

VITAMINS AND DEFICIENCY DISEASES

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INTRODUCTION

- **Vitamins are organic compounds required in the diet in small quantities to perform biological functions.**
- **We obtain them from :
foods or vitamin supplements.**

Classification of Vitamins

- Vitamins are classified in 2 groups-

1. Fat Soluble Vitamins-

- Adsorbed with dietary fat
- Stored in adipose tissue & liver

e.g., Vitamin A, D, E and K

2. Water Soluble Vitamins-

- Dissolve in water
- Readily excreted by kidney

e.g., Vitamin C and B complex vitamins

RECOMMENDED DIETARY ALLOWANCES (RDA)

- These are suggested levels of essential nutrients considered adequate to meet nutritional needs of healthy individuals of a specific sex, age, life stage, or physiologic condition.
- Requirements are influenced by physical characteristics , dietary habits, sex, pregnancy, lactation and age.

FAT-SOLUBLE VITAMINS

VITAMIN- A

- It is the name given to a group of related compounds :

Retinol, Retinal, Retinoic acid

- RDA- Adult Males- 900µg/d
Adult Females- 700µg/d
Children- 400µg/d
Lactating Women- 1300µg/d

SOURCES :

➤ Fish oil , Liver, Egg yolk, Milk, Cheese , Butter.

➤ Yellow and dark vegetables and fruits are sources of carotenes.

Carrots

Mango

Papaya

Spinach.

FUNCTIONS OF VITAMIN A

- **Maintenance of normal vision.**
- **Maintenance of normal cartilaginous and bone growth.**
- **Increased immunity against infections in children.**
- **Anti-proliferative effect.**

WHO IS AT RISK ?

- **Extremely Low Birth Weight Babies**
- **Children with severe measles.**
- **Adults with malabsorptive diseases**
e.g. Celiac Sprue, Short Bowel Syndrome

VITAMIN- A DEFICIENCY

- Xerophthalmia- Night blindness, Bitot's spots, Xerosis
- Follicular hyperkeratosis
- Impaired embryonic development
- Increased susceptibility to infections(diarrhoea, measles, malaria)

WHO Grading of Xerophthalmia

- XN = night blindness
- X₁ = conjunctival xerosis (X₁A) with Bitot spot (X₁B)
- X₂ = corneal xerosis
- X₃ = corneal ulceration, less than one-third (X₃A); more than one-third (X₃B)
- XS = corneal scar
- XF = xerophthalmic fundus

