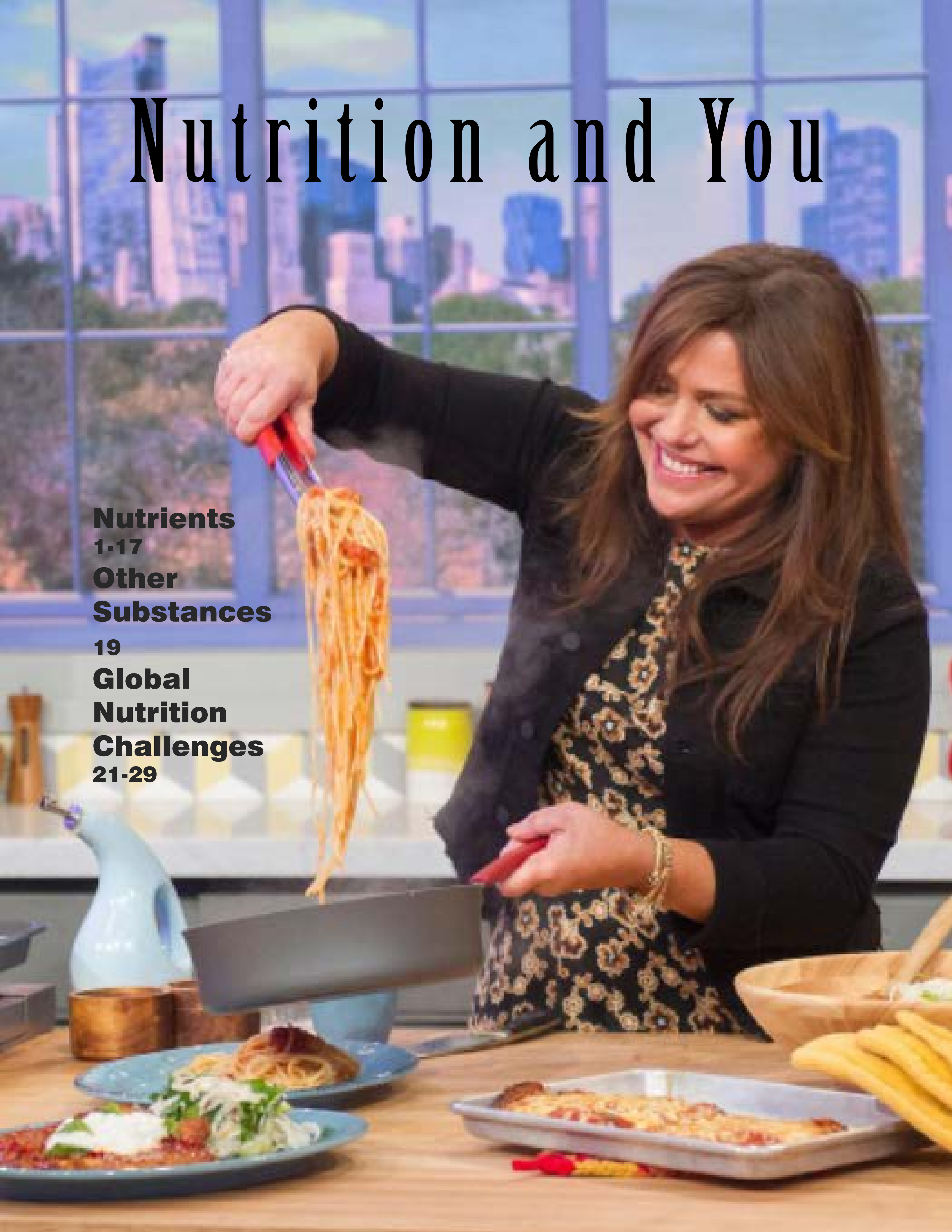
Nutrition and You



Nutrients

The seven major classes of nutrients are carbohydrates, fats, fiber, minerals, proteins, vitamins, and water. Nutrients can be grouped as either macronutrients or micronutrients (needed in small quantities). Carbohydrates, fats, and proteins are macronutrients, and provide energy. Water and fiber are macronutrients but do not provide energy. The micronutrients are minerals and vitamins.

