# Micronutrient deficiency-2

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# Iron Deficiency Anemia

# IRON DEFICIENCY ANEMIA

Iron Deficiency Anemia is a Nutritional Disorder in which the Blood Lacks Adequate Healthy Red Blood Cells with Hemoglobin Less than 12 g/dL (grams per deciliter).

About **2 Billion** of the World's Population are Anemic

Anemia is More Common in Women than Men

## Global

Prevalence of Anemia among Women

**29%** of Non-Pregnant Women

**38%** of Pregnant Women

Anemia Affects 43% of Children

- Iron deficiency is the most common and widespread nutritional disorder in the world.
- As well as affecting a large number of children and women in developing countries, it is the only nutrient deficiency which is also significantly prevalent in Industrialized Countries.
- The numbers are shocking: 2 billion people – over 30% of the world's population – are anemic, many due to iron deficiency, and in resource-poor areas, this is frequently exacerbated by infectious diseases.

- Malaria, HIV/AIDS, hookworm infestation, schistosomiasis, and other infections such as tuberculosis are particularly important factors contributing to the high prevalence of anemia in some areas.

- Iron deficiency can range from sub-clinical state to severe iron deficiency anemia.
- Different stages are identified by clinical findings & lab tests.
- Anemia is defined as a hemoglobin below the 5$^{th}$ percentile of healthy population.
- Most studies showed this cutoff point to be around 11 g/dl (-2SD below the mean).

# Who is most at risk?

**Young children and pregnant women are at higher risk of iron deficiency because of rapid growth and higher iron needs.**

**Adolescent girls and women of childbearing age are at risk due to menstruation.**

# IRON DEFICIENCY IS MOST COMMON AT TIMES IN LIFE WHERE IRON NEEDS INCREASE, LIKE

DURING **MENSTRUATION FOR WOMEN**

IN EARLY **CHILDHOOD**

DURING **PREGNANCY**

World Health Organization

- **Among children, iron deficiency is seen most often between six months and three years of age due to rapid growth and inadequate intake of dietary iron.**

**Infants and children at highest risk are the following groups:**

- **Babies who were born early or small.**
- **Babies given cow's milk before age 12 months.**
- **Breastfed babies who after age 6 months are not being given plain, iron-fortified cereals or another good source of iron from other foods.**
- **Formula-fed babies who do not get iron-fortified formulas.**

- **Children aged 1–5 years who get more than 24 ounces of cow, goat, or soymilk per day.**

**Excess milk intake can decrease child's desire for food items with greater iron content, such as meat or iron fortified cereal.**

- **Children who have special health needs, for example, children with chronic infections or restricted diets.**

# Causes of Iron Deficiency

- **Blood Loss**
  - Gastrointestinal Tract
  - Menstrual Blood Loss
  - Urinary Blood Loss (Rare)
  - Blood in Sputum (Rarer)
- **Increased Iron Utilization**
  - Pregnancy
  - Infancy
  - Adolescence
  - Polycythemia Vera
- **Malabsorption**
  - Tropical Sprue
  - Gastrectomy
  - Chronic atrophic gastritis
- **Dietary inadequacy** (almost never single cause)
- **Combinations of above**

| Recommended Dietary Allowance (RDA) for iron by age and sex. | | |
|---|---|---|
| **Age/Group** | **Life Stage** | **Iron (mg/day)** |
| **Infants** | **0–6 months** | *0.27 |
| | **7–12 months** | 11 |
| **Children** | **1–3 years** | 7 |
| | **4–8 years** | 10 |
| **Males** | **9–13 years** | 8 |
| | **14–18 years** | 11 |
| | **19–30 years** | 8 |
| | **31–50 years** | 8 |
| | **51–70 years** | 8 |
| | **>70 years** | 8 |
| **Females** | **9–13 years** | 8 |
| | **14–18 years** | 15 |
| | **19–30 years** | 18 |
| | **31–50 years** | 18 |
| | **51–70 years** | 8 |
| | **>70 years** | 8 |
| **Pregnant Women** | **14–18 years** | 27 |
| | **19–30 years** | 27 |
| | **31–50 years** | 27 |
| **Lactating Women** | **14–18 years** | 10 |
| | **19–30 years** | 9 |
| | **31–50 years** | 9 |

*This value is an Adequate I

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# DIETARY IRON

- There are 2 types of iron in the diet; haem iron and non- haem iron
- Haem iron is present in Hb containing animal food like meat, liver & spleen
- Non- haem iron is obtained from cereals, vegetables & beans
- Milk is a poor source of iron, hence breast-fed babies need iron supplements

# IRON ABSORPTION

- Haem iron is not affected by ingestion of other food items.
- It has constant absorption rate of 20-30%

which is little affected by the iron balance of the subject.

