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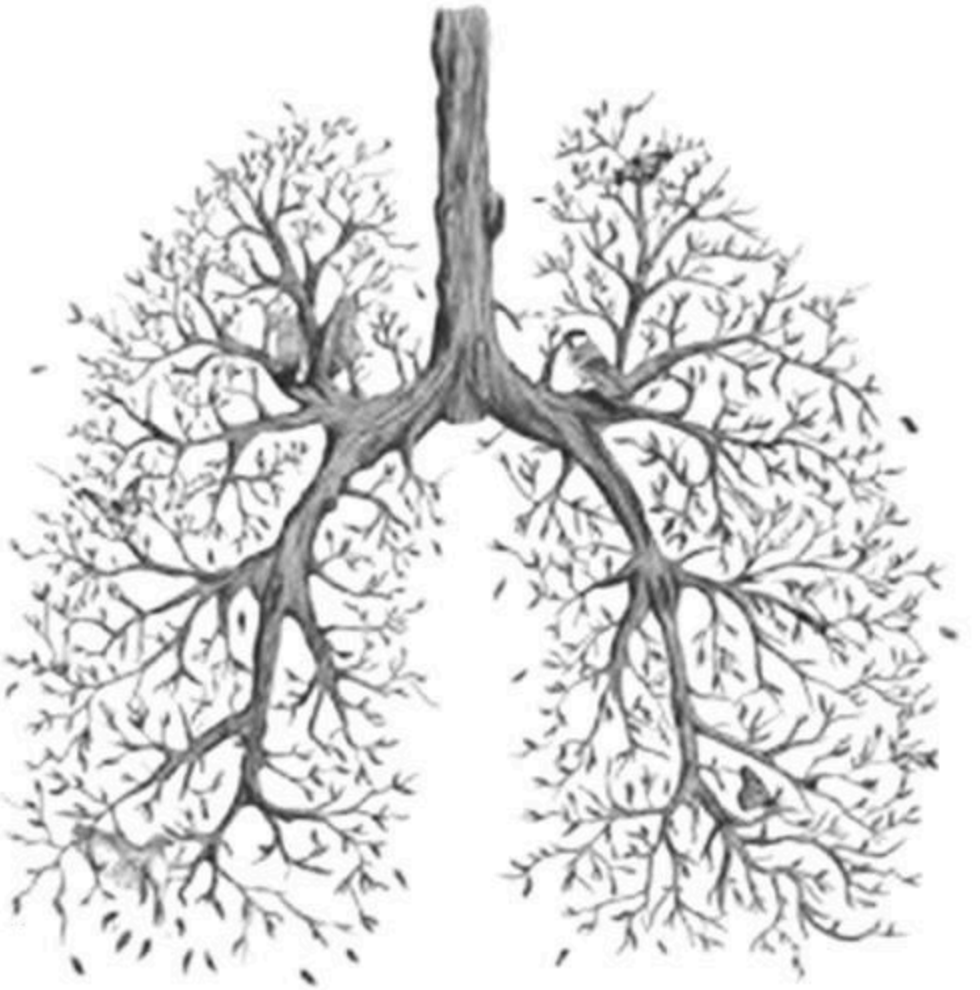
Community Medicine



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Lecture#: 1st week notes (1-3)
Doctor: Ahmad Al- Bataineh
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The Nutrients and Their Metabolism

Nutrition definition

"The science/study of nutrients (that come from food), their action, interaction, and balance in relation to health and disease; and the process by which the organism (body) ingests, digests, absorbs, transports, utilizes and execretes food substances."

What do we mean by nutrients: Carbohydrates, proteins, fat,..etc.

Background definitions:

- **Nutrients**: "Chemical substances in food that nourish the body by providing energy, building materials, and factors to regulate needed chemical reactions."
- **Essential nutrients**: Must be provided by food because the body does not produce them in sufficient quantities or can not make them at all.
- **Nonessential nutrients**: Healthy, well-nourished bodies can make them in sufficient quantities to satisfy their needs.

-Nutrients: Provide energy, building materials and factors to regulate needed chemical reactions.
-All chemical reactions in the body need some of these nutrients such as: minerals, which regulate different metabolic processes.
-Essential nutrients: Important, vital, without them, the body cannot survive. The body either provides them in small amounts or cannot make them at all thus, they must be provided by food.
Example on essential nutrients: The 9 essential amino acids.
-Nonessential nutrients: from proteins the body can manage and synthesize anything and we will manage to have nonessential amino acids. (The body can synthesize and build up these materials to satisfy the body's needs)

Functions of nutrients in food:

a. Provide energy sources

b. Build tissue

c. Regulate metabolic processes

What are the functions of these substances in food?
-Provide energy sources.
- Build tissues and cells in our body.
- Regulate metabolic processes.
Those nutrients help in regulating metabolic processes such as glycolysis, gluconeogenesis, ..etc.

Essential Nutrients cont'd:

- The essential nutrients are:
- Some forms of carbohydrate (glucose)
- Certain constituents of fat [the essential fatty acids: linoleic acid (omega-6) and linolenic acid (omega-3)]
- Certain constituents of protein (the essential amino acids such as lysine, histidine, etc)
- 15 vitamins
- About 25 minerals
- Water

What are these essential nutrients that the body should take with food:
- Glucose is the essential carbohydrate that the body needs to have energy. All food should be transformed into glucose because the glucose is the first thing that enters the blood.
- Linoleic acid (omega-6) and linolenic acid (omega-3).
-Essential amino acids (9 types of essential amino acid that we need to take daily such as lysine, histidine, etc.
-15 vitamins.
-25 minerals.
- Water (is one of these essential nutrients).

Six categories of nutrients

1. **Carbohydrates**: contain carbon, hydrogen, and oxygen combined in small molecules called sugars and large molecules represented mainly by starch.
2. **Lipids (fats and oils):** contain carbon, hydrogen, and oxygen as do carbohydrates, but the amount of oxygen is much less. Triglyceride is the main form of food fat.
3. **Proteins:** contain carbon, hydrogen, and oxygen, plus nitrogen and sometimes sulfur atoms arranged in small compounds called amino acids. Chains of amino acids make up dietary proteins.
4. **Vitamins: a**re organic compounds that serve to catalyze or support a number of biochemical reactions in the body.
5. **Minerals:** are inorganic elements or compounds that play important roles in metabolic reactions and serve as structural components in body tissues such as bone.
6. **Water:** is vital to the body as a solvent and lubricant and as a medium for transporting nutrients and waste.

