

<b>Course Name</b>	<b>: Nutrition &amp; Childhood development</b>
<b>Course Code</b>	<b>: APBPH 3106</b>
<b>Course level</b>	<b>: Level 5</b>
<b>Course Credit</b>	<b>: 4 CU</b>
<b>Contact Hours</b>	<b>: 60 Hrs</b>

### **Course Description**

The Course deals with exploring the nature of food required in our bodies to provide energy. It involves defining the functions of food, understanding what carbohydrates, proteins, fats & oils, vitamins, minerals, nutrient requirement and malnutrition in general.

### **Course Objectives**

- To help students learn much about how to feed themselves in terms of eating nutritious foods so as to increase on their life expectancy.
- To help them acquire adequate nutrition information that can be disseminated into the public for those who want to become practitioners.
- To enable them appreciate the importance of understanding early hood development in the life cycle of human beings.

### **Course content**

#### **Introduction**

- What is Food
- Functions of Food
- Nutrients and their function

#### **Macronutrients**

##### **Carbohydrates**

- Available carbohydrates
- Unavailable carbohydrates
- Functions of carbohydrates

##### **Proteins**

- Functions and sources of proteins
- Special features

##### **Fats and Oils**

- What are Fats and Oils
- Functions and sources of fats and oil
- Special features

#### **Micronutrients**

##### **Vitamins**

- Fat soluble vitamins: Functions and sources
  - ✓ Vitamin A
  - ✓ Vitamin D

- ✓ Vitamin E
- ✓ Vitamin K

### **Minerals**

- What minerals constitute
- Calcium
- Iron is essential for hemoglobin formation
- Iodine is necessary for growth and development

### **Nutrient Requirement**

- Age
- Height/weight
- Sex
- Climatic
- Health
- Occupation
- Physiological condition
- Inter-relationship of food, nutrient and health

### **Malnutrition**

- Definition of Malnutrition
- Effects of Malnutrition on Mortality
- Causes of malnutrition
- Psychological effects of malnutrition

**Mode of delivery**    Face to face lectures

### **Assessment**

**Course work** 40%

**Exams**        60%

**Total Mark** 100%

## NUTRITION AND CHILDHOOD DEVELOPMENT

### Try out Questions

*What Is Nutrition and why Is Nutrition Important?*

*What Is Malnutrition and what Causes Malnutrition?*

*As a Public health officer, what would you suggest to be done to curb the problem of Malnutrition in Uganda. In not more than 2500 words write an essay about what you would do to improve the issue at stake.*

The term 'food' brings to our mind countless images. We think of items not only that we eat and drink but also how we eat them and the places and people with whom we eat and drink. Food plays an important role in our lives and is closely associated with our existence. It is probably one of the most important needs of our lives.

The food that we eat is composed of small units that provide nourishment to the body. These are required in varying amounts in different parts of the body for performing specific functions. This means that good nutrition is essential for good health. However, if our diet provides the important units in incorrect amounts, either very less or in excess of what is required, it results in an imbalance of nutrients in your body. The condition is responsible for various deficiency diseases and slow or no growth of the body.

In this lesson you will learn about why food is essential, its functions and components. You will also be introduced to the terms like 'nutrition' and 'nutrients'. After learning the meaning of these terms, you will then learn the sources and functions of the nutrients and the amounts required by different individuals.

### **OBJECTIVES**

After reading this lesson, you will be able to explain the functions of food; enumerate the sources and functions of the nutrients; relate the nutritional requirements in terms of Recommended Allowances Dietary (RDAs) to nutrition and health.

### WHAT IS FOOD?

The term 'food' refers to anything that we eat and which nourishes the body. It includes solids, semi-solids and liquids. Thus, two important features for any item to be called food are:

- (i) It should be worth eating, that is, it should be 'edible'.
- (ii) It must nourish the body.

Have you ever wondered why food is considered a basic necessity? Food is anything that we eat and which nourishes our body. It is essential because it contains substances which perform important functions in our body.

### **FUNCTIONS OF FOOD**

There are basically three important functions of food:

#### **1. Social Function**

Food and eating have significant social meaning. Sharing food with any other person implies social acceptance. Food is also an integral part of festivity everywhere in the world. Have you noticed that certain occasions such as birth of a child or a marriage or birthdays, are celebrated by having feasts and serving delicacies? Food also has a specific significance and meaning in the religious context.

## **2. Psychological Function**

We all have emotional needs, such as need for security, love and affection. Food is one way through which these needs are satisfied. For example, how do you feel when your mother prepares your favourite food or dish? You feel that she loves you and cares for you. Food is often served as a reward also. Do you recall giving a chocolate because some one had been good to you? Similarly, certain foods become associated with sickness, such as Rice and meat and bland foods. Sickness is an unpleasant experience; hence, even the food items served during this state may be associated with unpleasant feelings.

## **3. Physiological Function**

There are three physiological functions performed by food. These are energy giving, body building, regulating body processes and providing protection against diseases. Let us see them in detail.

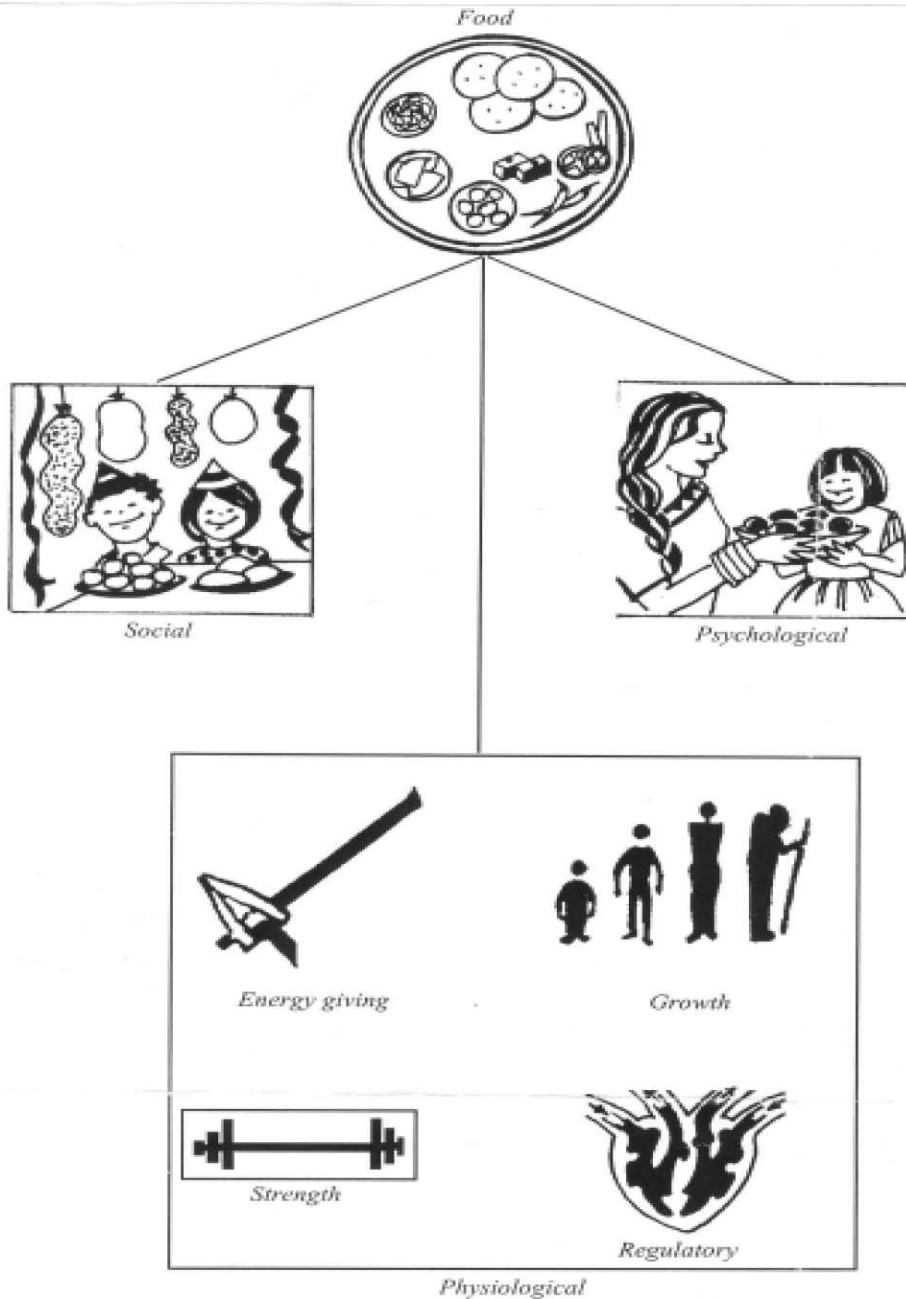
(i) Food provides energy Everybody needs energy to do work. Energy is required for walking,