Treatment

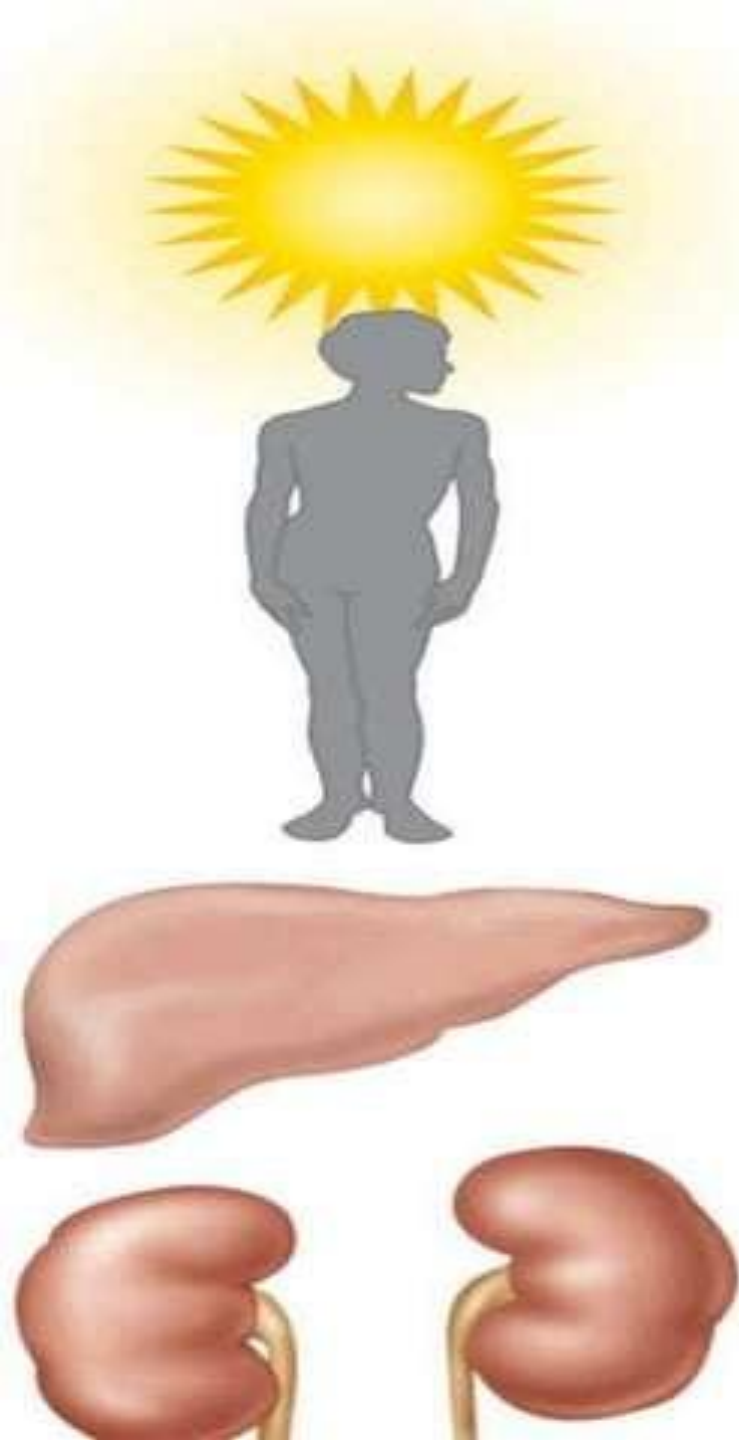
- For Xerophthalmia- 60 mg of Vitamin A in Oily Solution in soft gel Capsule on day 1 & day14
- Adults with Night Blindness or Bitot's Spots- 3mg/d or 7.5mg per week for 3 months
- For prevention in high risk areas-
 1. Infants(6 to 11 months)- 30mg of Vit A
 2. Children(12 to 59 months)- 60mg of Vit A

Hypervitaminosis A

- Acute Intoxication(>150mg in adults & >100mg in children)- increased ICP, vertigo, diplopia, bulging fontanel, seizures, and exfoliative dermatitis
- Chronic Intoxication(>15mg/d in adults and >6mg/d in children over months)- dry skin, cheilosis, glossitis, vomiting, alopecia, lymph node enlargement, hyperlipidemia, amenorrhea, pseudotumor cerebri, Liver fibrosis with portal hypertension.
- Excess in pregnant women -spontaneous abortion and congenital malformations (craniofacial abnormalities and valvular heart disease)

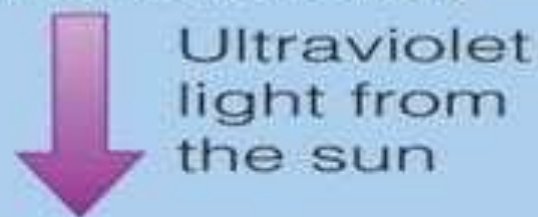
VITAMIN D

- Active Form- CALCITRIOL.
- Exists in two activated sterol forms:
 - Vitamin D₂ - ERGOCALCIFEROL
 - Vitamin D₃ - CHOLECALCIFEROL.