- Fats are divided into:
  - Saturated fats by which we need to get 10% daily from our food, but if we want a healthy diet it should be 7%. Saturated fats include fat animals.
  - Monounsaturated: we need to get 10% daily from our food.
  - Polyunsaturated: we need to get 10% daily from our food.

**So total fats percentage needed daily is 30%.

-If we have deficiency in proteins, we will develop sometimes diseases such as: protein energy malnutrition.
-Vitamins (organic chemical substances) are important to the body because they participate in different chemical reactions in the body.
-Minerals (inorganic chemical substances): Calcium participates in bones formation.
-Water: Is an international solved and lubricant.
-You need to know those 6 categories of nutrients.

Nutrients are classified into :

- A. Macronutrients (carbohydrates, fats, and proteins).
  1. Provide calories for energy
  2. Needed in large quantities
- B. Micronutrients (vitamins, minerals, and water).
  1. Needed in smaller amounts

Nutrients are classified into:

1) Macronutrients: big molecules.
   - They provide calories for energy and thus they are needed in large amounts.

2) Micronutrients: tiny, small molecules.
   - Needed in smaller amounts.
   - We measure them in micrograms not in kilograms.

**Pay attention to their differences as they doctor kept repeating the differences between Macronutrients

And Micronutrients.

Dietary guidelines for the population

- Eat a variety of foods.
- Maintain a healthy weight.
- Choose a diet low in fat, saturated fat, and cholesterol.
- Choose a diet with plenty od vegetables, fruits, and grains.
- Use sugars only in moderation.
- Use salt and sodium only in moderation.

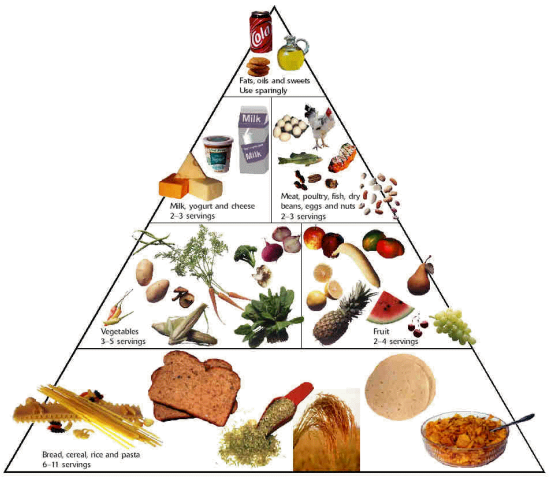
Dietary guidelines were set up by nutritionist to allow the population to eat balanced diet.
**Note that these are advisory guidelines, you can either follow them or not.

1) Eat variety of foods (different kinds of foods: vegetables, fruits, **...**etc)

2) Maintain a healthy weight: this is our problem nowadays to maintain a healthy weight in all age groups.
BMI= weight (kg)/height^2(m^2)
BMI is divided into:
-Underweight: below 18.5
-Normal weight: 18.5 -24.9
-Overweight: 25 – 29.9
-Obesity: 30 and above.

Energy we consume should be equal to the energy we take through food to maintain a healthy weight.

3) Our diet should be low in saturated fats and cholesterol.
   Cholesterol should not exceed 300 mg daily.
4) Moderation in using salts and sugars.
   Sugars, salts and white flour are called the 3 poisons; the higher their concentration in our food, the higher we get risk of having diseases.



Other than the mentioned recommendations, scientists also came up with food guide pyramid, which has a base of grains (11 servings), then vegetables and fruits, then dairy and meat products and at the top we have fats.
The most important component of food pyramid is its base which is grains, wheat, .. etc.

**Note that this image is not present in the slides however I added it to make it easier for you to understand what's being said.

Components of a nutritional assessment

- 1. Historical data: Medical history and diet history (24 hour recall, FFQ).
- Anthropometric measurements [height, weight, body mass index (BMI), waist circumference, hip circumference, etc..].
- Clinical assessment (physical examinations).
- Biochemical analyses (laboratory).

Components of nutritional assessment: (Those assessments are needed to tell whether a person eats a healthy diet or not)
1) Historical Data:
-Diet history: what you eat in 24-hour recall.
-Food frequency questionnaire: repetition of food during a week for an example, and what you eat on breakfast, lunch and dinner.
2) Anthropometric measurements: Height, weight, BMI, waist circumference (in men should not exceed 102 cm and women shouldn't exceed 88 cm), hip circumference...etc.
3) Clinical assessment (physical examination): doctor examines the skin any changes in the color, presences of ulcers, shortage of certain minerals, vitamins..etc.
4) Biochemical analyses: measuring protein level, RBCs in the blood,..etc.

Carbohydrates are classified into:

- Monosaccharides are seldom found free in nature and are the simplest form of carbohydrate.
- Disaccharides and polysaccharides consist of monosaccharides linked together.
- Also carbohydrates are classified into simple and complex carbohydrates.

Carbohydrates are classified into:
-Monosaccharaides, which are represented mainly by glucose.
-Disaccharides and polysaccharides.
-Oligosaccharides.

Carbohydrates can also be classified into simple and complex.

**Examples on monosaccharaides and disaccharides:

Monosaccharides

- Glucose
- Fructose
- Galactose

Disaccharides

- Sucrose
- Lactose
- Maltose

Sweetness of Sugars

Sugar or Sugar Product	Sweetness Value
Levulose, fructose	173
Invert sugar	130
Sucrose	100
Glucose	74
Sorbitol	60
Mannitol	50
Galactose	32
Maltose	32
Lactose	16

Sweetness of Artificial Sweeteners

Artificial Sweeteners	Sweetness Value
Cyclamate (banned in U.S.)	30
Aspartame (NutraSweet)	180
Acesulfame-K (Sunette)	200
Saccharin (Sweet'n Low)	300
Sucralose (Splenda)	600
Alitame (approval pending)	2000

-Glucose has a sweetness value of 74.
**Note: These tables are not for memorization.