The haem molecule is absorbed intact and the iron is released in the mucosal cells.

Iron from meat, poultry, and fish (i.e., hem iron) is absorbed two to three times more efficiently than iron from plants (i.e., non-hem iron).

- **The absorption of non-haem iron varies greatly from 2% to 100% because it is strongly influenced by:**
  - **The iron status of the body**
  - **The solubility of iron salts**
  - **Integrity of gut mucosa**
  - **Presence of absorption inhibitors or facilitators**

**The amount of iron absorbed from plant foods (non-heme iron) depends on the other types of foods eaten at the same meal.**

# INHIBITORS OF IRON ABSORPTION

- **Food with polyphenol compounds**
  - Cereals like oats
  - Vegetables such as spinach and spices
  - Beverages like tea, coffee, cocoa and wine.
  - A single cup of tea taken with meal reduces iron absorption by up to 11%.

## OTHER INHIBITORS

- **Food containing phytic acid i.e. Bran, cereals like wheat, rice, maize & barely. Legumes like soya beans, black beans & peas.**

- **Cow's milk due to its high calcium & casein contents.**

# Promoters of Iron Absorption

- Foods containing ascorbic acid like citrus fruits, broccoli & other dark green vegetables because ascorbic acid reduces iron from ferric to ferrous forms, which increases its absorption.
- Foods containing muscle protein enhance iron absorption due to the effect of cysteine containing peptides released from partially digested meat, which reduces ferric to ferrous salts and form soluble iron complexes.

- **Some fruits inhibit the absorption of iron although they are rich in ascorbic acid because of their high phenol content e.g strawberry ,banana ,and melon.**

## Dietary Sources of Iron

**Food Sources of Iron ranked by milligrams of iron per standard amount; also calories in the standard amount. (All amounts listed provide 10% or more of the Recommended Dietary Allowance (RDA) for teenage and adult females, which is 18 mg/day.)**