In the skin:

7-dehydrocholesterol
(a precursor made in the
liver from cholesterol)



Previtamin D₃



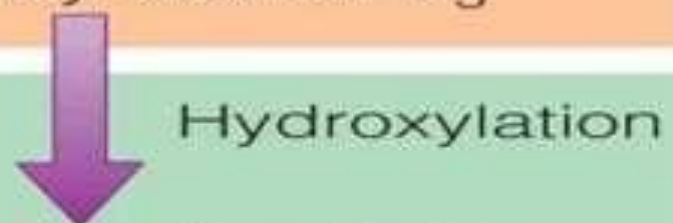
Vitamin D₃
(an inactive form)

In the liver:



25-hydroxy vitamin D₃

**In the
kidneys:**



1,25-hydroxy vitamin D₃
(active form)

SOURCES & RDA

- Sources- Sunlight, Fish, Fortified cereals and dairy products, Egg Yolk
- RDA- Adult Males- $15\mu\text{g}/\text{d}$
Adult Females- $15\mu\text{g}/\text{d}$
Children- $10\mu\text{g}/\text{d}$

FUNCTIONS OF VITAMIN D

- **Maintenance of adequate plasma levels of calcium and phosphorous.**
- **Normal Muscle Contraction.**
- **Bone mineralization.**
- **Neuromuscular transmission.**

VITAMIN -D DEFICIENCY

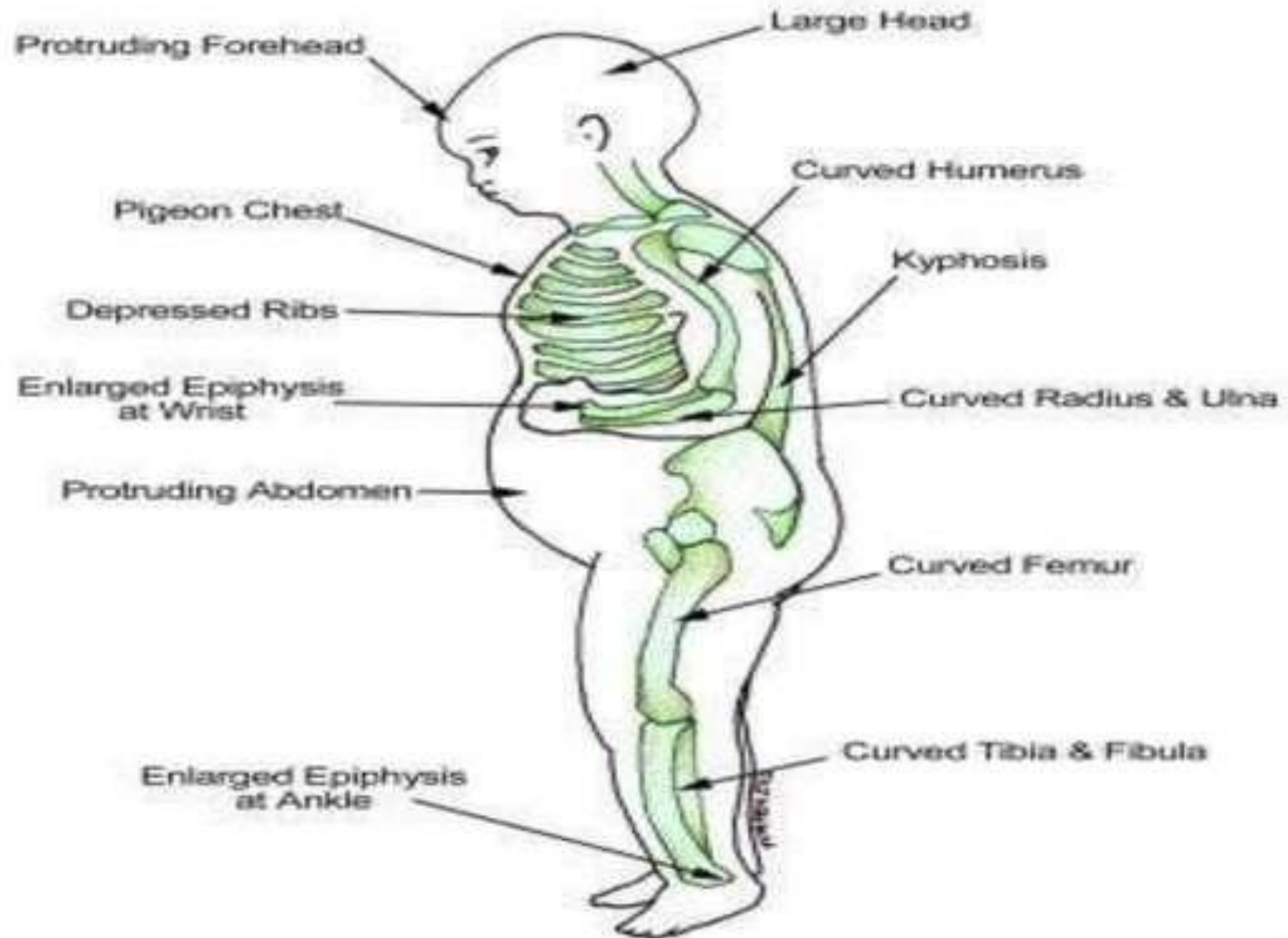
WHO IS AT RISK?

