Mount Kenya University

EARLY CHILDHOOD AND DEVELOPMENT

COURSE CODE: BEC 122

COURSE TITLE: FOOD AND NUTRITION

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BEC 122: FOOD AND NUTRITION.

PURPOSE OF THE COURSE

This course will help the learner conceptualize the aspects of food and nutrition critical in early childhood education. It will give the learner the required knowledge, skills and attitudes towards the nutritional value of foods and best practices in the provision of nutrition for young children.

COURSE DESCRIPTION

This course entails definition of terms related to food and nutrition, Sources of food and their nutritional values, nutritional requirements for infants and young children, importance of breastfeeding, forms of breastfeeding, weaning, nutritional deficiency diseases, causes, prevention and treatment. Methods of cooking and food hygiene, impact of food habits, taboos and food consumption patterns on nutrition. Food preservation and storage. Food fads. Challenges facing food production, consumption and possible remedies.

TEACHING/LEARNING METHODOLOGIES

This course will be offered and/or undertaken through tutorials, group discussions, group and individual assignments, presentations, interactive questions and answers, micro-teaching lessons, peer teaching and e-learning interactive forums. The learner will be required to go through this training module, make notes based on the objectives of the course and attempt the questions given at the end of every lesson. Tutorial classes will be organized by the university where the LESSON will take the student through the course. The purpose of tutorials is to help the learner conceptualize the course. It is, therefore, important to study the module before attending the tutorials. Further reading in this area of curriculum is encouraged. However all information gathered should be within the course description and objectives.

COURSE ASSESSMENT AND EVALUATION

Learning will be assessed through sit in Continuous Assessment Tests (CATs), Take Away Assignments and a Main Examination. The CATs will constitute 30% and the Examination 70%.

MODULE ORGANIZATION

This module is organized in form of lessons. In every lesson an introduction is given. The introduction shows what the lesson constitutes. This is followed by the lesson objectives. Then, the learner is taken through the lesson content. The content may be sub-divided into sub-topics depending on the nature of the topic in a lesson. A summary of what has been learnt is given. At the end of the lesson the learner is given activities.

These activities are in form ofquestions and practical. It is good to note that this is not a text book. The content is therefore in form of LESSON notes. Further reading from text books is recommended. A list of books to refer to is given at end of the module.

Course content

- Definition of terms related to food and nutrition,
- Sources of food and their nutritional values,
- Nutritional requirements for infants and young children,
- Importance of breastfeeding,
- Forms of breastfeeding,
- Weaning,
- Nutritional deficiency diseases, causes, prevention and treatment.
- Methods of cooking and food hygiene,
- Impact of food habits, taboos and food consumption patterns on nutrition.
- Food preservation and storage.
- Food fads.
- Challenges facing food production, consumption and possible remedies.

Course Objectives

i. Define food and nutrition.
ii. Identify food sources and their nutritional values.
iii. Discuss nutritional requirements for infants and young children.
iv. Identify and discuss nutritional deficiency diseases and their management.
v. Discuss methods of cooking, effects on nutritional value of foods and food hygiene.
vi. Discuss the impact of food habits, taboos and food consumption patterns on nutrition.

LESSONONE

Introduction

Definition of Concepts

Food

Nutrition

Infant

Breastfeeding

Weaning

Food habits

Food hygiene

Food fads

Food taboos

LESSONTWO

SOURCES OF FOOD AND THEIR NUTRITIONAL VALUES

The seven classes of food

The seven classes of food are Carbohydrates, Proteins, Fats, Vitamins, Water, Minerals and Fiber which are very important when eating. Human beings need these foods to grow healthy and strong. There are different sources of these foods that is mostly determined by the climate of the environment.

Proteins

Objectives

By the end of this LESSON, you should be able to:

1. Explain the functions of proteins in the body.
2. Give examples of locally available food that are rich sources in proteins.

Functions of proteins

The word protein comes from a Greek word meaning 'holding the first place' this is true of proteins because life cannot exist without them. They are essential constituents of all cells. They are the sources of the components of muscle and tissues that make up the body and are also needed to repair and replace worn-out tissues. They are called body building foods. Besides body building, proteins are also a source of energy. Excess protein in the body is converted into glucose in the liver or it will be directly used up to provide heat and energy. Proteins are made up of a large number of smaller units called amino acids which are joined together in a chain-like way. There are about 22 different amino acids. They are all absolutely essential for life. However eight of them are more basic than the other fourteen, because the body cannot manufacture them. Under some circumstances, the body can use one or the other of the eight to make the remaining fourteen, but not the other way round. These eight are called the essential amino acids.

Sources of proteins

The body obtains its proteins from plants and/or animals. The amount of proteins in these two different sources differs. Plant Proteins generally lack some of the essential amino acids, plant sources are called *second class* proteins and animal sources are called the first class proteins. Different plant sources have small amounts of different amino acids. A careful combination of different vegetables therefore needs to be consumed to provide a more superior intake of amino acids. Our bodies cannot store proteins, if the body receives more than is necessary for body building, the remainder will be used as a source of energy. Diets should therefore be planned in such a way that every meal contains a portion of protein.

Activity

1. Explain clearly why it is better to have a little protein every day rather than a large amount once in a while.
2. Why are some amino acids called inessentials?

Which foods are rich in proteins?

Animal sources include; beef, lamb, kidney, milk, fish, chicken, eggs and cheese.
Plant sources include; beans especially soya beans, unpolished rice, mixed legumes such as peas, runner bean; and nuts such as peanuts, cashew nuts, ground nuts, walnuts etc.

NB

- Although proteins from animal sources have a high biological value, they are also high on cholesterol, which is a major risk factor in heart diseases. Meat should therefore be served less often, and in small proportions.
- While most proteins of vegetable origin have low biological value, soya beans are notable exception. They have all the essential amino acids and are therefore first class protein, without the dangers of cholesterol. They are hence a good substitute to meat and products.

Activity

1. Differentiate between the two PEM diseases that is kwashiorkor and marasmus, both in definition and presentation

2. Discuss the role of nutritional education as part of treatment for PEM.

Carbohydrates And Fats

Objectives

By the end of this LESSON you will be able to:

1. Discuss the specific functions of carbohydrates and fats in the body
2. Generate a list of 20 foods available in Kenya that are rich in carbohydrates and fats
3. Group available foods according to the types of carbohydrates.
4. Explain the illnesses related to improper consumption of carbohydrates and fats

Types of carbohydrates

Carbohydrates are present in three forms:

i. Sugar
ii. Starch
iii. Cellulose and related materials

1. Sugar

The sugars are classified into two***, monosaccharides and disaccharides.***

<u>What are monosaccharides?</u>

Monosaccharides are also known as simple sugars. These include the following; glucose, fructose and glucose.

1. <u>Glucose</u> naturally occurs in grapes and other sweet fruits.
2. <u>Fructose</u> occurs naturally in honey and sweet fruits and is a little sweeter than glucose. It is very quickly absorbed into the body.
3. <u>Galactose</u> does not occur in the Free State that is; it is simply not found in food though it forms part of lactose. All these simple sugars are white and dissolve easily in water to form colorless sweet solutions.

What are Disaccharides?

These are complex sugars. Complex because they are formed by two monosaccharides linked together. They include sucrose, lactose, and maltose. <u>Sucrose</u> is a combination of glucose and fructose, that occurs naturally in sugarcane and sugar beat and is very sweet; <u>lactose</u> is a

combination of glucose and Galactose. This is the sugar that occurs in milk and is not as sweet as sucrose. Maltose is a combination of two glucose units, and it is the sugar which is formed by breaking down starch.

2 Starches

Starches are the main sources from which energy is derived. They are referred to as ***polysaccharides,*** meaning many sugars. Starch is made up of glucose units and is stored in plants as a reserve supply of energy. It is stored in the stem of plants and also found in seeds such as wheat. The difference between starch and sugar is that starch is not sweet and it does not dissolve in cold water.

3 Cellulose and related materials

These consist of many thousands of glucose units. They are therefore also in the class of polysaccharides. They cannot be digested by human bodies, but can be used as foods by cows. Cellulose and other indigestible polysaccharides are known as dietary fiber or roughage. They are very useful to humans as they help with the passage of indigestible materials and waste products through the intestines.

Sources of carbohydrates

Sugar:-sugary food, syrup, jam, fruits, honey, sugarcane, dairy products such as milk.

Starch: - Potatoes, beans, spinach, potatoes, cassavas, arrowroots, maize, oats.

Dietary fibers: - Legumes, oats, barley, wheat, bean, grains and vegetables

Fats

Fats are more concentrated source of heat and energy than carbohydrates. Much of the energy reserve of animals and some seeds are in form of fats. They are formed by linking together of ***glycerol (or glycerin)*** with fatty acids. Fatty acids are acids which form fats. There are two types of fatty acids: Saturated and Unsaturated fatty acids. The difference between the two is that the unsaturated fatty acids contain less hydrogen and are softer. They are also safer in the sense that they lower the cholesterol level in the body.

Sources of fats

Some foods are high in saturated fats these include butter, cream, milk, lard, and cheese, liver, beef, groundnuts, coconuts and hard margarine. Other foods are high in unsaturated fats these include soya bean oil, corn oil, sunflower seed oil, peanuts, soft margarine and oils.

NB Generally, fats from vegetable oils are safe than those from animal products as they contain no cholesterol, not even those that are high in saturated fats, like coconut oil.

Activity

Observe carefully a person you know to be overweight and discuss some of the health and social problems they face.

List the carbohydrates foods most commonly used around where you live and classify them according to the different types of carbohydrates.

Distinguish by use of examples, the following terms; monosaccharide, Disaccharide and polysaccharides

Vitamins

Objectives

At the end of the LESSON, you should be able to:

1. Discuss the various vitamins to the body

2. Give examples of locally available foods that are good sources of the various vitamins.
3. Explain the effects of inadequate consumption of each vitamin.

What are vitamins?

Vitamins are chemical substances needed in the body to keep it healthy. Unlike proteins, carbohydrates and fats, the body requires relatively smaller quantities of vitamins. They are important for healthy growth and development and generally help to keep the body strong enough to fight diseases and infection. They are called protective foods. There called protective foods. There are several vitamins, and they are named by the letters of the alphabet. They are divided into two groups: fat soluble and water soluble vitamins.

Fat soluble vitamins

These are vitamins that dissolve in fatty solutions; they are vitamins A, D, E and K.

(a) Vitamin A

This vitamin is found in yellow and green vegetables called ***carotene***. It is useful for the following purposes.

- Maintenance of healthy skin and surface tissues especially those that produce mucus
- Essential for vision in dim light

Sources of vitamin A

Animal sources include; animal fats, fish oils, whole milk including cream and cheese, egg yolk, liver, kidney and heart.

Plant sources include; carrots, dark green leafy vegetables, such as sukuma-wiki and spinach, pawpaw, yellow pumpkin, ripe mangoes, green beans, cashew nuts, water melon etc.

NB Vitamin A is destroyed when exposed to high temperatures in open air, as in sun drying. Therefore the traditional method of drying vegetables in the sun should be discouraged.

Vitamin D

This is fat a soluble vitamin and is necessary for proper absorption of calcium and phosphorous. Without it cartilage (soft young bone) cannot change to hard bone or both.

Sources of vitamin D

There are two sources

i. Sunlight: Vitamin D is produced by the body as a result of action of sunshine on the skin
ii. Food: Margarine, fatty fish, eggs and butter.

Vitamin E and K

Not much is known about these vitamins and their importance to human. I will therefore discuss very general about them.

Vitamin E

This is also a fat soluble vitamin. Its deficiency is very rare in humans. Its deficiency in rats causes sterility in males and abortion in females. Sources of vitamin E include eggs and oils. It is obtained from cereals like wheat germ oil; animal fats, meat and little in fruits and vegetables.

Vitamin K

Like vitamin E, it is fat soluble and not much about it is known. It is useful in the clotting of blood. Its main sources are green vegetables.

Water soluble vitamins

I have discussed in the previous section fat soluble vitamins A, D, E and K. In this section we shall look at the water soluble ones namely, vitamins B and C.

Vitamin B

This vitamin composes a number of important water soluble vitamins. These are B1 (Thiamin), Riboflavin, Niacin, Vitamin B6, vitamin B12, Folic acid, Biotin and Pantothenic acid. I shall briefly explain the uses, sources and deficiencies of each of them.