Oligosaccharides

- Polymers containing 2 to 20 sugar molecules
- Readily water soluble and often sweet

Polysaccharides

- Amylose
- Amylopectin
- Resistant starch
- Dextrins
- Glycogen (animal carbohydrate)

**The doctor mentioned every single detail included in these two slides so make sure you know them.

Dietary Fiber and Functional Fiber

- Cellulose
- Beta-glucans
- Chitin and chitosan
- Hemicellulose
- Pectins, gums, and mucilages
- Fructans
- Algal polysaccharides
- Lignin

Fibers are from plants and are important for the GI tract.
These are the components of the fibers as written in the slides. Those are <u>complex carbohydrates.</u>

Role of Fiber in Digestion and Absorption

- Increase fecal volume
- Decrease GI transit time
- Slowed or decreased nutrient absorption
- Bind cholesterol and minerals
- Modify serum lipid concentrations
  - Short-chain fatty acids

Importance of fibers:
-Decrease the chance of getting constipation.
-Dark bread contains fibers not the white bread. Also, some fruits and vegetables contain fibers.
-The more you eat grains, the more you have fibers and the more your body benefits more from these fibers.
-Decrease GI transit time: if there's a poison in the food, the longer it stayed in our intestines, the more damage it causes to our body. So fibers decrease the transit time and thus fibers are considered as anti-carcinogenic.
-Decrease nutrient absorption; like sugar, it decreases sugar absorption thus decreases sugar levels in the blood. Also, it decreases the absorption of cholesterol thus decrease its level in the blood.
**Those roles are VERY important.

Glycemic Index

- Relative ability of different dietary carbohydrates to raise blood glucose levels
- Advantages of foods with low glycemic index (GI)

Glycemic Index: How much the nutrients we eat excrete sugar in the blood.
-The lower the glycemic index the better it is for our body especially for diabetic patients who need food with LOW glycemic index.

Lipids

- Functions
  - Energy (9 kcal/g)
  - Organ positioning, protection
  - Fat-soluble vitamins and phytochemicals

-1 gram of **fats** gives **9** kcal of energy.
-1 gram of **proteins** or **carbohydrates** gives **4** kcal of energy.
-1 gram of **alcohol** gives **7** kcal of energy.
**Make sure you memorize the above numbers.
-Lipids help in providing us with fat-soluble vitamins.
-Vitamins are divided into: lipid-soluble vitamins and water-soluble vitamins.

Fatty Acids

- Saturated (SFA)
- Monounsaturated (MFA)
- Polyunsaturated (PUFA)
- Location of double bonds; how named:
  - Omega-6
  - Omega-3
- Essential fatty acids

-Fatty acids are divided into:
1) Saturated fatty acids
2) Monounsaturated fatty acids
3) Polyunsaturated fatty acids

-Fatty acids are divided according to the location of the double bonds into:
1) Omega-6
2) Omega-3

-Essential fatty acids are: linoleic acid (omega-6) and linolenic acid (omega-3).
-P/S is the ratio of polyunsaturated fatty acid to the ratio of saturated fatty acid in our diet.
-P/S should be closer to 1 for a healthy diet; which means that the polyunsaturated and monounsaturated fatty acids should be higher than the saturated fatty acids.

Trans-Fatty Acids

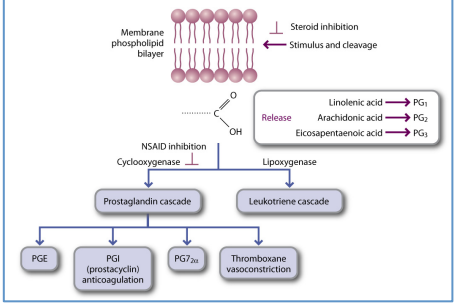
- *Trans* versus *cis* format
- Sources of *trans*-fatty acids
  - Partially hydrogenated margarine, shortening, commercial frying fat, high-fat baked goods, salty snacks
- Negative health effects

The doctor didn't emphasize a lot about these points because he considered that we took them in biochemistry.

Types of Lipids

- Triglycerides
- Phospholipids (e.g., lecithin)
- Sphingolipids, alcohols, waxes, isoprenoids, and steroids (including cholesterol)
- Glycolipids
- Synthetic lipids (MCT, structured lipids, fat replacers)

Other Lipid Issues: Eicosanoid Synthesis



-The doctor is just reminding us with types of lipids.

-Other lipid issues (the doctor won't be asking us about them).

-Eicosanoids are important for the heart as they protect the heart muscle from having myocardial infarction.

Alcohol

- Toxic substance
- 7 kcal/g
- Effects on drug metabolism
- Cirrhosis of the liver

Alcohol:
-Is a toxic substance.
-Gives 7 kcal/g.
-Causes liver cirrhosis.

Amino Acids and Protein

- Essential amino acids
- Nonessential amino acids

The doctor said that we are not required to know the structures of amino acids. So slides #29- #31 are not required for the exam.

Dietary Protein Quality

- Limiting amino acid
- Net protein utilization
- Protein digestibility corrected amino acid score (PDCAAS)
- Denaturation
- Vegetable vs animal protein
- Food processing
- Complementary proteins

-The higher the protein content in our diet especially with the high protein quality, the better our diet is.
-Limiting amino acid: if certain amino acids were reduced, the quality of protein becomes not good and thus the body cannot benefit from these proteins.
-We should eat all types of amino acids: essential and nonessential amino acids.
-Lysine is a limiting amino acid.
-Net protein utilization: how the body can utilize the protein and benefit from it.
-Protein digestibility: ability for the body to digest the protein.
-Denaturation of proteins.
-Protein source from plants as vegetables or animals.
-Food processing
-Complementary proteins.
**All these are important for proteins and most important, we care about the quality of the proteins.

Vitamins

- Vital dietary substances needed to regulate the metabolism, normal growth and body functions.
- Vitamins are organic compounds.

Make sure you know ALL the details mentioned in this slide.

Vitamins are classified into two groups according to their solubility:

Fat-Soluble Vitamins	Water-Soluble Vitamins
■ Vitamin A	■ Thiamin
■ Vitamin D	■ Riboflavin
■ Vitamin E	■ Niacin
■ Vitamin K	■ Pantothenic acid
	■ Vitamin B_6
	■ Folate
	■ Vitamin B_{12}
	■ Biotin
	■ Vitamin C

Vitamins are classified into:
1) Fat-soluble vitamins: Vitamin A, D, E, K (are grouped into a word Vitamin KADE)
2) Water-soluble vitamins: Thiamin (B1), Riboflavin (B2), Niacin, Pantothenic acid (B5), Vitamin B6, Folic acid, Vitamin B12 (it's related to pernicious anemia), Biotin and Vitamin C (it's related to scurvy disease).
**You need to know from now on the type of vitamins and their deficiencies.

