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Nutritional disorders in India and their alleviation through counseling and diet modification

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Abstract
Nutrition is a critical part of health and development. Better nutrition is related to improved health, stronger immune systems, lower risk of non-communicable diseases such as diabetes and cardiovascular disease and longevity. Today, nearly one in three persons globally suffers from at least one form of malnutrition: wasting, stunting, vitamin and mineral deficiency, overweight or obesity and diet-related non-communicable diseases. India ranks 100th among 119 developing nations on global hunger index. (GHI). 780 million, live in developing countries, representing 12.9 percent, or one in eight, of the population of developing counties are hungry. Malnutrition, in every form presents significant threats to human health. Micronutrient insufficiencies cause a variety of disorders, and correction of these deficiencies on an individual basis is cost prohibitive. One of the World's greatest challenges is to secure sufficient and healthy food for all, and to do so in an environmentally sustainable manner. Therefore, food fortification is an accepted, practical and affordable solution to overcome this problem. The cost of adding vitamins and minerals to commonly consumed foods is very low; estimated to range between 0.5% and 2.0% of the cost of a typical staple food. Current progress is insufficient to reach the World Health Assembly targets set for 2025 and the Sustainable Development Goals set for 2030. A lasting end to hunger and micronutrient deficiencies requires an immediate attention. The increased food production, providing food in an environmentally sustainable manner, proper distribution of food, safe water, public health, primary care services including immunization, nutritional education and raising the income of poor people can be the keys while addressing the hunger.

Keywords: Malnutrition, hunger, stunting, fortification, immunization, etc.

Introduction
Nutrition is the science that interprets the interaction of nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. It includes food intake, absorption, assimilation, biosynthesis, catabolism and excretion. The diet of an organism is what it eats, which is largely determined by the availability and palatability of foods (Chandra, 2002) [6]. Nutritional deficiencies occur when the quantity or quality of food is not sufficient to meet a person's needs. This may be caused by not having enough food to eat or by infections with bacteria, viruses or parasites. Infections can increase Peoples nutrient requirements and reduce their appetite. Nutritional deficiencies lead to malnutrition. Under-nutrition can lead to the wasting of kwashiorkor in acute cases, and the stunting of marasmus in chronic cases of malnutrition (Geary, 2001) [8].

Nutrients
Nutrients include the constituents in food that must be supplied to the body in adequate amounts. These include Carbohydrates, Proteins, Fats, Minerals and Vitamins. Nutritional status is the condition of health of the individual as influenced by the utilization of the nutrients. These are thought to be of two types: macro-nutrients which are needed in relatively large amounts, and micronutrients which are needed in smaller quantities.

Macronutrients
The macronutrients are carbohydrates, fibre, fats, protein, and water. The macronutrients (excluding fibre and water) provide structural material (amino acids from which proteins are built, and lipids from which cell membranes and some signalling molecules are built) and energy. Some of the structural material can be used to generate energy internally, and in either case it is measured in Joules or kilocalories, often called "Calories" (IFPRI, 2015) [10].

Micronutrients

Micronutrients are nutrients that the human body needs in minute amounts so that it can function properly. Although, they are needed only in small amounts, their deficiency leads to critical health problems. Vitamins and minerals are the two types of micronutrients. While only needed in small amounts, they play important roles in human development and well-being, including the regulation of metabolism, heartbeat, cellular pH, and bone density. Lack of micronutrients can lead to stunted growth in children and increased risk for various diseases in adulthood. Without proper consumption of micronutrients, humans can suffer from diseases such as rickets (lack of vitamin D), scurvy (lack of vitamin C), and osteoporosis (lack of calcium). (UNICEF, 2009) [22]

Malnutrition

Malnutrition as defined by World Health Organisation (WHO) is a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients, this state being clinically manifested or detected only by biochemical, anthropometric or physiological tests.