Vitamin B1 (Thiamin)

This vitamin plays an important role of breaking down carbohydrates in the body to release energy. This means that the more carbohydrates we eat, the more thiamin we require to break these carbohydrates down, in order to obtain energy.

Deficiency in vitamin B1

Lack of vitamin B1 causes a disease called beriberi. There are two types of beri beri, wet and dry beri beri.

Symptoms of wet Beriberi

- Edema of the legs, the legs swells and accumulates water. They become heavy and tired, numb and with a feeling of 'pins and needles'.
- The heart becomes enlarged, the heart beat slows down and the person becomes breathless
- Muscular pains and eventually death

Symptoms of dry Beriberi

- Wastage of muscles
- Numbness and cramps
- Pins and needles sensation on the hand and feet
- Difficulty in walking
- Extreme weakness
- Eventually leads to death

Sources of Thiamin

Animal sources of Thiamin include fresh and salt water fish, milk and meat.

Plant sources are the richest sources they include cereal grains, whole grain, sorghum, all the seeds and pulses, corn, whole meal, unpolished rice etc.

NB The milling of rice, wheat or maize to produce very white product results in the los of 80% of the thiamin in these cereals.

Since thiamin is soluble in water it can easily be lost by too much washing, cooking in excessive and then draining. It is therefore a good idea to use the water in which rice has been cooked to make a sauce.

Dangers of excessive intake of thiamin

No. Excessive intake will do no harm since the vitamin can be removed through the kidneys and leave the body in the urine.

Vitamin B2 (Riboflavin)

Like thiamin, it dissolves in water but it is not destroyed by the heat of cooking or canning, it is a growth promoting factor and is also concerned with making the energy of carbohydrates available to the body.

Deficiency in Vitamin B2

A lack of Riboflavin has the following effects

- Causes sores and cuts at the corners of the mouth
- Cracks which are sore on the lips
- The skin of the genitals becomes dry and irritated
- Swollen and patched tongue
- Inflamed eyes.

Sources of Riboflavin

The richest sources are milk, cheese, eggs, pulses, oilseeds, dark green leafy vegetables, liver, kidney and yeast.

NB Although riboflavin is stable to heat, it is lost when cooked under alkaline conditions such as using an excess of soda.

It is also affected by light; this means that milk should not be left outside in strong sunlight

Niacin

Niacin, like thiamin and riboflavin, helps to release energy from carbohydrates

Sources of Niacin

Animal sources include; liver, heart, kidney, beef, mutton, chicken, goat, dried fish, duck, turkey.

Plant sources include; whole grain sorghum and wheat, groundnuts, fresh and dried sesame seeds, sunflower seeds and yeast.

This vitamin is fairly stable and is not lost much by cooking, storage or preservation of food.

Dangers to the excessive intake of Niacin

There is no possibility of any excess niacin in the body. This is because any niacin not required by the body is removed in the urine. Very high doses administered as drug cause lack of appetite, nausea, vomiting and disturbance of liver function.

Vitamin B12

This vitamin is required in small amounts. It is involved in many processes in the body like the production of new blood cells, and in the maintenance of a healthy nervous system.

Deficiency of vitamin B12

Lack of vitamin B12 causes anemia and fatigue. This usually arises because; the body is not able to absorb the vitamin from the intestines usually as a result of illness. It is not necessarily due to a deficiency in the diet.

Sources of vitamin B12

Animal products are the main sources of vitamin B12. These include meat, fish poultry, milk, cheese and eggs. Other good sources are offal and brain.

Vitamin B6

It is important for the use of amino acids obtained from food protein. It is also important for the red blood cell formation and function and also in the formation of hemoglobin. Vitamin B6 also plays an important role in the proper working of the nervous system.

Deficiency of vitamin B6

A lack of vitamin B6 in the body is rarely observed. Alcoholics are thought to be most at risk of the deficiency, due to unimpaired metabolism of the vitamin. The symptoms include; Irritability in infants, anemia, and lack of sleep, skin infection and soreness of mouth and tongue.

Sources of vitamin B6

Good sources include meat, especially liver and brain, green vegetables, wheat germ and whole meal flour.

Are there any dangers of an excess consumption of vitamin B6?

An excess consumption from food sources is rare, and is seen only in the intake of supplements. The symptoms include, in very severe cases, pain, numbness and difficulty in walking.

Other compounds of the vitamin B complex

Pantothenic acid: It is useful for energy metabolism and is widely distributed, being found in almost all foodstuffs. Its reach sources are liver, kidney, yeast, egg yolk and fresh vegetables. Human deficiency is rare and it is not known to be toxin at high levels. The only adverse effect noted was diarrhea resulting from very high supplement intakes.

Biotin: It is used in amino acid and energy metabolism, fat synthesis and breakdown. Human deficiency has shown a particular form of skin infection, fatigue, loss of appetite and muscle pain.

Folic acid: This vitamin is important in the proper formation of blood cells. It is also concerned with the making of protein in the body. Its main sources are liver, kidney, dark

green leafy vegetables (spinach, sukuma wiki) and yeast. Deficiency in folic acid leads to anemia. Folic acid is easily destroyed by cooking, therefore as far as is possible. The vegetables should be eaten raw.

Vitamin C (Ascorbic acid)

Vitamin C is important for the following reasons

- Normal growth of the body
- It helps in the healing of wounds because it is the glue that maintains cells together.
- Prevention of infection of gums and promoting healthy development of teeth and bones.
- Assist in the absorption of iron from food and it participates in the metabolism of certain vitamins and amino acids.

Deficiency of vitamins C

Lack of vitamin causes a disease called **scurvy.** The symptoms include:

Restlessness and weakness in the early stages, swelling and bleeding of the gums, bleeding and bruising easily, slow healing of wounds, anemia, hair and tooth loss.

Sources of vitamin C

The main source is fresh fruits and vegetables. These include blank currants, cauliflower, spinach, orange, grapefruit, pineapple, cabbage, potatoes, citric fruit, and broccoli.

NB

- Vitamin Cis readily destroyed by high temperatures. This means that it is easily destroyed by cooking and since vitamin C is water soluble, boiling the fruits or vegetable in a lot of water will definitely destroy the vitamin. A little is also lost by freezing
- The vegetables should also not be cut into small pieces and then left exposed, as vitamin C is also destroyed by exposure.

Effects of excess intake of vitamin C

There is no harm recorded for taking an excess amount of vitamin C.

Activity

Draw a summery table with the following headlines: Name of vitamins, foods sources, functions, food deficiency and toxicity. Then fill in the information for all the vitamins we have discussed. An example for Thiamin is provided below

Name of vitamin	functions	Food sources	deficiency	Toxicity
Thiamin	Used in energy metabolism; nerves; tissue and muscle depend on them	Organ meats, legumes, nuts, whole grains, enriched cereals	Edema, heart damage, weakness, confusion, paralysis	Rapid pulse, weakness, headache, insomnia

Explain clearly some of the ways in which the various vitamins are lost as a result of food handling practices.

MINERALS

Objectives

By the end of this LESSON you should be able to

1. Give the function of each of the mineral to the body
2. Give examples of locally available foods that are rich in various minerals.
3. Discuss the effects of inadequate consumption of each mineral to the body.

Iron

Iron is a very essential nutrient. It is a life sustaining mineral. It serves the following functions

- Hemoglobin: Iron forms part of the pigment of the red blood cell known as hemoglobin. The function of hemoglobin is to carry oxygen from the lungs to the tissues of the body to where it is needed
- Myoglobin: Iron is also present in the muscle protein called myoglobin. It functions in the transportation and short-term storage of oxygen in muscle cells, helping to supply oxygen as is needed in the working muscles.
- Iron is required for a number of vital functions including growth, reproduction, healing and immune function.

Food sources

There are two main sources of iron, they are:

1. Heme-iron: Heme-iron mainly comes from hemoglobin and myoglobin in meat, poultry and fish. It provides up to third of total absorbed dietary iron. The absorption of Heme-iron is less influenced by other dietary factors like the consumption of calcium. The food sources of iron in meat include the kidney, liver and heart.
2. None-Heme iron: The main sources are vegetables like spinach, parsley, ginger and whole grain millet, sorghum, whole wheat flour, cow peas, other sources include curry powder, dairy products and brewers yeast. The absorption of non-heme iron is compromised by the consumption of calcium. Iron overload leads to increased incidences of liver, colon and brain damage.

Calcium

Calcium is the most common mineral in the human body. About 99% of the calcium in the body is found in the bones and teeth, while the other 1% is found in the blood and soft tissue. Calcium therefore, as a major structural element in bones and teeth.

What are the functions of calcium in the body?

- Formation of skeleton
- Blood clotting, calcium working together with vitamin (K) helps in the clotting of blood to prevent loss of blood from a wound or injury.

- Intercellular messenger, calcium plays a role in mediating the construction and relation of blood vessels, nerve function, and muscle contraction and for the activity of several enzymes.

Calcium deficiency

A lack of calcium in the body of young children results in stunted growth and in a condition called rickets. Rickets occur where the legs and the bones are deformed. In older people lack of calcium leads to a condition called osteomalacia which is a softening of bones.

Food sources

Calcium is available from food sources and non-food sources. Food sources are: milk, yogurt, cheddar, cheese, cabbage, oat meal and green leafy vegetables. Non-food sources are water and baking powder.

Phosphorus

This is the second most abundant mineral in the body. It is an essential mineral that is required by every cell in the body for normal function.

What are the functions of phosphorus?

The majority of phosphorus in the body, just like calcium is found in the bone. It is found in the form of calcium phosphate salt. It is therefore necessary for the formation of strong bone teeth.

It also helps with the working of enzymes, hormones and cell transmissions.

Phosphorus helps to build the hemoglobin in red blood cells and affects the oxygen delivery to the various body tissues.

Phosphorus deficiency

Inadequate phosphorous intake leads to a loss of appetite, muscle weakness, bone pain, anemia, rickets (in children), osteomalacia (in adults) difficulties in walking, reduced resistance to illness and severe cases even death.

Food sources

Phosphorus is found in most foods and hence dietary deficiency is usually rare.

Food source: dairy products, meat and fish.

Other sources; Lentils, peanuts, beans, spinach and cabbage.

The most serious adverse effect of an abnormally high blood level of phosphorus is kidney damage.

Fluorine

Fluorine occurs naturally in the earth's crust, water and food. It is considered a trace element because only small amount are present in the body. In other words the body needs very little of it for proper functioning. Fluorine however serves a very important function.

Function

Protection against tooth decay. It hardens the teeth and stabilizes bone mineral.

Fluorine deficiency

In human insufficient fluorine leads to an increased risk of dental decay.

Food sources

The major source of dietary fluorine is drinking water. It is also available in most foods but in small amounts. Rich sources include tea, fish without bones and chicken. Fluorinated toothpaste add fluoride intake in children especially the young ones who are more likely to swallow them. Fluorine is toxic when consumed in excessive amounts. The signs include

nausea, abdominal pains and vomiting. Too much fluorine in the water leads to the formation of small white spots on the teeth.

Iodine

Iodine is a non metallic trace element that means it is also needed in the body in small amounts.

What are the functions of iodine?

It is the essential component of the thyroid hormones and is therefore necessary for proper function of thyroid gland in the neck. The thyroid gland controls the processes of growth, development, metabolism and reproduction.

Iodine deficiency

1. Lack of iodine in the body leads to an enlargement of the thyroid gland which appears as a swelling of the neck. The swelling may be so small that it cannot be seen, or it may be very large and disfiguring. The condition is known as ***goiter.***

2. Iodine deficiency also has adverse effects in all stages of development, but is most damaging to the developing brain. Pregnant women with iodine deficiency are more likely to have still births, miscarriages and children with birth defects.
3. In prenatal development, iodine deficiency leads to a condition sometimes referred to as cretinism and results in irreversible mental retardation.
4. In infants, iodine deficiency may lead to impaired intellectual development and even death. School children and adolescents with iodine deficiency are more likely to have learning disabilities and poor school performance
5. In adults there is impaired mental function though the effects are less severe than those observed in children.

Sources

The iodine content in most foods depends on the iodine content of the soil on which it is grown. Sea food is rich in iodine because of the high content in sea water. Other sources include; green vegetables like cabbages, cauliflower, sukuma-wiki, onions, garlic, cassava,

diary products, salt and potatoes. Acute iodine toxicity is rare Symptoms include burning of the mouth, throat and stomach, fever, nausea, vomiting, diarrhea, a weak pulse, and coma.