# THIS IS HOW YOU CAN HELP TO PREVENT IRON DEFICIENCY:

## EAT A VARIETY OF IRON RICH FOODS LIKE

**Legumes** (beans, lentils, chickpeas)

**Eggs**

**Meat**

**Dark leafy greens**

**Nuts and seeds**

# AND TO HELP YOU ABSORB IRON FROM YOUR FOOD:

**Eat citrus fruits**

**and avoid coffee and tea during your meals**

World Health Organization

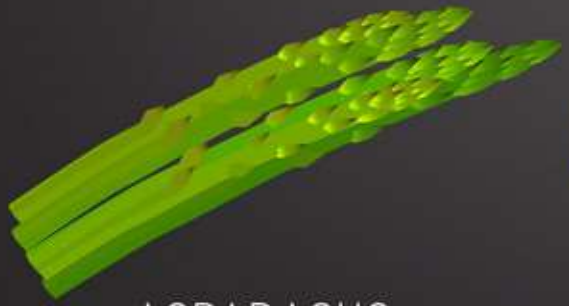
COOKED SPINACH

TOMATOS

KALE

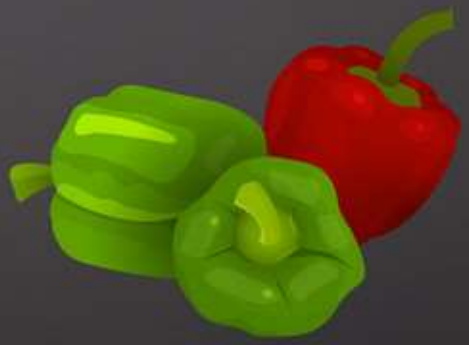
GREEN PEAS

# IRON Fe TOP IRON RICH VEGETABLES



ASPARAGUS

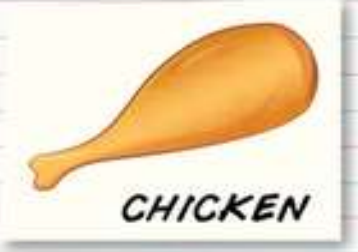
BROCCOLI

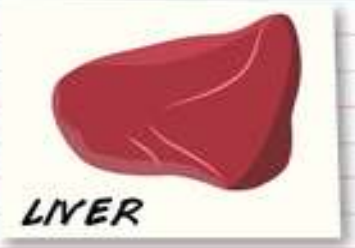


SWEET PEPPER

BRUSSELS SPROUTS

# IRON RICH FOOD:


CHICKEN

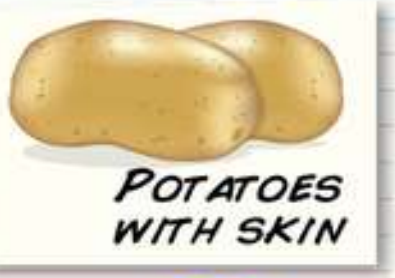

LIVER


BROCCOLI


DRIED BEANS/ GREEN PEAS


PORK


BEEF


POTATOES WITH SKIN


SPINACH


EGG YOLK

IRON FORTIFIED CEREALS

RAISINS


CLAMS


SHRIMP

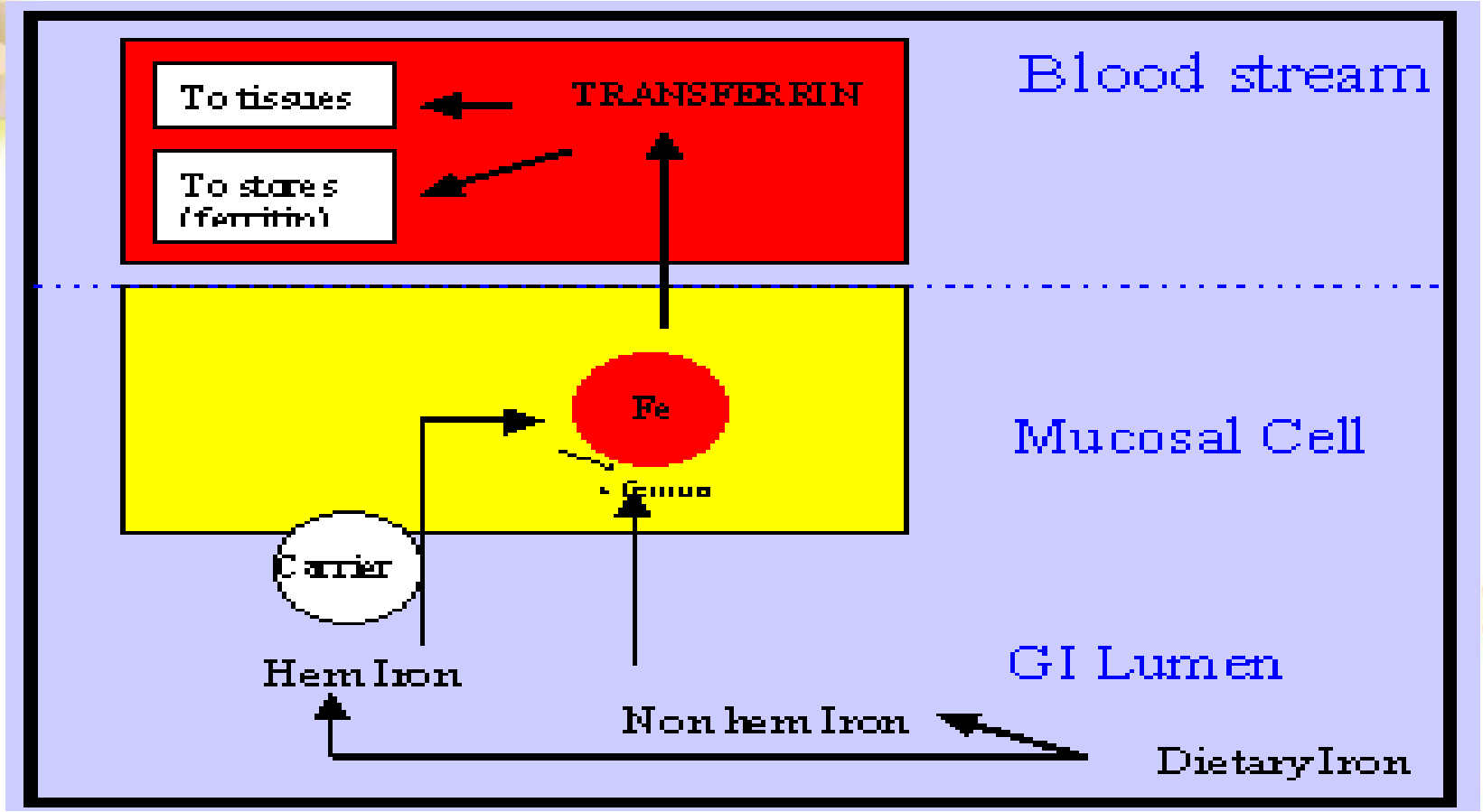

DRIED APRICOT


WATERMELON

# STORAGE OF IRON

- Tissues with higher requirement for iron ( bone marrow, liver & placenta) contain more transferrin receptors.
- Once in tissues, iron is stored as ferritin & hemosiderin compounds, which are present in the liver, RE cells & bone marrow.
- The amount of iron in the storage compartment depends on iron balance (positive or negative).
- Ferritin level reflects amount of stored iron in the body & is important in assessing ID.

