Anemia

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LEARNING OBJECTIVES

- **At the end of the lecture, you will be able to:**
  - **Discuss iron absorption, transport & stores**
  - **Know the burden of IDA in the world**
  - **Identify the causes & consequences of IDA**
  - **Know how to diagnose IDA**
  - **Recognize the strategies for control & prevention of IDA**

Anemia

Anemia is a condition in which the number of RBCs or the Hb concentration within them is lower than normal. Hb is needed to carry oxygen.

The optimal Hb concentration needed to meet physiologic needs varies according to:

Age

Sex

Elevation of residence

Pregnancy

Global burden of anemia

Anemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development.

The most common causes of anemia include Nutritional deficiencies particularly Iron deficiency anemia (IDA)

Iron deficiency is the most common micronutrient deficiency in the world affecting 1.3 billion people i.e. 24% of the world population.

It occurs at all stages of the life cycle, but is more prevalent in pregnant women and young children

Prevalence

Globally, anemia affects 1.62 billion people

which corresponds to 24.8% of the population

The highest prevalence is in preschool-age children (47.4%)&

The lowest prevalence is in men (18%)

Anemia is a serious global public health problem that particularly affects young children and pregnant women.

Worldwide, WHO estimates that anemia.

42% of children less than 5 years of age and

40% of pregnant women

Non-pregnant women 35%

Adult males 18%

Prevalence

Iron deficiency anaemia is considerably more prevalent in the developing (36%-versus 8%) in the industrialized world