- people with limited exposure to sunlight
- elderly
- people with fat malabsorption

Diseases-

- Rickets(Children) and Osteomalacia(Adults) – Due to defective bone mineralization
- Proximal Myopathy
- Acute Hypocalcemia accompanied with secondary hyperparathyroidism

Manifestations of Rickets



Treatment

- ❖ Adequate Sun Exposure
- ❖ Intake of Fortified Foods
- ❖ Oral administration of 1.25mg(50,000IU)/week for 6 to 8 weeks followed by 20µg/d(800IU) from food and supplements until normal level is achieved

VITAMIN E

- ✓ Vitamin E describes a family of eight antioxidants:
 - four tocopherols
 - four tocotrienols.
- ✓ It is an antioxidant in cells.
- ✓ RDA- 15mg/d in adults and 5-6mg/d in children

SOURCES

- ❖ Vegetables Oils:

 - sunflower & safflower oil

 - soybean & corn oil

- ❖ Meat

- ❖ Bread

- ❖ Almonds

- ❖ Peanuts

- ❖ vegetables- Spinach, Carrot

FUNCTIONS OF VITAMIN- E

- **Antioxidant.**
- **Inhibits platelets aggregation.**
- **Enhances vasodilation.**
- **Scavenger of free radicals.**

VITAMIN -E DEFICIENCY

- Increased risk of cardiovascular diseases.
- Peripheral Neuropathy with areflexia, Ataxic gait, decreased vibration & position sensation
- Ophthalmoplegia and skeletal myopathy
- RISK FACTOR : fat malabsorption syndrome.

Treatment

- Symptomatic deficiency- 800-1200mg/d α -tocopherol
- Patients with Abetalipoproteinemia- 5000-7000mg/d
- Deficiency in Children- 400mg/d oral dose or 2mg/kg/d i.m dose

TOXICITY

Excess vitamin E causes :

- Impaired blood clotting due to reduced platelet aggregation and interference with vitamin K metabolism.
- Nausea, flatulence, and diarrhea.