The macronutrients (excluding fiber and water) provide structural material (amino acids from which proteins are built, and lipids from which cell membranes and some signaling molecules are built), and energy. Some of the structural material can also be used to generate energy internally, and in either case it is measured in Joules or kilocalories (often called "Calories" and written with a capital 'C' to distinguish them from little 'c' calories). Carbohydrates and proteins provide 17 kJ approximately (4 kcal) of energy per gram, while fats provide 37 kJ (9 kcal) per gram,[8] though the net energy from either depends on such factors as absorption and digestive effort, which vary substantially from instance to instance.

Vitamins, minerals, fiber, and water do not provide energy, but are required for other reasons. A third class of dietary material, fiber (i.e., nondigestible material such as cellulose), seems also to be required, for both mechanical and biochemical reasons, though the exact reasons remain unclear. For all age groups, males on average need to consume higher amounts of macronutrients than females. In general, intakes increase with age until the second or third decade of life.

Some nutrients can be stored – the fat-soluble vitamins – while others are required more or less continuously. Poor health can be caused by a lack of required nutrients, or for some vitamins and minerals, too much of a required nutrient. Essential nutrients cannot be synthesized by the body, and must be obtained from food.

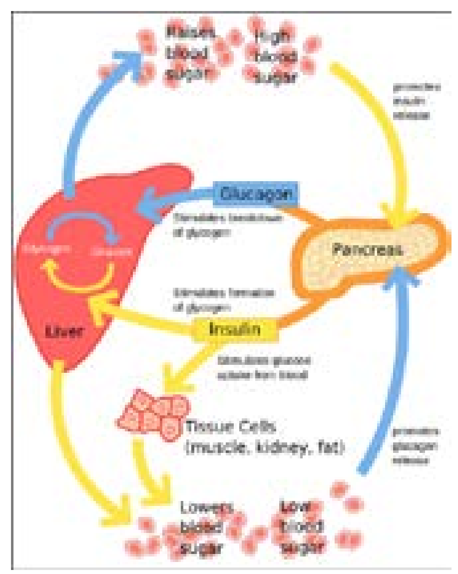
Molecules of carbohydrates and fats consist of carbon, hydrogen, and oxygen atoms. Carbohydrates range from simple monosaccharides (glucose, fructose, galactose) to complex polysaccharides (starch). Fats are triglycerides, made of assorted fatty acid monomers bound to a glycerol backbone. Some fatty acids, but not all, are essential in the diet: they cannot be synthesized in the body. Protein molecules contain nitrogen atoms in addition to carbon, oxygen, and hydrogen. The fundamental components of protein are nitrogen-containing amino acids, some of which are essential in the sense that humans cannot make them internally. Some of the amino acids are convertible (with the expenditure of energy) to glucose and can be used for energy production just as ordinary glucose, in a process known as gluconeogenesis. By breaking down existing protein, some glucose can be produced internally; the remaining amino acids are discarded, primarily as urea in urine. This occurs naturally when atrophy takes place, or during periods of starvation. The list of nutrients that people are known to require is, in the words of Marion Nestle, "almost certainly incomplete"

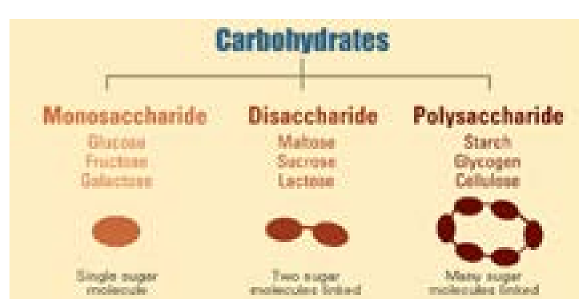
Carbohydrates

Carbohydrates may be classified as monosaccharides, disaccharides or polysaccharides depending on the number of monomer (sugar) units they contain. They are a diverse group of substances, with a range of chemical, physical and physiological properties.They make up a large part of foods such as rice, noodles, bread, and other grain-based products, but they are not an essential nutrient, meaning a human does not need to eat carbohydrates. The brain is the largest consumer of sugars in the human body, and uses particularly large amounts of glucose, accounting for 20% of total body glucose consumption. The brain uses mostly glucose for energy; if glucose is insufficient however, it switches to using fats.