# IRON CYCLE IN THE BODY



# ROLE OF IRON IN THE BODY

- **Iron have several vital functions**
- Carrier of oxygen from lung to tissues
- Transport of electrons within cells
- Co-factor of essential enzymatic reactions:
  - Neurotransmission
  - Synthesis of steroid hormones
  - Synthesis of bile salts
  - Detoxification processes in the liver

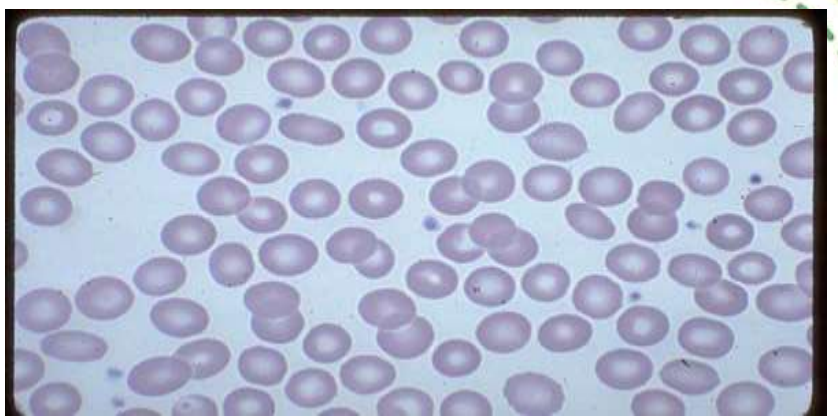
# DIAGNOSIS OF IDA

- **Clinical:** symptoms (fatigue, dizziness , palpitations..etc.) & signs (pallor, smooth tongue, Koilonychia, splenomegaly & dysphagia in elderly women).
- **Laboratory**
- Stainable iron in bone marrow
- Response to iron supplements

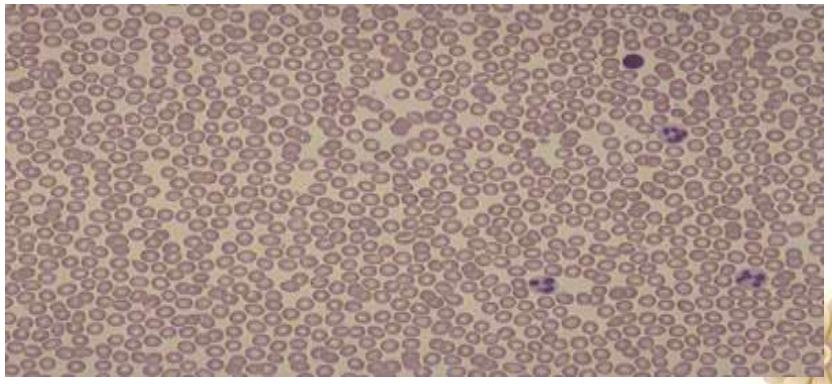
# LAB FINDINGS IN IDA

- Microcytic hypochromic anaemia
- Low Hb level (< 11.0 g/dl)
- Low MCV, MCH, MCHC
- Low serum ferritin
- High iron binding capacity
- High erythrocyte protoporphyrin

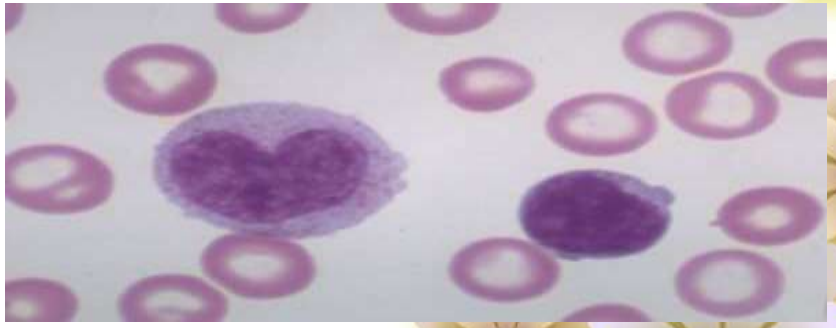
Normal Blood Film



MICROCYTES



HYPOCHROMIA



**Anemia prevalence in the population: Iron deficiency is considered to be about 2 to 2.5 times the rate of anemia. This estimate applies when malaria is not endemic in the region and there are no reasons to suspect widespread hemoglobinopathies.**

| Category of public health significance | Prevalence of anemia in any at-risk group (%) |
|---|---|
| High | >20 |
| Medium | 12.0–19.9 |
| Low | 5.0–11.9 |

