NUTRITIONAL ANEMIA
DEFINITION

• Anemia is defined as a condition where the hemoglobin conc. or hematocrit of an individual is lower than the level considered normal for the person’s age and sex group.

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Hb &lt;g/dl</th>
<th>Hct %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 to 5</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>6 to 14</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>Non Pregnant</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>Pregnant</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Men</td>
<td>13</td>
<td>39</td>
</tr>
</tbody>
</table>
# PREVALENCE OF ANEMIA

40% world population (> 2 billion people)

<table>
<thead>
<tr>
<th></th>
<th>Developing nations</th>
<th>Developed nations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre School Children</td>
<td>42%</td>
<td>17%</td>
</tr>
<tr>
<td>School children</td>
<td>53%</td>
<td>9%</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>56%</td>
<td>18%</td>
</tr>
<tr>
<td>Men</td>
<td>33%</td>
<td>5%</td>
</tr>
</tbody>
</table>

NB: Nutritional anemia accounts for most anemia cases
### PREVALENCE OF ANEMIA
(Children aged 6-35 months)

<table>
<thead>
<tr>
<th>Anemia Grade</th>
<th>(Hb g/dl)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>(10-10.9)</td>
<td>26.3</td>
</tr>
<tr>
<td>Moderate</td>
<td>(7-9.9)</td>
<td>40.2</td>
</tr>
<tr>
<td>Severe</td>
<td>(&lt;7)</td>
<td>2.9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>69.4</td>
</tr>
</tbody>
</table>

NATIONAL FAMILY HEALTH SURVEY-3 DATA (2005-06)
# Age Wise Prevalence of Anemia

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Prevalence of Anemia(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;8</td>
<td>33.3</td>
</tr>
<tr>
<td>9-10</td>
<td>38.5</td>
</tr>
<tr>
<td>10-11</td>
<td>48.5</td>
</tr>
<tr>
<td>11-12</td>
<td>49.8</td>
</tr>
<tr>
<td>12-13</td>
<td>52.9</td>
</tr>
<tr>
<td>13-14</td>
<td>50.2</td>
</tr>
<tr>
<td>14-15</td>
<td>51.2</td>
</tr>
<tr>
<td>15-16</td>
<td>49.3</td>
</tr>
<tr>
<td>16-17</td>
<td>47.8</td>
</tr>
<tr>
<td>17-18</td>
<td>49.2</td>
</tr>
<tr>
<td>18+</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>50.1</td>
</tr>
</tbody>
</table>

*Multicentric Study on Adolescent Girls (Gujarat, Mumbai Delhi), 1998*
CAUSES OF NUTRITIONAL ANEMIA

• Iron deficiency predominantly.

• Vitamin B 12 and folic acid deficiency in a significant number of cases.

• Deficiency of Vitamin A, thiamine, riboflavin, pyridoxine, Vitamin C, Vitamin E, trace elements could be important.
CAUSES OF IRON DEFICIENCY ANEMIA (IDA)

- Inadequate intake of iron.
- Reduced bioavailability of dietary iron.
- Decreased absorption of the iron.
- Increased need of the iron.
- Chronic blood loss due to worm infestations and other causes.
- Nonspecific e.g. chronic infection.
ROLE OF IRON

- Hemoglobin – 70%
- Myoglobin
- Enzymes
- Storage Iron
  - 4-5% earth’s crust is iron
  - Child – 70 mg/kg
  - Male – 4.0 gms, Female – 3.0 gms
DETERMINANTS OF IRON ABSORPTION

Heme Iron : High bioavailability (20-30%)
Non heme Iron : Poor bio availability (2-5%)

IRON STATUS OF HOST

Absorption Promoters
• Ascorbic acid
• Heme iron (meat, fish)
• Germination
• Fermentation

Absorption Inhibitors
• Phytates (Cereals)
• Tannin (Tea, coffee)
• Calcium
• Soy protein

Absorption promoters can enhance iron absorption up to 40%
RISK FACTORS IN INFANCY

• Maternal iron deficiency
• Breastfeeding beyond 6 mo without complementary food
• Complementary food low in iron or poorly bioavailable.
ADVERSE EFFECTS OF IRON DEFICIENCY EVEN BEFORE DEVELOPMENT OF ANEMIA

• Impairment in mental and motor development, poor concentration, attention, distractibility

• Decreased physical performance and endurance leads to poor motor skill and productivity.

• Decreased physical activity affects learning due to limited exploratory activities.

• Cumulative deficits in school performances result in dropouts.
APPROACH TO IDA

• History
• Physical examination
• Laboratory tests
• Management
HISTORY IN IDA

• Age of onset: 6 mo-36 months
• Sex: Both sexes equally affected in childhood, after adolescence females > males
• Diet: Lack of breastfeeding, Excess of animal milk, inadequate weaning food, predominantly vegetarian diet. Exclusive breastfeeding up to 6 mo prevents anemia.
HISTORY IN NUTRITIONAL ANEMIA – CONTD..