Africa and South Asia have the highest overall regional prevalence rates

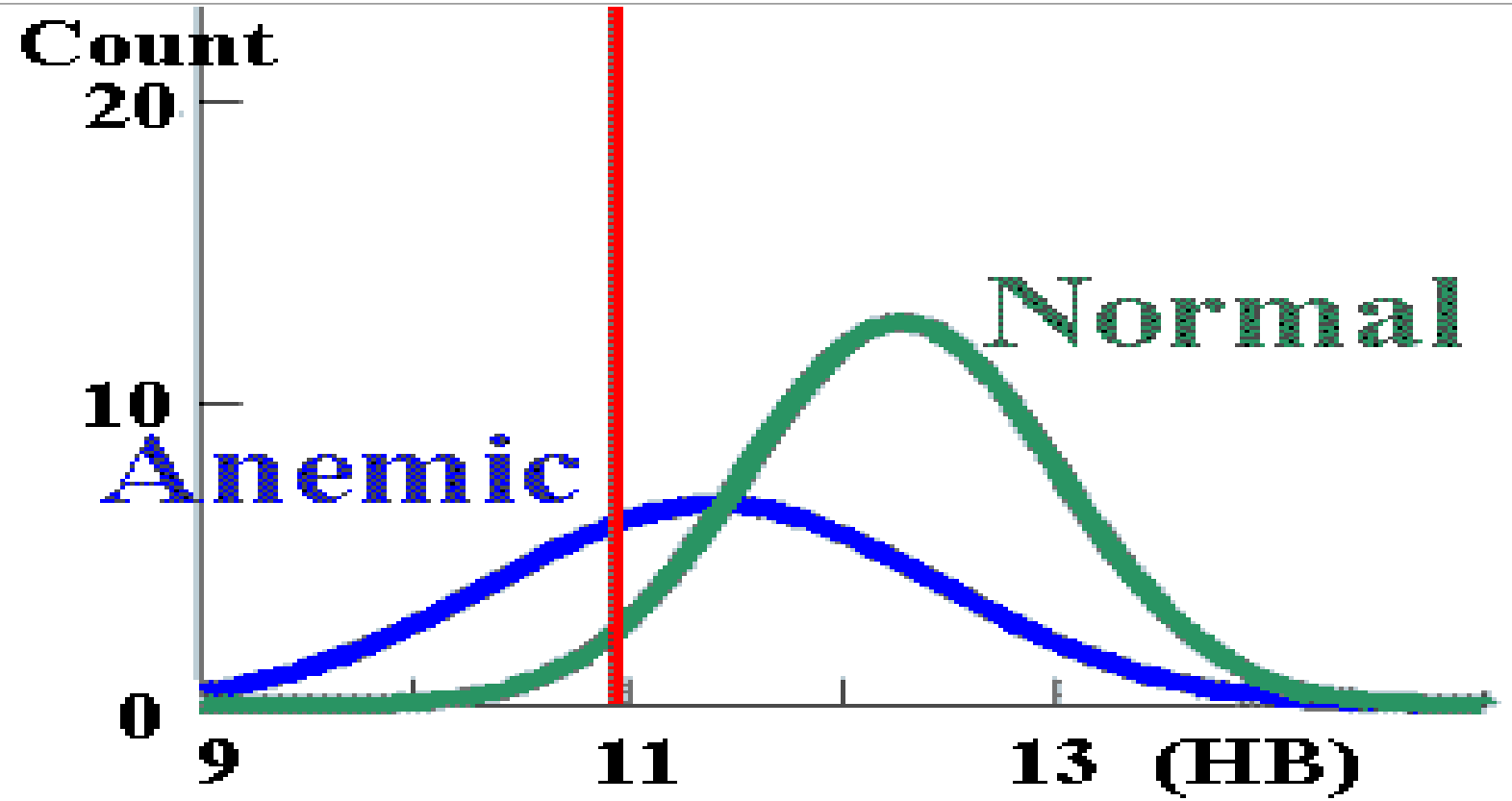
Prevalence of Anemia in Jordan

prevalence of anemia:
4.9% in males,
19.3% in non-pregnant females, and
27.4% in pregnant females.
Anaemia was predominantly mild
males: 81%,
non-pregnant females: 57%, and
pregnant females: 65.2%.

IRON DEFICIENCY

- 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 5th percentile of healthy population.
- Most studies showed this cutoff point to be around 11 g/dl (-2SD below the mean).

HB IN IDA



AT RISK GROUPS

- Infants
- Under 5 children
- Children of school age
- Women of child bearing age

PREVALENCE OF ID

Region	0-4yr	5-12yr	Women
South Asia	56%	50%	58%
Africa	56%	49%	44%
Latin Am	26%	26%	17%
Gulf Arabs	40%	36%	38%
Developed	12%	7%	11%
World	43%	37%	35%

ETIOLOGY

- Inadequate intake of iron & of food, which enhances iron absorption.
- High intake of inhibitors of iron absorption
- Hookworm infestation.
- Blood loss (heavy menses & use of aspirin & NSAID).
- High fertility rate in womem.
- Low iron stores in newborns.

TYPES OF DIETARY IRON

- There are 2 types of iron in the diet
  - Haem iron
  - Non-haem iron
- Haem iron is a constituent of haemoglobin and myoglobin therefore is present in meat, fish and poultry, 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
- **Vitamin C, meat, and fish are enhancers the of iron absorption of the nonheam contained in the rest of the meal**

IRON ABSORPTION (2)

- 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

Determinants of Iron Absorption

factors that enhance non-haem iron absorption:

- Ascorbic Acid (vitamin C)
- Meat, poultry, fish and other seafood
- Low pH (e.g., lactic acid)

(2) factors that inhibit non-haem iron absorption:

- 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.
- 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.

INHIBITION-HOW?

- The dietary phenols & phytic acids compounds bind with iron decreasing free iron in the gut & forming complexes that are not absorbed.
- Cereal milling to remove bran reduces its phytic acid content by 50%.

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.

Main Risk Factors For IDA

Low intake of iron,

b. Poor absorption of iron from diets high in phytate or phenolic compounds,

c. Period of life when iron requirements are especially high (i.e.growth and pregnancy).

d. Heavy blood loss as a result of menstruation, or parasite infections such as hookworms, ascaris, and schistosomiasis can lower blood Hb concentrations.

e . Acute and chronic infections, including malaria, cancer, TB.

Repeated episodes of infection as diarrhea or respiratory tract infections result in the development of anemia,

particularly in young children

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**

IRON TRANSPORT

- Transferrin is the major protein responsible for transporting iron in the body.
- Transferrin receptors, located in almost all cells of the body, can bind two molecules of transferrin.
- Both transferrin concentration & transferrin receptors are important in assessing iron status.