Monosaccharides contain one sugar unit, disaccharides two, and polysaccharides three or more. Monosaccharides include glucose, fructose and galactose. Disaccharides include sucrose, lactose, and maltose; purified sucrose, for instance, is used as table sugar. Polysaccharides, which include starch and glycogen, are often referred to as 'complex' carbohydrates because they are typically long multiple-branched chains of sugar units.

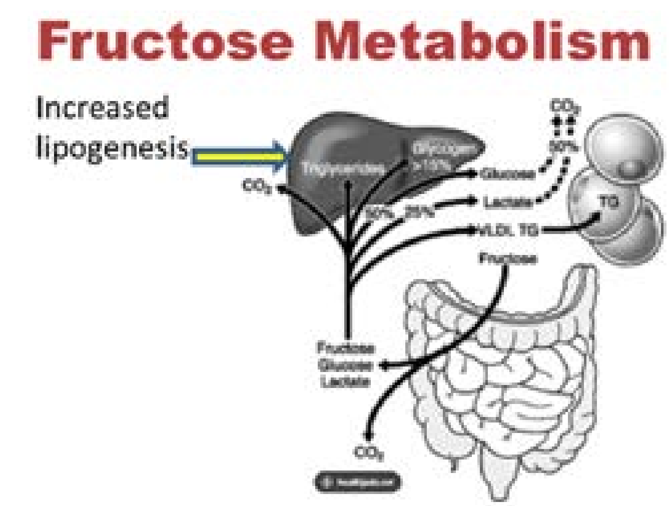
Traditionally, simple carbohydrates were believed to be absorbed quickly, and therefore raise blood-glucose levels more rapidly than complex





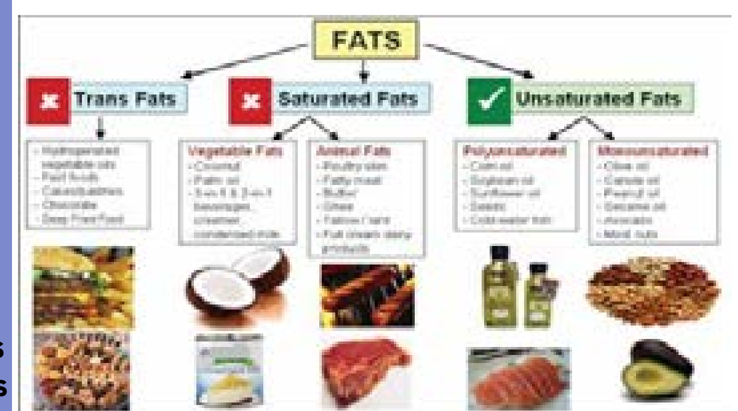
carbohydrates. This, however, is not accurate. Some simple carbohydrates (e.g., fructose) follow different metabolic pathways (e.g., fructolysis) that result in only a partial catabolism to glucose, while, in essence, many complex carbohydrates may be digested at the same rate as simple carbohydrates. The World Health Organization recommends that added sugars should represent no more than 10% of total energy intake.

The most common plant carbohydrate nutrient – starch – varies in its absorption. Starches have been classified as rapidly digestible starch, slowly digestible starch and resistant starch. Starches in plants are resistant to digestion (resistant starch), but cooking the starch in the presence of water can break down the starch granule and releases the glucose chains, making them more easily digestible by human digestive enzymes. Historically, food was less processed and starches were contained within the food matrix, making them less digestible. Modern food processing has shifted carbohydrate consumption from less digestible and resistant starch to much more rapidly digestible starch. For instance, the resistant starch content of a traditional African diet was 38 grams/day. The resistant starch consumption from countries with high starch intakes has been estimated to be 30-40 grams/day. In contrast, the average consumption of resistant starch in the United States was estimated to be 4.9 grams/day (range 2.8-7.9 grams of resistant starch/day).



