NUTRITION (PRACTICAL)
NUTRITION

• The word “Nutrition” — From the Latin word “Nutritus” means “to suckle”
• The science of food and its relationship to health
• Nutrient — specific dietary constituent
• Essential for proper growth, development and maintenance of day to day body functions (physical activity, metabolic needs, repair of aging or damaged tissues)
CLASSIFICATION OF FOODS

• By Origin
  ➢ Foods of Animal Origin
  ➢ Foods of Vegetable origin

• By Chemical Composition
  ➢ Proteins
  ➢ Fats
  ➢ Carbohydrates
  ➢ Vitamins
  ➢ Minerals
  ➢ Dietary Fibre
CLASSIFICATION OF FOODS

• By Predominant Function
  - Body Building (protein rich) – milk, meat, egg, fish, pulses, nuts
  - Energy Giving – cereals, sugars, roots, tubers, fats, oils
  - Protective Foods (rich in vitamins, minerals, essential fatty acids, essential amino acids) – vegetables, fruits, milk
CLASSIFICATION OF FOODS

• By Nutritive Value
  ➢ Cereals and millets
  ➢ Pulses (legumes)
  ➢ Vegetables
  ➢ Nuts and oil seeds
  ➢ Fruits
  ➢ Animal foods
  ➢ Fats and oils
  ➢ Sugar and jaggery
  ➢ Miscellaneous
ENERGY

• Essential for body functions and growth
• Expressed in Kilo-calorie (Cals, C)
• Energy values
  - Proteins – 4 C/gram
  - Carbohydrates – 4 C/gram
  - Fats – 9 C/gram
• Energy requirement should be met from carbohydrates and fats (to avoid using proteins for energy purpose which is considered wasteful)
DAILY ENERGY REQUIREMENTS

• Holiday and Segar Formula
  ➢ First 10 kg --- 100 C/kg
  ➢ Next 10 kg (11-20kg) --- + 50 C/kg
  ➢ After 20 kg --- + 20 C/kg
  o Based on expected weight of the child, not based on actual weight
  o For an 8 years old child weighing 20kg, expected weight is actually 25 kg. Required energy is 1000 C + 500 C + 100 C = 1600 C
### DAILY ENERGY REQUIREMENTS
**ICMR 2010 RECOMMENDATION**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Energy Requirement (C)</th>
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<tbody>
<tr>
<td>0-6 months</td>
<td>92/kg (expected weight)</td>
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<tr>
<td>7-12 months</td>
<td>80/kg (expected weight)</td>
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<tr>
<td>1-3 years</td>
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<tr>
<td>4-6 years</td>
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<td>7-9 years</td>
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<tr>
<td>10-12 years (boys)</td>
<td>2190</td>
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<tr>
<td>10-12 years (Girls)</td>
<td>2010</td>
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<tr>
<td>13-15 years (boys)</td>
<td>2750</td>
</tr>
<tr>
<td>13-15 years (girls)</td>
<td>2330</td>
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</table>
NUTRIENTS

- Proximate Principles- Carbohydrates, Fats and Proteins
- Vitamins – Water soluble (B-complex and C), Fat soluble (A,D,E and K)
- Minerals- Small inorganic elements
- Macro-minerals- Calcium, Phosphorus, Sodium, Potassium, Magnesium, Chloride
- Micro-Minerals (Trace Elements)- Iron, Iodine, Zinc, Selenium, Copper, Molybdenum, Chromium, Manganese
- Non Nutrients- Fibre
PROTEINS

• “Proteins” → “of first importance”
• Made up of amino acids, absorbed as amino acids
• 24 amino acids, 9 are essential (EAA) (can not be synthesised in our body)
• All EAA should be present adequately in every day diet
• For body building (important in growing period)
• Repair and maintenance of body tissue
• Antibodies, plasma proteins, various enzymes are all proteins
## Daily Protein Requirements

**ICMR 2010 Recommendation**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Requirement (Grams)</th>
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<tbody>
<tr>
<td>0-6 months</td>
<td>1.2/kg (expected weight)</td>
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<tr>
<td>7-12 months</td>
<td>1.7/kg (expected weight)</td>
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<tr>
<td>1-3 years</td>
<td>17</td>
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<tr>
<td>4-6 years</td>
<td>20</td>
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<tr>
<td>7-9 years</td>
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<tr>
<td>10-12 years (boys)</td>
<td>40</td>
</tr>
<tr>
<td>10-12 years (Girls)</td>
<td>40</td>
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<tr>
<td>13-15 years (boys)</td>
<td>54</td>
</tr>
<tr>
<td>13-15 years (girls)</td>
<td>52</td>
</tr>
</tbody>
</table>
PROTEINS- QUALITY