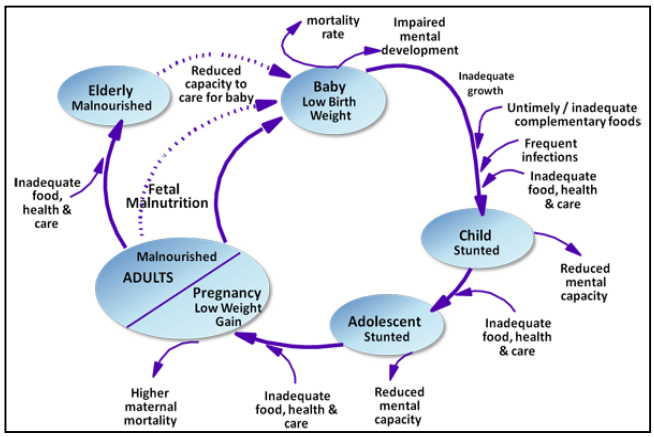
Four forms can be distinguished

a. **Under-nutrition:** The pathological state resulting from the consumption of an inadequate quantity of food over an extended period of time.
b. **Marasmus:** Is synonymous with severe under-nutrition. Starvation implies total elimination of food and hence the rapid development of under nutrition and marasmus.
c. **Specific deficiency:** The pathological state resulting from a relative or absolute lack of an individual nutrient.
d. **Over nutrition:** The pathological state resulting from a disproportion of essential nutrients with or without the absolute deficiency of any nutrient as determined by the requirement of a balanced diet.

Malnutrition is a condition that results from eating a diet in which nutrients are either not enough or are too much such that the diet causes health problems. It may involve calories, protein, carbohydrates, vitamins or minerals. Not enough nutrients is called under nutrition or undernourishment while too much is called over nutrition.

Malnutrition infection cycle

There is a simple mechanism which can explain the cycle of malnutrition. Dietary insufficiency leads to inadequacy of the body to repair the tissues that are damaged. This inadequacy does not allow the body to create new cells to replenish the damaged ones. This occurs more in the small intestine which is the hub for absorption of food. The food that is absorbed is further utilized for making new cells. In the event of malnutrition poor absorption of food further damages the body's ability to replenish new cells and hence the cycle continues and deteriorates the condition. Also, one more effect of malnutrition is dark spots in the skin although it is rarely noticed (Bhaskaram, 1992) [4]. Malnutrition affects children very badly. If the children are born malnourished they are most likely to have a poor body growth. The most common deficiencies found in children are iron, iodine and Vitamin A, and this poses a major challenge for countries. Deficiencies like these reduce the body's ability to fight diseases.



Source: United Nations Subcommittee on Nutrition Fourth Report on the World Nutrition Situation, 2000

Malnutrition can be divided into two different types, SAM and MAM. SAM refers to children with severe acute malnutrition. MAM refers to moderate acute malnutrition. Under-nutrition is sometimes used as a synonym of protein–energy malnutrition (PEM. Two forms of PEM are kwashiorkor and marasmus, and they commonly coexist (WHO, 2001) [26].

Kwashiorkor

Kwashiorkor is mainly caused by inadequate protein intake. The main symptoms are oedema, wasting, liver enlargement, hypo-albuminaemia, steatosis, and possibly depigmentation of skin and hair. Kwashiorkor is further identified by swelling of the belly, which is deceiving of actual nutritional status. The term means ‘displaced child’ and is derived from a Ghana language of West Africa, means "the sickness the older one gets when the next baby is born," as this is when the older child is deprived of breast feeding and weaned to a diet composed largely of carbohydrates.

Marasmus

Marasmus (‘to waste away’) is caused by an inadequate intake of protein and energy. The main symptoms are severe wasting, leaving little or no edema, minimal subcutaneous fat, severe muscle wasting, and non-normal serum albumin levels. Marasmus can result from a sustained diet of inadequate energy and protein, and the metabolism adapts to prolong survival. It is traditionally seen in famine, significant food restriction, or more severe cases of anorexia Conditions are characterized by extreme wasting of the muscles and a gaunt expression.

Under-nutrition, hunger

Under-nutrition encompasses stunted growth (stunting), wasting, and deficiencies of essential vitamins and minerals (collectively referred to as micronutrients). The term hunger, which describes a feeling of discomfort from not eating, has been used to describe under-nutrition, especially in reference to food insecurity (UNICEF, 2017) [20, 21].