Fat

A molecule of dietary fat typically consists of several fatty acids (containing long chains of carbon and hydrogen atoms), bonded to a glycerol. They are typically found as triglycerides (three fatty acids attached to one glycerol backbone). Fats may be classified as saturated or unsaturated depending on the chemical structure of the fatty acids involved. Saturated fats have all of the carbon atoms in their fatty acid chains bonded to hydrogen atoms, whereas unsaturated fats have some of these carbon atoms double-bonded, so their molecules have relatively fewer hydrogen atoms than a saturated fatty acid of the same length. Unsaturated fats may be further classified as mono-unsaturated (one double-bond) or polyunsaturated (many double-bonds). Furthermore, depending on the location of the double-bond in the fatty acid chain, unsaturated fatty acids are classified as omega-3 or omega-6 fatty acids. Trans fats are a type of unsaturated fat with trans-isomer bonds; these are rare in nature and in foods from natural sources; they are typically created in an industrial process called (partial) hydrogenation. There are nine kilocalories in each gram of fat. Fatty acids such as conjugated linoleic acid, catalpic acid, eleostearic acid and punicic acid, in addition to providing energy, represent potent immune modulatory molecules.

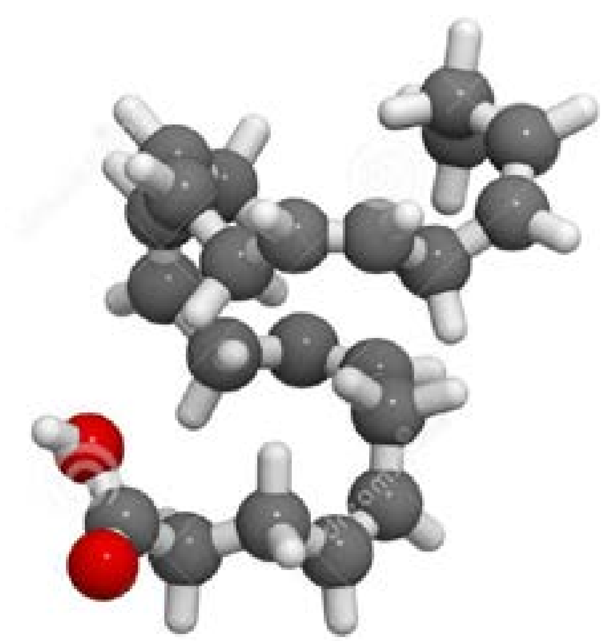


Saturated fats (typically from animal sources) have been a staple in many world cultures for millennia. Unsaturated fats (e. g., vegetable oil) are considered healthier, while trans fats are to be avoided. Saturated and some trans fats are typically solid at room temperature (such as butter or lard), while unsaturated fats are typically liquids (such as olive oil or flaxseed oil). Trans fats are very rare in nature, and have been shown to be highly detrimental to human health, but have properties useful in the food processing industry, such as rancidity resistance.

Essential fatty acids

Most fatty acids are non-essential, meaning the body can produce them as needed, generally from other fatty acids and always by expending energy to do so. However, in humans, at least two fatty acids are essential and must be included in the diet. An appropriate balance of essential fatty acids—omega-3 and omega-6 fatty acids—seems also important for health, although definitive experimental demonstration has been elusive. Both of these “omega” long-chain polyunsaturated fatty acids are substrates for a class of eicosanoids known as prostaglandins, which have roles throughout the human body.

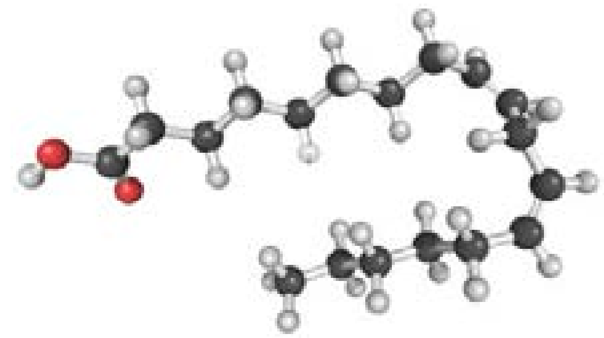
The omega-3 eicosapentaenoic acid (EPA), which can be made in the human body from the omega-3 essential fatty acid alpha-linolenic acid (ALA), or taken in through marine food sources, serves as a building block for series 3 prostaglandins (e.g., weakly inflammatory PGE3). The omega-6 dihomo-gamma-linolenic acid (DGLA) serves as a building block for series 1 prostaglandins (e.g. anti-inflammatory PGE1), whereas arachidonic acid