• As important as quantity
• Reference protein– egg protein (contains all EAA in adequate quantity)
• Digestibility Coefficient (DC) -- % of ingested protein absorbed
• Biological Value (BV) -- % of absorbed protein retained
• Net Protein Utilisation (NPU) -- % of ingested protein retained in body
• NPU = DC x BV/ 100
PROTEIN SYNTHESIS

• Each protein has got a unique sequence of AA (like beads of different colours in a chain)
• If bead of a particular colour is lacking, you can not continue to thread the bead further
• Similarly protein synthesis can not be completed even if a single AA is deficient. All other AA are wasted, either used up for energy or excreted in urine. Growth is affected
• This highlights the importance of consuming good quality proteins every day
PROTEINS- QUALITY

• Limiting Amino Acid- EAA deficient in a particular protein
• Cereal protein deficient in- Lysine, Threonine
• Pulse protein deficient in- Methionine
• Supplementary action of protein– protein quality improves when two proteins with different limiting AA are combined in diet. E.g. Cereal-pulse combination (idly, dosa→ rice + black gram, roti with dal, rice with green gram etc.)
• Animal proteins are of superior quality compared to vegetable proteins
FATS

- Energy dense
  - Simple lipids—triglycerides
  - Compound lipids—phospholipids
  - Derived lipids—cholesterol

- Fatty Acids—saturated, unsaturated (mono and poly unsaturated—PUFA)

- Vegetable fats—(ground nut, mustard, sun flower, safflower) rich in PUFA (except coconut oil)

- Animal fats—(ghee, butter, egg, meat) rich in saturated fats (except fish oils)
FATS- FUNCTIONS

• Energy (25-30% energy intake should be from fats)
• Absorption of fat soluble vitamins (A,D,E,K)
• Support viscera
• Insulation, helps maintain body temperature
• Makes food tastier
• Precursors of prostaglandins, steroid hormones, bile acids
• Very essential for brain growth
ESSENTIAL FATTY ACIDS (EFA)

• Can not be synthesised in our body
• EFA are PUFA, but all PUFA are not essential
  ➢ Omega 3 FA– linolenic acid, eicosa pentanoic acid, decosa hexanoic acid. Important content of Grey mater, improve intellectual performance
  ➢ Omega 6 FA– linoleic acid, arachidonic acid. Deficiency cause phrynoderma
• EFA deficiency- growth failure, alopecia, diarrhoea, impaired wound healing, weak bones
• Requirement- 1-1.5 gram/day (0.5% of total calories)
FATS- TYPES

• Visible fat- consumed as fat (oils, ghee)
• Invisible fat- present in cereals, pulses, nuts, milk, egg (this forms the major contribution)
• Hydrogenated oil (vanaspathi)- EFA lost, can be stored for longer period
• Trans fatty acids- partial hydrogenation to improve shelf life. More atherogenic than saturated fats (increase LDL and cholesterol, decrease HDL)
• Present in deep fried fast foods, cakes, candy, chips
CARBOHYDRATES

• Main source of energy
• Needed for oxidation of fats, synthesis of certain amino acids
  ➢ Starches—cereals, roots, tubers
  ➢ Sugars – Monosaccharides (glucose, galactose, fructose), Disaccharides (lactose, sucrose, maltose)
  ➢ Cellulose—not digestible, contributes to dietary fibre
• Forms 55-60% of energy intake
• 4 C/gram
• Excess carbohydrates- converted to fat
MINERALS - CALCIUM

• Most abundant mineral in body (98% in bone)
• Essential for coagulation, nerve conduction, muscle stimulation
• Absorption regulated by vit D
• Dietary fibre, oxalates (in vegetables), phytates (in cereals) and fatty acids inhibit absorption
• Source- milk, cereals (ragi), fish, egg, fruits
• RDA- 1-10 yrs– 500-800mg, adolescents- 1000-1200mg
• Deficiency- tetany, seizure, rickets, osteoporosis (mainly in vit. D deficiency rather than dietary calcium deficiency)
MINERALS - MAGNESIUM

