :** start supplementation @ 4 mo.
- **Premature :** iron supplementation 2-4mg/kg/day during 1st year of life

PREVENTION

- **Dietary recommendations**
 - Exclusive breastfeeding 6mo
 - > 6 months: iron fortified food, rich vit c (citrus, fruits, strawberries, tomatoes, green vegetables, pureed meats)
 - Avoid unmodified cow milk < 12 mo
 - 1-5 y :
 - ✓ limit cow milk @ < 600ml/day
 - ✓ At least 2 servings of iron containing food (Tofu, meat, etc)

TREATMENT

- Oral administration - ferrous salts (sulfate, gluconate, fumarate) 4–6mg/kg of iron
- Above preventive & dietary measures
- Blood loss from intolerance to cow's milk proteins is reduced
- 3-6 months treatment to replenish stores

(7)

Oral iron failure?

- Incorrect diagnosis (eg, thalassemia)
- Patient is not taking the medication
- Not absorbed (enteric coated?)
 - malabsorption syndromes
 - gastrectomy/celiac disease
- Rapid iron loss?
- Anemia of chronic disease-impairs bone marrow response

TREATMENT

- Parenteral iron preparation (iron dextran) : Intolerance to oral iron, severe gastrointestinal complaints
- Packed or sedimented RBCs : with Hb values < 5g/dL
- congestive heart failure: fresh-packed RBCs should be considered

(2,7,9)

Screening Recommendations

- Routine screening /all infants 6-24 mo
- FBC (–MCV-RDW) : Positive PV 40%
- Screen everyone with risk factors (4,7).

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Thank you