studying, eating, working in the house or outside. You get this energy from the food that you eat. You need energy even when you are resting. Can you tell why? Different organs inside your body are always working, for example, heart is pumping blood, stomach is digesting food, lungs are breathing in air, etc. All these organs need energy for their respective functions and food provides that energy.

(ii) Food helps in body building Have you ever wondered how a small child grows into an adult? Our body is already made up of thousands of small cells. New cells are added to these to help the body to grow. Food is needed for the formation of new cells. Cells also die or are damaged due to injury. New cells need to be formed and this repair work is done with the help of food.

(iii) Food regulates body processes and provides protection against diseases Regulatory functions refer to the role of food in controlling body processes, for example, our body temperature is maintained at 98.60F or 370C. Similarly, the heart beats are also maintained at 72 beats/minute. Excretion of waste products from the body is also regular. If not, the body suffers from a disease called constipation which can lead to further complications. All these processes are regulated by the food that you eat. The food that we eat gives us strength to fight against disease and germs.

***Look at the illustration 4.1 to learn about the functions of food.***



### **NUTRITION AND NUTRIENTS**

Let us now read about the meaning of nutrition. All of us eat food. Food provides nourishment to the body and enables it to stay fit and healthy. The food that we eat undergoes many processes, like, first the food is digested, then it is absorbed into blood and transported to various parts of the body where it is utilised. The waste products and undigested food are excreted from the body.

**NUTRITION is the process by which food is taken in and utilised by the body.**

NUTRITION = Eating → Digestion → Absorption → Transportation → Utilisation

**Nutrients and their Functions**

We all know that food helps in the nourishment and health of our body. The nourishment is brought about by small units called nutrients present in food. Now what are these nutrients?

*Nutrients are the chemical substances present in food and are responsible for nourishing the body.*

Nutrients are of two types:

*Macronutrients*

*Micronutrients*

Both macronutrients and the micronutrients are equally essential for good health. Each nutrient plays a significant role in the body.

### **1. Macronutrients**

These are present in large quantities in foods and are also required in large amounts by the body. Carbohydrates, proteins, fats and oils are macronutrients.

#### **A. Carbohydrates**

(i) Available carbohydrates ;Carbohydrates are present in a large quantity as starch in cereals, legumes, pulses and potatoes. They are presented as simple carbohydrates in sugar, jaggery, fruits, honey and milk. Starch and sugars are easily digested and provide energy to the body.

(ii) Unavailable carbohydrates or dietary fibre

They are present in the form of cellulose and hemicellulose which are not digested in our body. They add bulk to the stool and help in easy defecation process. Energy can be derived from carbohydrates, fats and proteins and it is measured in kilo calories. However, carbohydrates are cheapest sources of energy. If there is a short supply of carbohydrates and fats in our body, proteins are utilised for energy production. Function of proteins is to provide for body building. Therefore, carbohydrates have to be consumed in proper amounts to spare proteins for body building purpose.

Functions of carbohydrates are summarised here:.

- Carbohydrates provide energy
- . Carbohydrates are the main source of energy
- . Carbohydrates spare proteins for body building function
- . Dietary fibre increases the bulk in stool and helps in defecation

1 gm of carbohydrate gives 4kcal of energy. Kilocalorie is the measure of energy in food.

Food sources of carbohydrates are: Cereals - wheat, rice, bajra, maize, etc. Pulses - Rajma, channa, all dals Roots and tubers - potatoes, sweet potatoes, beetroot and tapioca Sugar, jaggery

#### **B. Proteins**

Protein are needed in the body for body building.

1 gm of protein gives 4kcal of energy

Proteins are made up of smaller units known as amino acids. There are all together 22 amino acids, out of which there are 8 amino acids which our body cannot manufacture. Rest of the amino acids can be manufactured by the body. Essential amino acids are those which our body cannot manufacture and

hence have to be supplied through the diet. Non essential amino acids are those amino acids which our body can manufacture.

### **Functions and sources of proteins**

- (i) Needed for growth, maintenance and repair of tissues.
- (ii) Necessary for production of enzymes, hormones, antibodies, haemoglobin, etc.
- (iii) Help in the clotting of blood
  - (iii) Provide energy, if necessary

### **Sources ;**

- Meat, poultry, fish, eggs
- Milk, cheese, paneer, curd
- soybeans, peas, pulses,
- cereals, nuts and oilseeds like til, groundnuts, etc.

### **Special features**

- (i) Animal proteins, i.e., proteins from meat, eggs, milk, etc., are better than vegetable proteins, i.e., proteins, from pulses, cereals, etc. This is because proteins from vegetable sources do not contain all essential amino acids.
- (ii) Including two or more sources of vegetable proteins in each meal helps to improve the quality of proteins and their utilization.

Note:

When the body does not get enough carbohydrates or fats to meet its energy needs, proteins are broken down to supply these calories. When proteins are used for energy they are not available for other vital functions.

## **C. Fats and Oils**

Fats and oils are the concentrated source of energy in our diet. 1 gm of fat gives 9 kcal of energy. Fats are made up of small units called fatty acids. The nature of fats is dependent on the type of fatty acids present. Fatty acids may be saturated or unsaturated. Saturated fatty acids are found in solid fats whereas oils contain more of unsaturated fatty acids. Vegetable oils are rich in unsaturated fatty acids. Do you know there is a difference between fats and oils?

If a substance is liquid at room temperature it is called oil and if it is solid at the room temperature, it is known as fat.