- Essential for energy metabolism, membrane transport, signal transmission
- For the action of more than 300 enzymes
- Sources - legumes, nuts, banana, whole grains
- Deficiency - mainly due to malabsorption
- Manifestations - tetany, seizure, irritability
- Requirement - 40-60mg/day during first year
- Older children - 200mg/day
MINERALS – SODIUM, POTASSIUM

• Present in most of the food items, dietary deficiency unlikely
• Requirement increase when loss is high (diarrhoea, excess sweat, renal loss)
• Diets rich in Potassium- fruits, tender coconut
• Excess Sodium- oedema, hypertension, fluid retention, seizure
• Low potassium- flaccidity, cardiac conduction abnormality, paralytic ileus
MINERALS – IRON

• Most important cause for nutritional anaemia
• Infants, young children and adolescents are more prone
• Important role in brain function, immune function
• Sources- Haem iron- meat, fish, liver- better absorbed
• Non Haem iron- leafy vegetables, dates, water melon, jaggery, cereals, pulses- less well absorbed
• Blood loss (hook worm, occult GI loss, menstruation)- cause anaemia even with adequate intake
MINERALS – IODINE

• Iodine Deficiency Disorders (IDD)
  - Fetus- abortion, stillbirths, congenital anomalies, endemic cretinism, increased perinatal mortality
  - Neonate- neonatal goitre, endemic mental retardation, neonatal hypothyroidism
  - Child, adolescent- goitre, impaired mental function, subclinical hypothyroidism, retarded physical development

• RDA- 90-120mg

• Sources- fish, water

• Prevention of deficiency- iodisation of salt
MINERALS – ZINC

• Component of more than 100 metalloenzymes
• Regulates gene transcription and their by protein synthesis and cell growth
• Deficiency- usually associated with malnutrition, diarrhoea
• Manifestation- poor physical growth, hypogonadism, anaemia, anorexia, diarrhoea, alopecia, impaired immunity, poor wound healing
• Skin manifestation similar to acrodermatitis enteropathica
• Requirement- 3.5- 5 mg/day
• Source- meat, fish (better absorbed) cereals, pulses, vegetables
ZINC DEFICIENCY

Peri orificeal lesions in Zinc deficiency- around mouth, nose, peri anal, perineal
MINERALS – COPPER

• Component of several metalloenzymes
• 95% of Copper in blood is as Ceruloplasmin
• Sources- meat, fish, liver, nuts, seeds, shell fish
• Food prepared in copper vessels
• Primary dietary deficiency unlikely
• Manifestation- microcytic hypochromic anaemia, osteoporosis, depigmentation of skin and hair, anorexia, diarrhoea, failure to thrive
• Diseases related to copper metabolism- Wilson disease, Menkes disease (inherited)
MINERALS – SELENIUM

• Component of glutathione peroxidase, an antioxidant
• Protects cells from free radical damage
• Severe deficiency- Keshan disease (a type of cardiomyopathy in young children)
• Also, skeletal muscle weakness, macrocytosis, hypopigmented hair
MINERALS – SELENIUM

• Decreased antibody production in association with vit. E deficiency
• Severe form of malnutrition- associated with Selenium deficiency
• Garlic- a good source
MINERALS – CHROMIUM

- Glucose intolerance in malnutrition- said to be partly due to Chromium deficiency
- Potentiates insulin action
- Deficiency can cause peripheral neuropathy
- Source- yeast, cereals, nuts, cocoa
VITAMIN A

• Sources- shark and cod liver oil, fish, carrots, mango, papaya, orange, tomato

• RDA- infants-300-400 microgram, children-400-600, adolescents-750

• Functions
  ✔ Vision, especially night vision
  ✔ Epithelial integrity- respiratory, GI, urinary
  ✔ Regulation of gene expression, tissue differentiation
VITAMIN A

• Deficiency
  ➢ Xerophthalmia- night blindness, dryness of cornea, conjunctiva, Bitot’s spots, corneal ulcers and scarring
  ➢ Lower respiratory infections
  ➢ Persistent diarrhoea
  ➢ Urinary tract infections, urinary calculi
  ➢ Infertility

• Measles can precipitate vit. A deficiency

• Prevention- National Vitamin A Prophylaxis Program- 1,00,000 IU at 9 months, 2,00,000 IU every 6 months from 18 months to 5 years
VITAMIN A DEFICIENCY

Different Manifestations of Xerophthalmia
Bitot’s spot, dryness of conjunctiva and cornea, corneal ulcer and corneal opacity
HYPERVITAMINOSIS A