• H/O Pica: craving for mud (geophagia), chalk, ice (phagophagia), laundry starch, cardboard etc.
• H/O breath holding spells
• Infections: rule out worms infestation esp. hook worm, round worms, giardia
• Symptoms: Irritability, fatigue, shortness of breath, lassitude, weakness, dyspnea on exertion. If fall of Hb is gradual the onset of symptoms is insidious, and symptoms may not be noticed till Hb falls to 4-5 g%.
ANEMIA – PHYSICAL EXAM

- Signs: pallor, puffiness, edema feet, hemic murmur
- Tongue: pallor, bald & shining tongue, loss of papillae
- Angular stomatitis
- Nails: platynychia, koilonychia in iron deficiency
- Hyper pigmented knuckles in megaloblastic anemia
- Plummer-Vinson syndrome (Patterson - Kelly syndrome): Triad of dysphagia due to esophageal webs, koilonychia, splenomegaly rarely.
ANEMIA – PHYSICAL EXAM – CONTD..

Rule out other causes of anemia by looking for:

- Abnormal facies (e.g. Hemolytic facies)
- Splenohepatomegaly (e.g. Thalassemia)
- Lymphadenopathy (infections, tuberculosis)
- Bony tenderness (e.g. leukemia)
- Petechiae/purpura (aplastic anemia, leukemia)
- Recent weight loss (e.g. malignancies)
- Skeletal changes (e.g. Fanconi’s anemia)
LABORATORY DIAGNOSIS OF IDA

• Hb estimation by cyanmethemoglobin method or Hemocue Hb photometer

• P/S: RBC’s hypochromic microcytic

• Automated Red cell indices:
  - MCV < 80 fl
  - MCH < 27 pg
  - MCHC < 33%
  - Elevated RDW > 14.5%
• Serum ferritin: < 12 ng/ml
• Serum iron: < 35 mcg/dl
• TIBC: > 470 mcg/dl
• Transferrin saturation: Infants < 12%
  Children < 14%
• Serum transferrin receptor: > 9 mg/l
• FEP >75 mcg/dl RBC & P:H ratio > 32
• Bone marrow: Reduction in stainable iron
1. Multiple indices are more specific
   • Hb \(\Leftrightarrow\) + Serum Ferritin /
   • MCV \(\Leftrightarrow\) + RDW \(\Leftrightarrow\)

2. Response to iron therapy: Reticulocytosis and daily increase in Hb 0.1 g/dl (0.3 or 1% rise in Hct) from the fourth day onwards.

3. Field level: Clinical diagnosis by looking at conjunctiva, tongue, nails.
## STAGES OF IRON DEFICIENCY

<table>
<thead>
<tr>
<th></th>
<th>NORMAL</th>
<th>PRELATENT</th>
<th>LATENT</th>
<th>IRON DEFICIENCY ANEMIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IRON STORES</strong></td>
<td>PRESENT</td>
<td>DECREASED</td>
<td>ABSENT</td>
<td>ABSENT</td>
</tr>
<tr>
<td>Serum ferritin (ng/ml)</td>
<td>&gt;40</td>
<td>&lt;20</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Transferrin Saturation(%)</td>
<td>35</td>
<td>35</td>
<td>&lt;16</td>
<td>&lt;16</td>
</tr>
<tr>
<td>FEP (ng/100mlbld)</td>
<td>10</td>
<td>10</td>
<td>&gt;35</td>
<td>&gt;35</td>
</tr>
<tr>
<td>Hb (g/dL)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>&lt;11</td>
</tr>
<tr>
<td>MCV(fl)</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>&lt;70</td>
</tr>
</tbody>
</table>
TREATMENT OF IDA

• Hb below 5 g/dl: Risk of cardiac failure; Hospitalization is desirable.
  If Hb is below 3 g/dl (< 4 g/dl with infection and in young children): Blood transfusion is usually required; packed red cell transfusion 2-3 ml/kg at one time.

• For treatment dose of oral iron is 3 mg/kg/day; ferrous sulphate, gluconate and fumarate are most commonly used and cost effective. Newer iron compounds like ferrous glycine sulphate, carbonyl iron are costly and have not been studied adequately in children
ORAL IRON SIDE EFFECTS

• Nausea, vomiting, pain in abdomen, diarrhea, constipation in about 14% cases and not related to any particular compound

• Discoloration of stool

• Staining of tongue / teeth

• True intolerance rare
ORAL IRON THERAPY

- Dose: 3-6 mg/kg of elemental iron
- Divided in 1-2 doses
- On empty stomach – ideal
  On full stomach if intolerance
- Duration: 3 mo after Hb has normalized
- Daily Vs twice a week therapy
RESPONSE TO IRON THERAPY

• 12-24 hrs Replacement of enzymes
  Subjective improvement
  Decreased irritability
  Increased appetite
• 24-48 hrs Erythroid hyperplasia
• 48-72 hrs Reticulocytosis
• 4-20 days Increase in Hb level
• 1-3 months Repletion of stores
NON RESPONDERS TO IRON THERAPY

Investigate after 2 weeks of therapy

Possibilities

• Megaloblastic anemia
• Thalassemia
• Red cell aplasia
• Wrong formulation and dosage
• Poor compliance
• Basic cause not treated esp. bleeding
• Other causes
MEGALOBLASTIC ANEMIA