Potassium

Potassium is an essential dietary mineral that is also known as ***electrolyte***. An electrolyte is a substance that is capable of producing electricity

Function

It is important for the proper working of nerve impulse transmission, muscle contraction and heart function.

Potassium deficiency

Potassium deficiency in the diet is uncommon. However there are cases of abnormally low potassium levels in the blood and this condition is referred to as ***hyperkalemia***. This results from excessive loss of potassium, e.g. from prolonged vomiting and kidney disease. The symptom of ***hyperkalemia*** include fatigue, muscle weakness and cramps, and intestinal paralysis, which may lead to bloating, constipation and abdominal pain. Severe hyperkalemia may result in a muscular paralysis or abnormal heart rhythms that are too fast. Abnormally high levels of potassium results when the intake exceeds the capacity of the body to eliminate it. A condition known as ***hyperkalemia*** then results. The symptoms include tingling of the hands and feet, muscular weakness and temporary paralysis.

Food sources

The richest sources of potassium are fruits and vegetables. People who eat large amounts of fruits and vegetables have a high potassium intake.

The following are foods rich in potassium: Banana, potato, oranges, tomato, spinach, fruit juices are noted to have a higher concentration of potassium.

Activity

Draw a summary table and fill in the information for all the minerals discussed in this lesson.

LESSON THREE

NUTRITIONAL DEFICIENCY DISEASES

Objectives

1. Define terms related to nutritional deficiency diseases.
2. Describe five common nutritional diseases in children.
3. Explain the treatment of common nutritional diseases in children.
4. Discuss the illnesses that are related to insufficient consumption of proteins

Introduction

Nutritional deficiency diseases result primarily from a diet that does not have enough of the nutrients that are essential to health or development. Another cause is that an individual may not be able to utilize properly the nutrients consumed in the diet. Deficiency diseases may result from a person's abnormally high metabolic needs for a nutrient or from some imbalance in the nutrients ingested. Certain drugs or medicines may also affect nutrient use.

Deficiency diseases often result from insufficient food intake, or a poorly balanced diet, but may also be caused by ill health (diarrhea, parasitic infections, cancer, AIDS) or, especially in children, by inadequate care. The most severe deficiency disease is starvation, where there is marked weight reduction, loss of fat and other tissues, including from the liver and intestines. Most systems are affected, including the body's immune system. The skin and hair become dry. Endocrine disturbances may occur, and in women amenorrhea is common. Diarrhea often develops, and the sufferer may die of secondary infection.

Nutritional deficiency contributes too much of the ill health in developing countries. The most important forms of malnutrition there are protein-energy malnutrition; iodine deficiency disorders; vitamin A deficiency; and nutritional anemia.

Humans obtain energy (measured in calories or joules) from carbohydrates, fat, and protein and also from alcohol. In the majority of societies the most available source of calories is carbohydrates, whereas fat and protein are less available. In general, as families or communities become more affluent, the proportion of fat and animal protein in the diet increases.

Protein-Energy Malnutrition

A failure to consume adequate quantities of food energy may lead to loss of weight or growth failure in children, wasting of tissues, and eventually starvation. The production of enzymes and hormones is impaired in severe protein deficiency. Young children living in poorer communities throughout the world commonly have protein-energy malnutrition (PEM). This condition is aggravated by common infections, such as diarrhea, and sometimes by the irregular intervals at which a child may have food to eat. The two clinical forms of PEM are nutritional **marasmus** and **kwashiorkor**. **Marasmus** is due primarily to an energy (calorie) deficiency; in **kwashiorkor**, protein deficiency predominates. Mild or moderate PEM is much more common than these two severe forms and leads to a slow rate of growth, to poor development, to increased susceptibility to infections, and eventually to permanent physical stunting. Kwashiorkor, a disease of protein deficiency is generally, associated with many other types of nutritional deficiency, but the lack of protein has its own consequences. The muscles shrink, the hair develops a reddish tint, the liver swells and its fat content grows to compensate for the lack of protein, which gives the impression of a fat bellybut that is not fat, it represents a liver that is diseased and not functioning properly.

One cause of kwashiorkor is of course simple famine. A person can become malnourished even if they are getting enough general foodstuffs in the form of simple calories. This is because there are three main categories of food: carbohydrates, fats and proteins. Carbohydrates are mainly used for basic calories, for fuel for the cells to live. Fats are used also mainly for fuel, but also some of its components are important as building blocks; Proteins are broken down into amino acids that are mainly used for building blocks in growing new tissues or replacing old cells. We need all three types.

It's possible to have a diet that is made up mainly of calories, interestingly enough. The second is used both for fuel, and the building blocks. We need both. In the picture of the baby on the right, it was probably fed on corn mush or what some might call "empty calories." They're not empty in the sense of providing nutrition as fuel, but it doesn't adequately provide the variety of proteins and other nutrients to keep up health. This baby also has kwashiorkor, even though she isn't starving. Sadly, there are babies in poor families (and even some pampered babies in rich

families who get fine sweets!) who don't get a truly balanced diet and get sick as a result! Thus, being a little fat in cheeks and elsewhere isn't a reliable guide. This baby may have been fed mainly on corn mush. The raw creases at the edges of the mouth are called cheilosis. Other signs include the reddish hair and empty vision. Protein deficiency, kwashiorkor, leads to mild mental retardation, because the brain lacks the nutrients to work with. Thus part of prevention is education of parents about good nutrition, and some teen parents aren't bothering to learn what they need to about child care their babies are thus a population at risk. Indeed, one of the points of this and the next LESSON is an appreciation of the nature of public health as a preventive force in society.

Micronutrient deficiencies

Mineral Deficiency

The most prevalent and important mineral deficiencies are iron deficiency, the most common cause of anemia; iodine deficiency, a cause of endemic goiter and mental retardation; low fluoride intake, which contributes to tooth decay; and zinc deficiency. Vitamin Deficiency Among the major vitamin-deficiency diseases is **xerophthalmia**, which is due to vitamin A deficiency.

It can result in ulceration of the cornea of the eye, sometimes blindness, as well as increased mortality rates. **Beriberi**, a thiamine, or vitamin B deficiency, is commonly found among rice-eating peoples and occurs in alcoholics. **Pellagra** results from a deficiency in niacin and is associated with persons whose staple diet is corn or maize. A riboflavin, or vitamin BM, deficiency causes **ariboflavinosis**, in which there may be cracks of the lips and lesions in the genital areas. The **macrocytic anemias** (involving abnormally large red blood cells) result particularly from folic-acid deficiency during pregnancy.**Rickets** and **osteomalacia** (softening of the bones) are due to vitamin D deficiency, and **scurvy** is due to vitamin C deficiency. Other vitamin deficiencies, such as vitamin K deficiency in the newborn and vitamin B deficiency in those taking certain medications, are much less important and less prevalent.

Treatment

The specific treatment for each of these deficiency states is usually the medical provision of appropriate doses of the nutrient in question and also an assurance that foods rich in these nutrients are consumed in the diet. This latter approach is also the basis for prevention of these diseases. Some diseases may also be prevented by fortification of commonly eaten foods with nutrients, by various food supplement programs, by increasing local production of nutritious foods, and, in the long run, by better nutrition education.

Iron and Hemoglobin

Iron is needed to build blood cells, and if there isn't enough in the diet, the body works overtime. The bone marrow where blood cells are manufactured expands. For example, while the skull doesn't usually have much space for marrow between the outer and inner external plates, in chronic anemia this space expands and the bone becomes strangely porous---a condition known as porotic hyperostosis (bony overgrowth).

In acidic environment of the tissues, where new oxygen is needed and carbon dioxide is building up, hemoglobin molecule lets go of its loosely bound oxygen and binds instead to carbon dioxide. Thus, hemoglobin is the key messenger substance of blood, the blood corpuscle is its package, and iron is its core component. If there isn't enough iron, the body can't easily build up the rest of the system, the blood cells become pale---not enough red-colored molecules of hemoglobin---and the result is anemia.
In anemia, the tissues aren't getting enough oxygen and the person feels bad, tired, and exertion quickly becomes exhausting. Not understanding that slaves and other poorly nourished people really were suffering with a handicap of low blood hemoglobin, their seeming sluggishness was interpreted as laziness, "shiftlessness," and proof that they were unworthy of respect. This reinforced the illusions of righteousness of the class of people who exploited their labor. This dynamic still goes on in many parts of the world today. With anemia, the problem is fatigue.

Iron Deficiency

In the last several centuries it seemed to be profitable to slave-owners or managers of institutions to cut costs and maximize profit by feeding their charges with the cheapest foods.

As a result, children, the insane, prisoners, slaves, often soldiers and sailors too, received the most meagre rations compatible with life.

There are three levels of iron deficiency

a. Storage iron depletion: Here the iron stores are depleted, but the functional iron supply is not limited
b. Early functional iron deficiency: Thos occurs when the supply of functional iron is low enough to impair red blood cell formation, but not low enough to form measurable anemia. This situation leads to impaired capacity for physical work and poor cognitive and school performance of children.
c. Iron deficiency anemia: Anemia occurs when there is inadequate iron to support normal red blood cell formation. The hemoglobin level in the blood is lowered. In an anemic person, the body's power to carry oxygen from the lungs to the rest of the body is reduced because of the Lack of hemoglobin. The person then has the following symptoms; rapid heart rate, fatigue, rapid breathing on excretion, brittle spoon-shaped nails, sores at the corners of the mouth, sore tongue, difficulty in swallowing and poor appetite.

Scurvy: Vitamin C Deficiency

Another condition described centuries ago and not correctly understood was the disease called scurvy. It was prevalent among a variety of groups of people who had been restricted to a narrow range of food, generally not including fresh fruits and vegetables. Prisoners, slaves, soldiers on long campaigns, poor people or children living in asylums, orphanages, or institutions, and especially sailors---all were not uncommonly afflicted with scurvy. It's been estimated that, reviewing the losses on returning ships, possibly more than a million sailors died from scurvy during the thousands of voyages that were undertaken between 1500 and 1830! Their diet had little that would provide the proper nutrients, you see: It consisted of salted meats (bacon or fish), old cheese, dried beans or lentils, occasional oatmeal or other cereals, hardtack (a dense, dry biscuit), water, beer, or "grog," which had a higher level of alcohol than beer.

Vitamin C is needed for connective tissues to form with some strength. So one sign is that the skin has little blue-red places where blood leaks out from fragile capillaries, or larger areas of sub dermal (under-the-skin) bleeding that looks like a bad bruise. The gums become tender---

there's just little resistance to the prevalence of gum disease. Really, only small amounts of vitamin C are needed, and a deficiency takes months to appear, unless one has already been marginally malnourished. For soldiers and especially sailors on many month-long or longer expeditions, biscuits can give enough calories, but those in themselves are not sufficient. Gradually, they begin to tire easier, and have other symptoms.

Iodine deficiency and Thyroid Function

Another previously unappreciated mineral deficiency involves the element of iodine. This lack makes it difficult for the thyroid gland to manufacture enough thyroxin, a hormone that helps in the process of basic metabolism, the chemical processes that maintain life. Too little thyroxin and the person develop hypothyroidism or myxedema, a sluggishness of mind and body that comes from a reduced metabolism. Iodine is a common element in seawater and fish, but in inland areas, the iodine tends to have been washed away with the millennia of rain and rivers, so areas such as Switzerland in Europe or Michigan in the United States have little iodine in the soil or the growing foods. Before iodine fortification of salt and food, people in such regions (and even today in many other areas of the world that don't have iodine supplementation), people would get large lumps in their neck (which comes from an overgrowth of the thyroid gland---trying to make more thyroid, even in the face of the lack of a key building block---iodine, much as I described above how in iron deficiency the bone marrow also expands and distorts its surroundings). The overgrowth looks like a lump in the neck that's called "**goiter**" (two examples in photos on the left).

Goiter is disfiguring, but what's even worse is a condition that happens to the babies of mothers with not enough thyroids. They have a characteristic appearance that comes from a growth delay. If it is not corrected, they grow up stunted in height and also mentally retarded. This condition is known as ***cretinism,*** and the children called ***cretins***. If the children are treated early with thyroid hormone and given adequate iodine in their diets, as you may see in the picture on the left, some or much of this mental retardation can be reversed and they change their appearance! In most cases, goiter of short duration also can be treated with iodine supplementation in the diet. If goiter is untreated for around five years, however, iodine supplementation or thyroxin treatment may not reduce the size of the thyroid gland because the thyroid is permanently damaged.