### **Functions and sources of fats and oils**

- Provide concentrated source of energy
- Reduce the use of proteins for energy
- Carry fat soluble vitamins (A, D, E, K) into the body and help in the absorption of these vitamins
- Help to maintain body temperature. The layer of fat under the skin helps to conserve body heat
- Act as a cushion to certain vital organs

- Help in growth of tissues

#### Sources

-Cooking oils, ghee, butter

-Oilseeds, nuts, Meat, poultry, fish, eggs -Whole milk, cheese

#### **Special features**

(1)Fats improve the texture as well as absorb and retain flavours making meals more appetizing.

(ii) Fats have properties that help them to remain in the stomach longer and prolong the feeling of fullness

#### **2. Micronutrients**

Other important nutrients which are present in small quantities in foods but are essential for our body are called micronutrients. These are minerals and vitamins and are required in very small quantities. If these micronutrients are not eaten in required amounts, it results in deficiency diseases.

Minerals and vitamins are called micronutrients. Let us study some of the important micronutrients.

#### **1. Vitamins**

Our body contains very little quantity of vitamins, however, you will be surprised to know that they are responsible for all the major functions of the body. These vitamins are of two types:

(i) Fat soluble: A,D,E and K

(ii) Water soluble: B and C

Now, let us study the functions, food sources and deficiency diseases of these vitamins as given in table 4.1 and 4.2.

#### **Table 4.1 Fat Soluble Vitamins: Functions and Sources**

##### **Vitamin A**

- ❖ Essential for proper functioning of eyes, that is, vision in dim light, Liver, eggs, fish liver oils.

Milk and its products, Green leafy vegetables, i.e., bathua, etc.

- ❖ Necessary for healthy skin and linings of nose, mouth, throat, eyes, ears, lungs and other organs
- Sources are Yellow or orange fruits and vegetables such as pumpkin, carrot, papaya, mango, etc.

##### **Vitamin D**

- ❖ Necessary for formation of strong and healthy teeth and bones
- ❖ Helps in proper absorption and utilisation of Calcium in the body

-Exposure of skin to sunlight (When the body is exposed to the sun rays, a substance in the skin is converted into vitamin D and transferred to the blood stream)

-Sources are Eggs, liver, fish liver oils, Milk, butter, Refined oils and ghee are fortified with vitamin D



## **Vitamin E**

- ❖ Prevents destruction of certain substance in presence of oxygen
- Sources are All cereals, pulses, vegetables oils

## **Vitamin K**

- ❖ Necessary for clotting of blood

-Formed in the intestines by bacteria normally present there

Sources are Green leafy vegetables, like cabbages, Spinach, Egg, liver

## **2. Minerals**

Minerals constitute a very small amount of the total body tissues. However, these are essential for many vital processes and also for the maintenance of the body. In total, there are about 19 minerals required by the body in various amounts.

Let us now study some of the important minerals.

**Calcium:** Calcium and phosphorus are available in sufficient quantities in milk, curd, green leafy vegetables, ragi and oil seeds. Other foods also provide fair quantity of calcium.

The major function of calcium is the formation and development of bones and teeth. Calcium is also required in blood clotting and muscular contraction. Calcium is necessary for bone formation, blood clotting and muscular contraction

Deficiency of calcium in the body results in poor bone development, particularly in children, women and elderly. The deficiency disease is known as osteoporosis. In this, the bones becomes brittle and people become prone to frequent fractures.

**Iron:** Iron is required in very small quantity by the body. It is an important material present in haemoglobin which is a part of red blood cells and is responsible for the red colour of blood. Whole grain cereals and pulses are the major sources of iron in our diet. Other sources of iron are green leafy vegetables, egg yolk, liver and meat. In our country, majority of the population, especially women and children, suffer from iron deficiency disease called anaemia.

Young girls (12-18 yrs.) need more iron rich foods in their diets because of loss of iron during the menstrual cycle. Extra iron is also needed during pregnancy for healthy development and growth of the fetus.

This is not because people do not consume food which are rich in iron but because the absorption and utilization of iron is poor. This is due to the presence of certain naturally occurring constituents in food called oxalates and phytates. These oxalates and phytates are called inhibitors of iron. Vitamin C and proteins help in better absorption of iron and are known as enhancers of iron.

### **Iron is essential for haemoglobin formation.**

**Iodine:** Iodine is an important substance present in thyroxine hormone produced from thyroid gland. Thyroxine regulates various functions of the body. We get iodine from water and food. The foods which grow in iodine rich

soil provide iodine for us. Sea foods are also rich in iodine. Iodine deficiency disorder is known as goitre or enlargement of the neck region. Deficiency of iodine causes mental retardation in children. Recent studies have shown a direct link between iodine deficiency and academic performance of children. Iodine deficiency disorders have been identified in many parts of India.

**Iodine is necessary for growth and development.**

To avoid goitre we must have iodine rich food sources in our daily meals. Iodized salt is a good source of iodine and we must consume it instead of the non-iodized salt.

**Make iodized salt a part of your daily diet.**

Certain foodstuff like cabbage, cauliflower, radish, ladies finger, oilseeds etc., contains substances known as goitrogens which interfere with the body's ability to produce and use thyroxin. These goitrogens are destroyed on cooking. Therefore, these foodstuffs should be cooked before eating.

**3. WATER**

Water is the major constituent of our body. It forms about two-thirds of the body weight. We can do without food more readily than water. It is present in all the cells, being a vital part of all living tissues. It surrounds tissues and organs, and gives protection from shock. Water helps in digestion, absorption and transportation of nutrients in the body. It helps to excrete unwanted materials in the form of urine and maintains body temperature through perspiration.

Normally, we need to drink 6-8 glasses of water everyday. Other forms in which we can receive water are milk, juice, kanji, etc. Water is vital for survival

**NUTRIENT REQUIREMENTS**

Now we know that all the nutrients are required for good health. But how much should we eat so that our nutritional requirements are met? There are various factors which influence the nutritional requirements of an individual. Let us learn about them.

Nutritional requirements are influenced by:

- Age
- height/weight
- sex
- climatic condition
- . health
- . occupation
- . physiological condition

Indian Council of Medical Research (ICMR) after conducting a lot of research has recommended nutritional intakes for various age groups. You will find recommended dietary allowances (RDAs) given by ICMR for various physiological age groups. Have you noticed that a sedentary worker needs lesser calories than a person performing heavy work? There is a difference in energy requirements of males and females as well as physically fit or sick persons. Notice the difference in nutritional requirements of a woman during pregnancy and lactation and between boys and girls, men and women.

If you take a closer look at the above table, you will find the recommendations for infants, preschool and school children, adults and adolescents. Variations in energy needs according to activity are indicated in adult stage. Special requirements of pregnancy and lactation are also covered in the recommendation. A liberal margin of safety is provided in the recommended allowances to cover individual differences for need of the nutrients.

### **INTER-RELATIONSHIP OF FOOD, NUTRITION AND HEALTH**

Earlier in this lesson you have learnt about the meaning and functions of food. You have also read the definition of health in previous unit. Let us now learn about nutrition in detail and understand how food and nutrition are related to health.