Effects

Malnutrition increases the risk of infection and infectious disease, and moderate malnutrition if there is lethargy, limpness, convulsion, or loss of consciousness. Protein and energy malnutrition and deficiencies of specific micronutrients (including iron, zinc, and vitamins) increase susceptibility to infection. Malnutrition affects HIV

transmission by increasing the risk of transmission from mother to child and also increasing replication of the virus. 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. Hypoglycemia (low blood sugar) can result from a child not eating for 4 to 6 hours. Hypoglycemia should be considered immediately and quickly, perform a finger or heel stick (Bhargava, 2016) [3].

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. Clinical malnutrition, such as: cachexia, is a major burden also in developed countries. 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 that is within poor governments may be at risk if the area lacks health-related services, but on a smaller scale certain households or individuals may be at an even higher risk due to differences in income levels, access to land, or levels of education.

Poverty and Food Prices

Poor socioeconomic position is associated with chronic malnutrition since it inhibits purchase of nutritious foods such as milk, meat, poultry, and fruits. 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. It has been observed that, in recent decades, famine has always been a problem of food distribution and/or poverty, as there has been sufficient food to feed the whole population of the world. Malnutrition and famine are more related to problems of food distribution and purchasing power (FAO, 2001) [7].

Micronutrient Deficiency

Micronutrient deficiency is a lack of essential vitamins and minerals required in small amounts by the body for proper growth and development.

Vitamins have three characteristics:

- They're natural components of foods; usually present in very small amounts.
- They're essential for normal physiologic function (e.g., growth, reproduction, etc).
- When absent from the diet, they will cause a specific deficiency.
- vitamin deficiencies can create or exacerbate chronic health conditions. (Tulchinsky, 2010) [19]

Minerals

The five major minerals in the human body are calcium, phosphorus, potassium, sodium, and magnesium. All of the remaining elements in a human body are called "trace elements". The trace elements that have a specific biochemical function in the human body are, iron, Iodine, chlorine, cobalt, copper, zinc, manganese, and Chromium (Behrman, 2000) [2].

Macro-minerals

Table 1

Minerals	Functions	Deficiency diseases
Calcium	Component of bones and teeth. Helps in blood clotting Muscle contraction Conduction of nerve impulses etc. Acts as cofactor of Myosin ATPase	Defective bones and teeth Tetany and rickets Loss of muscle coordination
Phosphorus	Formation of bones and teeth Component of nucleic acids, energy molecules and coenzymes	Rare
Sodium	Maintenance of ionic and water balance, muscle contraction; conduction of nerve impulses; component of digestive juices	Improper muscle contraction; nervous depression; loss of Na+ in urine, dehydration
Potassium	Osmotic balance; muscle contraction; nerve impulse conduction	Nervous disorder; poor muscle control leading to paralysis
Magnesium	Cofactor for enzymes e.g. of hexokinase	Heart and vascular irregularities; dilated blood vessels, loss of muscle coordination
Iron	Formation of Hb so help in O2 transport Component of cytochromes of ETS. Cofactor of catalase enzyme	Anaemia; skin problems
Iodine	Normal functioning of thyroid; component of thyroxin so controls BMR	Goiter, Cretinism, Myxoedema
Zinc	Cofactor of carbonic anhydrase so helps in CO_2 transport Vitamin A metabolism	Reduced respiration
Manganese	Normal reproductive functions, cofactor for enzymes	Reproductive failure; menstrual irregularities
Copper	Cofactor for enzymes e.g. oxidases and tyrosinase. Component of haemocyanin.	Anaemia
Fluorine	Maintains enamel and prevents dental caries.	Dental caries.
Chromium	Catabolic metabolism	Irregularities of catabolism and ATP product
Chlorine	Main anion of ECF Acid- base balance	Vomiting and hypochloremic alkalosis

Source: Sharon M. Nutrients A-Z: A user's guide to foods, herbs, vitamins, minerals & supplements, 2009

Anemia

According to the WHO, "Anemia is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking, and pregnancy status". The red blood cells (RBCs) constitute the most abundant component of human blood and are responsible for providing life-supporting oxygen to other cells of the body. Haemoglobin, a pigment present in red blood cells, binds oxygen and delivers it to various cells in the body. A lower number of RBCs, poor haemoglobin concentrations, or inability of haemoglobin to transport sufficient oxygen, result in decreased oxygen transport to the body cells and subsequent physiological effects (Stein *et al*, 2016) [17]