Vitamin A

- Retinol (animal sources) and carotenoids (plant sources)
- Absorption, transport, and storage
- Essential roles in vision, normal cell differentiation, and cell surface function, growth and development, immune functions, and reproduction
- DRIs

**You are required to know the scientific name of the vitamin, its resources and its deficiency.
Vitamin A:
-Scientific name: Retinol
-Sources: Animals and plants (carotenoids present in carrots, and possibly yellow vegetables.)
-Essential Roles: vision, normal cell differentiation especially in respiratory system, growth and development, immune functions (vitamin A deficiency increases the risk of having infections), and reproduction.
-DRI: Dietary Reference Intake (how much we need vitamin A in our diet daily).
-There are several international tables for males, females, ages,..etc.
-In general, we all need **1000** International Units or RE Unit (Retinol Equivalent) in our daily diet.

Sources of Vitamin A

Vitamin A Content of Selected Foods

Food	RAE*
Turkey, 1 cup	15,534
Sweet potato, baked, 1 small	7,374
Carrots, raw, 1 cup	5,553
Spinach, cooked, 1 cup	6,882
Mixed vegetables, frozen, 1 cup	2,337
Cantaloupe, 1 cup	1,625
Peaches, canned, 1 cup	283

Sources of Vitamin A:
-Foods that are yellow or green in color mostly are rich with vitamin A: like pumpkin, peaches, sweet potato, and carrots.

Vitamin A Deficiency

- Blindness in the developing world
- Night blindness
- Failures in systemic functions
- Xerophthalmia, hyperkeratosis, and keratomalacia
- Follicular hyperkeratosis
- Increased risk for infection

Vitamin A Deficiency:
-**Blindness** in developing world like Africa and Asia.
-Night blindness (inability to see in the dark)
-Failure in systemic functions.
-Xerophthalmia, hyperkeratosis and keratomalacia of the eye (inflammation of the eye).
-Follicular hyperkeratosis in skin (thick layer of skin especially in foot).
-Increased risk for infection.
-Affects the reproductive system especially in pregnant women.

Signs of Vitamin A Toxicity

- Serum vitamin A of 75 to 2000 RAE/100 ml
- Bone pain and fragility
- Hydrocephalus and vomiting (infants and children)
- Dry, fissured skin
- Brittle nails
- Hair loss (alopecia)
- Gingivitis
- Cheilosis
- Anorexia
- Irritability
- Fatigue
- Hepatomegaly and abnormal liver function
- Ascites and portal hypertension

-You will not be asked about the signs of Vitamin A toxicity. You are only required to know that you need 1000 IU of vitamin A daily.

Vitamin D (chole-calceferol)

- Production in skin when exposed to UV irradiation
- Absorption, transport, and storage
- Functions as a steroid hormone
- Maintains calcium and phosphorus homeostasis
- DRIs

-Vitamin D:
-Scientific name: Chole-calceferol
-UV radiation changes pro-vitamin D to vitamin D and thus cells will produce vitamin D in the body.
-It's advised to expose infants to sunlight daily for 15 minutes, in order to be able to benefit from vitamin D.
-Also adults are required to be exposed to sunlight.
-Functions as a steroid hormone.
-Maintains calcium and phosphorus homeostasis. (Vitamin D controls calcium and phosphorus metabolism and thus deposition of calcium and phosphorus is connected to vitamin D)
-Normal levels of vitamin D maintain strong structure of our bones.
-Imbalance levels of vitamin D ---> not strong bones.
-DRIs not required to memorize.

**Vitamin D metabolism and function (slide 41) is not required.

Vitamin D Deficiency

- Rickets in children
- Osteomalacia in adults
- Osteoporosis

Vitamin D Deficiency:
-Causes Rickets in **children** (bowed legs).
-Osteomalacia in **adults**. (Ages: 20-40)
-Osteoporosis (in **women above 45** years (after menopause))
**When we mention osteoporosis, we mainly target women because it mostly attacks women while it's in low % in men.

**Make sure you know vitamin D deficiency in different age groups.
** Slide 44 is not required (signs of vitamin D toxicity).

Vitamin E (tocopherol)

- Protection against damage by reactive oxygen species
- Tocopherols and tocotrienols
- Absorption, transport, and storage
- Lipid-soluble antioxidant
- DRIs

Vitamin E:
-Scientific name: tocopherol
-Protects against damage by reactive oxygen species.
**Anti-oxidant substances (get rid of free radicals):

1) Vitamin A
2) Vitamin E
3) Vitamin C
4) Selenium (present in plants and soil)

- Present in nuts.

Vitamin E deficiency

- Breakdown of red blood cells
- Anemia

Vitamin E deficiency:
-Causes hemolysis (breakdown of RBC)
-Causes anemia **indirectly**.

Vitamin K

- Blood clotting and bone formation
- Phylloquinones and menaquinones
- Absorption, transport, and storage
- DRIs
- Best sources are green leafy vegetables; smaller amounts in dairy products, meats, eggs, fruits, and cereals

Vitamin K:
-Scientific name: Quinone.
-It's a blood-clotting factor.
-Important for bone formation.
-Sources: **Vegetables especially green leafy vegetables**, dairy products, fruits, meat and cereals.

Vitamin K Deficiency

- Hemorrhage
- Fatal anemia
- Hemorrhagic disease in the newborn
- Hip fracture in older adults
- Bleeding tendencies

Vitamin K deficiency:
-Mainly related to **hemorrhage** or **bleeding** tendency.

Water-soluble Vitamins

Thiamin

- Coenzyme in carbohydrate metabolism
- Normal growth
- Normal function of heart, nerves, and muscle
- Absorption, transport, and storage
- DRIs
- Richest sources are yeast and liver; cereal grains provide most in human diets
- Destroyed by heat, oxidation, and radiation; stable when frozen

Thiamin B1:
-An important coenzyme in carbohydrate metabolism (important for energy).
-Normal growth and function of the heart, nerves, and muscle.
-This vitamin is related mainly to the **heart** and **CNS**.
-Richest sources: Yeast, liver and cereal grains.
-Destroyed by heat, oxidation and radiation.
-Deficiency of Thiamin B1 causes **beriberi**.
-We have different forms of beriberi: dry, wet and infant forms.
-Beriberi causes edema in the legs and is reflected on the heart (causes heart failure) and on the CNS.

**You will not be asked about the details mentioned in slides (50-52).

Riboflavin

- Essential for metabolism of carbohydrates, amino acids, and lipids; supports antioxidant protection
- Absorption, transport, and storage
- DRIs
- Green leafy vegetables are rich sources; most comes from meat, dairy products, and fortified grains in American diet

Ribofalvin B2:
-Make sure you know all the details mentioned in the slide and forget about the DRIs.
-Source: Green leafy, meat, dairy products and fortified grains (grains that have added riboflavin by food industry).