VITAMIN K

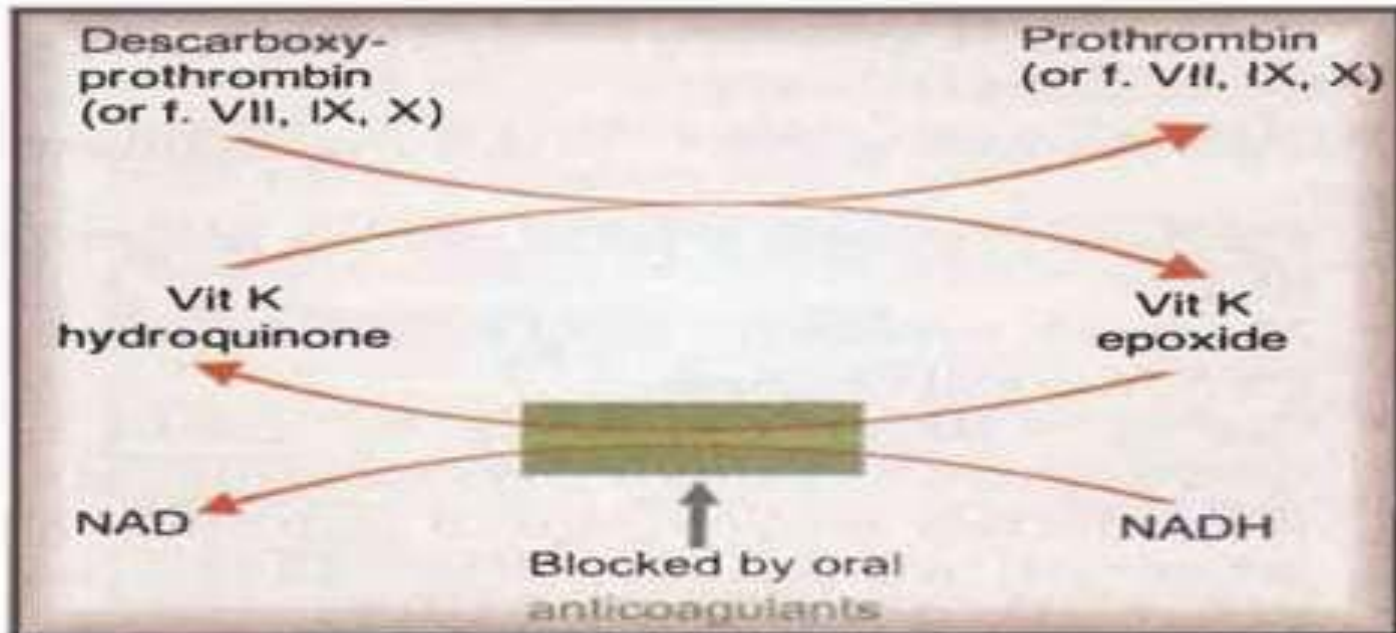
- **K** derived from the German word **KOAGULATION**
- Two naturally occurring forms :
 - Plants synthesize phyloquinone – Vitamin K₁
 - Bacteria synthesize menaquinone-3 – Vitamin K₂
- RDA- Males- 120µg/d, Females- 90µg/d, Children 30-50µg/d

SOURCES

- ✓ Vegetable oils- Olive oil, Soybean oil
- ✓ Almonds
- ✓ Peanuts
- ✓ Spinach
- ✓ Soybean
- ✓ From bacteria in intestine

FUNCTIONS OF VITAMIN -K

- ✓ Helps in clotting .
- ✓ Assist in bone mineralization.



VITAMIN K DEFICIENCY

Risk Factors -

- ✓ Common in new borns.
- ✓ Chronic small intestinal diseases with biliary obstruction or small bowel resection.
- ✓ Due to broad spectrum antibiotic therapy.
- ✓ Due to malabsorption syndrome.
- ✓ Deficiency may appear in infants resulting Intracranial, GI and Skin bleeding
- ✓ Patient on anticoagulant therapy.

Treatment

- Prophylactically 0.5 to 1 mg i.m at delivery to newborns
- For Treatment in Adults- 10 mg i.m
- For patients with chronic malabsorption- 1-2 mg/d orally or 1-2 mg per week i.m

WATER-SOLUBLE VITAMINS

VITAMIN C

- Active form- L- ascorbic acid.
- RDA-
 - Adult Males- 90mg/d
 - Adult Females- 75mg/d
 - Children- 15-25mg/d
 - Pregnant and Lactating mothers- 120mg/d

SOURCES

- Indian Gooseberry/Amla(Richest Source)
- Vegetables
- Tomato
- Sweet potato
- Citrus fruits
- Orange
- Lemon