Causes of Anemia

Anemia can occur due to a variety of reasons –

1. Nutritional deficiencies – Vitamin B12, folate and iron deficiencies
2. Genetic disorders – Hemolytic anemia, sickle cell anemia
3. Parasitic infections – Such as malaria, hookworms, schistosomiasis
4. Chronic diseases – Cancer, HIV/AIDS, Kidney disease

Signs and Symptoms of Anemia

Fatigue/ lack of energy, Shortness of breath, Headaches, Heart palpitations, Pale complexion, In severe cases, spoon shaped nails (koilonychia), Numbness or hands and feet, low body temperature

Treatment and Prevention

Iron supplements are used to treat iron-deficiency anaemia. Infants who have this problem tend to be bottle-fed. A baby is able to absorb more iron from breast milk than from cow's milk. Vitamin B12, vitamin C, and folic acid are all crucial to RBC production, and a deficiency in any one of these vitamins puts us at risk for anaemia. Good sources of vitamin B12 include beef and fish. Vegetables don't contain this vitamin, so if we don't eat meat, fish, or dairy products, we need to take vitamin B12 supplements. Sources of folic acid include spinach, green peas, oranges, and cantaloupe (Bruce and Patricia, 2002) [5].

Diabetes

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin (a hormone that regulates blood sugar) or alternatively, when the body cannot effectively use the insulin it produces. The overall risk of dying among people with diabetes is at least double the risk of their peers without diabetes.

Type 1 diabetes is characterized by a lack of insulin production. Without daily administration of insulin, type 1 diabetes is rapidly fatal.

Type 2 diabetes results from the body's ineffective use of insulin. About 90% of people with diabetes around the world have type 2. It is largely the result of excess body weight and physical inactivity.

WHO projects that diabetes deaths will double between 2005 and 2030.Almost half of diabetes deaths occur in people under the age of 70 years, and nearly 80% of diabetes deaths occur in low and middle-income countries. Elevated blood sugar is a common effect of uncontrolled diabetes, and over time can damage the heart, blood vessels, eyes, kidneys, and nerves (Grams and Garvey, 2015) [9].

Prevention

Without urgent action, diabetes-related deaths will increase by more than 50% in the next 10 years. To help prevent type 2 diabetes and its complications, people should:

- Achieve and maintain healthy body weight.
- Be physically active - at least 30 minutes of regular, moderate-intensity activity on most days.
- Early diagnosis can be accomplished through relatively inexpensive blood testing.
- Treatment of diabetes involves lowering blood sugar and the levels of other known risk factors that damage blood vessels.
- Tobacco cessation is also important to avoid complications.

Obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). The simplest and most widely used classification for obesity in adults is based on body mass index (BMI)

Table 2

		BMI (kg/m^2)
Under weight		≤ 18.5
Healthy/ normal weight		18.5 – 24.9
Over weight (Pre-obese)		25 – 29.9
Obesity	moderate (Class 1)	30 -34.9
	Severe (Class 2)	35 -39.9
	Morbid (Class 3)	≥ 40

Source: Report of a WHO Consultation on Obesity. (WHO, Geneva.1998)

Contributing causes and clinical consequences

Obesity results from an excess of dietary energy intake over energy expenditure and thus both an increase in intake and a decrease in expenditure will lead to excess calories being stored as fat and, ultimately, to obesity.(WHO, 2000) [28]

Increased energy intake

Energy dense foods are more available and it has become easier and quicker to obtain, prepare, and eat palatable meals. Although the concentrated calories found in a high fat, high sugar diet undoubtedly contribute to an excessive energy intake, this is not the only factor responsible for the present obesity epidemic.

Metabolic factors

There is no evidence to support the concept that a low metabolic rate is the major cause of obesity. However, in a very small number of individuals, endocrine disorders such as Cushing's syndrome and hypothyroidism, Prader–Willi syndrome, and congenital leptin deficiency are the cause of obesity.

Genetic factors

Obesity tends to run in families but shared environmental factors (meals and level of activity) probably contribute more to obesity than common genetic factors and the current, rapid increase in obesity prevalence cannot be explained by the gene pool changing so quickly. However, it is likely that some

individuals are genetically more susceptible to the effects of an obesogenic environment (Siddiqui and Donato, 2016) [18].