Riboflavin deficiency

- Ariboflavinosis
- Wound aggravation
- Cracks at corners of the mouth
- Swollen red tounge
- Eye irritation
- Skin eruptions

Riboflavin deficiency:
Causes **Ariboflavinosis.**

-Symptoms of Ariboflavinosis:
-Wound aggravation.
-Cracks at corners of the mouth.
-Swollen red tongue.
-Eye irritation.
Skin eruptions.

Niacin

- Nicotinamide and nicotinic acid
- Essential for energy production and metabolism
- Biosynthesis (from tryptophan), absorption, transport, and storage
- DRIs
- Sources: lean meats, poultry, fish, peanuts, and yeasts

Niacin B3:
-Scientific name: Nicotinamide and nicotinic acid.
-We get it from an essential amino acid (tryptophan).
-Sources: lean meats (red meats), poultry, fish, peanuts and yeasts.

Niacin deficiency

- Pellagra is the four D syndrome:
  1. Dermatitis
  2. Diarrhea
  3. Dementia
  4. Death

Niacin deficiency:
-Causes **Pellagra**

-Pellagra syndrome is a four D syndrome:
1) Dermatitis.
2) Diarrhea.
3) Dementia.
4) Death.

Pantothenic Acid

- Critical roles in metabolism, integral part of coenzyme A: fat, cholesterol, and heme formation and amino acid activation.
- Absorption, transport, and storage
- DRIs
- Present in all plant and animal tissues
- Deficiency impairs lipid synthesis and energy production

Pantothenic Acid:
-Make sure you know all the details mentioned in the slide except DRIs.

Vitamin B_6

- Pyridoxine
- Metabolism of amino acids, neurotransmitters, glycogen, sphingolipids, heme, and steroids
- Absorption, transport, and storage
- DRIs
- Good sources include meats, whole grains, vegetables, nuts

Vitamin B6:
-Make sure you know all the details in the slide except DRIs.
-Main source: red meats.

Vitamin B6 deficiency

- Anemia
- CNS: hyperirritability, convulsions, neuritis

Vitamin B6 deficiency:
-Causes **Anemia**
-**CNS symptoms**: hyperirritability, convulsions and neuritis

Folate (Folic acid)

- Pteroylmonoglutamic acid
- Part of DNA
- Formation and maturation of red and white blood cells in bone marrow; single-carbon carrier in heme formation
- DRIs
- Rich sources include liver, mushrooms, and green leafy vegetables

Folic Acid:
-Important constituent of DNA.
-Formation and maturation of RBCs and WBCs in **bone marrow**.
-Rich sources: Liver, mushrooms and green leafy vegetables.

Folate Deficiency

- Impaired biosynthesis of DNA and RNA
- Certain type of anemia: Megaloblastic anemia (large immature red blood cells), macrocytic anemia
- Folate-responsive homocystinemia
- Neural tube defects (NTD).

Folic Acid deficiency:

-Impaired biosynthesis of DNA and RNA.
-Causes **megaloblastic/macrocytic anemia** (large immature RBCs)**.**
-Folate-responsive homocystinemia.
-NTD (neural tube defects in newborns).
Prevention of NTD: give 400 mg of folic acid before pregnancy.

Vitamin B_{12}

- Cobalamin: coenzyme in synthesis of heme for hemoglobin, normal red blood cell formation
- Absorption, transport, and storage
- DRIs
- Richest sources are liver, kidney, milk, eggs, fish, cheese, and muscle meats
- Not naturally found in plant foods

Vitamin B12:
-Scientific name: Cobalamin.
-Vitamin B12 contains Cobalt (Cobal----> from cobalt).
-Important for RBCs formation.
-Sources: **Animal sources** only. Not found in plant foods.

Vitamin B_{12} Deficiency

- Impaired cell division
- Megaloblastic anemia
- Neurologic abnormalities
- Pernicious anemia: B12 is necessary extrinsic factor that combines with intrinsic factor of gastric secretions for absorption.

Vitamin B12 deficiency:
-Impaired cell division.
-**Megaloblastic** anemia (like folic acid).
**Megaloblastic anemia could be caused by: Folic acid or Vitamin B12 deficiency.
-Neurologic abnormalities.
-B12 is an extrinsic factor, when we ingest it, it goes to the stomach. In the stomach, intrinsic factor combines with extrinsic factor in order to absorb B12.
If we stopped B12 absorption, pernicious anemia is formed (type of megaloblastic anemia).

Biotin

- Coenzyme A partner
- Synthesis of fatty acids
- Synthesis of amino acids and purines
- Carboxyl carrier; also has noncarboxylase roles
- DRIs
- Rich sources are milk, liver, egg yolk and a few vegetables
- Deficiency is rare: parenteral nutrition

Biotin:
-Make sure you know all the information in this slide.

Ascorbic Acid (Vitamin C)

- Vitamin C; oxidation-reduction reactions
- Intercellular cement substance, firm capillary walls and collagen formation
- Helps prepare iron for absorption and release to tissue for red blood cell formation
- Synthesis of collagen and carnitine and other metabolic reactions; antioxidant; promotes resistance to infection
- DRIs
- Best sources are fruits, vegetables, organ meats

Vitamin C:
-One of the most important water-soluble vitamins.
-Important for oxidation-reduction reactions.
-Anti-oxidant (scavenger of free-radicals).
-Important for firm capillary walls and collagen formation.
-Enhances iron absorption.
-Best sources: Citrus fruits, green vegetables and some organ meats.

Vitamin C Deficiency

- Easily destroyed by oxidation, lost in cooking water
- Scurvy (deficiency disease)
- Impaired wound healing; edema; hemorrhages; and weakness in bone, cartilage, teeth, and connective tissues
- Sore gums
- Anemia
- Wound healing, tissue formation
- Tendency to bruise easily

Vitamin C deficiency:
-Causes scurvy disease (sailors' disease).
-Scurvy causes:
-Impaired wound healing, edema, hemorrhages, and weakness in bone, cartilage, teeth and connective tissues.
-Sore gums.
-Anemia.
-Tendency to bruise easily.
**Most important thing to keep in mind, tendency to bleed especially in teeth and oral cavity occurs with vitamin C deficiencies.

Vitamin C Toxicity

- GI disturbances and diarrhea
- Possible role in gastric carcinogenesis
- Renal oxalate stones
- False-positive urinary glucose test

Vitamin C toxicity:
-GI disturbances and diarrhea.
-Role in gastric carcinogenesis.
-Causes kidney stones.