STORAGE OF IRON

- Tissues with higher requirement for iron

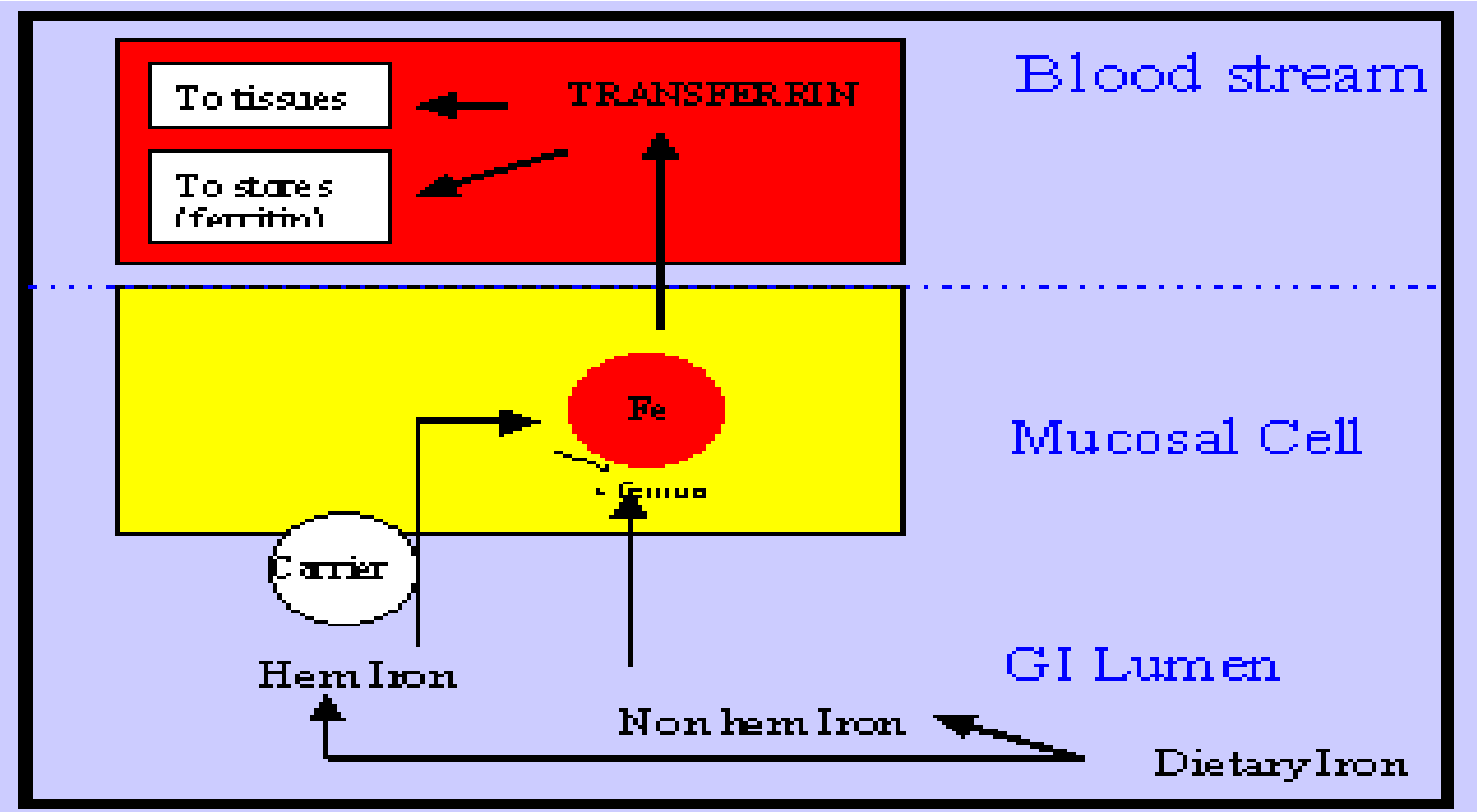
  (bone marrow, liver & placenta) contain more transferrin receptors.

- 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



DIAGNOSIS OF IDA

- **Clinical: symptoms**

  Fatigue, dizziness , palpitations.