• Mostly caused by nutritional deficiency of vit. B12 or folate

• Clinically and hematologically def. of B12 and folate are indistinguishable

• Infancy and young children B12 def. is more common

• Most cases occur in vegetarian / vegan families
MEGALOBLASTIC ANEMIA ETIOLOGY

- Folate deficiency: Mainly nutritional, Food fads, Goat’s Milk (poor in folate), Malabsorption, drugs (antimetabolites)

- B12 deficiency: Mainly dietary food fads, pure vegan, worms, rarely pernicious anemia in children

- Rare: Congenital – enzyme deficiency
MEGALOBLASTIC ANEMIA: CLINICAL PROFILE

- Malnourished
- Prolonged exclusively breast-feeding
- Mild hepato-splenomegaly
- Bleeding manifestations 20-30% cases
- Mimic aplastic anemia/ acute leukemia
- Tremors
- Developmental retardation/ regression
- Hyper-pigmentation of knuckles/ terminal phalange
NUTRITIONAL ANEMIA

Pale conjunctiva  Bald tongue  Hyperpigmented knuckles
MEGALOBLASTIC ANEMIA: DIAGNOSIS

- MCV increased
  - 2-10 yr MCV = (age x 0.6) + 84 fl
- MCH normal or decreased
- MCHC normal or decreased
- Leucopenia
- Thrombocytopenia
- Pancytopenia (30-70 % cases)
DIAGNOSIS OF MEGALOBLASTIC ANEMIA

- P/smear: Macro ovalocytosis of RBCs
  - Multilobed (>5) neutrophils (>5%); high RDW
  - Polychromasia, basophilic stippling, Howell Jolly bodies.
- Bone marrow: Megaloblasts
- Serum B12 level: < 150 pg/ml
- Serum Folic acid level: < 3 ng/ml
- Erythrocyte folate level: < 150 ng/ml
- Therapeutic trial
PERIPHERAL SMEAR EXAMINATION

- Normocytic Normochromic
- Microcytic Hypochromic – IDA
- Microcytic Hypochromic – Thalassemia (Target cells, NRs)
- Macro ovalocytes and multilobed neutrophil – Megaloblastic anemia
MEGALOBLASTIC ANEMIA: THERAPY

• Vitamin B12 i.m. 100-200 mcg biweekly or 1000 mcg weekly x 4 to 8 weeks, followed by oral dose of 100 mcg per day.

• Folic acid: 500 mcg-1 or more daily; 5 mg per week will also be effective. To be given for 4-8 weeks.
RESPONSE TO TREATMENT

- Bone marrow may totally revert in 24 hours
- Patient starts feeling well in days
- Retic response will peak at 5-7 days
- Hb starts rising after 1-2 weeks
- Hb normalizes by 3 months
- PS becomes normal after 1-2 months as old macrocytic RBCs will persist till their life
PREVENTION OF NUTRITIONAL ANEMIA

• Dietary modification
  Promotion of breastfeeding
  Increasing dietary intake
  Enhancing bioavailability of iron

• Supplementation with medicinal iron

• Food fortification

• Control of infection: Parasitic, Bacterial, Viral
PROMOTING CONSUMPTION OF IRON RICH FOOD

• Encourage consumption of GLV, fruits, cereals, pulses (sprouted), jaggery, (gur) if feasible animal flesh foods.
• GLV in weaning food of infants.
• Reduced consumption of tea.
• Kitchen garden for iron rich food.
• Antenatal clinics and immunization sessions to be utilized for promotion.
SUPPLEMENTATION WITH MEDICINAL IRON

6-12 mo: 10 mg IFA daily in syrup form
1-3 yrs: 20 mg IFA (1ml) for 100d/yr in syr. form
>3-5 Yrs: IFA tab (20 mg + 100 mcg) as above
> 5-10 Yrs: 40 mg IFA tab as above.
Adolescents: IFA Tab(100 mg+ 500 mcg) 100d/yr

ICMR consultative group recommendations 2004

NB: Addition of Vit B12 1 mcg daily to IFA tab/syrup has been suggested especially for vegetarians by many experts
WEEKLY/BIWEEKLY SUPPLY OF IRON

• Iron absorption is 30-40 mg /wk from a single 100 mg dose : equivalent 5 mg/ d.

• Efficacy trials have shown that weekly suppl. of iron is effective in older children and specially when given under supervision.

• Weekly dose is given same as daily dose but once a week.
IRON FORTIFICATION OF FOODS

• Food items like wheat flour, other cereals, sugar, curry powder, noodles can be fortified.
• In many countries food fortification has been found to be effective in reducing prevalence of anemia.
• In India, Double fortified salt (salt fortified with iodine and iron) have been found compatible with cooking.
RECOMMENDATIONS FOR PREVENTION OF NUTRITIONAL ANEMIA

Exclusive Breastfeeding: Up to 6 months.

Promotion of Iron & Vitamin C Rich Foods (GLV, Citrus fruits)

Discouraging intake of Tea/coffee with meal.

Iron Folate (+ B 12) suppl. with counseling.
THANK YOU