Omega 3

(AA) serves as a building block for series 2 prostaglandins (e.g. pro-inflammatory PGE 2). Both DGLA and AA can be made from the omega-6 linoleic acid (LA) in the human body, or can be taken in directly through food. An appropriately balanced intake of omega-3 and omega-6 partly determines the relative production of different prostaglandins. In industrialized societies, people typically consume large amounts of processed vegetable oils, which have reduced amounts of the essential fatty acids along with too much of omega-6 fatty acids relative to omega-3 fatty acids.

The conversion rate of omega-6 DGLA to AA largely determines the production of the prostaglandins PGE1 and PGE2. Omega-3 EPA prevents AA from being released from membranes, thereby skewing prostaglandin balance away from pro-inflammatory PGE2 (made from AA) toward anti-inflammatory PGE1 (made from DGLA). The conversion (desaturation) of DGLA to AA is controlled by the enzyme delta-5-desaturase, which in turn is controlled by hormones such as insulin (up-regulation) and glucagon (down-regulation).



Omega 6

Fiber

Dietary fiber is a carbohydrate, specifically a polysaccharide, which is incompletely absorbed in humans and in some animals. Like all carbohydrates, when it is metabolized, it can produce four Calories (kilocalories) of energy per gram, but in most circumstances, it accounts for less than that because of its limited absorption and digestibility.

The two subcategories are insoluble and soluble fiber.

Insoluble dietary fiber

Includes cellulose, a large carbohydrate polymer that is indigestible by humans, because humans do not have the required enzymes to break it down, and the human digestive system does not harbor enough of the types of microbes that can do so.
Includes resistant starch, an insoluble starch that resists digestion either because it is protected by a shell or food matrix (Type 1 resistant starch, RS1), maintains the natural starch granule (Type 2 resistant starch, RS2), is retrograded and partially crystallized (Type 3 resistant starch, RS3), has been chemically modified (Type 4 resistant starch, RS4) or has complexed with a lipid (Type 5 resistant starch, RS5).[30] Natural sources of resistant starch (RS1, RS2 and RS3) are fermented by the microbes in the human digestive system to produce short-chain fatty acids which are utilized as food for the colonic cells or absorbed.

Soluble dietary fiber

Comprises a variety of oligosaccharides, waxes, esters, and other carbohydrates that dissolve or gelatinize in water. Many of these soluble fibers can be fermented or partially fermented by microbes in the human digestive system to produce short-chain fatty acids which are absorbed and therefore introduce some caloric content.

Whole grains, beans, and other legumes, fruits (especially plums, prunes, and figs), and vegetables are good sources of dietary fiber. Fiber has three primary mechanisms, which in general determine their health impact: bulking, viscosity and fermentation. Fiber provides bulk to the intestinal contents, and insoluble fiber facilitates peristalsis – the rhythmic muscular contractions of the intestines which move contents along the digestive tract. Some soluble and insoluble fibers produce a solution of high viscosity; this is essentially a gel, which slows the movement of food through the intestines. Fermentable fibers are used as food by the microbiome, mildly increasing bulk, and producing short-chain fatty acids and other metabolites, including vitamins, hormones, and glucose. One of these metabolites, butyrate, is important as an energy source for colon cells, and may improve metabolic syndrome.