Nutrition is a scientific discipline in which food is a major focus of interest. The simplest definition of nutrition is the study of what happens to food once it enters the mouth and thereafter. A more formal definition of nutrition is study of processes by which the living organism receives and utilises the materials necessary for growth, renewal and maintenance of body components. All foods contain some essential substances which perform important functions in our body. These essential substances contributed by our food are called nutrients. These nutrients help us to maintain our body functions, that is, to grow and to protect our organs from diseases and infections.

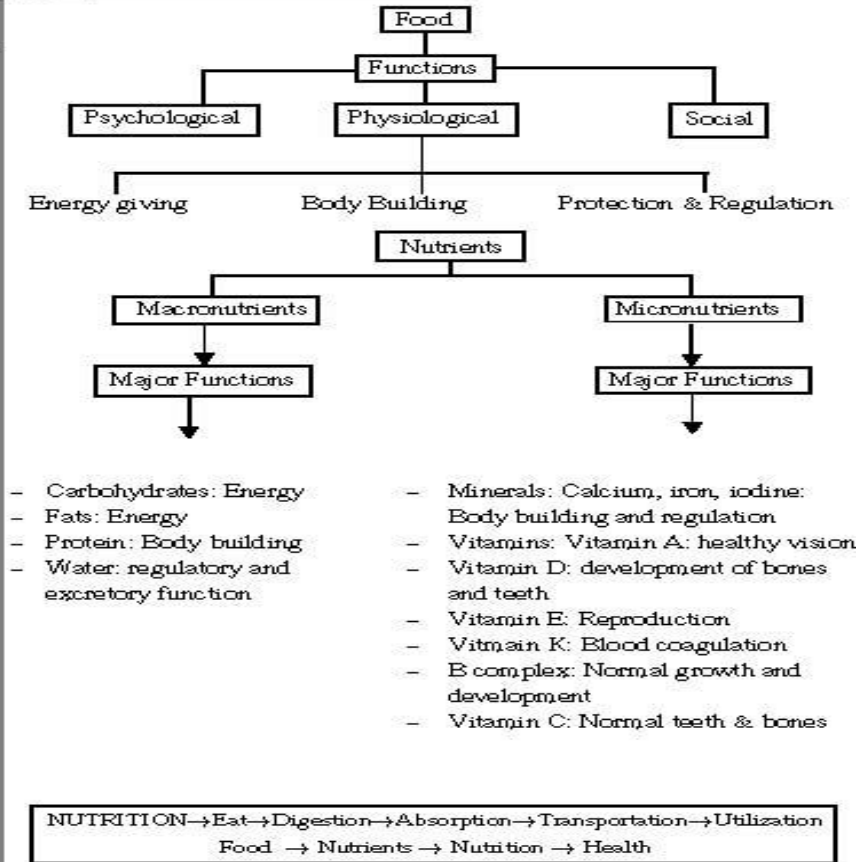
The health of a person depends on the type and Food Nutrition quantity of food stuff consumed. Good nutrition is essential for a person to grow and develop normally and to remain healthy throughout life. When a person does not eat proper food, there are chances of the body not developing normally. There are chances that some organs of the body Health may start malfunctioning or there may be some disease. Poor nutrition may also influence the mental and social well being adversely. Good nutrition is a prerequisite for good health.



Notes



**WHAT HAVE YOU LEARNT**



**MALNUTRITION**

According to the National Health Service (NHS), UK, it is estimated that over two million people are affected by malnutrition (sub nutrition).

Malnutrition is a broad term which refers to both under nutrition (sub nutrition) and over nutrition. Individuals are malnourished, or suffer from under nutrition if their diet does not provide them with adequate calories and protein for maintenance and growth, or they cannot fully utilise the food they eat due to illness. People are also malnourished, or suffer from over nutrition if they consume too many calories.

Malnutrition can also be defined as the insufficient, excessive or imbalanced consumption of nutrients. Several different nutrition disorders may develop, depending on which nutrients are lacking or consumed in excess.

Perhaps Malnutrition is the condition that results from taking an unbalanced diet in which certain nutrients are lacking, in excess (too high an intake), or in the wrong proportions.

A number of different nutrition disorders may arise, depending on which nutrients are under or overabundant in the diet.

Sub nutrition occurs when an individual does not consume enough food. It may exist if the person has a poor diet that gives them the wrong balance of basic food groups.

The World Health Organization cites malnutrition as the greatest single threat to the world's public health. Improving nutrition is widely regarded as the most effective form of aid. Emergency measures include providing deficient micronutrients through fortified sachet powders, such as peanut butter, or directly through supplements. The famine relief model increasingly used by aid groups calls for giving cash or cash vouchers to the hungry to pay local farmers instead of buying food from donor countries, often required by law, as it wastes money on transport costs.

There are various methods used to gauge the degree of malnutrition, including the Gomez Classification. This classifies as 1st, 2nd or 3rd degree malnutrition according to the percentage of normal body weight a person is.

Long term measures include fostering nutritionally dense agriculture by increasing yields, while making sure negative consequences affecting yields in the future are minimized.

Recent efforts include aid to farmers. However, World Bank strictures restrict government subsidies for farmers, while the spread of fertilizer use may adversely affect ecosystems and human health and is hampered by various civil society groups.

## **EFFECTS**

### **Mortality**

According to Jean Ziegler (the United Nations Special Rapporteur on the Right to Food for 2000 to March 2008), mortality due to malnutrition accounted for 58% of the total mortality in 2006: "In the world, approximately 62 million people, all causes of death combined, die each year. One in twelve people worldwide is malnourished. In 2006, more than 36 million died of hunger or diseases due to deficiencies in micronutrients". According to the World Health Organization, malnutrition is by far the biggest contributor to child mortality, present in half of all cases. Six million children die of hunger every year. Underweight births and inter-uterine growth restrictions cause 2.2 million child deaths a year. Poor or non-existent breastfeeding causes another 1.4 million. Other deficiencies, such as lack of vitamin A or zinc, for example, account for 1 million. Malnutrition in the first two years is irreversible. Malnourished children grow up with worse health and lower educational achievements. Their own children also tend to be smaller. Malnutrition was previously seen as something that exacerbates the problems of diseases as measles, pneumonia and diarrhoea. But malnutrition actually causes diseases as well, and can be fatal in its own right.

### **Causes**

Malnutrition increases the risk of infection and infectious disease; for example, it is a major risk factor in the onset of active tuberculosis. In communities or areas that lack access to safe drinking water, these additional health risks present a critical problem.

Lower energy and impaired function of the brain also represent the downward spiral of malnutrition as victims are less able to perform the tasks they need to in order to acquire food, earn an income, or gain an education.