Near the end of the 19th century the use of extracts of thyroid was found to help low thyroid conditions, and also biochemists noted that the thyroid gland was rich in iodine. The introduction

of iodized salt from 1920s has eliminated this condition in many affluent countries. However, in Australia, New Zealand, and several European countries, iodine deficiency is a significant public health problem. It is more common in poorer nations. While noting recent progress, the main medical journal in Great Britain, *The Lancet*, editorialized, "According to the World Health Organization (WHO), in 2007 *nearly 2 billion individuals had insufficient iodine intake*, a third being of school age. ... Thus iodine deficiency, as the single greatest preventable cause of mental retardation, is an important public-health problem." Another complicating factor comes from the way public health initiatives to lower the risk of cardiovascular disease have resulted in lower discretionary salt use at the table. Also, with a trend towards consuming more processed foods, the *non-iodized* salt used in these foods also means that people are less likely to obtain iodine from adding salt during cooking.

Finally, the thyroid was one of the earlier glands to have its function recognized, though that was only in the late 19th century. Most glands we know about---tear ducts, sweat glands, and even the mucus-secreting tissues of the nose or windpipe---are "*exo*crine"---meaning they secrete to the outside (exo-). Claude Bernard (picture, right) in the mid-1800s began to explore the way some organs such as the liver or pancreas secrete inside the body (though such bile and digestive secretions are technically also exocrine. He began to consider that some organs also secrete directly into the bloodstream---and that's where the *endo*crine organs began to be understood---organs such as the thyroid, adrenals, and others.

Rickets: A Disease Arising from a Deficiency of Vitamin D

This disease was noted in the 17th century, but became more common when increasing numbers of people moved from the farm---where kids played outdoors and got more sunlight---to the city, where a child might help earn a living by working indoors. It was easy, also, to live so much in the shadows in a smoggy city that again there's not much sunlight---and sunlight stimulates the production of Vitamin D in the skin. So for shut-ins or people in the northern climates who couldn't get it in milk, rickets became rather common. (The adult form of vitamin D deficiency is osteomalacia, a word that hints at the main pathology: The bones "osteo" become more soft ("-malacia) and other problems arise from this! Also, a diet that includes milk also includes calcium, which helps Vitamin D be absorbed; in turn, Vitamin D helps calcium be absorbed! Vitamin D also helps regulate the levels and use of calcium, but sadly many people get insufficient doses of either.

Another problem is that girls tend to get pelvic deformities that then increase significantly the likelihood of complications of delivery, requiring the use of forceps or sometimes resulting in the death of the baby and mother. The frequency of such problems (secondary to rickets) increased the use of male physicians as obstetricians, and the decline of the role and influence of the midwife.

Vitamin D is present in significant amounts in cod liver oil (also Vitamin A). When I was a kid I was given cod-liver-oil by my mom. It was a fashionable supplement in the 1920s through the 1940s, before the Vitamins were synthesized and included in many fortified foods. Though it didn't taste good, cod liver oil was recommended for rickets treatment as early as 1789 by Thomas Percival in England, though this treatment wasn't widely recognized. Dickens' London was prime territory for rickets and Tiny Tim may have been suffering from it.

In the American South, an interesting problem came up: Melanin in the skin blocks ultra-violet light, so African-Americans only absorb about a third compared with caucasians. So those who work indoors or in overcasts conditions were prone to rickets, and some doctors even came to think of it as a disease of slaves! Even as late as the 1950s more black women had obstetrical problems due to deformed pelvises due to low-grade rickets, and as late as 1977 a national study of black pre-schoolers found a very high incidence of at least sub-clinical rickets. Also, the full body clothing of some Muslim women in some cultures is also associated with increased rickets. In Ethiopia, full swaddling of babies again leads to higher incidence of rickets in children there. The problem with some northern animal livers is that they are so rich in Vitamins A and D that they can make you sick---it's called "Hyper-vitaminosis"---applicable only to the fat-soluble vitamins---and if you have a nice meal of polar bear liver it can kill you!

Beriberi: Vitamin B_1 (Thiamine) Deficiency

Thiamine is found in a variety of food, more with whole grains. With rice, the vitamin is found in the pericarp or covering of the grain, which gets rubbed off in the process of polishing. Brown rice doesn't keep as well, it tends to get rancid, and the idea of polished white rice has always been considered a refinement, eaten by the better sorts of people. If there are enough other types of food this is not a problem, but it's a bit like the problem described above with scurvy: Sailors, soldiers, others on otherwise somewhat restricted diets, if they don't get the whole rice, come down with a multi-system disease called beriberi, which is found throughout Asia in a varied

population. It was common in some armies and also navies, because as with Europe, common soldiers and sailors were given rather meager rations.

Pellagra: Vitamin B3 (Niacin) Deficiency

Pellagra is caused by a deficiency of niacin

Although described in Italy in 1735, pellagra was not recognized in the United States until the early 20th century. This disorder, like beriberi, affects many systems in the body, though it shows most clearly in what has been called the three "D"s: dermatitis, diarrhea, and dementia. Pellagra is easily treated through receiving doses of niacin, although it must be done carefully as overdosing on niacin can be very dangerous. Niacin in high amounts is considered toxic to the body and can cause serious consequences if too much is administered and too quickly. That is why a doctor or medical professional or some sort is a must for dealing with this disease. However, preventing the disease is done simply through maintaining a properly balanced diet. Most plant and animal foods are rich in niacin, so it is not difficult for those in a developed country to receive the proper amounts just by eating normally. Foods that are especially high in niacin are yeast, all kinds of meat especially liver and fish, any kind of beans or soy products such as kidney beans, green beans, pinto beans, tofu and soy beans, milk and green leafy vegetables like lettuce, kale and spinach. Seeds are another good source of niacin, like sunflower seeds, which also make a great snack.

Deficiency in vitamin A

A continued intake of food which has lack of vitamin A will lead to a condition known as **keratomalacia** and also to skin problems

(i) Keratomalacia

This is a serious disease of the eye. It mainly occurs in young children and may cause blindness or death. We saw a little earlier, that vitamin A helps the eyes to adjust from bright light to dim light. In the early stages of its absence this adjusting process becomes very slow and may be lost altogether leading to inability to see in dim light. This condition is called night blindness. If the lack of vitamin A persist then the eyes dry up, become grey and opaque, infections and ulceration set in and then vision is completely lost.

(ii) Skin problems

The skin becomes rough with patches and cracks. This is commonly seen on the backs of the fore arms, the trunk and the buttock area.

Is there a problem associated with excess consumption of vitamin A?

Yes there is. Although vitamin A is very useful, if taken in excess it leads to poisoning. The poisoning occurs because the body is not able to excrete the excess amounts. This excess remains in the tissues and the following symptoms occur.

- Loss of appetite
- Dry itching skin
- Dry hair
- Painful swellings on the bones of the arms and legs

Diseases resulting from improper consumption of carbohydrates

Carbohydrate foods are the most abundant foods. These are the foods most commonly known as staple foods. A situation seldom arises of lack of it, even in the poorest of countries, except when there are situations of natural disasters like drought and famine. However there are diseases that are related with the over consumption of carbohydrates: Generally, an excessive intake of carbohydrates leads to ***obesity***; this is a situation where one has body fat and is overweight. Excess fat causes the workload of the heart to increase and therefore increases the risk of diseases of the heart, blood vessels and gall bladder. Cases of cancer, diabetes and blood pressure are also higher in people who are obese. Excess consumption of sugar and sugary foods leads to tooth and dental cavities.

Fats, just like carbohydrates, are available in abundance, and are sometimes consumed in excess. Excess fats are excreted in the stool, or stored subcutaneously, especially in the abdomen, or around the internal organs. Increased consumption of fats, just like with carbohydrates, generally leads to obesity, with all its complications.

Deficiency of vitamin D

Lack of vitamin D causes **rickets** in children and a softening of bones called **osteomalacia** in adults.

Is there a problem associated with excess amounts of vitamin D in the body?

Yes there is. It however, has not been observed to a result from sun exposure. Excess vitamin D appears primarily from vitamin supplementation, and it causes more calcium than is required by the body, to be absorbed. The symptoms include loss of appetite, nausea, vomiting, excessive thirst, excessive urination, severe itching, muscular weakness, joint pain and ultimately disorientation and death. The organs like heart and kidney also get damaged.

Deficiency in vitamin B1

Lack of vitamin B1 causes a disease called beriberi. There are two types of beri beri, wet and dry beri beri.

What are symptoms of wet Beriberi?

- Edema of the legs, the legs swells and accumulates water. They become heavy and tired, numb and with a feeling of 'pins and needles'.
- The heart becomes enlarged, the heart beat slows down and the person becomes breathless
- Muscular pains and eventually death

What are the symptoms of dry Beriberi?

- Wastage of muscles
- Numbness and cramps
- Pins and needles sensation on the hand and feet
- Difficulty in walking
- Extreme weakness
- Eventually leads to death

Dangers of excessive intake of thiamin

No. Excessive intake will do no harm since the vitamin can be removed through the kidneys and leave the body in the urine.

Deficiency in Vitamin B2

A lack of Riboflavin has the following effects

- Causes sores and cuts at the corners of the mouth
- Cracks which are sore on the lips
- The skin of the genitals becomes dry and irritated
- Swollen and patched tongue
- Inflamed eyes.

Deficiency of Niacin

Serious and prolonged lack of niacin in the diet eventually leads to a condition known as ***pellagra***. The symptoms include;

- Skin discoloration which looks like sunburn, and can be seen on the parts of the cheeks, neck and the back hands normally exposed to the sun.
- The mouth becomes sore and ulcerated at the corners
- The tongue looks like 'raw beef'
- Nausea or diarrhea or sometimes constipation
- Depression, anxiety, irritability and lack of concentration

Dangers to the excessive intake of Niacin?

There is no possibility of any excess niacin in the body. This is because any niacin not required by the body is removed in the urine. Very high doses administered as drug cause lack of appetite, nausea, vomiting and disturbance of liver function.

Deficiency of vitamin B12

Lack of vitamin B12 causes anemia and fatigue. This usually arises because; the body is not able to absorb the vitamin from the intestines usually as a result of illness. It is not necessarily due to a deficiency in the diet.

Efficiency of vitamin B6

A lack of vitamin B6 in the body is rarely observed. Alcoholics are thought to be most at risk of the deficiency, due to unimpaired metabolism of the vitamin. The symptoms include; Irritability in infants, anemia, and lack of sleep, skin infection and soreness of mouth and tongue.

Dangers of an excess consumption of vitamin B6

An excess consumption from food sources is rare, and is seen only in the intake of supplements. The symptoms include, in very severe cases, pain, numbness and difficulty in
Deficiency of vitamins C

Lack of vitamin causes a disease called **scurvy.** The symptoms include:

Restlessness and weakness in the early stages, swelling and bleeding of the gums, bleeding and bruising easily, slow healing of wounds, anemia, hair and tooth loss.

Effects of excess intake of vitamin C?

There is no harm recorded for taking an excess amount of vitamin C.

Calcium deficiency

A lack of calcium in the body of young children results in stunted growth and in a condition called rickets. Rickets occur where the legs and the bones are deformed. In older people lack of calcium leads to a condition called osteomalacia which is a softening of bones.

Phosphorus deficiency

Inadequate phosphorous intake leads to a loss of appetite, muscle weakness, bone pain, anemia, rickets (in children), osteomalacia (in adults) difficulties in walking, reduced resistance to illness and severe cases even death.

Fluorine deficiency

In human insufficient fluorine leads to an increased risk of dental decay.

Iodine deficiency

Lack of iodine in the body leads to an enlargement of the thyroid gland which appears as a swelling of the neck. The swelling may be so small that it cannot be seen, or it may be very large and disfiguring. The condition is known as ***goiter*.**

Iodine deficiency also has adverse effects in all stages of development, but is most damaging to the developing brain. Pregnant women with iodine deficiency are more likely to have still births, miscarriages and children with birth defects.

In prenatal development, iodine deficiency leads to a condition sometimes referred to as cretinism and results in irreversible mental retardation.

In infants, iodine deficiency may lead to impaired intellectual development and even death. School children and adolescents with iodine deficiency are more likely to have learning disabilities and poor school performance

In adults there is impaired mental function though the effects are less severe than those observed in children.