Choline

- Essential component of animal tissues
- Widely distributed in fat, in the form of lecithin, in eggs, soybeans, milk, etc.
- Supplemental choline successful in diminishing short-term memory loss associated with Alzheimer's disease

Carnitine

- Functions in the transport of long-chain fatty acids into mitochondria for oxidation as sources of energy
- Meats and dairy products are good sources
- Muscle weakness and hypoglycemia are symptoms of deficiency

myo-Inositol

- Provides structural support in membranes
- Source of arachidonic acid and important intracellular signals and secondary cell messengers
- Synthesized from glucose and also obtained from fruits, grains, vegetables, nuts, legumes, and organ meats

Ubiquinones

- Referred to as coenzyme Q_{10} (CoQ_{10})
- Function as essential components of the mitochondrial electron transport chain
- Function as a fat-soluble antioxidant
- Found in fish oils, nuts, fish, and meats

**The doctor only read these four slides and mentioned everything in them.

Minerals

- Minerals are inorganic elements or compounds that play important roles in metabolic reactions and serve as structural components in body tissues such as bones.
- Minerals cannot be manufactured in the body, they have to be provided with food.

Minerals:
-Are inorganic elements or compounds that play important roles in metabolic reactions and serve as structural components in body tissues such as bone (calcium and phosphorus are important in bone formation in 2:1 ratio 2 calcium to every 1 phosphorus).
-Minerals cannot be manufactured in the body; they have to be provided with food.

Mineral Classifications

- Macrominerals
- Microminerals
- Ultratrace minerals

Minerals are classified according to their needed amounts into:
1) Macrominerals (taken in milligrams amount).
2) Microminerals (taken in micrograms amount).
3) Ultratrace minerals (very little amounts).

Bioavailability of Minerals

- Reduced by formation of soaps, binding to free fatty acids, precipitation, mineral-mineral interactions, organic inhibitors such as phytates and oxalates, stress
- Enhanced by ascorbic acid (for nonheme iron), gastric acidity,

Make sure you know the details mentioned in this slide.

Calcium Metabolism

- Intestinal absorption
- Renal excretion
- Skin losses
- Serum calcium
- Blood calcium and parathyroid hormone
- Role of other hormones

Calcium metabolism:
-Absorption through the intestines.
-Excretion through the kidney or skin.
-Serum calcium present in the body with certain amounts, if increased or decreased, it could cause problems.
-Parathyroid hormone is affected by blood calcium concentration. Thus, parathyroid gland regulates calcium concentration in the body.
-Role of other hormones such as vitamin D steroids.

Functions of Calcium

- Acquire optimal bone mass and density
- Maintain bone health
- Transport functions of cell membranes
- Nerve transmission
- Regulation of heart muscle function
- Blood clotting
- Role in obesity

Functions of Calcium:
-Acquire optimal bone mass and density. When we want to test osteoporosis in females, we do it by measuring BMD (bone mass density) using DEXA machine.
- **Maintain bone health**.
-**Participates in nerve transmission**.
-Regulation of heart muscle function.
-**Blood clotting factor.**
-Role in obesity.

Sources of Calcium

- Yogurt
- Milk
- Cheese
- Small bones of sardines and
- Dark green leafy vegetables
- Molasses
- Clams and oysters
- Fortified foods

Sources of calcium:

Mainly dairy products
And dark green leafy vegetables.

Calcium Deficiency

- Lower peak bone mass
- Increased blood PTH levels leads to low bone mass
- Osteomalacia
- Chronic diseases, such as colon cancer, hypertension, osteoporosis

Calcium Deficiency:
-Lower peak bone mass.
-Increased blood PTH levels which leads to low bone mass.
(Increased blood Parathyroid Hormone levels means lower calcium levels thus low bone mass)
-Osteomalacia in adults.
-Chronic diseases such as colon cancer, hypertension and osteoporosis.

Phosphorus

- Absorption, transport, storage, and excretion
- DNA and RNA are phosphate based
- High-energy phosphate bonds in ATP and other cellular forms of energy
- Phospholipids
- Enzyme activation and buffer system
- Hydroxyapatite in bones and teeth

Phosphorus:
Make sure you know every detail in this slide.
-**Important for bones and teeth** like calcium**.**

Sources of Phosphorus

- Meat, poultry, fish, and eggs
- Milk and milk products
- Nuts and legumes
- Cereals and grains
- Food additives

Sources of phosphorus:
-Dairy products.
-Cereal and grains.
-Nuts.

Magnesium

- Absorption, transport, storage, and excretion
- Cofactor for more than 300 enzymes
- Neuromuscular transmission and activity
- Bone density

Magnesium:
-Cofactor for more than 300 enzymes.
-Neuromuscular transmission and activity.
-Has a role in bone density.

Sources of Magnesium

- Milk
- Bread
- Coffee
- Ready-to-eat cereals
- Beef
- Potatoes
- Dried beans and lentils

Sources of magnesium:

Milk, bread, potato, beef, dried beans and lentils.

Sulfur

- Constituent of three amino acids: cystine, cysteine, and methionine
- May be considered an antioxidant
- Essential component of three vitamins: thiamin, biotin, and pantothenic acid
- Food sources include meat, poultry, fish, eggs, dried beans, broccoli, and cauliflower

Sulfur:
-Constituent of some amino acids: cysteine and methionine.
-Maybe considered as an antioxidant.
-Important for 3 vitamins: thiamin, biotin and pentatonic acid.
-Sources: meat, poultry, fish, eggs, dried beans, broccoli and cauliflower.

Microminerals (Trace Elements)

- Essential to optimal growth, health, and development
- Exist in two forms
  - As charged ions
  - Bound to proteins or complexed in molecules

Microminerals (Trace Elements):
-Essential to optimal growth, health and development.
-Exist in two forms:
1) As charged ions like Fe+2
2) Bound to proteins or complex in molecules.
-Microminerals mainly are represented by iron.

Iron

- Heme vs nonheme iron
- Ferritin carries bound iron
- Ferric vs ferrous iron
- Role of transferrin
- Factors affecting bioavailability

Iron:
-We have two types of iron: Heme (RBCs production) and nonheme iron (binds to RBCs).
-Ferritin carries bound iron
-Ferric Fe+2 vs Ferrous Fe+3.
-Factors affecting bioavailability:
-Vitamin C enhances iron absorption while fibers in dark bread reduces iron absorption.