Nutrients	Deficiency	Excess
Food energy	Starvation, Marasmus	Obesity, diabetes mellitus, Cardiovascular disease
Simple carbohydrates	none	diabetes mellitus, Obesity
Complex carbohydrates	none	Obesity
Saturated fat	low sex hormone levels	Cardiovascular disease
Trans fat	none	Cardiovascular disease
Unsaturated fat	none	Obesity
Fat	Malabsorption of Fat-soluble vitamins, Rabbit Starvation (If protein intake is high)	Cardiovascular disease (claimed by some)
Omega 3 Fats	Cardiovascular disease	Bleeding, Hemorrhages
Omega 6 Fats	none	Cardiovascular disease, Cancer
Cholesterol	none	Cardiovascular disease
Protein	kwashiorkor	Rabbit starvation
Sodium	hyponatremia	Hypernatremia, hypertension
Iron	Iron deficiency: Anemia	Cirrhosis, heart disease
Iodine	Iodine deficiency: Goiter, hypothyroidism	Iodine Toxicity (goiter, hypothyroidism)
Vitamin A	Vitamin A deficiency: Xerophthalmia and Night Blindness, low testosterone levels	Hypervitaminosis A (cirrhosis, hair loss)
Vitamin B <sub>1</sub>	Beri-Beri	
Vitamin B <sub>2</sub>	Ariboflavinosis: Cracking of skin and Corneal Ulceration	
Vitamin B <sub>3</sub>	Pellagra	dyspepsia, cardiac arrhythmias, birth defects
Vitamin B <sub>12</sub>	Pernicious anemia	
Vitamin C	Scurvy	diarrhea causing dehydration
Vitamin D	Rickets	Hypervitaminosis D (dehydration, vomiting, constipation)

Vitamin E	nervous disorders	Hypervitaminosis E (anticoagulant:
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			excessive bleeding)
Vitamin K	Vitamin K deficiency: Haemorrhage		
Calcium	Osteoporosis, tetany, carpopedal spasm, laryngospasm, cardiac arrhythmias		Fatigue, depression, confusion, anorexia, nausea, vomiting, constipation, pancreatitis, increased urination
Magnesium	Magnesium deficiency: Hypertension		Weakness, nausea, vomiting, impaired breathing, and hypotension
Potassium	Hypokalemia, cardiac arrhythmias		Hyperkalemia, palpitations
Boron	Boron deficiency		
Manganese	Manganese deficiency		

### Psychological

Malnutrition, in the form of iodine deficiency, is "the most common preventable cause of mental impairment worldwide." Even moderate iodine deficiency, especially in pregnant women and infants, lowers intelligence by 10 to 15 I.Q. points, shaving incalculable potential off a nation's development. The most visible and severe effects disabling goitres, cretinism and dwarfism affect a tiny minority, usually in mountain villages. But 16 percent of the world's people have at least mild goitre, a swollen thyroid gland in the neck.

Protein-calorie malnutrition can cause cognitive impairments. For humans, "critical period varies from the final third of gestation to the first 2 years of life".

Research indicates that improving the awareness of nutritious meal choices and establishing a long-term habit of healthy eating has a positive effect on a cognitive and spatial memory capacity, potentially increasing a student's potential to process and retain academic information.

Some organizations have begun working with teachers, policymakers, and managed food service contractors to mandate improved nutritional content and increased nutritional resources in school cafeterias from primary to university level institutions. Health and nutrition have been proven to have close links with overall educational success. Currently less than 10% of American college students report that they eat the recommended five servings of fruit and vegetables daily. Better nutrition has been shown to have an impact on both cognitive and spatial memory performance; a study showed those with higher blood sugar levels performed better on certain memory tests. In another study, those who consumed yogurt performed better on thinking tasks when compared to those who consumed caffeine free diet soda or confections. Nutritional deficiencies have been shown to have a negative effect on learning behaviour in mice as far back as 1951.

"Better learning performance is associated with diet induced effects on learning and memory ability".

The "nutrition-learning nexus" demonstrates the correlation between diet and learning and has application in a higher education setting.

"We find that better nourished children perform significantly better in school, partly because they enter school earlier and thus have more time to learn but mostly because of greater learning productivity per year of schooling."

91% of college students feel that they are in good health while only 7% eat their recommended daily allowance of fruits and vegetables.

Nutritional education is an effective and workable model in a higher education setting. More "engaged" learning models that encompass nutrition is an idea that is picking up steam at all levels of the learning cycle.

There is limited research available that directly links a student's Grade Point Average (G.P.A.) to their overall nutritional health. Additional substantive data is needed to prove that overall intellectual health is closely linked to a person's diet, rather than just another correlation fallacy.

Nutritional supplement treatment may be appropriate for major depression, bipolar disorder, schizophrenia, and obsessive compulsive disorder, the four most common mental disorders in developed countries. Supplements that have been studied most for mood elevation and stabilization include eicosapentaenoic acid and docosahexaenoic acid (each of which are an omega-3 fatty acid contained in fish oil, but not in flaxseed oil), vitamin B12, folic acid, and inositol.

### **Cancer**

Cancer is now common in developing countries. According a study by the International Agency for Research on Cancer, "In the developing world, cancers of the liver, stomach and oesophagus were more common, often linked to consumption of carcinogenic preserved foods, such as smoked or salted food, and parasitic infections that attack organs." Lung cancer rates are rising rapidly in poorer nations because of increased use of tobacco. Developed countries "tended to have cancers linked to affluence or a 'Western lifestyle' cancers of the colon, rectum, breast and prostate that can be caused by obesity, lack of exercise, diet and age."

### **Metabolic syndrome**

Several lines of evidence indicate lifestyle-induced hyperinsulinemia and reduced insulin function (i.e. insulin resistance) as a decisive factor in many disease states. For example, hyperinsulinemia and insulin resistance are strongly linked to chronic inflammation, which in turn is strongly linked to a variety of adverse developments such as arterial microinjuries and clot formation (i.e. heart disease) and exaggerated cell division (i.e. cancer). Hyperinsulinemia and insulin resistance (the so-called metabolic syndrome) are characterized by a combination of abdominal obesity, elevated blood sugar, elevated blood pressure, elevated blood triglycerides, and reduced HDL cholesterol. The negative impact of hyperinsulinemia on prostaglandin PGE1/PGE2 balance may be significant.

The state of obesity clearly contributes to insulin resistance, which in turn can cause type 2 diabetes. Virtually all obese and most type 2 diabetic individuals have marked insulin resistance. Although the association between overweight and insulin resistance is clear, the exact (likely multifarious) causes of insulin resistance remain less clear. Importantly, it has been demonstrated that appropriate exercise, more regular food intake and reducing glycemic load (see below) all can reverse insulin resistance in overweight individuals (and thereby lower blood sugar levels in those who have type 2 diabetes).

Obesity can unfavourably alter hormonal and metabolic status via resistance to the hormone leptin, and a vicious cycle may occur in which insulin/leptin resistance and



obesity aggravate one another. The vicious cycle is putatively fuelled by continuously high insulin/leptin stimulation and fat storage, as a result of high intake of strongly insulin/leptin stimulating foods and energy. Both insulin and leptin normally function as satiety signals to the hypothalamus in the brain; however, insulin/leptin resistance may reduce this signal and therefore allow continued overfeeding despite large body fat stores. In addition, reduced leptin signalling to the brain may reduce leptin's normal effect to maintain an appropriately high metabolic rate.