  Clinical signs

  pallor, smooth tongue, Koilonychia, splenomegaly & dysphagia in elderly

- Laboratory

- Stainable iron in bone marrow

- Response to iron supplements

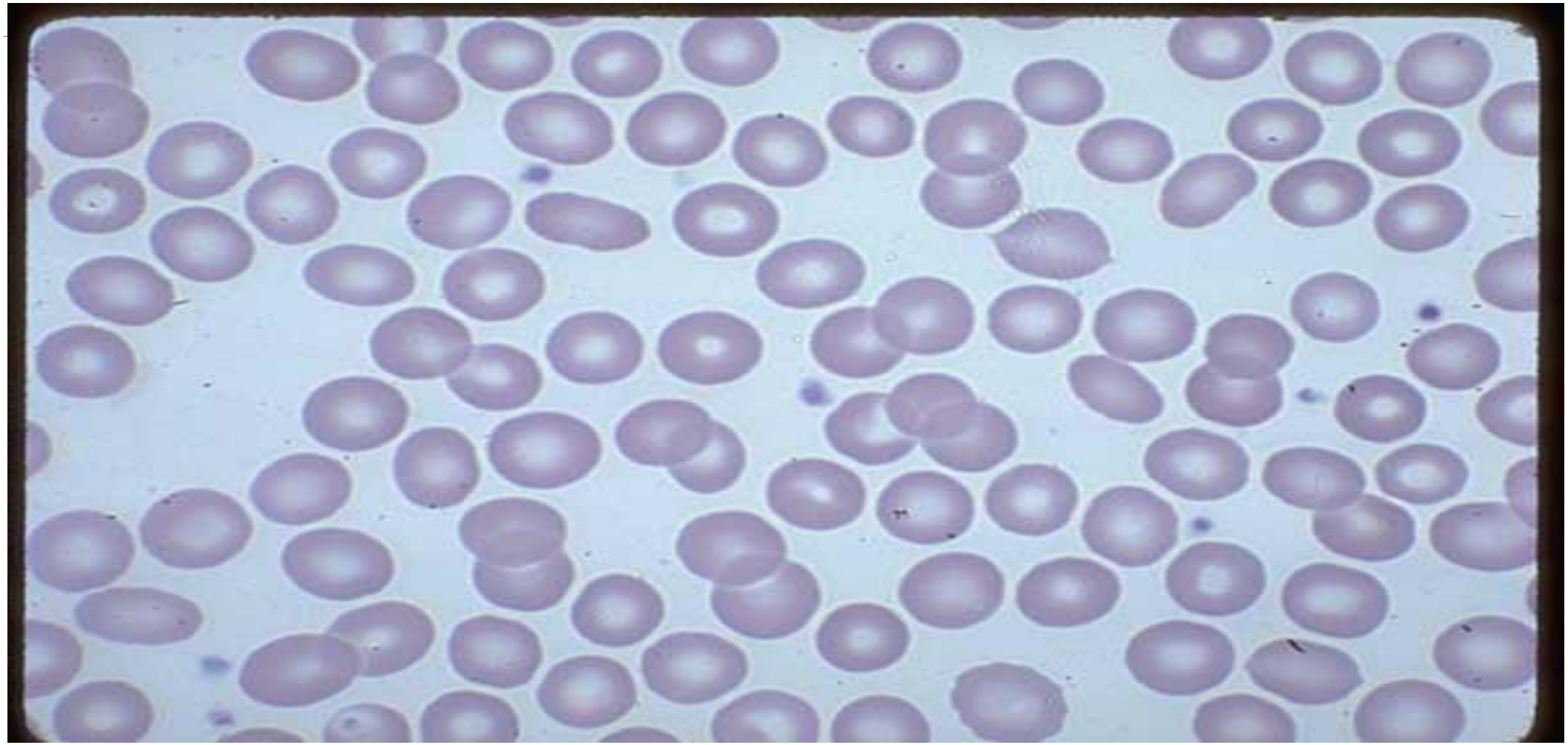
LAB FINDINGS IN IDA

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

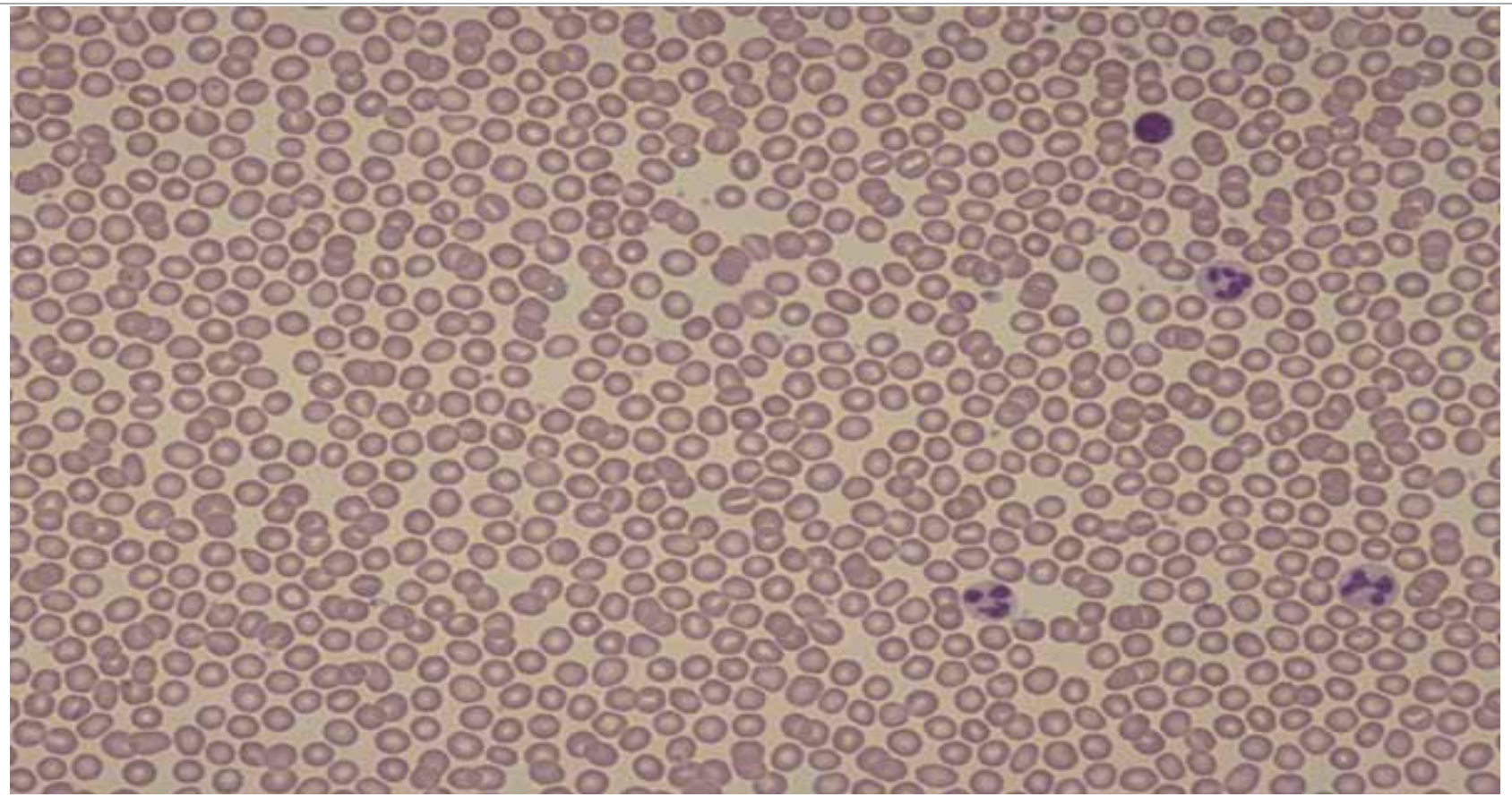
Table 5.2: Stages of anemia. Source (48) and values used in demographic and health surveys.

	Anemia measured by hemoglobin (g/dL)			
	Anemia	Mild	Moderate	Severe
Children 6–59 months	<11.0	10–10.9	7.0–9.9	<7.0
Children 5–11 years	<11.5	10–11.4	7.0–9.9	<7.0
Children 12–14 years	<12.0	10–11.9	7.0–9.9	<7.0
Non-pregnant women above 15 years	<12.0	10–11.9	7.0–9.9	<7.0
Pregnant women	<11.0	10–10.9	7.0–9.9	<7.0
Men (above 15 years)	<13.0	12–12.9	9.0–11.9	<9.0