Functions of Iron

- Red blood cell function
- Myoglobin activity
- Numerous heme and nonheme enzymes
- Oxidation-reduction activity in respiratory gas transport and cytochrome activity
- Immune function and cognitive performance

Functions of Iron:
-Important in RBCs and in hemoglobin production, which is important to carry oxygen to our cells (heme (iron) + globin (protein)).
-Make sure you know the details mentioned in the slide.

Sources of Iron

- Liver
- Seafood
- Kidney, heart
- Lean meat, poultry
- Dried beans and vegetables
- Egg yolks
- Dried fruits
- Dark molasses
- Whole grain and enriched breads and cereals

Sources of Iron:
-Fortification of food (food enrichment of certain elements or vitamins)
-Make sure you go over all sources of Iron as the doctor mentioned them.

Iron Deficiency

- High-risk groups
- Hypochromic, microcytic anemia
- Caused by injury, hemorrhage, or illness, unbalanced diet
- Athletic amenorrhea

Iron Deficiency:
-Anemia
High-risk groups of having anemia: pregnant women, breast-feeding

women and children under 5 years old of age.
-Anemia caused by Iron deficiency is called: **Hypochromic, microcytic** anemia while the anemia caused by vitamin B12 and folic acid deficiency is called: **megaloblastic, macrocytic.**
**Iron deficiency anemia is caused by:
-Injury, hemorrhage or illness, unbalanced diet.
-Athletic Amenorrhea.

Iron Overload

- Major cause is hemochromatosis
- Hemosiderosis may lead to hemochromatosis
- Risks of iron supplements for older adults

-Iron overload:
If iron level in the body is increased it goes to the lungs and accumulates there (hemochromatosis or hemosiderosis).
-We shouldn't give iron supplements for elderly people if we suspect to have Iron overload.

Zinc

- Functions in association with more than 300 enzymes
- Synthesis or degradation of major metabolites
- Structural roles in proteins
- Intracellular signal in brain cells
- Transport processes, immune function, and genetic expression

Zinc:
-Zinc Deficiency causes cretinism; organs are not fully mature especially reproductive organs in children. So zinc deficiency causes growth retardation.
-Zinc affects taste, so zinc deficiency could result in not tasting certain food.

Sources of Zinc

- Met, fish, poultry
- Milk and milk products
- Oysters and other shellfish
- Liver
- Ready-to-eat fortified breakfast cereals
- Whole grain cereals
- Beans, nuts, soy products

Zinc Deficiency

- Decreased taste acuity
- Delayed wound healing
- Growth retardation
- Immune deficiencies
- Skin lesions

**The doctor went through the sources of zinc and emphasized the importance of zinc deficiency. So make sure you focus more on zinc deficiency and go through the sources of zinc.

Fluoride

- Beneficial to tooth enamel, prevention of dental caries
- Found in fluoridated drinking water, fluoridated toothpaste, foods and drinks made using fluoridated water
- Toxicity, fluorosis appears at daily doses of 0.1 mg/kg

Fluoride:
-Protective against dental caries.
-**High levels** of fluorides more than 1 ppm (parts per million) in water causes **dental fluorosis** (it' s yellow-dark pigments on the teeth).
-**Low levels** of fluorides lower than 1 ppm in water causes **dental caries** (deficiency).

Copper

- Component of many enzymes
- Ceruloplasmin
- Roles in mitochondrial energy production

-Plays role in mitochondrial energy production.

Copper:
-Copper with zinc form (copper-zinc superoxide dismutase enzyme which is important for heart muscle).
-Ceruloplasmin (transport of important elements).

Sources of Copper

- Shellfish
- Organ meats
- Muscle meats
- Chocolate
- Nuts
- Cereal grains
- Dried legumes
- Dried fruits

Sources of copper:
-Shellfish.
-Chocolate.
-Nuts.
-Muscle meats.
-Organ meats.
-Cereal grains.
-Dried fruits and legumes.

Iodine

- Synthesis of triiodothyronine (T_3) and thyroxine (T_4)
- Inhibited by goitrogens
- Selenium is important in iodine metabolism

Iodine:

-Is important for the synthesis of T3 and T4.
-Deficiency in Iodine causes **goitre** disease.

Sources of Iodine

- Iodized salt
- Seafood
- Content of cow's milk and eggs depends on the animal's diet
- Content of vegetables depends on soil
- Iodophors used in food processing

Sources of Iodine:
-Iodized salt.
-Seafood.

Iodine deficiency

- 1. Endemic goiter
- Cretinism
- Hypothyroidism
- Hyperthyroidism

Iodine deficiency:
1) Endemic goiter (disease is higher than normal).
2) Cretinism (growth retardation).
3) Hypothyroidism
4) Hyperthyroidism (thyrotoxicosis).

-Signs of thyrotoxicosis:
1) Exophthalmos.
2) Tremors.
3) Tachycardia.

Selenium

- Component of enzyme glutathione peroxidase (GSH-Px)
- Antioxidant and free radical scavenger
- Role in iodine metabolism
- Interaction with vitamin E

Sources of Selenium

- Brazil nuts
- Seafood
- Kidney, liver
- Meat, poultry

Selenium:
-Important anti-oxidant.

**Make sure you know all the details in those two slides.

Selenium deficiency

- Keshan disease: heart muscle failure and Cardiomyopathy.

Selenium Deficiency:
-Causes Keshan disease (only affects Chinese people).
-Keshan disease causes heart muscle failure and cardiomyopathy (cardiomyopathy especially in children).

Manganese

- Component of many enzymes, especially in mitochondria
- Activates many other enzymes
- Formation of connective and skeletal tissues
- Growth and reproduction
- Carbohydrate and lipid metabolism

Manganese:
-Make sure that you know the details mentioned in this slide.

Chromium

- Potentiates insulin action
- Possible glucose tolerance factor
- Possible role in regulation of gene expression

Chromium:
-Related to diabetes and insulin.

**Make sure that you know the details mentioned in this slide.

Molybdenum

- Role in enzymes that catalyze oxidation-reduction reactions
- Possible role in response of some asthmatics to sulfites
- Deficiency causes mental changes and abnormalities of sulfur and purine metabolism

Boron

- Essentiality not yet established
- Influences activity of metabolic enzymes and metabolism of several nutrients
- Associated with cell membranes

**The doctor went through these slides roughly.

Cobalt

- Component of vitamin B_{12} (cobalamin)
- Required for enzyme methionine aminopeptidase
- Macrocytic anemia

Cobalt:
-Component of vitamin B12.
-Required for enzyme methionine.
-Cobalt deficiency causes macrocytic/megaloblastic anemia (since it's a component of vitamin B12).