FUNCTIONS OF VITAMIN C

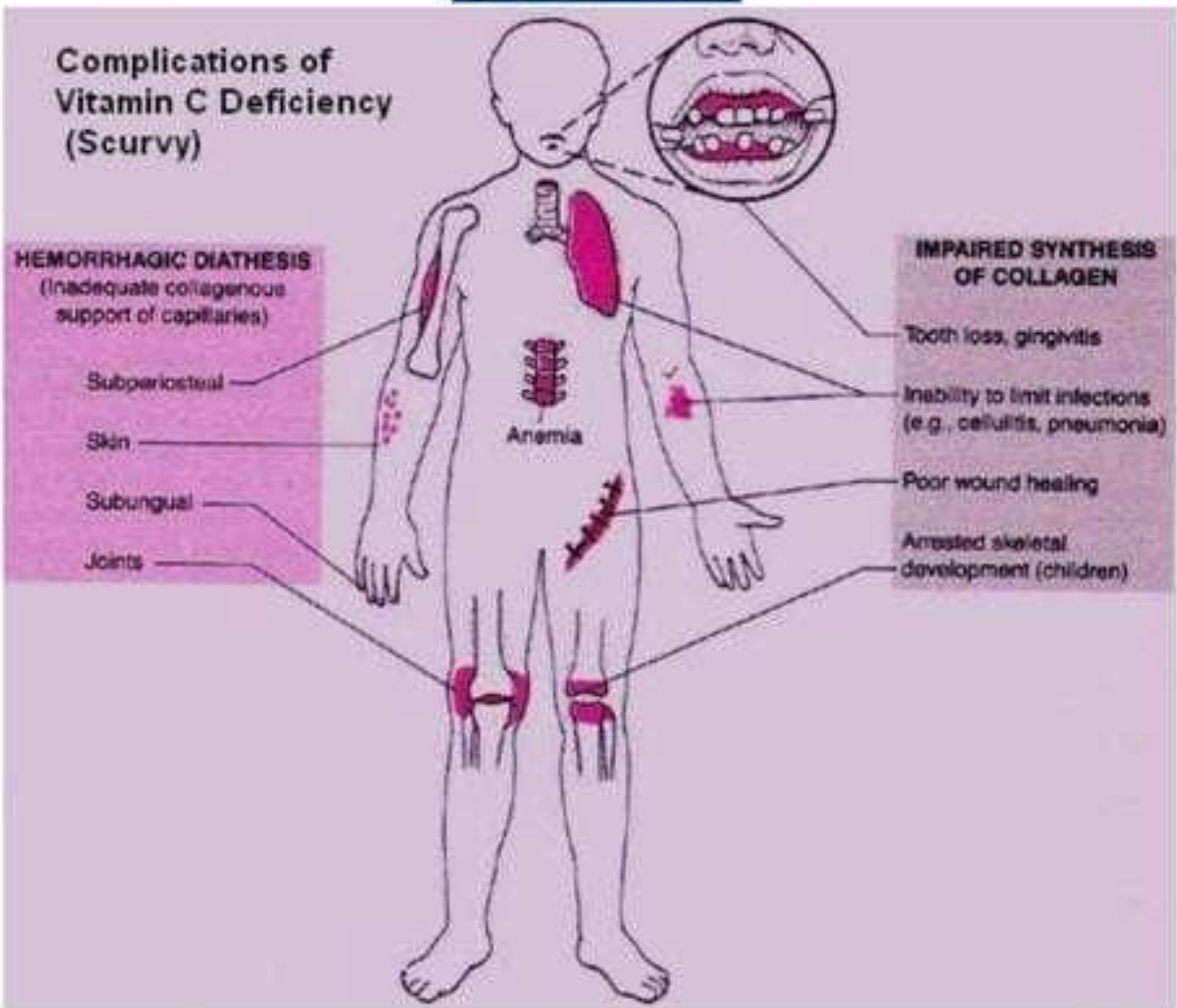
- **Collagen synthesis.**
- **Helps body to fight against infections.**
- **Antioxidant activity.**
- **Aids in the prevention of heart disease and cancer.**

VITAMIN C DEFICIENCY

- ✓ Scurvy(impaired formation of mature connective tissue)
- ✓ Skin Bleeding(petechiae, ecchymoses)
- ✓ Bleeding into Joints(haemarthrosis), Peritoneum & Pericardium
- ✓ Slow healing of wound and fractured bone.
- ✓ Fatigue and joint pain.
- ✓ Impaired Bone growth in Children.