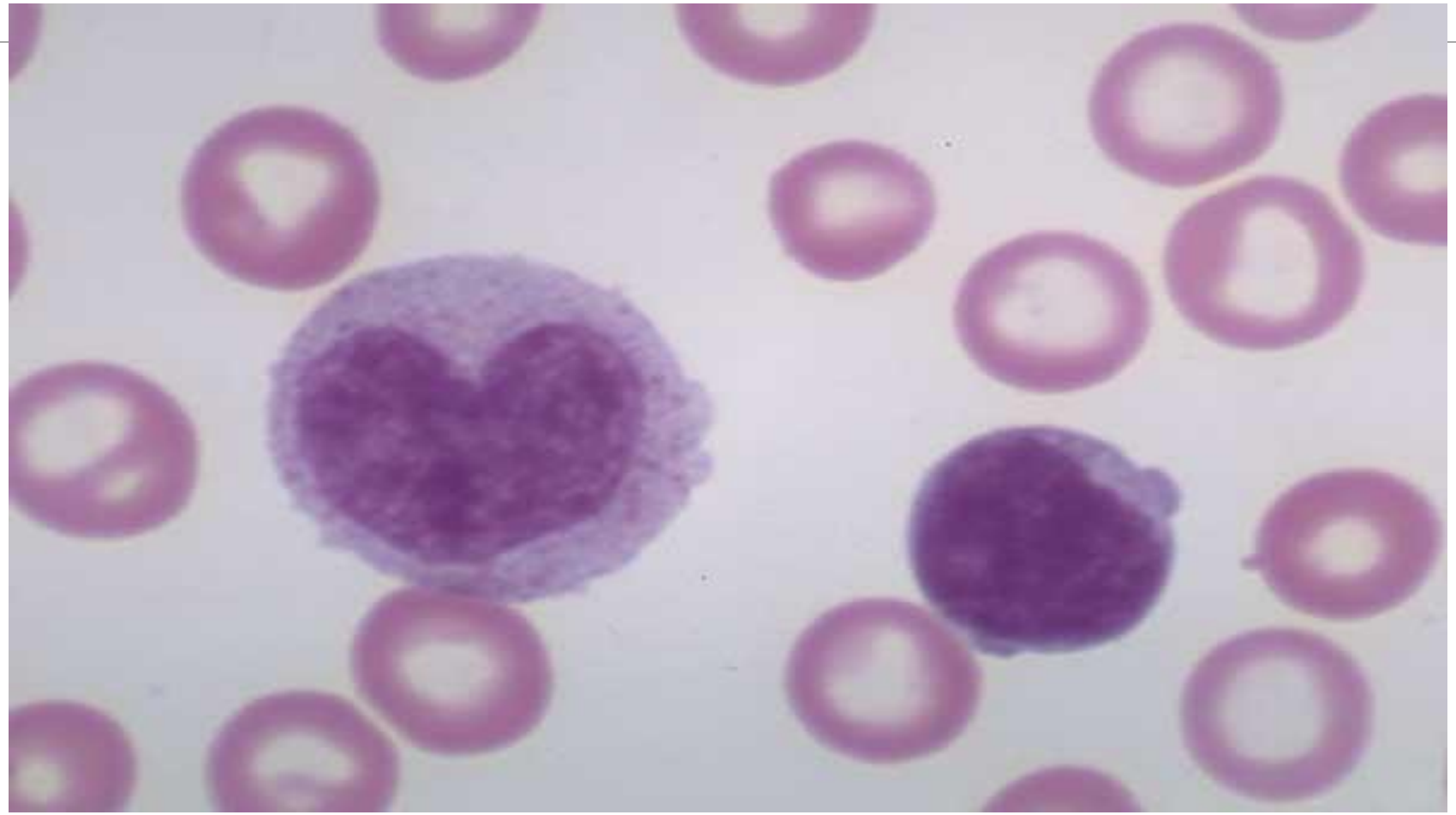
Normal Blood Film



MICROCYTES



HYPOCHROMIA



Classification of Anemia as a significant Public Health Problem

Prevalence of anaemia (%)	Category of public health significance
≤4.9	No public health problem
5.0–19.9	Mild public health problem
20.0–39.9	Moderate public health problem
≥40.0	Severe public health problem

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.

Consequences In infants and children

- Impaired motor development and coordination;
- Impaired language development and scholastic achievement
- Psychological and behavioral effects (inattention, fatigue, insecurity) decreased physical activity

Consequences In Adults

- Decreased physical activity :
- Decreased physical work and earning capacity;
- Decreased resistance to fatigue

- **Consequences n pregnant women**

- increased maternal morbidity and mortality;
- increased fetal morbidity and mortality;
- increased risk of low birth weight

PREVENTION OF IDA

- Dietary modification
- Food fortification
- Iron supplementation

PREVENTION OF IDA /2

- **Diet & nutrition education**
  - eat more fruits and vegetable
  - no coffee or tea with meals
  - programmes should be targeted to at risk groups
  - reduce phytic content of cereals and legumes by fermentation

PREVENTION OF IDA /3

❑Short term approach:

- ✓supplementation with iron tablets.

❑Long-term approach:

- ✓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.

MANAGEMENT OF IDA

- Blood transfusion if heart failure is eminent
- IV or IM iron in pregnant women
- Oral iron 3-5 mg Fe/kg/day
- Treat underlying cause
- Dietary education


Thank
you