Potassium deficiency

Potassium deficiency in the diet is uncommon. However there are cases of abnormally low potassium levels in the blood and this condition is referred to as ***hyperkalemia***. This results from excessive loss of potassium, e.g. from prolonged vomiting and kidney disease. The symptom of ***hyperkalemia*** include fatigue, muscle weakness and cramps, and intestinal paralysis, which may lead to bloating, constipation and abdominal pain. Severe hyperkalemia may result in a muscular

paralysis or abnormal heart rhythms that are too fast. Abnormally high levels of potassium results when the intake exceeds the capacity of the body to eliminate it. A condition known as ***hyperkalemia*** then results. The symptoms include tingling of the hands and feet, muscular weakness and temporary paralysis.

Problems of world health

In recent years world concern has increased about hunger and malnutrition. In most parts of the world major famines have led to international action to reduce the extent of starvation. The World Health Organization (WHO), the Food and Agriculture Organization (FAO), and United Nations Children's Education Fund (UNICEF), all agencies of the UN, play important and different roles in trying to reduce the extent and seriousness of malnutrition, particularly in developing countries. They coordinate activities and attempt to establish international standards of classification and reporting; they also make recommendations about nutrient requirements for different population groups. In the United States the Food and Nutrition Board of the National Academy of Sciences/National Research Council publishes Recommended Dietary Allowances (RDA) of all the important nutrients.

Activity

1. Discuss five common nutritional deficiency diseases in your locality.
2. Describe what you would advice parents of some children in your class with nutritional inadequacies.
3. Draw a summary table and fill in the information for all the minerals discussed in this LESSON.

LESSONFOUR

Nutritional requirements for infants and young children

Objectives

a. Describe the components of breast milk.
b. Compare breast and formula milk.
c. Discuss the nutritional requirements of an infant.
d. Explain situations that inhibit breast-feeding.
e. Define weaning and give characteristics of weaning foods.

FEEDING THE INFANT (BIRTH-18MONTHS)

Introduction

As soon as the infant is born she should be put on the mother's breast. This helps the infant to feel connected with the mother, warm, secure and loved. It also helps to develop bonding/attachment between the mother and the infant. The infant is born with three reflexes which help him to breast feed. These are rooting, sucking and swallowing reflexes. During the first three four days, the breast milk produced by the mother is called colostrums. This is thick, yellowish and slippery milk which is very rich in antibodies. The infant should be encouraged to suckle the colostrums as it protects him from infections and also helps to clean the intestines by removing the 'black stool'. Colostrum is referred to as the first vaccination to the baby against infections.

Suckling soon after birth also stimulates the production of more breast milk and infants benefit from colostrum. If the infant does not suckle, the breast milk may stop to flow after three or four days after birth. All infants should not be breast- fed exclusively for the first six months. Exclusive breast- feeding means that the infant is fed only on the mother's breast milk. Nothing else, even water should be given to the infant. The breast milk contains adequate nutrients for the infant during the first six months of life. Mothers who are employed are not able to practice exclusive breast-feeding. They are forced to introduce other 'milk' or food as soon as they resume work. In all cases mothers should continue to breast-feed their babies up to the age of

two years. In order to have adequate breast milk the mother is encouraged to eat adequate balanced diet. She should also drink a lot of liquids. Porridge made out of mixture of maize flour, sorghum and millet and various types of soups are particularly very good for increasing breast milk production. A breast feeding mother should never take alcohol as this interferes with the production of breast milk. The breast milk of a mother who has taken alcohol also contains alcohol which is dangerous for the brain development of the baby.

Breast Feeding

Most nutritionists and Pediatrics strongly recommends exclusive breastfeeding for the first six months of life and that breastfeeding continue for at least 12 months. It is optimal for both babies and mothers. For babies it can protect against infections and reduce the rates of later health problems including diabetes, obesity, and asthma.

For mothers breastfeeding helps the uterus to contract and bleeding to cease more quickly after delivery. Breastfeeding can reduce the risk of breast and ovarian cancer and also provides a great way for mothers to bond with their babies.

The advantages of breastfeeding are numerous. Breast milk is ultimately the best source of nutrition for a new baby. Many components in breast milk help protect your baby against infection and disease. The proteins in breast milk are more easily digested than in formula or cow's milk. The calcium and iron in breast milk are also more easily absorbed.

Components of breast milk and their nutrients.

Proteins

Human milk contains two types of proteins: ***whey*** and ***casein***. Approximately 60% is whey, while 40% is casein. This balance of the proteins allows for quick and easy digestion. If artificial milk, also called formula, has a greater percentage of casein, it will be more difficult for the baby to digest. Approximately 60-80% of all protein in human milk is whey protein. These proteins have great infection-protection properties.
Listed below are specific proteins that are found in breast milk and their benefits:

- **Lactoferrin** inhibits the growth of iron-dependent bacteria in the gastrointestinal tract. This inhibits certain organisms, which require iron.
- **Secretory IgA** also works to protect the infant from viruses and bacteria, specifically those that the baby, mother, and family are exposed to. It also helps to protect against allergies. Other immunoglobulin's in breast milk also help protect against bacterial and viral infections. Eating fish can help increase the amount of these proteins in your breast milk.
- **Lysozyme** is an enzyme that protects the infant against salmonella. It also promotes the growth of healthy intestinal flora and has anti-inflammatory functions.
- **Bifidus factor** supports the growth of lactobacillus. Lactobacillus is a beneficial bacteria that protects the baby against harmful bacteria by creating an acidic environment where it cannot survive

Fats

Human milk also contains fats that are essential for the health of your baby. It is necessary for brain development, absorption of fat-soluble vitamins, and is a primary calorie source. Long chain fatty acids are needed for brain, retina, and nervous system development. They are deposited in the brain during the last trimester of pregnancy and are also found in breast milk.

Vitamins

The amount and types of vitamins in breast milk is directly related to the mother's vitamin intake. This is why it is essential that she gets adequate nutrition, including vitamins. Fat-soluble vitamins, including vitamins A, D, E, and K, are all vital to the infant's health. Water-soluble vitamins such as vitamin C, riboflavin, niacin, and panthothenic acid are also essential. Because of the need for these vitamins, many healthcare providers and lactation consultants will have nursing mothers continue on prenatal vitamins.

Carbohydrates

Lactose is the primary carbohydrate found in human milk. It accounts for approximately 40% of the total calories provided by breast milk. Lactose helps to decrease the amount of unhealthy

bacteria in the stomach, which improves the absorption of calcium, phosphorus, and magnesium. It helps to fight disease and promotes the growth of healthy bacteria in the stomach.

Breast Milk is Best

Breast milk has the perfect combination of proteins, fats, vitamins, and carbohydrates. There is nothing better for the health of your baby. Leukocytes are living cells that are only found in breast milk. They help fight infection. It is the antibodies, living cells, enzymes, and hormones that make breast milk ideal. These cannot be added to formula.

Breast milk and night sleep

Feeding babies fresh breast milk can help them sleep at night, according to research.

Breast milk contains ingredients which are specific to the child's nutritional needs at certain times of day or night, scientists have found.

So giving infant breast milk expressed in the morning just before it goes to bed is likely to keep it awake.

Researchers looked at three key ingredients of the milk which stimulate or relax the central nervous system, promoting restfulness and sleep, and observed how these varied throughout a 24-hour period.

Results showed that the highest concentrations were found in nightime samples taken between 8pm and 8am and that the composition of breast milk changes "quite markedly" during the day.

Cristina L. Sánchez, of the University of Extremadura, said: "This made us realise that milk induces sleep in babies."

She added: "You wouldn't give anyone a coffee at night, and the same is true of milk it has day-specific ingredients that stimulate activity in the infant, and other night-time components that help the baby to rest."

In order to provide the optimum nutrition babies should be given milk at the same time of day that it was expressed from the mother's breast.

"It is a mistake for the mother to express the milk at a certain time and then store it and feed it to the baby at a different time", added Dr Sanchez whose research involving milk samples taken from 30 women was published in the journal Nutritional Neuroscience.

Doctors say breast milk is the best food for babies during the first six months of life. It not only protects against many illnesses such as colds, diarrhea and sudden infant death syndrome, but can also prevent future diseases such as asthma, allergies and obesity, and promotes intellectual development.

Women who breastfeed lose the weight gained during pregnancy more quickly, and it also helps prevent against anemia, high blood pressure and postnatal depression.

Osteoporosis and breast cancer are also less common among women who breastfeed their children.

Breast feeding offers many benefits to your baby. Breast milk contains the right balance of nutrients to help your infant grow into a strong and healthy toddler. Some of the nutrients in breast milk also help protect your infant against some common childhood illnesses and infections. It may also help your health. Certain types of cancer may occur less often in mothers who have breastfed their babies.

Women who don't have health problems should try to give their babies breast milk for at least the first six months of life. There are some cases when it's better not to breast feed. If you have HIV or active tuberculosis, you should not breast feed because you could give the infection to your baby. Certain medicines, illegal drugs, and alcohol can also pass through the breast milk and cause harm to your baby.

Comparing Formula and Breast Milk

One of the major issues to consider when deciding how to feed your baby is the quality of the food itself. Perhaps you've heard that breastfed babies get hungry sooner than bottle-fed babies. Does that mean formula sustains babies better than breast milk? Maybe you've read that formula contains more protein than breast milk. Does that mean your milk is somehow deficient?

Most baby formulas are derived from cow's milk (although dairy-free formulas are also available). When milk — from the breast or from a cow — is digested, it breaks down into two byproducts: curds and whey. The *curd* is white and rubbery, and the *whey* is liquid.

When cow's milk breaks down, the curd that forms is hard for human babies to digest. Breast milk, on the other hand, forms more whey than curd, and the curd is softer and more easily digested. Because the baby can digest breast milk more easily than cow's milk, he's less likely to decorate your favorite sweater with spit-up.

Formula makers are striving to make their formulas contain more whey and less curd, so they can be digested more like breast milk. Some formulas, like Nutramigen and Alimentum, are made of *hydrolyzed* protein, which is already broken down, so they are more easily digested than standard cow's milk or soy formulas. In all cases, breast milk is still the gold standard that formula companies are continually trying to match!

Custom-made nutrition

Formula and breast milk look very different; formula is creamier and looks richer than breast milk. This may lead you to believe that formula is more nutritious for your baby, but that's not the case.

One of the amazing things about breast milk is that *your* milk is specially formulated to have the right composition for *your* baby, and to contain exactly the right amounts of nutrients. Bottle-fed babies receive the exact same nutrients every time they eat. Breast milk, on the other hand, continually changes in composition so that your baby gets what he or she needs at any age.

Colostrum

The first liquid the breasts produce (starting a few months before the baby is born) actually doesn't even look like milk. *Colostrum,* which is yellow and thicker than breast milk, is a great example of how your body custom-makes the right nutrition for your baby. Here are some of its benefits:

- Colostrum has a high concentration of antibodies, especially *IgA,* an antibody that helps protect the lungs, throat, and intestines.
- Colostrum helps "seal" the permeable newborn intestines to prevent harmful substances from penetrating the gut.
- Colostrum is very high in concentrated nutrition.
- Colostrum has a laxative effect, which helps the baby pass the first bowel movements (and prevents newborn jaundice).
- Colostrum is low in fat, high in proteins and carbohydrates, and very easy to digest.

Within a few days after delivery, your body begins to produce mature milk that takes over the work of giving your baby the necessary ingredients for healthy growth. Colostrum is still present for around two weeks; the milk produced during this time is called *transitional* milk.

Comparing ingredients

Breast milk contains more than 100 ingredients that the formula industry simply can't duplicate. For example, breast milk is full of antibodies that protect babies from illness and help them develop their own immune systems. Some other key differences between the ingredients in breast milk and formula include the following:

- Formula has higher protein content than human milk. However, the protein in breast milk is more easily and completely digested by babies.

- Breast milk has higher carbohydrate content than formula and has large amounts of *lactose,* a sugar found in lower amounts in cow's milk. Research shows that animals whose milk contains higher amounts of lactose experience larger brain development.

- Minerals such as iron are present in lower quantities in breast milk than in formula. However, the minerals in breast milk are more completely absorbed by the baby. In formula-fed babies, the unabsorbed portions of minerals can change the balance of bacteria in the gut, which gives harmful bacteria a chance to grow. This is one reason why bottle-fed babies generally have harder and more odorous stools than breastfed babies.