In 2016, the U.S. FDA approved a qualified health claim stating that resistant starch might reduce the risk of type 2 diabetes, but with qualifying language for product labels that only limited scientific evidence exists to support this claim. The FDA requires specific labeling language, such as the guideline concerning resistant starch: "High-amylose maize resistant starch may reduce the risk of type 2 diabetes. FDA has concluded that there is limited scientific evidence for this claim."

fermentation

Amino acids

Proteins are chains of amino acids found in many nutritious foods.
Proteins are the basis of many animal body structures (e.g. muscles, skin, and hair) and form the enzymes that control chemical reactions throughout the body. Each protein molecule is composed of amino acids which contain nitrogen and sometimes sulphur (these components are responsible for the distinctive smell of burning protein, such as the keratin in hair). The body requires amino acids to produce new proteins (protein retention) and to replace damaged proteins (maintenance). Amino acids are soluble in the digestive juices within the small intestine, where they are absorbed into the blood. Once absorbed, they cannot be stored in the body, so they are either metabolized as required or excreted in the urine.
Proteins consist of amino acids in different proportions. The most important aspect and defining characteristic of protein from a nutritional standpoint is its amino acid composition.
For all animals, some amino acids are essential (an animal cannot produce them internally so they must be eaten) and some are non-essential (the animal can produce them from other nitrogen-containing compounds). About twenty amino acids are found in the human body, and about ten of these are essential. The synthesis of some amino acids can be limited under special pathophysiological conditions, such as prematurity in the infant or individuals in severe catabolic distress, and those are called conditionally essential.
A diet that contains adequate amounts of amino acids (especially those that are essential) is particularly important in some situations: during early development and maturation, pregnancy, lactation, or injury (a burn, for instance). A complete protein source contains all the essential amino acids; an incomplete protein source lacks one or more of the essential amino acids. It is possible with protein combinations of two incomplete protein sources (e.g., rice and beans) to make a complete protein source, and characteristic combinations are the basis of distinct cultural cooking traditions. However, complementary sources of protein do not need to be eaten at the same meal to be used together by the body. Excess amino acids from protein can be converted into glucose and used for fuel through a process called gluconeogenesis. There is an ongoing debate about the differences in nutritional quality and adequacy of protein from vegan, vegetarian and animal sources, though many studies and institutions have found that a well-planned vegan or vegetarian diet contains enough high-quality protein to support the protein requirements of both sedentary and active people at all stages of life.

Water

Water is excreted from the body in multiple forms; including urine and feces, sweating, and by water vapour in the exhaled breath. Therefore, it is necessary to adequately rehydrate to replace lost fluids.Early recommendations for the quantity of water required for maintenance of good health suggested that six to eight glasses of water daily is the minimum to maintain proper hydration. However, the notion that a person should consume eight glasses of water per day cannot be traced to a credible scientific source. The original water intake recommendation in 1945 by the Food and Nutrition Board of the National Research Council read: "An ordinary standard for diverse persons is 1 milliliter for each calorie of food. Most of this quantity is contained in prepared foods."More recent comparisons of well-known recommendations on fluid intake have revealed large discrepancies in the volumes of water we need to consume for good health. Therefore, to help standardize guidelines, recommendations for water consumption are included in two recent European Food Safety Authority (EFSA) documents (2010): (i) Food-based dietary guidelines and (ii) Dietary reference values for water or adequate daily intakes (ADI). These specifications were provided by calculating adequate intakes from measured intakes in populations of individuals with "desirable osmolarity values of urine and desirable water volumes per energy unit consumed."For healthful hydration, the current EFSA guidelines recommend total water intakes of 2.0 L/day for adult females and 2.5 L/day for adult males. These reference values include water from drinking water, other beverages, and from food. About 80% of our daily water requirement comes from the beverages we drink, with the remaining 20% coming from food.Water content varies depending on the type of food consumed, with fruit and vegetables containing more than cereals, for example. These values are estimated using country-specific food balance sheets published by the Food and Agriculture Organisation of the United Nations. The EFSA panel also determined intakes for different populations. Recommended intake volumes in the elderly are the same as for adults as despite lower energy consumption, the water requirement of this group is increased due to a reduction in renal concentrating capacity. Pregnant and breastfeeding women require additional fluids to stay hydrated. The EFSA panel proposes that pregnant women should consume the same volume of water as non-pregnant women, plus an increase in proportion to the higher energy requirement, equal to 300 mL/day. To compensate for additional fluid output, breastfeeding women require an additional 700 mL/day above the recommended intake values for non-lactating women. Dehydration and over-hydration – too little and too much water, respectively – can have harmful consequences. Drinking too much water is one of the possible causes of hyponatremia, i.e., low serum sodium.