SCURVY

Complications of Vitamin C Deficiency (Scurvy)



Treatment

- Daily administration of 200mg/d until symptoms of deficiency are relieved
- High dose treatment i.e. 1-2 g/d decreases symptoms and duration of upper respiratory tract infections.

VITAMIN B

- Group of eight water-soluble vitamins :
 - Thiamine
 - Riboflavin
 - Niacin
 - Pyridoxine
 - Cobalamin
 - Biotin
 - Pantothenic acid
 - Folic acid

VITAMIN B₁-THIAMINE

Active form- Thiamine pyrophosphate

Sources-

- ✓ Yeasts
- ✓ Pork
- ✓ Beef
- ✓ Whole Grains
- ✓ Nuts

RDA- Adults- 1.2 mg/d, Children- 0.6 mg/d

Pregnancy and Lactation- 1.4 mg/d

FUNCTIONS OF THIAMINE

- **ATP production.**
- **Peripheral Nerve Conduction.**

VITAMIN -B1 DEFICIENCY

- **BERI-BERI.**
- **WERNICKE –KORSAKOFF SYNDROME.**
- **Muscle weakness and wasting**
- **Ophthalmoplegia**

RISK OF THIAMINE DEFICIENCY

- **Excessive loss: hemodialysis and diuretic therapy.**
- **Chronic alcoholism.**

Dry & Wet Beri-Beri

Dry Beri-Beri	Wet Beri-Beri
No Edema	Pitting Edema on Trunk, Limbs and Face
Progressive Wasting of Muscles	Tachycardia, Laboured Breathing
Numbing and weakening of Extremities	Symptoms similar to Congestive Heart Failure
Slowly Progressive Course	Rapid Deterioration and Fatal Circulatory Collapse
	Responds rapidly to Vitamin B1 Supplements

Wernicke-Korsakoff Syndrome

- Wernicke's Encephalopathy-
 - G- Global Confusion
 - O- Ophthalmoplegia & Horizontal Nystagmus
 - A- Ataxia
- Wernicke's-Korsakoff Syndrome-
 - Above symptoms with:
 - Confabulatory Psychosis
 - Loss of Memory

Treatment

- In Acute Thiamine Deficiency-200mg of Thiamine i.v three times a day until improvement of acute symptoms.
- Oral Thiamine 10mg/d given until complete recovery.

VITAMIN B₂-RIBOFLAVIN

- Active Form- Flavin Mononucleotide(FMN)
Flavin Adenine Dinucleotide(FAD)
- RDA- Adult Males- 1.3 mg/d
Adult Females- 1.1mg/d
Children- 0.6 mg/d
Pregnant and Lactating Females- 1.6mg/d

SOURCES

- Eggs.
- Meat.
- Leafy green vegetables.
- Milk and other dairy products.
- Cereals

FUNCTIONS OF RIBOFLAVIN

- **Carbohydrate ,fat and protein metabolism.**
- **Energy Production.**
- **Plays a role in detoxification of drugs**
- **Maintenance of good vision ,skin ,nails.**

RIBOFLAVIN DEFICIENCY

- ✓ Magenta Tongue.
- ✓ Angular Stomatitis.
- ✓ Dermatitis and Cheilosis.
- ✓ Cracks and sores in mouth and lips.

VITAMIN B₃ - NIACIN

➤ Active form:

Nicotinamide Adenine Dinucleotide(NAD)

Nicotinamide Adenine Dinucleotide

Phosphate(NADP)

➤ RDA- Adult Males- 16mg/d

Adult Females- 14 mg/d

Children- 8mg/d

Pregnant and Lactating Females- 18mg/d

SOURCES

- Meat.
- Green leafy vegetables.
- Cereals.
- Beans.
- Milk.
- Eggs.