Types of breast- feeding

There are three types of breast- feeding

1. **Exclusive breast-feeding-**Baby depends on breast milk for all nutrients. No other foods or drinks are given. This should continue up to six months. The mother must be with the baby all the time.
2. **Partial breast-feeding**- Baby fed partly on breast milk and also on the supplementary foods. This happens after weaning. Partial breast feeding may be introduced earlier for working mothers. Breast-feeding must continue up to 2 years. Such a mother needs to express the breast milk into a clean cup. This milk should be stored in a clean place and given to the infant.
3. **Token breast-feeding**- Baby gets most of the nutrients from other foods. The baby is not really breast fed. It is not the best for very young babies.

Production of breast milk

As long as the placenta is expelled, the mother loses the hormones of pregnancy. There is sudden decrease in oestrogen hormone. This causes colostrum to start flowing into the breast ready for the baby to suckle. Production of colostrum lasts for 3-4 days.

- After this, breast milk will only flow in response to suckling by the baby.

- Suckling of the nipple sends messages to pituitary gland which produces two hormones which are:
  - Prolactin in hormone stimulates gland cells in breast to produce milk.
  - Oxytocin hormone stimulates milk to flow through milk ducts in the breast.

Changes in breast milk

- During the first 3-4 days after birth colostrum is produced.
- After this period, the breasts produce two types of milk.

These are:

✓ Foremilk- beginning of feed; bluish and watery, rich in vitamins, proteins, lactose (sugar), and mineral.
✓ Hind milk-end of feed looks whiter, rich in fat for energy.

Feeding frequencies

Breastfed babies often want to eat again sooner after a feeding than bottle-fed babies, which may lead you (or an outspoken relative) to conclude that you aren't producing enough milk, or your milk isn't rich enough.

Breastfed babies eat more often than bottle-fed babies because the fats and proteins in breast milk are more easily broken down than the fats and proteins in formula, so they are absorbed and used more quickly. This means that breastfed babies often have fewer digestive troubles than bottle-fed babies. (Fats in formula aren't as well absorbed, which is one reason why bottle-fed babies have more unpleasant smelling bowel movements.) However, it also means that if you choose to breastfeed, you can expect to be on call for feedings every few hours. (A bottle-fed baby, by contrast, may be able to sleep longer between feedings.)

An important consideration for breastfeeding mothers is the length of time your baby spends nursing on each breast. A baby receives thinner breast milk known as *foremilk* (with a lower fat content) at the beginning of a feeding, and thicker milk (with a higher fat content) after he has been nursing for several minutes. This thicker milk is called *hindmilk.* Allowing the baby to

completely empty the breast ensures that he gets an adequate amount of hindmilk. Hindmilk has a sleep-inducing effect, resulting in the relaxed look your baby may have at the end of a meal.

It's wonderful to hear that breastfeeding is going so well for you and your son. Nursing a toddler can definitely be a great experience.

There is absolutely nothing at all unusual about a 20-month-old continuing to enjoy breastfeeding. Unfortunately, in our country, we don't see many toddlers and older children openly nursing, so many nursing mothers begin "closet nursing" to avoid confrontation with family, friends and strangers!

The natural time of weaning, of course, varies from child to child.

"In societies where children are allowed to nurse 'as long as they want,' they usually self-wean, with no arguments or emotional trauma, between three and four years of age ... The minimum predicted age for a natural age of weaning in humans is two and a half years, with a maximum of seven years." When weaning proceeds at a child's pace, most often it is very gradual, and sometimes the decrease in nursing is hardly noticeable. All of a sudden, you might observe that your little one hasn't asked to nurse in the past couple of days. This seems to be very common when a child's "timetable" is followed. If you both remain comfortable with the nursing relationship, it really isn't necessary to watch for signs of weaning. It will happen all on its own, in its own time. My very best wishes in mothering!

Weaning

Your baby has reached six months, and it's time for him to try solid food. Every baby is different, so there's no telling how your baby will take to this new experience. He may need a while to get used to different textures and tastes or he may tuck in straight away.
Some mothers will rely on baby-led weaning, whereas others find their babies are happier with spoon-fed purées.

Why isn't milk enough any more?
At six months, your baby starts to need extra nutrients, in particular iron, from food. But he still needs breast milk or formula milk as well, and will do until he is a year old.

During the baby's first six months, his digestive and immune systems have been gradually gaining strength. Your baby's body is now ready to process solid foods. The fact that he's physically ready means he is less likely to have a reaction to something he's eaten.
If you wish to give your baby solid food before he is six months old, it's worth talking to your GP or health visitor first. Before six months, there are many foods that aren't suitable for your baby. These include gluten, which is found in grains, cow's milk and eggs.
Once your baby is six months old, you can in theory give him most foods, and try new ones quite quickly. Here are some foods you may wish to begin with:

- puréed or well-mashed cooked vegetables, such as potato, sweet potato, butternut squash, parsnip, carrot, courgette, broccoli or cauliflower
- fruit purée, such as ripe cooked apple, pear, mango or papaya or mashed fruit such as ripe avocado or banana
- baby rice or other cereal mixed with your baby's usual milk

Purées may be easiest for your baby at first, but some babies can cope with soft lumps, as long as the food is well-mashed. Babies can quickly learn to chew soft, lumpy food even if they have no teeth.
Once your baby is happy eating from a spoon, you can increase the range of foods you offer. Just like us, babies can get bored with the same thing. So rather than just offering fruit or cereal purées, try these:

- Puréed or blended meat, fish or chicken. Be sure to cook the food thoroughly and remove bones.
- Puréed or well-mashed lentils, split peas, chickpeas or other pulses.
- Whole milk yoghurt, fromage frais or custard. But remember your baby shouldn't have cow's milk (or goat's or sheep's) as his main drink until he's a year old.
- Vegetable purées which have stronger flavours, such as peas, cabbage or spinach.

Try the best you can to offer your baby home-made fare. It's best to use pre-prepared jars or packs of baby food as a stop-gap rather than for all your baby's meals.

Even though official guidelines say its right to start solids at six months, you'll see products on the shelves for babies aged four months. Product ranges normally from four to seven months and upwards. There's no nutritional reason why a baby of six months can't eat jars of food labelled seven months-plus, although you may need to mash or blend the contents.

Whenever you buy any pre-packaged food for your baby, check the labels and choose the products that are lowest in salt and sugar.

What to give a baby from seven to nine months?

From now on, your baby will be able to join in with family meals much more easily. There are advantages of giving your baby home-cooked meals:

- you know what's gone into his meals
- you'll be getting him used to what you eat

If your baby is breastfed, he'll get the flavours of what you eat through your milk. This makes him more likely to take to the sort of food you enjoy.

Your baby can now try mashed or minced food, rather than purées. Babies who are first given lumpy food when they're older than 10 months are more likely to reject it. This may make them reluctant to try different textures and tastes as they grow.

It's a good idea to base your baby's meals on starchy foods. The following starchy foods are fine for your baby:

- breakfast cereals
- baby breadsticks
- potatoes
- couscous
- bread
- pasta
- millet
- rice
- oats

As well as starchy foods, your baby needs one protein-rich food at each meal. The protein-rich food could be:

- fish, but **not** shark, swordfish and marlin
- well-cooked eggs
- dairy produce
- lean red meat
- poultry
- lentils

If your baby regularly eats pulses and lentils, perhaps as part of a vegetarian diet, make sure that he has some white bread, rice and pasta as well. Too much fibre can fill up a small tummy, leaving little space for other, higher energy foods.

If your baby is happier with finger foods, let him get on with it. He may enjoy the control it allows him. Try cooked green beans or carrots, cubes of cheese, slices of banana or soft pear.

Although your baby is still having his usual milk, he can start to have other drinks. Give him cooled, boiled water from a beaker with a soft spout. If you choose to give your baby fruit juice, keep it to mealtimes only. Dilute it one part juice to 10 of cooled boiled water.

Give diluted juice to your baby in a beaker or feeding cup, rather than a bottle. Keeping juice to mealtimes helps your baby to absorb the iron in his meals and is kinder to his emerging teeth.

Follow-on formula milk can be used if you wish. But there's no need for you to give it to your baby if he's already eating balanced meals.

What to give the baby from 10 months?

Your baby's meals can be more adult-like now. They should be chopped or minced and you may like to follow a two or three-meal-a-day pattern along with one or two snacks.

If your baby is breastfed you can keep offering him regular feeds. You may find he doesn't want to feed as often as he used to. If you are bottle-feeding, you can drop one or two formula feeds a

day. But carry on giving your baby formula milk, between 500ml and 600ml a day, until he's a year old.

What not to give a baby under a year?

There are some foods and ingredients your baby should not have until he's one. These are:

- **Salt.** Your baby's kidneys can't cope with salt yet. It's best not to encourage a liking for it, anyway. Don't blend adult ready-meals for your baby. Ready meals contain high levels of salt.
- **Honey.** Even if he has a cough, your baby shouldn't have honey until he's one. Very occasionally, it can contain a type of bacteria that can be toxic to a baby's intestines.
- **Sugar.** Try sweetening desserts with mashed banana or a purée of stewed dried fruit. Or you could use expressed breast milk or formula milk.
- **Artificial sweeteners.** Diet drinks or squashes containing artificial sweeteners are not suitable for your baby. They are not nutritious and can encourage a sweet tooth.
- **Whole nuts.** These are a choking hazard.
- **Certain fish.** Your baby should not have shark, swordfish and marlin. These may contain traces of mercury.
- **Tea or coffee.** Don't be tempted to add a little tea to your baby's bottle to warm his milk. The tannin in tea may prevent him from absorbing the iron in his food properly. Any caffeinated drink is unsuitable for your baby.
- **Low-fat foods.** Low-calorie spreads, yogurts and reduced-fat cheeses aren't right for your baby. Always offer your baby the full-fat versions. He needs the calories.

Some foods carry a risk of food poisoning. To be on the safe side, don't give your baby:

- soft, mould-ripened cheeses, such as brie or camembert
- raw or undercooked shellfish
- soft-boiled or raw eggs
- liver pate

Food allergies

If allergies run in your family, then it's worth talking to your GP or health visitor for their advice.

If your child already has an allergy or an allergic condition such as asthma or eczema, then he has more of a chance being allergic to peanuts. So talk to your GP or health visitor before giving him peanut butter or products containing peanuts for the first time (FSA nd c).

It may be worth trying foods that are most likely to cause a reaction one at a time. That way you can see how your baby gets on, and isolate any trigger foods. Start with a very small amount, and don't give any of them to your baby before he's six months old. Foods to introduce one at a time are:

- grains, such as wheat, rye, barley and oats, that contain gluten
- fish and shellfish
- citrus fruits
- nut butters
- cow's milk
- soya
- egg

Other Weaning Foods: Characteristics and Guidelines

Weaning foods are generally introduced between the ages of six months to three years old as breastfeeding is discontinued. While breastfed infants are often able to maintain adequate growth through their sixth month, additional nutrients are required to complement or, in some cases, replace breastfeeding completely. The main concern is making sure that there is no gap between nutrient requirements and what a child is able to consume, absorb, and utilize. Nutritional status in children is most vulnerable during the weaning stages when both macro and micronutrients may be insufficient to maintain growth and development. Protein energy malnutrition and micronutrient under-nutrition occur together. It is an important part of weaning strategies to optimize nutritional status and to tackle under-nutrition-related problems as a group for maximum effectiveness.

Traditionally, weaning foods are liquids and semisolids which are later replaced by foods eaten by older family members. In some cases these types of foods can be filling and yet not meet the

child’s nutrient needs. Establishing appropriate characteristics for nutrients and other aspects of weaning foods that assist in motor skills and mental development will be important to assure the appropriateness of targeting foods to this age group.

Characteristics of Weaning Foods

Guidelines for weaning foods suggest that weaning can occur between theages of 6-12 months. The foods given should have characteristics accordingto nutritional needs, appropriate textures and viscosity, and appropriateforms (liquid, semisolid, solid) to support mental and physical development. Special attention should be paid to microbial safety during thesemonths as the immune system is still maturing and the protection providedby mother’s milk may not be present. For a summary of weaning foodCharacteristics and recommendations,Digestion and absorption capacity of the gastrointestinal tract may still be relatively immature during the early weaning period and can impact the effectiveness of weaning foods and theability to recover nutritional status in malnourished children.