• Acute - pseudotumor cerebri- Raised intra cranial pressure → irritability, bulging fontanel, head ache, vomiting, seizure

• Chronic – (fish oils, vit. A capsules, acne medications) dermatitis, alopecia, hepatosplenomegaly, hyperostosis

• During pregnancy- foetal anomalies, poor reproductive outcome
VITAMIN D

• Ergocalciferol (D$_2$) Plant origin
• Cholecalciferol (D$_3$) Animal origin
• Vitamin D $\rightarrow$ 25 Hydroxy Vit D (Liver) $\rightarrow$ 1, 25 Dihydroxy Vitamin D (Kidney) Active form
• Action-Calcium homoeostasis
• Sources- synthesised from 7 dehydrocholesterol in skin on exposure to UV rays
• Dietary sources- fish, fish oils, egg yolk
• Requirement- infants-200 IU, children- 400 IU
• No requirement if adequate sun exposure
VITAMIN D

• Deficiency- in growing bone - nutritional rickets
  ➢ Bow legs, widening of wrists, knock knees, craniotabes, rickety rosary, Harrison groove, double malleoli, bossing of skull, easy fracture, hypotonia, visceroptosis, dental problem, frequent respiratory infections
  ➢ X ray- widening of physes due to loss of provisional calcification, cupping, fraying, splaying of metaphysis
  ➢ Later- osteomalacia

• Hypervitaminosis D- hypercalcemia, hyperphosphattemia, anorexia, vomiting, hypertension, renal insufficiency, failure to thrive, nephrolithiasis
RICKETS
RICKETS
VITAMIN E

• Tocopherol
• Membrane bound anti oxidant
• Requirement- infants- 0.4 mg/kg/day (3-6mg/day)
• For premature babies- 15-20mg/day
• Source- vegetable oils (corn, cotton seed, safflower), leafy vegetables, nuts, breast milk, colostrum
• Deficiency- in preterm babies- haemolytic anaemia
• In older children- neuropathy, retinopathy, spinocerebellar ataxia, ophthalmoplegia
• Hypervitaminosis E- haemorrhage (vit. K antagonism)
VITAMIN K

- Co factor for post translational carboxylation of glutamic acid of vit K dependant factors in liver (factor II, VII, IX and X, protein C, protein S)
- Deficiency in newborns- haemorrhagic disease of newborn (breast fed babies more prone)
- Prevention- injection vit K 1mg IM to all newborns soon after birth
- Children with Biliary atresia, fat malabsorption can have vit. K deficiency
- Source- microbial biosynthesis in intestine, green leafy vegetables, animal foods
WATER SOLUBLE VITAMINS

- B1 - Thiamine
- B2 - Riboflavin
- B3 - Niacin
- B5 - Pantothenic acid
- B6 - Pyridoxine
- Folic acid
- B12 - Cyanocobalamin
- Vit. C - Ascorbic acid
THIAMINE- B1

• RDA- 0.4mg/ 1000 Cals of carbohydrate intake
• Source- unrefined cereal grains, legumes, liver, kidney
• Heat sensitive
• For oxidative decarboxylation in carbohydrate metabolism
• Deficiency- beriberi (dry, wet and acute types)
• Wet beriberi- edema, ataxia, mental impairment, ocular paralysis
• Dry- cardiomegaly, severe muscle wasting
RIBOFLAVIN- B2

• Source- meat, fish, vegetables
• Not heat labile
• Needed in oxidation reduction reactions
• Deficiency- affects fatty acid biosynthesis
• Requirement- 0.4-1.2mg/1000Cals
• Deficiency- photophobia, glossitis, angular stomatitis, cheilosis, seborrhoeic dermatitis, corneal vascularisation, cataract
NIACIN- B3

- Formed from tryptophan in our body
- Sources- milk, cereals, leafy vegetables, fish, coffee, tea
- Resistant to heating
- Requirement- 6.4-8mg (60mg Tryptophan will yield 1 mg Niacin)
- Deficiency- Pellagra (dermatitis, dementia, diarrhoea)
- Photosensitive rash progressing to scaling, keratinisation, vesiculation and ulceration, red tongue
PYRIDOXINE- B6

• Aids in food assimilation, protein and EFA metabolism
• Involved in the production of antibodies
• Deficiency- anaemia, neuropathy, seizures, skin problem, mouth sores
• Sources- yeast, sunflower oil, wheat germ, soya beans, walnuts
FOLIC ACID