Symptoms and Complications

The health risks associated with obesity include: breathing disorders (e.g., sleep apnea, chronic obstructive pulmonary disease), certain types of cancers (e.g., prostate and bowel cancer in men, breast and uterine cancer in women), coronary artery (heart) disease, depression, diabetes, gallbladder or liver disease, gastro esophageal reflux disease (GERD), high blood pressure, high cholesterol, joint disease (e.g., osteoarthritis), stroke

General strategies for obesity prevention

The prevention of obesity in infants and young children should be considered of high priority. For infants and young children, the main preventive strategies are: Promotion of exclusive breastfeeding, avoiding the use of added sugars and starches when feeding formula, Instructing mothers to accept their child's ability to regulate energy intake rather than feeding until the plate is empty, Assuring the appropriate micronutrient intake needed to promote optimal linear growth. For children and adolescents, prevention of obesity implies the need to promote an active life style, limit television viewing, Promote the intake of fruits and vegetables, Restrict the intake of energy-dense, micronutrient-poor foods (e.g. packaged snacks), Restrict the intake of sugars-sweetened soft drinks (Kopelman and Caterson, 2005) [12].

Skeltal Fluorosis

Skeletal fluorosis is a bone disease caused by excessive accumulation of fluoride in the bones. In advanced cases, skeletal fluorosis causes painful damage to bones and joints.

Symptoms

Symptoms are mainly promoted in the bone structure. Due to a high fluorine concentration in the body, the bone is hardened and thus less elastic, resulting in an increased frequency of fractures. Other symptoms include thickening of the bone structure and accumulation of bone tissue, which both contribute to impaired joint mobility. Ligaments and cartilage can become ossified. As a result, bone flexibility decreases making the bone more amenable to fractures (Reddy, 2009) [16].

Causes

Common causes of fluorosis include inhalation of fluoride dusts/fumes by workers in industry, consumption of fluoride from drinking water and consumption of fluoride from drinking tea, particularly brick tea. Skeletal fluorosis can be caused by cryolite (Na_3AlF_6, sodium hexafluoroaluminate). In India, the most common cause of fluorosis is fluoride-laden drinking water which is sourced as groundwater from deep-bore wells. Over half of groundwater sources in India have fluoride above recommended levels (UNICEF, 2007) [20, 21].

Prevention

Fluorosis can be prevented by avoiding excessive intake of fluoride by individuals / community. Excessive fluoride intake and its adverse effects can be minimized or prevented by adapting following measures:

- by using alternative water sources,
- by removing excessive fluoride from drinking water,
- By improving the nutritional status of population/individuals at risk. (Whyte *et al*. 2005) [24].

Iodine Deficiency

Iodine is an important trace element that is a necessary constituent of the thyroid hormones Tri-iodothyronine and Thyroxine. The body cannot produce iodine. Naturally, it needs to be obtained from the diet. In places where there is very little or no iodine present in the diet, people may suffer from various disorders caused by iodine deficiency, such as goiter and cretinism. Insufficient amounts of iodine leads to the enlargement of thyroid gland, hypothyroidism, mental retardation as well as developmental delays in newborns and young children. The disease is also referred to as Iodine deficiency disorder (UNICEF, 2009) [22]

Iodine Deficiency Symptoms

Deficiency of iodine leads to improper development of the thyroid gland, which eventually causes a number of symptoms, such as:

Goiter

Lower amounts of Thyroxine in the plasma give rise to higher quantities of the thyroid stimulating hormone or TSH. This causes stimulation of the thyroid gland that leads to the increase of many biochemical processes. This cellular growth along with proliferation can lead to hyperplasia or the characteristic swelling of thyroid gland; a condition commonly referred to as goiter.

Cretinism

Cretinism is said to be the most extreme form of IDD. It is commonly associated with lack of iodine and goiter, and is characterized by: Deaf- mutism, Stunted growth, Squint, Mental deficiency, Disorders of gait and stance, Hypothyroidism

Hypothyroidism

In places where only very little amounts of iodine is present in the diet, such as in typically remote inland localities and semiarid equatorial climates where marine foods are not consumed, iodine deficiency can give rise to hypothyroidism, the signs of which include goiter, extreme fatigue, mental slowing, weight gain, depression, and also lower basal body temperatures. Individuals suffering from severe iodine deficiency may also complain of dry skin, cold intolerance, constipation as well as diseases of oral and the salivary glands (Patrick, 2008) [15].