In the case of maternal HIV infection recommendations are different in thatexclusive breastfeeding should be followed by immediate weaning ratherthan mixed feeding or complementary feeding as is commonly recommendedin non-HIV infected populations. This can place the child at additional riskduring the gap between breastfed and fully weaned. Whatever the circumstance, mothers/care givers will require clear and appropriate information on whichto base their choices for child feeding and the introduction of non-breast milk foods. Between the ages of 6-8 months pureed and mashed foods can be introducedgiven from a cup or bowl. Viscosity of the foods can affect the volume andnutrient consumption of the weaning foods and this can be used to advantage by individualizing the instructions for an undernourished child. From 8-12 months of age cutup foods that can be handled by the child are appropriate. After 12 months of age, family foods should be relied on for nutrient supplies. There can be a variety of food sources that can offer the mix of nutrients required.

Foods that are lacking can be fortified with protein and micronutrients with special care to assure that amounts are adequate, but care should be taken to avoid high-doses. Of special interest in resource-limited settings is the ability to provide iron rich weaning foods. Meats provide a good source of iron but may not be available or economically feasible for some families. Plant sources of iron should be included.

Fortification with iron is also an option as long as weaning foods contain appropriateamounts of both iron and vitamin C. Recipes and instructions on preparation for the preservation of nutrients and the assurance of safety are important features of introducing home-processed or home-prepared weaning foods. Mothers/care givers should be instructed on how to introduce a cup or bowl for feeding with better hygiene. In addition, general food handling precautions such as hand washing before and after food preparation, careful cleaning of utensils, and appropriate food preparation and storage methods should be included in education activities. Specific recommendations include assuring adequate fluid provision. Vitamin-rich fruits and vegetables should be provided every day along with adequate protein sources.

Fortified foods are recommended and vitamin-mineral supplementation is recommended where fortified foods are not available. Animal foods or adequate substitutes should be provided to assure a source of quality protein and other nutrients. Ready to use products are especiallyappropriate where animal foods and breast milk substitutes are less commonly available.

Weaning foods should have good acceptability by both the mothers/caregivers and the infants. It is possible that the child's feeding preferences are set early by foods and beverages that may be used as an adjunct to breastfeeding as early as the first week of life. Local foods and fortifying Ingredients have been utilized creatively with acceptability in mind. Ingredients should meet expected standards for nutrient content and value as well as food safety. Sources of fluids, calories, protein, and other nutrients can include a wide variety of ingredients that are likely to range in acceptability by mothers/care givers as well as children. The development and introduction of weaning foods that meet both generally-accepted guidelines and local preferences

Activity

1. Describe four methods of breast feeding.
2. Discuss the factors that inhibit breast feeding.
3. Prepare a menu that you can use to feed a 2 year old baby.

LESSON FIVE

Challenges Facing Food Production and Consumption

Objectives

a. Discuss the challenges facing food production and consumption.
b. Explain some practical solutions to food shortages in Africa.

The food crisis equation has three main components.

First, life-styles, incomes and social organization determine levels of consumption.

Second, the technologies in use determine both the extent to which human activities damage or sustain the environment and the amount of waste associated with a given level of consumption. Poverty may prevent the adoption of more appropriate technologies that could halt or slow down environmental degradation. These two factors determine the impact on individuals.

Thirdly is the factor of inequality. Most land is in large holdings, and the poor are forced to live on smallholdings or in marginal areas. A large share of the population remains undernourished, and thedegradation of land and ecosystems worsens food insecurity.

A fourth factor, population, acts as the multiplier that determines the total impact. Population is always part of the equation.The more people there are, the greater the impact on the environment is and, in turn, the greater the impact on food production capacity will be.

Land fragmentation affects food production and is a direct result of rapid population growth in many poor countries. Often landholdings which are too small to provide a tolerable livelihood have been turned into part-time farms, with some household members (usually the women and children) staying at home to tend crops while others (often the men) migrate in search of wage employment. Alternatively, land is sold to wealthier landowners, making land distribution more uneven and adding to the creation of a large pool of landless labourers.

In addition, rapid population growth can lead to inappropriate farming practices that impoverish and erode the soil; reduce vegetation; over-use and improperly use agrochemicals; and frustrate water resource management. The result of such practices is severe land degradation.

Population pressures continue to tip the balance against proper land and water management in many developing countries. While agricultural production is critical for any form of sustainable future, focusing on the agricultural sector alone without regard for other important factors which influence food production is certainly not the way to tackle the problems. Population programmes must be integrated into overall development objectives and be linked to other resource issues. Some of the challenges that contribute to food shortages in the world include:

- Poor education and lack on awareness of the benefits of SCP among allstakeholders;
- Government failures (lack of legislation and/or enforcement; weak recognition ofSCP in most policies; weak institutional capacity for monitoring and usingeconomic instruments; absence of enforceable pollution standards; lack ofdecentralization to local authorities; lack of appropriate consumer rights, policiesand legal instruments for promotion of sustainable consumption; incoherentpolicies);
- Lack of human and technical capacity (lack of capacity for product development and formulation of bankable CP projects in industry; lack of capacity on SCPtools in government; widespread reliance on obsolete technologies; lack ofinformation on emerging clean technologies);
- Economic failures (financial instability of NCPCs; under-pricing of naturalresources; lack of appropriate financing mechanisms for SCP investments; lackof financial incentives; widespread poverty);
- Systemic failures (absence of monitoring; lack of systematic training of employees and lack of research and development in industry.

- Organizational failures (poor institutional setting; absence of collaborative projects and exchange programmes in the region to facilitate knowledgesharing).

A key opportunity for addressing the above challenges lies in regional cooperation, given that countries often face similar problems. Many successful initiatives have been implemented at local level in such areas as energy efficiency, waste management, buildings and viable education programmes.

Remedies to food challenges

A key opportunity for addressing the above challenges lies in regional cooperation given that countries often face similar problems. Many successful initiatives have been implemented at local level in such areas as energy efficiency, waste management, buildings and viable education programmes.

In order for hard-pressed developing countries to come to grips with falling food production and resource degradation, they need strategic plans that incorporate population concerns such as population growth, distribution and rural-urban migration patterns. Wherever possible, community development strategies which integrate essential social services as well as production resources should be encouraged.

Sustainable development strategies which combat soil erosion and impoverishment, deforestation, falling agricultural output, and poor water management should also be implemented, as should rural agricultural extension schemes which provide credit, seeds, fertilizers and advice to poorer farmers, regardless of whether they are men or women. Finally, support must be given to research on the integration of traditional and emerging technologies for food production.

Given the current levels of population and likely trends, it is imperative to anticipate future needs. At the same time, improved resource management would go a long way toward increasing crop yields, preventing land degradation in the first place and providing sustainable livelihoods for millions of rural poor. The management of natural resources will require an equal commitment to the development of human resources: this means, among other things, extending population programmes and family planning services to the millions who currently lack them. National population programmes should include comprehensive and accessible maternal and child health care programmes and family planning services in order to reduce the size of families

and improve the health and well-being of the entire community. With such efforts, there is a chance of increasing food production while protecting the environment and easing the burdens of the rural poor.

Overall, women are responsible for half the food production in developing countries (N. Sadik, 1989). The time and energy required of women for cultivation and harvesting, food processing and preparation as well as the fetching of fuel and water rarely figure in national labour statistics. Their central place in resource use and crop production has yet to be recognized by most governments. Women rarely participate other than in rather peripheral ways in shaping their countries' economic and social policies. Successful policies will secure women's involvement from the outset and will also ensure that development does not merely mean additional burdens for women.

By formally recognizing women's pivotal role, governments will be taking a big step toward safeguarding food production. First, recognition of the dual role of women is needed. It is imperative that family planning services, improvements in nutrition, access to education and health care be made available to those women who lack access to them. Insuring women's health by implementing family planning and maternal child health services will not only bring down fertility rates, it will also mean that women will have more time for other activities including growing food and tending the land. If women have improved access to family planning services - accompanied by changes in traditional beliefs and attitudes about the role and status of women - they will bear fewer children. The downward spiral of large families, poverty and landlessness can be broken.

Measures taken by Africancountries to boost the development of the agricultural and rural sector include the Maputo Summit Declaration which endorsed the Plan of Action of the Comprehensive Africa Agriculture Development Programme, and the commitment by African leaders to allocate atleast 10 per cent of their national budget to agricultural development; the Sirte Declaration onAgriculture and Water which called for the development of strategic agricultural commodities; the Fertilizer Summit which adopted the resolution to increase fertilizer use in Africa; and the Abuja Food Security Summit that recommended the establishment of an African common market for basic food products. Food supply chain members share the responsibility of producing and supplying food in the most environmentally

sustainable way. Consumers on the other hand indirectly influence upstream environmental impacts through their purchasing decisions. Scientifically reliable and understandable environmental information can help consumers in cities to consider the wider sustainability implications of their purchasing decisions and behaviour. There is great potential for organic food production in African countries, but the development of certified organic farming in African countrieslags behind significantly.

In addition, special agricultural and environmental extension services available to women (who carry out most of the land and water management in poorer areas of the developing world) should be developed. There must be assurances that women can inherit, buy and have full legal title to land and that they have access to credit and marketing facilities. Better educated women are more effective as farmers and environmental managers and they have smaller families (UNFPA, 1989); therefore, education for women and girls in rural areas should be emphasized.

UNFPA'S Initiative

To confront the immense population and resource challenges facing humanity, the United Nations Fund for Population Activities has launched a major initiative.[1] The purpose of this effort is outlined in the Amsterdam Declaration which calls for the following goals to be achieved by the year 2000:

The Amsterdam Forum on Population in the Twenty-first Century was held in November 1989. A result of this forum was the Amsterdam Declaration which calls for annual funding of US$9000 million for population and family planning programmes by the end of this decade and the linking of population concerns with overall development objectives.

- ✓ increase the number of couples practicing contraception from the current 381 million to 567 million;
- ✓ reduce the rate of infant mortality by 50 percent;
- ✓ increase average life expectancy at birth to 62 years or more for men and women in countries with high mortality rates;
- ✓ improve the geographical distribution of the population within national boundaries;
- ✓ strive to improve the status of women throughout all spheres of life;

- ✓ ensure that couples and individuals are guaranteed their basic human right to decide freely and responsibly the number and spacing of their children;
- ✓ increase the quality, effectiveness and outreach of national population programmes;
- ✓ promote community participation and youth involvement;
- ✓ Ensure that the results are taken into account in the formulation of the development strategy.

Activity

1. Using examples from your locality, discuss the major drawbacks to adequate food production.
2. What solutions would you offer members of your community to fight against famine?

LESSON SIX

Food Preservation methods

Objectives

a. Define terms related to food preservation
b. Describe the methods of preserving food
c. Discuss the advantages and disadvantages of preserving food.

The process of treating and handling food in a way to stop or cut down spoilage to prevent the food-borne illness without hampering the texture, nutritional value and flavour is called food preservation. In other words food preservation is a method of preparing food to be stored for future use. Food preservation is practiced from the early ages to make food edible for a long time. The foods preserved in early times were cheese, butter, raisins, pemmican, sausage, bacon and grains.Food preservation involves preventing the growth of bacteria, fungi and other micro-organisms and retarding the oxidation of fats causing rancidity. Food preservation to a great extent means preventing the contamination of food substances.

Preservation processes include:

- Heating to kill or denature organisms (e.g. boiling)
- Oxidation (e.g. use of sulphur dioxide)
- Toxic inhibition (e.g. smoking, use of carbon dioxide, vinegar, alcohol etc)
- Dehydration (drying)
- Osmotic inhibition (e.g. use of syrups)
- Low temperature inactivation (e.g. freezing)
- Ultra high water pressure (e.g. fresherized, a kind of “cold” pasteurization, the pressure kills naturally occurring pathogens, which cause food deterioration and affect food safety.)
- Chelation

Drying

One of the oldest methods of food preservation is by drying, which reduces water activity sufficiently to delay or prevent bacterial growth. Most types of meat can be dried. This is especially valuable in the case of pig meat, since it is difficult to keep without preservation. Many fruits can also be dried; for example, the process is often applied to apples, pears, bananas, mangos, papaya, and coconut. Zante currants, sultanas and raisins are all forms of dried grapes. Drying is also the normal means of preservation for cereal grains such as wheat, maize, oats, barley, rice, millet and rye.

Smoking

Meat, fish and some other foods may be both preserved and flavoured through the use of smoke, typically in a smoke-house. The combination of heat to dry the food without cooking it, and the addition of the aromatic hydrocarbons from the smoke preserves the food.