FUNCTIONS OF NIACIN

- **Energy production.**
- **Improves circulation.**
- **Maintenance of skin and tongue.**
- **Maintenance of nervous system.**

VITAMIN B₃ DEFICIENCY

✓ Pellagra –

Characterised by 4D's

Diarrhoea

Dermatitis

Dementia

Death

Casal's Necklace- Pigmented and scaling rash forming a ring around sun exposed area of neck

✓ Treatment- 100-200mg of nicotinamide 3 times a day for 5 days

VITAMIN B₅-PANTOTHENIC ACID

FUNCTIONS

- Produces energy.
- Fatty Acid Metabolism

SOURCES

Fruits ,meats, poultry ,legumes, yeast.

VITAMIN B₆-PYRIDOXINE

Active Forms:

Pyridoxine , Pyridoxal , Pyridoxamine.

RDA- Adults- 1.3 mg/d

Children- 0.6 mg/d

Pregnant & Lactating females- 2.0 mg/d

SOURCES

Meat

Legumes & Nuts

Wheat Bran

FUNCTIONS OF VITAMIN B₆

- **Production of red blood cells.**
- **Nervous system function.**
- **Immunity.**
- **Maintaining proper balance of sodium and phosphorous.**

DEFICIENCY OF VITAMIN B₆

- Peripheral Neuropathy and Depression
- Microcytic Hypochromic Anemia
- Loss of muscle control, muscle weakness, cramps and numbness
- Hyperhomocysteinemia and Cardiovascular Risk

Treatment of deficiency- 50mg/d until resolution of symptoms

VITAMIN B₇ - BIOTIN

SOURCES

- Meat
- Egg yolk
- Soyabean
- Yeast

RDA- Adult Males & Females- 30µg/d

Children- 12 µg/d

FUNCTIONS OF VITAMIN B₇

- **Role in Gluconeogenesis**
- **Fatty Acid synthesis.**
- **In gene expression.**

VITAMIN-B₇ DEFICIENCY

- ✓ Nausea, Anorexia, scaling seborrheic erythematous rash around eyes, nose and mouth.
- ✓ In infants- Alopecia, Rash involving Ears and hypotonia.

Treatment of deficiency- 10mg/d of biotin

VITAMIN B₉-FOLIC ACID

Active form- Polyglutamate forms of Tetrahydrofolate

SOURCES

- ❖ Liver, Yeast
- ❖ Spinach & other green leafy vegetables
- ❖ Nuts

RDA- Adult Males & Females- 400 µg/d
Pregnant & Lactating Females-500 µg/d
Children- 200 µg/d

Functions & Deficiency

Functions of Folic Acid-

DNA and RNA replication

Deficiency Symptoms-

- Megaloblastic Anaemia.
- Atrophic Glossitis
- Depression

Treatment – Oral doses of 5-15 mg/d for 4 months

During Pregnancy- 500µg/d to prevent Neural Tube Defects

VITAMIN B₁₂- COBALAMIN

- Active Form- Methylcobalamine and Adenosylcobalamine
- Sources-
Meat, Fish, Egg & Dairy Products
(No known plant source)
- RDA- Adult Males & Females- 2.4µg/d
Pregnant and Lactating Females- 2.8µg/d
Children- 1.2µg/d

VITAMIN B₁₂- COBALAMIN

Total Body stores of Cobalamine- 2 to 3 mg

FUNCTIONS

- Proper nerve function.
- Production of red blood cells.
- DNA replication.
- Metabolism of fats and proteins.

VITAMIN- B₁₂ DEFICIENCY

- ✓ Megaloblastic Anemia.
- ✓ Loss of Vibratory and Position Senses
- ✓ Abnormal Gait
- ✓ Dementia
- ✓ Loss of Bladder and Bowel Control

Treatment

- ❑ Six intramuscular injections of 1000µg of Hydroxocobalamin at 3 to 7 days interval to replenish body stores.

- ❑ For maintenance therapy- 1000µg of Hydroxocobalamin every 3 months

THANK YOU