Iodine Deficiency Treatment

IDD is generally treated by supplementing iodine with food substances. Mild cases can be treated with increasing the quantities of iodized salt in daily food consumption of patients. It can also be done by adding egg yolks, saltwater fishes or more milk in the regular diet. Iodized salt can offer amounts of iodine appropriately needed by the patients. For an animal product and/or salt restricted diet, the patients can be advised to have sea vegetables like hijiki, kelp, dulse, and nori as they are excellent sources of iodine. In a non-pregnant adult, 150 µg/d is generally sufficient for sustaining normal thyroid functions. However, women might need additional amounts of iodine. For this, the recommended dosage of daily iodine intake is around 150 to 300 µg/d. If a patient is exhibiting compressive symptoms due to a large goitre, a thyroidectomise procedure may be required to be carried out.

Anorexia

Anorexia Nervosa is a psychological and possibly life-threatening eating disorder defined by an extremely low body weight relative to stature (this is called BMI [Body Mass Index] and is a function of an individual's height and weight), extreme and needless weight loss, illogical fear of weight gain, and distorted perception of self-image and body (Attia, 2010) [1].

Major Types of Anorexia

There are two common types of anorexia, which are as follows:

- Binge/Purge Type – The individual suffering from this type of eating disorder, will purge when he or she eats. This is typically a result of the overwhelming feelings of guilt a sufferer would experience in relation to eating; they compensate by vomiting, abusing laxatives, or excessively exercising.
- Restrictive – In this form, the individual will fiercely limit the quantity of food consumed, characteristically ingesting a minimal amount that is well below their body's caloric needs, effectively slowly starving him or herself.

Anorexia Treatment

Given the complexities of this eating disorder, a professional treatment team involving medical doctors, dietitians, and therapists is necessary for the recovery from this eating disorder. Effective, holistic eating disorder treatment of anorexia involves three necessary components:

- Medical: The highest priority in the treatment of anorexia nervosa is addressing any serious health issues that may have resulted from malnutrition, such as an unstable heartbeat.
- Nutritional: This component encompasses weight restoration, implementation and supervision of a tailored meal plan, and education about normal eating patterns.
- Therapy: The goal of this part of treatment is to recognize underlying issues associated with the eating disorder, address and heal from traumatic life events, learn healthier coping skills and further develop the capacity to express and deal with emotions (Klein and Walsh, 2004).

Approaches to Mitigate Micronutrient Deficiency

The widespread recognition of the importance of micronutrient deficiencies in global health, and the potential to address such deficiencies relatively cheaply through fortification or supplementation has led to several multilateral efforts to support traditional interventions Supplementation and fortification are intervention strategies that often are aimed at the immediate or short term amelioration of the situation and often address the symptoms of micronutrient deficiencies.

Supplementation

Supplementation refers to the provision of added nutrients in pharmaceutical form (such as capsules, tablets, or syrups) rather than in food where it is most appropriate for targeted populations with a high risk of deficiency or under special circumstances, such as during pregnancy or in an acute food shortage (Ottaway 2008) [14] Globally, supplementation with iron tablets is the most widely used strategy for the prevention and control of iron-deficiency or anemia in pregnancy. Pregnant women require nearly three times as much iron as nonpregnant women owing to the physiological demands of pregnancy (expanded red-blood-cell volume, the needs of the fetus and placenta, and blood loss at delivery)

Fortification

Food fortification stands out among public health interventions as one of the most effective methods of preventing nutritional deficiencies where it has contributed significantly to the virtual elimination of goiter, rickets, beriberi and pellagra in the Western world (Mannar and Sankar, 2011) [13].. Fortification refers to the addition of nutrients to foods from which they were either absent or present in small amounts to increase the intake of one or more nutrients. It also includes additions to fulfill the role of another food in the diet. Fortification can be done in three ways. First, by restoring the nutrients lost during food processing to their natural level (for example restoring B-vitamins which are lost during milling). Second, by increasing the level of a nutrient above that normally found in the food (for example adding extra iron to wheat flour or extra calcium to milk). Third, by adding nutrients that are not normally present in a food item otherwise considered a good vehicle for delivering micronutrients to the consumer (for example putting vitamin A into sugar, or iodine into salt)

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