There is a debate about how and to what extent different dietary factors such as intake of processed carbohydrates, total protein, fat, and carbohydrate intake, intake of saturated and Trans fatty acids, and low intake of vitamins/minerals contribute to the development of insulin and leptin resistance. In any case, analogous to the way modern man-made pollution may potentially overwhelm the environment's ability to maintain homeostasis, the recent explosive introduction of high glycemic index and processed foods into the human diet may potentially overwhelm the body's ability to maintain homeostasis and health (as evidenced by the metabolic syndrome epidemic).

### **Hyponatremia**

Excess water intake, without replenishment of sodium and potassium salts, leads to hyponatremia, which can further lead to water intoxication at more dangerous levels. A well-publicized case occurred in 2007, when Jennifer Strange died while participating in a water-drinking contest. More usually, the condition occurs in long-distance endurance events (such as marathon or triathlon competition and training) and causes gradual mental dulling, headache, drowsiness, weakness, and confusion; extreme cases may result in coma, convulsions, and death. The primary damage comes from swelling of the brain, caused by increased osmosis as blood salinity decreases. Effective fluid replacement techniques include Water aid stations during running/cycling races, trainers providing water during team games such as Soccer and devices such as Camel Bakes which can provide water for a person without making it too hard to drink the water.

### **Overeating vs. Hunger**

Although a lot of the focus regarding malnutrition centres around undernourishment, overeating is also a form of malnutrition. Overeating is much more common in the United States, where for the majority of people, access to food is not an issue. The issue in these developed countries is choosing the right kind of food. Fast food is consumed more per capita in the United States than in any other country. The reason for this mass consumption of food is the affordability and accessibility. Oftentimes the fast food, low in cost and nutrition, is high in calories and heavily promoted. When these eating habits are combined with increasingly urbanized, automated, and more sedentary lifestyles, it becomes clear why gaining weight is difficult to avoid.

However, overeating is also a problem in countries where hunger and poverty persist. In China, consumption of high-fat foods has increased while consumption of rice and other goods has decreased. Overeating leads to many diseases, such as heart disease and diabetes that may result in death.

### **Causes**

Major causes of malnutrition include poverty and food prices, dietary practices and agricultural productivity, with many individual cases being a mixture of several

factors. Malnutrition can also be a consequence of other health issues such as gastroenteritis or chronic illness, especially the HIV/AIDS pandemic. Clinical malnutrition, such as in cachexia, is a major burden also in developed countries.

### **Poverty and food prices**

As much as food shortages may be a contributing factor to malnutrition in countries with lack of technology, the FAO (Food and Agriculture Organization) has estimated that eighty percent of malnourished children living in the developing world live in countries that produce food surpluses. The economist Amartya Sen observed that, in recent decades, famine has always a problem of food distribution and/or poverty, as there has been sufficient food to feed the whole population of the world. He states that malnutrition and famine were more related to problems of food distribution and purchasing power.

It is argued that commodity speculators are increasing the cost of food. As the real estate bubble in the United States was collapsing, it is said that trillions of dollars moved to invest in food and primary commodities, causing the 2007–2008 food price crisis.

The use of bio fuels as a replacement for traditional fuels may leave less supply of food for nutrition and raises the price of food. The United Nations special rapporteur on the right to food, Jean Ziegler proposes that agricultural waste, such as corn cobs and banana leaves, rather than crops themselves be used as fuel.

### **Dietary practices**

A lack of breastfeeding can lead to malnutrition in infants and children. Possible reasons for the lack in the developing world may be that the average family thinks bottle feeding is better. The WHO says mothers abandon it because they do not know how to get their baby to latch on properly or suffer pain and discomfort.

Deriving too much of one's diet from a single source, such as eating almost exclusively corn or rice, can cause malnutrition. This may either be from a lack of education about proper nutrition, or from only having access to a single food source.

Many tend to think malnutrition only in terms of hunger, however, overeating is also a contributing factor as well. Many parts of the world have access to a surplus of non-nutritious food, in addition to increased sedentary lifestyles. In turn, this has created a universal epidemic of obesity. Yale psychologist Kelly Brownell calls this a "toxic food environment" where fat and sugar laden foods have taken precedent over healthy nutritious foods. Not only does obesity occur in developed countries, problems are also occurring in developing countries in areas where income is on the rise.

### **Agricultural productivity**

Food shortages can be caused by a lack of farming skills such as crop rotation, or by a lack of technology or resources needed for the higher yields found in modern agriculture, such as nitrogen fertilizers, pesticides and irrigation. As a result of widespread poverty, farmers cannot afford or governments cannot provide the technology. The World Bank and some wealthy donor countries also press nations that depend on aid to cut or eliminate subsidized agricultural inputs such as fertilizer, in the name of free market policies even as the United States and Europe extensively subsidized their own farmers. Many, if not most, farmers cannot afford fertilizer at market prices, leading to low agricultural production and wages and high, unaffordable food prices. Reasons for the unavailability of fertilizer include moves to

stop supplying fertilizer on environmental grounds, cited as the obstacle to feeding Africa by the Green Revolution pioneer Norman Borlaug.

### **Future threats**

There are a number of potential disruptions to global food supply that could cause widespread malnutrition.

Climate change is of great importance to food security. With 95% of all malnourished peoples living in the relatively stable climate region of the sub-tropics and tropics. According to the latest IPCC reports, temperature increases in these regions are "very likely." Even small changes in temperatures can lead to increased frequency of extreme weather conditions. Many of these have great impact on agricultural production and hence nutrition. For example, the 1998–2001 central Asian droughts brought about an 80% livestock loss and 50% reduction in wheat and barley crops in Iran. Similar figures were present in other nations. An increase in extreme weather such as drought in regions such as Sub-Saharan would have even greater consequences in terms of malnutrition. Even without an increase of extreme weather events, a simple increase in temperature reduces the productiveness of many crop species, also decreasing food security in these regions.

Colony collapse disorder is a phenomenon where bees are dying in large numbers. Since many agricultural crops worldwide are pollinated by bees, this represents a serious threat to the supply of food.

An epidemic of stem rust on wheat caused by race Ug99 is currently spreading across Africa and into Asia and, it is feared, could wipe out more than 80% of the world's wheat crops.

### **Management**

Main articles: Ready-to-Use Therapeutic food and famine relief

Fighting malnutrition, mostly through fortifying foods with micronutrients (vitamins and minerals), improves lives at a lower cost and shorter time than other forms of aid, according to the World Bank. The Copenhagen Consensus, which look at a variety of development proposals, ranked micronutrient supplements as number one. However, roughly \$300m of aid goes to basic nutrition each year, less than \$2 for each child below two in the 20 worst affected countries. In contrast, HIV/AIDS, which causes fewer deaths than child malnutrition, received \$2.2 billion—\$67 per person with HIV in all countries.

### **Emergency measures**

Micronutrients can be obtained through fortifying foods. Fortifying foods such as peanut butter sachets (see Plumpy'Nut) and Spirulina have revolutionized emergency feeding in humanitarian emergencies because they can be eaten directly from the packet, do not require refrigeration or mixing with scarce clean water, can be stored for years and, vitally, can be absorbed by extremely ill children. The United Nations World Food Conference of 1974 declared Spirulina as 'the best food for the future' and its ready harvest every 24 hours make it a potent tool to eradicate malnutrition. Additionally, supplements, such as Vitamin A capsules or Zinc tablets to cure diarrhea in children, are used.