Focal Points

- The major nutrients with roles in the human body include energy-containing macronutrients (carbohydrates, lipids, protein and alcohol as well as the micronutrients (vitamins and minerals.)
- The indigestible food component, fiber is essential for health, especially related to the gastrointestinal tract and cardiovascular system, but 80% of Americans do not get enough fiber.
- Alcohol contains calories for heat but not for muscular work, and it impacts health positively in moderation and negatively in excess.
- Changing concepts regarding the structure, function, and utilization of nutrients in the body are important to keep in mind as they determine the impact of nutrient deficiencies or excesses on health and disease management.
- Miscellaneous trace elements exist in human tissues, especially in the skeleton, because of their abundance on the earth's surface; their essentiality in humans is not totally clear.

Things that tells you what to focus on throughout this whole topic.

This is the last page for nutrients and their metabolism topic.

Nutrition during infancy

Physiologic Development

- Length of gestation, the mother's pre-pregnancy weight, and the mother's weight gain during gestation determine an infant's birth weight
- After birth, the infant's growth is influenced by genetics and nourishment

Infant nutrition:
-Infancy starts from day 28 after birth till 1 year old of age.
-From 0-28 days of age is called neonates.
-Normal birth weight of babies should be 2.5 kg and above.
-Birth weight from 1.5 kg to 2.5 is called Low Birth Weight (LBW).
-Birth weight below 1.5 kg is called Very Low Birth Weight (VLBW).
-If birth weight above 5 kgs, it's considered abnormal. The doctor should ask the mother if she has diabetes or family history of diabetes, or the doctor asks about inborn errors of metabolism.
-Mother's weight before pregnancy and during pregnancy is of great importance to determine the infant birth weight.
-Prenatal clinic should give pregnant women 400 mg of folic acid in order to prevent having infants with NTD (neural tube defect).
-Nutrition is very important for infants after birth.

**The doctor skipped slides from 4-7, but you can find most of the needed information in the lines above.

Energy Requirements

- Infants adjust intake to meet energy needs
- Sensitivity to hunger and satiety cues
- Monitor gains in weight and length over time
- Formula-fed infants consume more kcals than breast-fed infants

Energy requirements:
-We should adjust energy intake for infants for infants' growth and development.
-Growth at infant age is the fastest type of growth.
-Infant is sensitive to hunger to satiety cues.
-Doctor should monitor the curve for the weight and length of the infant over time.
-Formula-fed infants consume more energy than breast-fed infants.

Protein Requirements

- Higher per kg weight than for adults because of rapid growth
- Recommendations based on composition of human milk
- Require large percentage of essential amino acids than adults
- Human milk or infant formula; supplemental protein sources after age 6 months

Protein Requirements:
-We should give infants higher amount of proteins than adults because of the rapid growth.
-If mother's milk doesn't have the enough or doesn't have necessary components for her baby's growth, we can either give her these components (improve her diet) or by giving formula-milk with needed requirements.
-According to WHO recommendations, all women should breast-feed their babies until 6 months of age.

Lipid Requirements

- Minimum of 30 g fat per day
- Essential fatty acid content of human milk vs infant formula: linoleic and linolenic acids, as well as longer chain arachidonic and docosahexaenoic acids
- Linoleic acid should provide 3% of total kcals
- Long-chain polyunsaturated fatty acids; visual acuity and neural development

Lipid Requirements:
-Infants should be given 30 g fat per day.
-Fat is important for building and developing the nervous system.

**Make sure you know all the details in this slide.

Carbohydrate Requirements

- 30% to 60% of energy intake
- Lactose tolerance
- Avoid honey and corn syrup; source of botulism spores

Carbohydrate Requirements:
- 30% to 60% of energy intake.
-Lactose intolerance (not being able to withstand milk's sugar, so we give an alternative, we change the milk's type).
-Avoid honey and corn syrup until 2 years of age; since they cause botulism disease (respiratory muscles paralysis).

Water Requirements

- 0.7 L/day up to age 6 months; 0.8 L/day for age 7 to 12 months
- Renal concentrating capacity may be less than for adults
- May require additional water in hot, humid environments
- Hypernatremic dehydration; neural consequences

Water Requirements:
- 0.7 L/day up to age of 6 months then 0.8L/day for age 7-12 months.
-Renal concentrating capacity may be less than that for adults.
-May require additional water in hot, humid environments; we should keep the infant hydrated because if sodium concentration increases, it might cause problems.

Mineral Requirements

- Calcium: more is retained from breast milk than from infant formula
- Iron: supplement with iron-fortified cereal or fortified infant formula by 4 to 6 months; deficiency has cognitive effects
- Zinc
- Fluoride

Mineral Requirements:
-Calcium is more retained from breast milk than formula-milk.
-Iron is given through iron-fortified cereal or fortified infant formula milk by 4-6 months.
-Formula-milk of infants is of two types: either with Iron or without iron.
-Iron causes constipation in some infants so we try to reduce this by giving one meal of formula-milk with iron and a second meal of formula-milk without iron.
-We should also give infants zinc and fluoride with sufficient amounts.

Vitamin Requirements

- Vitamin D: Supplements recommended for breast-fed infants, especially those with dark skin
- Vitamin B_{12}: Depends on maternal diet and status
- Vitamin K: Hemorrhagic disease of the newborn; preventive injection at birth or supplements
- Supplementation issues

Vitamin Requirements:
**Make sure you know everything in this slide as the doctor mentioned them all.
-Supplementation issues: if the doctor felt that a certain infant lacks off certain vitamins, he/she can provide vitamin supplements to the infant.

Human Milk

- Food of choice for infants
- Provides appropriate energy and nutrients
- Specific and nonspecific immune factors
- Prevents diarrhea and otitis media
- Allergic reactions are rare
- Attachment and bonding
- Maternal health benefits

Human Milk:
-Most important food for infants.
-Provides appropriate energy and nutrients.
-Contains specific and nonspecific immune factors; which protect the infant against infections especially respiratory tracts infections.
-Prevents diarrhea and otitis media.
-Allergic reactions are rare compared with that of formula milk, which are common.
-Important for attachment and bonding between the moth and her infant.

I tried to make those notes as brief and as clear as possible, please forgive me if you found any mistakes.
Don't forget me from your Duaa.

Your colleague,
Sura Mubarak