# Proposed classification of public health significance of anemia in populations on the basis of prevalence estimated from blood levels of hemoglobin or haematocrit

| Category of public health significance | Prevalence of anemia (%) |
|---|---|
| Severe | > or = 40 |
| Moderate | 20.0 – 39.9 |
| Mild | 5.0 – 19.9 |
| Normal | < or = 4.9 |

**According to IFHS 2006/2007,the prevalence of anemia was35.5% for all women, and 37.9% for currently pregnant women.**

# Consequences of Iron Deficiency

- Increase maternal & fetal mortality.
- Increase risk of premature delivery and LBW.
- Learning disabilities & delayed psychomotor development.
- Reduced work capacity.
- Impaired immunity (high risk of infection).
- Inability to maintain body temperature.
- Associated risk of lead poisoning because of pica.

# MANAGEMENT OF IDA

- Blood transfusion if heart failure is distinguished
- IV or IM iron in pregnant women
- Oral iron supplement
- Treat underlying cause
- Dietary education

# PREVENTION OF IDA

## Food-based approaches

**Food-based approaches represent the most desirable and sustainable method of preventing micronutrient malnutrition.**

**Food-based approaches should therefore include strategies to:**

- **improve the year-round availability of micronutrient-rich foods; ensure the access of households, especially those at risk, to these foods; and change feeding practices with respect to these foods.**

Applied to iron deficiency, efforts should be directed towards promoting the availability of, and access to, iron-rich foods. Examples include meat and organs from cattle, fish, and poultry; and non-animal foods such as legumes and green leafy vegetables.

Similarly, focus should be upon foods which enhance the absorption or utilization of iron.

**Finally, effective nutrition education - and information on health and nutrition for both supply and demand aspects of programs - maybe needed to increase the demand for and consumption of such foods.**

## Examples of simple but effective modifications in meal patterns that enhance iron absorption might include:

- separate tea drinking from mealtime - one or two hours later,

the tea will not inhibit iron absorption because most of the food will have left the stomach

- include in the meal fruit juices such as orange juice, or another source of

ascorbic acid such as cabbage, carrots, or cauliflower

- **consume milk, cheese, and other dairy products as a between-meal snack, rather than at mealtime; and consume foods containing inhibitors at meals lowest in iron content, e.g. a breakfast of a low-iron cereal(bread) consumed with tea or milk products.**

**This meal pattern can provide adequate calcium without obstructing iron nutrition.**

## Short term approach:

- **supplementation with iron tablets.**
- **Iron supplementation is the most common strategy currently used to control iron deficiency in developing countries.**
- **This is likely to remain the case until either significant improvements are made in the diets of entire populations or food fortification is achieved.**

## Long-term approach:

- Iron fortification of foods is a preventive measure that aims at improving and sustaining iron nutrition on a permanent basis
- For fortification of any kind to be effective, three essential factors are necessary: (1) an effective and affordable iron compound must be available and acceptable; (2) a food vehicle must also be available and accessible; and (3) detailed production instructions and monitoring procedures must be in place and enforced by law.
- Food fortification with iron either for the whole population (blanket fortification) or for specific target groups like infants. It requires no cooperation from users unlike taking iron supplements.

**There is a consensus that enrichment (or fortification) of food is an effective long-term approach to improving the iron status of populations.**

**Essential requirements for implementing fortification strategies include the identification of an appropriate food vehicle that reaches the target population, that is centrally processed, and that is widely available and consumed in relatively predictable amounts by vulnerable population groups.**

**The dietary habits of the population are an important consideration in selecting a food for fortification.**

**For example, possible appropriate food vehicles range from wheat flour or pasta and condiments like sugar, salt, curry powder.**

# Other actions that indirectly affect iron status might include:

- **parasitic disease control programs, in particular those directed to hookworm, schistosomiasis and malaria control;**
  **these programs can enhance iron deficiency anemia control programme effectiveness in a population with moderate to severe levels of infection.**

- **incentive policies and improved farming systems that favour the development, availability, distribution, and use of foods that enhance iron absorption.**

## Integration with other micronutrient control programs

**Preventive supplementation is particularly well-suited to strategies that combine multiple micronutrient interventions.**

**Accordingly, efforts should be intensively directed to this area.**

**Programs that involve preparations containing iron, folic acid, and vitamins A and C, directed to infants, children, and pregnant and lactating women, are highly desirable.**