There is a growing realization among aid groups that giving cash or cash vouchers instead of food is a cheaper, faster, and more efficient way to deliver help to the hungry, particularly in areas where food is available but unaffordable. The UN's World Food Program, the biggest non-governmental distributor of food, announced that it will

begin distributing cash and vouchers instead of food in some areas, which Josette Sheeran, the WFP's executive director, described as a "revolution" in food aid. The aid agency Concern Worldwide is piloting a method through a mobile phone operator, Safaricom, which runs a money transfer program that allows cash to be sent from one part of the country to another.

However, for people in a drought living a long way from and with limited access to markets, delivering food may be the most appropriate way to help. Fred Cuny stated that "the chances of saving lives at the outset of a relief operation are greatly reduced when food is imported. By the time it arrives in the country and gets to people, many will have died." US Law, which requires buying food at home rather than where the hungry live, is inefficient because approximately half of what is spent goes for transport. Fred Cuny further pointed out "studies of every recent famine have shown that food was available in-country though not always in the immediate food deficit area" and "even though by local standards the prices are too high for the poor to purchase it, it would usually be cheaper for a donor to buy the hoarded food at the inflated price than to import it from abroad." Ethiopia has been pioneering a program that has now become part of the World Bank's prescribed recipe for coping with a food crisis and had been seen by aid organizations as a model of how to best help hungry nations. Through the country's main food assistance program, the Productive Safety Net Program, Ethiopia has been giving rural residents who are chronically short of food, a chance to work for food or cash. Foreign aid organizations like the World Food Program were then able to buy food locally from surplus areas to distribute in areas with a shortage of food. Not only has Ethiopia been pioneering a program but Brazil has also established a recycling program for organic waste that benefits farmers, urban poor, and the city in general. City residents separate organic waste from their garbage, bag it, and then exchange it for fresh fruit and vegetables from local farmers. As a result, this reduces its countries waste and the urban poor get a steady supply of nutritious food.

### **Long-term measures**

The effort to bring modern agricultural techniques found in the West, such as nitrogen fertilizers and pesticides, to Asia, called the Green Revolution, resulted in decreases in malnutrition similar to those seen earlier in Western nations. This was possible because of existing infrastructure and institutions that are in short supply in Africa, such as a system of roads or public seed companies that made seeds available. Investments in agriculture, such as subsidized fertilizers and seeds, increases food harvest and reduces food prices. For example, in the case of Malawi, almost five million of its 13 million people used to need emergency food aid. However, after the government changed policy and subsidies for fertilizer and seed were introduced against World Bank strictures, farmers produced record-breaking corn harvests as production leaped to 3.4 million in 2007 from 1.2 million in 2005, making Malawi a major food exporter. This lowered food prices and increased wages for farm workers. Proponents for investing in agriculture include Jeffrey Sachs, who has championed the idea that wealthy countries should invest in fertilizer and seed for Africa's farmers.

Breast-feeding education helps. Breastfeeding in the first two years and exclusive breastfeeding in the first six months could save 1.3 million children's lives. In the longer term, firms are trying to fortify everyday foods with micronutrients that can be sold to consumers such as wheat flour for Beladi bread in Egypt or fish sauce in Vietnam and the iodization of salt.

Restricting population size is a proposed solution. Thomas Malthus argued that population growth could be controlled by natural disasters and voluntary limits through “moral restraint.” Robert Chapman suggests that an intervention through government policies is a necessary ingredient of curtailing global population growth. However, there are many who believe that the world has more than enough resources to sustain its population. Instead, these theorists point to unequal distribution of resources and under- or unutilized arable land as the cause for malnutrition problems. For example, Amartya Sen advocates that, “no matter how a famine is caused, methods of breaking it call for a large supply of food in the public distribution system. This applies not only to organizing rationing and control, but also to undertaking work programmes and other methods of increasing purchasing power for those hit by shifts in exchange entitlements in a general inflationary situation.” One suggested policy framework to resolve access issues is termed food sovereignty, the right of peoples to define their own food, agriculture, livestock, and fisheries systems in contrast to having food largely subjected to international market forces. Food First is one of the primary think tanks working to build support for food sovereignty. Neoliberals advocate for an increasing role of the free market. Another possible long term solution would be to increase access to health facilities to rural parts of the world. These facilities could monitor undernourished children, act as supplemental food distribution centres, and provide education on dietary needs. These types of facilities have already proven very successful in countries such as Peru and Ghana. New technology in agricultural production also has great potential to combat under nutrition. By improving agricultural yields, farmers could reduce poverty by increasing income as well as open up area for diversification of crops for household use. The World Bank itself claims to be part of the solution to malnutrition, asserting that the best way for countries to succeed in breaking the cycle of poverty and malnutrition is to build export-led economies that will give them the financial means to buy foodstuffs on the world market.

When aiming to prevent rather than treat overeating, which is also a form of malnutrition, starting in the school environment would be the perfect place as this is where the education children receive today will help them choose healthier foods during childhood, as well as into adulthood. As seen in Singapore, if we increase nutrition in school lunch programs and physical activity for children and teachers, obesity can be reduced by almost 30–50%.

### **Epidemiology**

Disability adjusted life year for nutritional deficiencies per 100,000 inhabitants in 2002. Nutritional deficiencies included: protein-energy malnutrition, iodine deficiency, vitamin A deficiency, and iron deficiency anaemia.

There were 925 million undernourished people in the world in 2010, an increase of 80 million since 1990, despite the fact that the world already produces enough food to feed everyone 6 billion people and could feed double 12 billion people.

Percentage of population affected by undernutrition by country, according to United Nations statistics. Number of undernourished people (million) in 2001–2003 and 2005–2007. According to the FAO, these countries had 5 million or more undernourished people in 2001–2003 and in 2005–2007

Country	2001-2003	2005-2007
India	217.05	237.7
China	154.0	130.4
Bangladesh	43.45	41.7
Democratic Republic of Congo	37.0	41.9
Pakistan	35.2	43.4
Ethiopia	31.5	31.6
Tanzania	16.1	13.7
Philippines	15.2	13.2
Brazil	14.4	12.1
Indonesia	13.8	29.9
Vietnam	13.8	9.6
Thailand	13.4	10.8
Nigeria	11.5	9.2
Kenya	9.7	11.2
Sudan	8.8	8.8
Mozambique	8.3	8.1
North Korea	7.9	7.8
Yemen	7.1	6.7
Madagascar	7.1	4.5
Colombia	5.9	4.3
Zimbabwe	5.7	3.7
Mexico	5.1	-
Zambia	5.1	5.2
Angola	5.0	7.1
Myanmar	-	7.8

Note: This table measures "undernourishment", as defined by FAO, and represents the number of people consuming (on average for years 2001 to 2003) less than the minimum amount of food energy (measured in kilocalories per capita per day) necessary for the average person to stay in good health while performing light physical activity. It is a conservative indicator that does not take into account the extra needs of people performing extraneous physical activity, nor seasonal variations in food consumption or other sources of variability such as inter-individual differences in energy requirements.