• Needed for normal growth and maintenance of cell
• Co enzyme for RNA and DNA synthesis
• Deficiency impairs cell division
• Sources- leafy vegetables, dried beans and pea, sunflower seeds, fruits
• Heat labile
• RDA- 25-200mg
• Deficiency- megaloblastic anaemia, memory problem
• Maternal deficiency- neural tube defect to foetus
B12- COBALAMIN

• Sources- liver, kidney, heart and muscle meat, oysters, clams
• Produced by micro organisms
• Requirement- 0.3-2 micrograms/day
• Deficiency can occur in strict vegetarians
• Manifestation- megaloblastic anaemia, subacute combined demyelination of posterior and lateral columns of spinal cord and peripheral nerves, hyperpigmented knuckles
BIOTIN

- Deficiency- seen in those who consume large amount of raw eggs (avidin)
- Anorexia, vomiting, scaling dermatitis, glossitis, hypercholesterolemia
- Sources- liver, egg yolk, milk, yeast, meat
- Produced by gastro intestinal flora
PANTOTHENIC ACID

• Present in virtually all natural food items
• Isolated deficiency is rare
• Manifestation- insomnia, burning feet, gastro intestinal symptoms
• Requirements- 2-5mg/day
VITAMIN C

• Capacity for reversible oxidation reduction
• Source- fruits (berries, citrus) vegetables (cauliflower, broccoli, cabbage), sprouting cereals
• Heat labile
• Deficiency- if prolonged- scurvy (irritability, subperiosteal and perifollicular haemorrhage, bleeding and spongy gums, pseudo paralysis), scorbutic rosary with subluxation at costochondral junction
• X-ray long bones- thin cortex, signet ring epiphyses, white line of Frenkel, zone of rarefaction, Pelken’s spur, periosteal elevation
SCURVY

Bleeding spongy gums, perifollicular haemorrhage
BALANCED DIET

• Nutritionally adequate and appropriate food item
• That provide all nutrients in required amounts and proper proportions
• To ensure proper growth and development
• To stay healthy and disease free
• 55-60% energy from carbohydrate, 25-30% from fat and 10-12% from proteins
• Should contain cereals, pulses, good protein source, fruits, vegetables, fats
FOOD PYRAMID
ASSESSMENT OF DIET

• Recall of diet of a full day (24 hour)
• At a time when child is healthy, not admitted to hospital
• On an average day
• Enquire each and every item
• If milk, how much diluted, how much sugar added
• Snacks, drinks, peanuts etc are likely to be missed
• Mention if still breast-fed
• Calculate calories, protein, assess its quality
• Mention adequacy of vitamins, minerals, fibre.....
DIETARY ADVICE

• Exclusive breast feeds- initial 6 months
• Day and night, average 8 feeds/24 hour, semi demand feeding
• Continue even if child is sick
• Complementary feeding- after 6 months
• Mashed roti/rice/ragi/biscuits/bread in undiluted milk with added ghee
• Initiate one cereal/pulse at a time
• Initiate cereal-pulse combination
• Introduce fruits, vegetables, egg, fish
DIETARY ADVICE

• By one year child should be sharing all food items prepared at home (family pot feeding)
• Child should be “eating” the complimentary food, not to “drink” it
• Avoid feeding bottles
• Avoid using mixer/grinder to mash food
• 3-5 times a day (6 months to 1 year)
• Continue breast feeding almost to 2 years
• During second year, encourage feeding self
• 5 feeds/day, apart from breast feeds
DIETARY ADVICE

- Third year, 3 main meals, 2 or 3 snacks
- Do not force-feed
- Encourage dining of all family members together
- Do not offer TV/videos to encourage the child to feed
- Encourage eating uncooked/semi-cooked food items like fruits, vegetables, sprouting seeds
- Preferred cooking method is steaming and boiling
- Try to restrict deep frying
- Try to minimise junk foods, fast foods, carbonated beverages, tea, coffee, dilute porridge
DIETARY ADVICE

• Encourage physical activity/games
• Adequate water and dietary fibre
• Encourage regular bowel habits
• Food hygiene, washing hands before and after food intake and after going to toilet
• Regular growth monitoring
• Try to continue feeding even when child is sick
• Do not restrict food items unless medically indicated (thinking that a particular food is cold..., may cause infection, allergy...)
Thank You