Freezing

Freezing is also one of the most commonly used processes commercially and domestically for preserving a very wide range of food stuffs including prepared food stuffs which would not have required freezing in their unprepared state. For example, potato waffles are stored in the freezer, but potatoes themselves require only a cool dark place to ensure many months' storage. Cold stores provide large volume, long-term storage for strategic food stocks held in case of national emergency in many countries.

Vacuum Packing

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival, hence preventing the food from spoiling. Vacuum-packing is commonly used for storing nuts.

Salt

Salting or curing draws moisture from the meat through a process of osmosis. Meat is cured with salt or sugar, or a combination of the two. Nitrates and nitrites are also often used to cure meat.

Sugar

Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallization and the resultant product is then stored dry. This method is used for the skins of

citrus fruit (candied peel), angelica and ginger. A modification of this process produces fruit such as cherries where the fruit is preserved in sugar but is then extracted from the syrup and sold, the preservation being maintained by the sugar content of the fruit and the superficial coating of syrup. The use of sugar is often combined with alcohol for preservation of luxury products such as fruit in brandy or other spirits. These should not be confused with fruit flavoured spirits such as Cherry Brandy or Sloe gin

Pickling

Pickling is a method of preserving food by placing it or cooking it in a substance that inhibits or kills bacteria and other micro-organisms. This material must also be fit for human consumption. Typical pickling agents include brine (high in salt), vinegar, ethanol, and vegetable oil, especially olive oil but also many other oils. Most pickling processes also involve heating or boiling so that the food being preserved becomes saturated with the pickling agent. Frequently pickled items include vegetables such as cabbage, peppers, and some animal products such as corned beef and eggs. Calcium is essential for bacterial growth.

Lye

Sodium hydroxide (lye) makes food too alkaline for bacterial growth. Lye will saponify fats in the food, which will change its flavor and texture. Lutefisk and hominy use lye in their preparation, as do some olive recipes.

Canning and Bottling

Canning involves cooking fruits or vegetables, sealing them in sterile cans or jars, and boiling the containers to kill or weaken any remaining bacteria as a form of pasteurization. Various foods have varying degrees of natural protection against spoilage and may require that the final step occur in a pressure cooker. High-acid fruits like strawberries require no preservatives to can and only a short boiling cycle, whereas marginal fruits such as tomatoes require longer boiling and addition of other acidic elements. Many vegetables require pressure canning. Food preserved by canning or bottling is at immediate risk of spoilage once the can or bottle has been opened Lack of quality control in the canning process may allow ingress of water or micro-organisms. Most such failures are rapidly detected as decomposition within the can causes gas production and the can will swell or burst. However, there have been examples of poor manufacture and poor hygiene allowing contamination of canned food by the obligate , Clostridium botulinum which produces an acute toxin within the food leading to severe illness or death. This organism

produces no gas or obvious taste and remains undetected by taste or smell. Food contaminated in this way has included Corned beef and
Tuna.

Jellying

Food may be preserved by cooking in a material that solidifies to form a gel. Such materials include gelatine, agar, maize flour and arrowroot flour.

Meat can be preserved by jugging, the process of stewing the meat (commonly game or fish) in a covered earthenware jug or casserole. The animal to be jugged is usually cut into pieces, placed into a tightly-sealed jug with brine or gravy, and stewed. Red wine and/or the animal's own blood is sometimes added to the cooking liquid. Jugging was a popular method of preserving meat up until the middle of the 20th century.

Irradiation

Irradiation of food is the processing of food with ionizing radiation; either high-energy electrons or X-rays from accelerators, or by gamma rays (emitted from radioactive sources as Cobalt-60 or Caesium-137). The treatment has a range of effects, including killing bacteria, molds and insect pests, reducing the ripening and spoiling of fruits, and at higher doses inducing sterility. The technology may be compared to pasteurization; it is sometimes called 'cold pasteurization', as the product is not heated. Irradiation is not effective against viruses, and is only useful for food of high initial quality.

As any other technology it is not a panacea and cannot resolve food problems in general. Only food of high initial quality is suitable for radiation processing; a spoiled food cannot be reverted to un-spoiled.

The radiation process is unrelated to nuclear energy, but it may use the radiation emitted from radioactive nuclides produced in nuclear reactors. Ionizing radiation is hazardous to life; for this reason irradiation facilities have a heavily shielded irradiation room where the process takes place. Radiation safety procedures ensure that neither the workers in such facility nor the environment receive any radiation dose from the facility. Irradiated food does not become radioactive, and national and international expert bodies have declared food irradiation as wholesome. However, the wholesomeness of consuming such food is disputed by opponents and consumer organizations. [1] National and international expert bodies have declared food irradiation as 'wholesome'; UN-organizations as WHO and FAO are endorsing to utilize food

irradadiation. International legislature on whether food may be irradiated or not varies worldwide from no regulation to full banning. [2]

It is estimated that about 500,000 tons of food items are irradiated per year world-wide in over 40 countries. These are mainly spices and condiments with an increasing segment of fresh fruit irradiated for fruit fly quarantine [3][4]

Modified atmosphere

Modified atmosphere is a way to preserve food operating on the atmosphere around it. Salad crops which are notoriously difficult to preserve are now being packaged in sealed bags with an atmosphere modified to reduce the oxygen (O_2) concentration and increase the carbon dioxide (CO_2) concentration. There is concern that although salad vegetables retain their appearance and texture in such conditions, this method of preservation may not retain nutrients, especially vitamins.

Grains may be preserved using carbon dioxide. A block of dry ice is placed in the bottom and the can is filled with grain. The can is then "burped" of excess gas. The carbon dioxide from the sublimation of the dry ice prevents insects, mold, and oxidation from damaging the grain. Grain stored in this way can remain edible for five years.

Nitrogen gas (N_2) at concentrations of 98% or higher is also used effectively to kill insects in grain through hypoxia. However, carbon dioxide has an advantage in this respect as it kills organisms through both hypoxia and hypercarbia, requiring concentrations of only 80%, or so. This makes carbon dioxide preferable for fumigation in situations where a hermetic seal cannot be maintained.

Clamps

Many root vegetables are very resistant to spoilage and require no other preservation other than storage in cool dark conditions, usually in field clamps.

Biological processes

Some foods, such as many traditional cheeses, will keep for a long time without use of any special procedures. The preservation occurs because of the presence in very high numbers of beneficial bacteria or fungi which use their own biological defenses to prevent other organisms gaining a foot-hold.

Fresherized process

An ultra-high pressure food preservation technique using water pressure of approximately 50-100,000 pounds per square inch, equivalent to 3-6 times the pressure found at the bottom of the ocean. A kind of “cold” pasteurization, the pressure kills naturally occurring pathogens, which cause food deterioration and affect food safety.

Fresherized food is different than other methods of food preservation which use heat pasteurization and chemical additives. The taste, texture and naturally occurring vitamins are equal to “freshly made” food. In addition, the amount of energy used for fresherized foods is relatively low, compared to food preservation methods that require heat.

Advantages and disadvantages of Food Preservation Methods

Drying

Advantages:

- Produces concentrated form of food.
- Inhibits microbial growth & autolytic enzymes.
- Retains most nutrients.

Disadvantages:

- Can cause loss of some nutrients, particularly thiamin & vitamin C.
- Sulphur dioxide is sometimes added to dried fruits to retain vitamin C, but some individuals are sensitive to this substance.

Smoking

Advantages:

- Preserve partly by drying, partly by incorporation of substances from smoke.

Disadvantages:

- Eating a lot of smoked foods has been linked with some cancers in some parts of the world.

Refrigeration

Advantages

- Slows microbial multiplication.
- Slows autolysis by enzymes.

Disadvantages:

- Slow loss of some nutrients with time

Freezing

Advantages

- Prevents microbial growth by low temperature & unavailability of water.
- Generally good retention of nutrients.

Disadvantages:

- Blanching of vegetables prior to freezing causes loss of some B-Group vitamins and vitamin C.
- Unintended thawing can reduce product quality.

Adding Salt or Sugar

Advantages

- Makes water unavailable for microbial growth.
- Process does not destroy nutrients.

Disadvantages:

- Increases salt and sugar content of food.
- High heat processing (e.g. pasteurisation)

Advantages

- Inactivates autolytic enzymes
- Destroys microorganisms.

Disadvantages:

- Loss of heat-sensitive nutrients.

Canning (involves high heat processing)

Advantages

- Destroys microorganisms & autolytic enzymes.

Disadvantages:

- Water-soluble nutrients can be lost into liquid in can.

Chemical Preservatives

Advantages

- Prevent microbial growth
- No loss of nutrient.

Disadvantages:

- Some people are sensitive to some chemical preservatives.

Ionizing Radiation

Advantages

- Sterilizes foods (such as spices) whose flavour would change with heating.
- Inhibits sprouting potatoes
- Extends shelf life of strawberries and mushrooms

Disadvantages:

- Longer shelf life of fresh foods can lead to greater nutrient losses than if eaten sooner after harvesting.

ACTIVITY

1. Identify one traditional food in your community and discuss various methods used to preserve it.
2. Discuss the advantages of using these methods.

LESSON SEVEN

Objectives

a) Define terms related to food fads
b) Describe food fads
c) Identify characteristics of food fads
d) State examples of food fads
e) Discuss disadvantages of fad diets

Fad diets

Food fad is term originally used to describe simple, catchy diets that often focused on a single element such as cabbage, grapefruit or cottage cheese. Food fads are diets which become fashionable, but which are not necessarily nutritious (Lehninger 1982)Food fads are just popular trends in food an intense but short lived craze for particular foods.

In the recent past, the term was defined in three categories of food fads;

1. A particular food or food group is exaggerated and purported to cure specific diseases.
2. Foods are eliminated from an individual's diet because they are viewed as harmful.
3. An emphasis is placed on eating certain foods to express a particular lifestyle.

Fad diets promote quick weight loss by following a specific set of guidelines, which differ depending on the diet plan. Some fad diets endorse specific foods to be eaten while others claim certain foods need to be avoided. Others conform to particular methods of eating such as when and how much, as well as what food or foods should be consumed.

Fad diets are quick-fixes. In general, any diet with one of more of the following characteristics is considered a fad diet:

- Quick weight loss
- Easy to follow
- No exercise required

- Eat whatever you want
- Great amount of weight loss guaranteed
- Extremely limited food choices or entire food groups
- Expensive products and/or seminars required

In summary, if the advertisements, including testimonials, sound like the magic answer to your weight issues, the diet is a fad.

Examples of Fad Diets

These types of diets have been in our society for centuries. Some of them continue to be prominent philosophies in today's weight loss world. Others contend to be the newest, hottest diet to hit the diet scene. A few examples of fad diets are:

- The Cabbage Soup Diet
- The Grapefruit Diet
- The Cambridge Diet
- The Scarsdale Diet
- The 3-day Diet
- The 7-day Diet
- The Coconut Diet
- The Blood Type Diet
- The Bread and Butter Diet
- The Shangri-La Diet

The Pros and Cons

Fad diets function mainly by restricting calories. When calories are limited, weight loss occurs, which is the first and foremost advantage of following such a plan.

On the other hand, the disadvantages of fad diets are many. First, due to the extreme food, restrictions, weight loss is rapid and unsafe. The Mayo Clinic suggests a safe, sustainable rate of weight loss is one to two pounds per week. Avoid diets claiming more than two pounds of loss a

week, due to potential health risks from the loss of muscle mass and lean tissue. Secondly, according to **Straight Health**, these diets may not provide the nutrition needed for proper body functions because they restrict calories to less than 1200 calories or they eliminate entire food groups. In fact, these diets breach the primary recommendation of good nutrition: eat a variety of food to achieve a healthy, balanced food intake.

Long-term weight maintenance is critical to support optimum health. These plans do not provide the tools necessary for behavior changes to occur. Furthermore, if you regain the weight, it may be more than you lost on the diet.

Safer Diet Suggestions

If you choose to follow a fad diet, be cautious. Seek medical attention, if you experience any side effects. Be prepared for weight loss that may cause further weight issues later.

From a nutrition standpoint, these diets are not recommended. Instead, eating a healthy diet and maintaining an adequate exercise is the healthiest and safest way to lose weight and keep it off. Consulting with your physician or a nutritionist will benefit you far greater and longer than any fad or crash diet available.

Activity

1. What are food fads?

2. Describe with examples some characteristics of food fads.

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