Malnutrition and undernourishment are cumulative or average situations, and not the work of a single day's food intake (or lack thereof). This table does not represent the number of people who "went to bed hungry today." Various scales of analysis also have to be considered in order to determine the socio-political causes of malnutrition. For example, the population of a community may be at risk if it lacks health-related services, but on a smaller scale certain households or individuals may be at even higher risk due to differences in income levels, access to land, or levels of education.

Also within the household, there may be differences in levels of malnutrition between men and women, and these differences have been shown to vary significantly from one region to another with problem areas showing relative deprivation of women. Children and the elderly tend to be especially susceptible. Approximately 27 percent of children under 5 in developing world are malnourished, and in these developing countries, malnutrition claims about half of the 10 million deaths each year of children under 5.

### **Middle East**

Malnutrition rates in Iraq had risen from 19% before the US-led invasion to a national average of 28% four years later.

### **South Asia**

According to the Global Hunger Index, South Asia has the highest child malnutrition rate of world's regions. India contributes to about 5.6 million child deaths every year, more than half the world's total. The 2006 report mentioned that "the low status of women in South Asian countries and their lack of nutritional knowledge are important determinants of high prevalence of underweight children in the region" and was concerned that South Asia has "inadequate feeding and caring practices for young children".

Half of children in India are underweight, one of the highest rates in the world and nearly double the rate of Sub-Saharan Africa.

Research on overcoming persistent under-nutrition published by the Institute of Development Studies, argues that the co-existence of India as an 'economic powerhouse' and home to one-third of the world's under-nourished children reflects a failure of the governance of nutrition: "A poor capacity to deliver the right services at the right time to the right populations, an inability to respond to citizens' needs and weak accountability are all features of weak nutrition governance." The research suggests that to make under-nutrition history in India the governance of nutrition needs to be strengthened and new research needs to focus on the politics and governance of nutrition. At the current rate of progress the MDG1 target for nutrition will only be reached in 2042 with severe consequences for human wellbeing and economic growth.

### **United States**

Childhood malnutrition is generally thought of as being limited to developing countries, but although most malnutrition occurs there, it is also an ongoing presence in developed nations. For example, in the United States of America, one out of every six children is at risk of hunger.<sup>1</sup> A study, based on 2005–2007 data from the U.S. Census Bureau and the Agriculture Department, shows that an estimated 3.5 million children under the age of five are at risk of hunger in the United States. In developed countries, this persistent hunger problem is not due to lack of food or food programs, but is largely due to an underutilization of existing programs designed to address the issue, such as food stamps or school meals. Many citizens of rich countries such as the United States of America attach stigmas to food programs or otherwise discourage their use. In the USA, only 60% of those eligible for the food stamp program actually receive benefits. The U.S. Department of Agriculture reported that in 2003, only 1 out of 200 U.S. households with children became so severely food insecure that any of the children went hungry even once during the year. A substantially larger proportion of these same households (3.8 percent) had adult members who were hungry at least one day during the year because of their households' inability to afford enough food.

### **Underweight**

Underweight refers to a human who is considered to be under a healthy "weight". "Underweight" means weighing less than what is expected to be a healthy person (underweight = insufficiency of weight). The definition is usually made with reference to the body mass index (BMI). A BMI of under 18.5 is usually referred to as underweight. *Calculate your Body Mass Index*, National Institutes of Health, retrieved 2009-04-27

### **Causes**

The most common cause of a person being underweight is primarily malnutrition caused by the unavailability of adequate food.

Some people are underweight due to genetics; others due to poverty.

Being underweight can sometimes be the result of mental or physical disease, such as hyperthyroidism, cancer, or tuberculosis. People with gastrointestinal or liver problems may be unable to absorb nutrients adequately. People with eating disorders, such as anorexia nervosa, are likely to become underweight.

### **Problems**

The immediate problem with being underweight is that it might be secondary to, and/or symptomatic of, an underlying disease. Unexplained weight loss requires professional medical diagnosis.

Underweight can also be a primary causative condition. Severely underweight individuals may have poor physical stamina and a weak immune system, leaving them open to infection. According to Robert E. Black of the Johns Hopkins School of Public Health, "Underweight status ... and micronutrient deficiencies also cause decreases in immune and non-immune host defences, and should be classified as underlying causes of death if followed by infectious diseases that are the terminal associated causes. People who are malnourished underweight raise special concerns, as not only gross caloric intake may be inadequate, but also intake and absorption of other vital nutrients, especially essential amino acids and micro-nutrients such as vitamins and minerals.

In women, being grossly underweight can result in amenorrhea (absence of menstruation), infertility and possible complications during pregnancy. It can also cause anaemia and hair loss.

Underweight is an established risk factor for osteoporosis, even for young people. This is a particular insidious consequence, because the affected persons do not notice the danger. After the occurrence of first spontaneous fractures the damage is often already irreversible.

Being underweight causes increased mortality at rates comparable to that seen in morbidly obese people.

## **TREATMENT**

### **Diet**

There are two ways to gain weight through diet- an unhealthy way and a healthy way. The unhealthy route to gaining weight is consuming junk food and not getting adequate exercise. The healthy way to gain weight is by increasing calorie amounts of the food that you already eat. Placing reasonable amounts of butter, cream or cheesesauces, peanut butter, olive oil, salad dressing, seeds, and nuts on foods help increase food calories. Eating calorie-dense foods can also be beneficial. Some examples of calorie-dense foods are: dried fruits, cheese, raisins, and nuts. Drinking



liquids with high calories can add up weight. Some examples of popular weight gain drinks are Ensure and Boost. Other examples are milk and fruit juice. Eating a healthy diet is also crucial in weight gain. Consuming starchy vegetables like potatoes and corn can also add weight gain. Eating protein, healthy fats, carbohydrates, vegetables, fruits are important for a weight gain diet. Nutritional supplements may be beneficial for people who aren't getting enough vitamins or minerals.

### **Exercise**

Another way for underweight people to gain weight is by exercising. The addition of muscles will increase your body mass. Weight-lifting exercises are effective in helping to increase muscle tone as well as helping with gaining weight.

### **Appetite Stimulants**

#### **Orexigenic**

Finally, certain drugs may increase appetite either as their primary effect, or as a side-effect as in the majority of cases. Antidepressants such as mirtazapine or amitriptyline, antipsychotics (particularly chlorpromazine and haloperidol, as well as tetrahydrocannabinol (found in cannabis), all present an increase in appetite as a side-effect. In states where it is approved, medicinal marijuana may be prescribed for severe appetite loss, such as that caused by cancer, AIDS or even severe levels of persistent anxiety. Other drugs which may increase appetite include certain benzodiazepines (such as diazepam), sedating antihistamines (such as diphenhydramine or promethazine, or B vitamin supplements.

Exercise itself is catabolic, which results in a brief reduction in mass. The gain in weight that can result of it comes from the anabolic over-compensation when the body recovers (via rest and eating) and overcompensates via muscle hypertrophy. This can happen via an increase in the muscle proteins, or through enhanced storage of glycogen in muscles. Exercise can help stimulate people's appetite if they are not inclined to eat.

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