Minerals

Dietary minerals are inorganic chemical elements required by living organisms,[55] other than the four elements carbon, hydrogen, nitrogen, and oxygen that are present in nearly all organic molecules. Some have roles as cofactors, while others are electrolytes.[56] The term "mineral" is archaic, since the intent is to describe simply the less common elements in the diet. Some are heavier than the four just mentioned – including several metals, which often occur as ions in the body. Some dietitians recommend that these be supplied from foods in which they occur naturally, or at least as complex compounds, or sometimes even from natural inorganic sources (such as calcium carbonate from ground oyster shells). Some are absorbed much more readily in the ionic forms found in such sources. On the other hand, minerals are often artificially added to the diet as supplements; the most well-known is likely iodine in iodized salt which prevents goiter.

Macrominerals

Elements with recommended dietary allowance (RDA) greater than 150 mg/day are, in alphabetical order:

Calcium (Ca^{2+}) is vital to the health of the muscular, circulatory, and digestive systems; is indispensable to the building of bone; and supports the synthesis and function of blood cells. For example, calcium is used to regulate the contraction of muscles, nerve conduction, and the clotting of blood. It can play this role because the Ca^{2+} ion forms stable coordination complexes with many organic compounds, especially proteins; it also forms compounds with a wide range of solubility, enabling the formation of the skeleton.[57]

Chlorine as chloride ions; very common electrolyte; see sodium, below.

Magnesium, required for processing ATP and related reactions (builds bone, causes strong peristalsis, increases flexibility, increases alkalinity). Approximately 50% is in bone, the remaining 50% is almost all inside body cells, with only about 1% located in extracellular fluid. Food sources include oats, buckwheat, tofu, nuts, caviar, green leafy vegetables, legumes, and chocolate.

Phosphorus, required component of bones; essential for energy processing.Approximately 80% is found in the inorganic portion of bones and teeth. Phosphorus is a component of every cell, as well as important metabolites, including DNA, RNA, ATP, and phospholipids. Also important in pH regulation. It is an important electrolyte in the form of phosphate. Food sources include cheese, egg yolk, milk, meat, fish, poultry, whole-grain cereals, and many others.

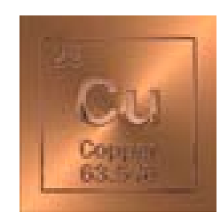
Potassium, a common electrolyte (heart and nerve function). With sodium, potassium is involved in maintaining normal water balance, osmotic equilibrium, and acid-base balance. In addition to calcium, it is important in the regulation of neuromuscular activity. Food sources include bananas, avocados, nuts, vegetables, potatoes, legumes, fish, and mushrooms

Sodium, a common food ingredient and electrolyte, found in most foods and manufactured consumer products, typically as sodium chloride (salt). Excessive sodium consumption can deplete calcium and magnesium. Sodium has a role in the etiology of hypertension demonstrated from studies showing that a reduction of table salt intake may reduce blood pressure.

Trace minerals

Many elements are required in smaller amounts (microgram quantities), usually because they play a catalytic role in enzymes. Some trace mineral elements (RDA < 200 mg/day) are, in alphabetical order:

Cobalt as a component of the vitamin B12 family of coenzymes



Copper required component of many redox enzymes, including cytochrome c oxidase (see Copper in health)

Iodine required not only for the biosynthesis of thyroxin, but probably, for other important organs as breast, stomach, salivary glands, thymus etc. (see Iodine deficiency); for this reason iodine is needed in larger quantities than others in this list, and sometimes classified with the macrominerals; Nowadays it is most easily found in iodized salt, but there are also natural sources such as Kombu.

Chromium required for sugar metabolism

Iron required for many enzymes, and for hemoglobin and some other proteins

Manganese (processing of oxygen)

Molybdenum required for xanthine oxidase and related oxidases

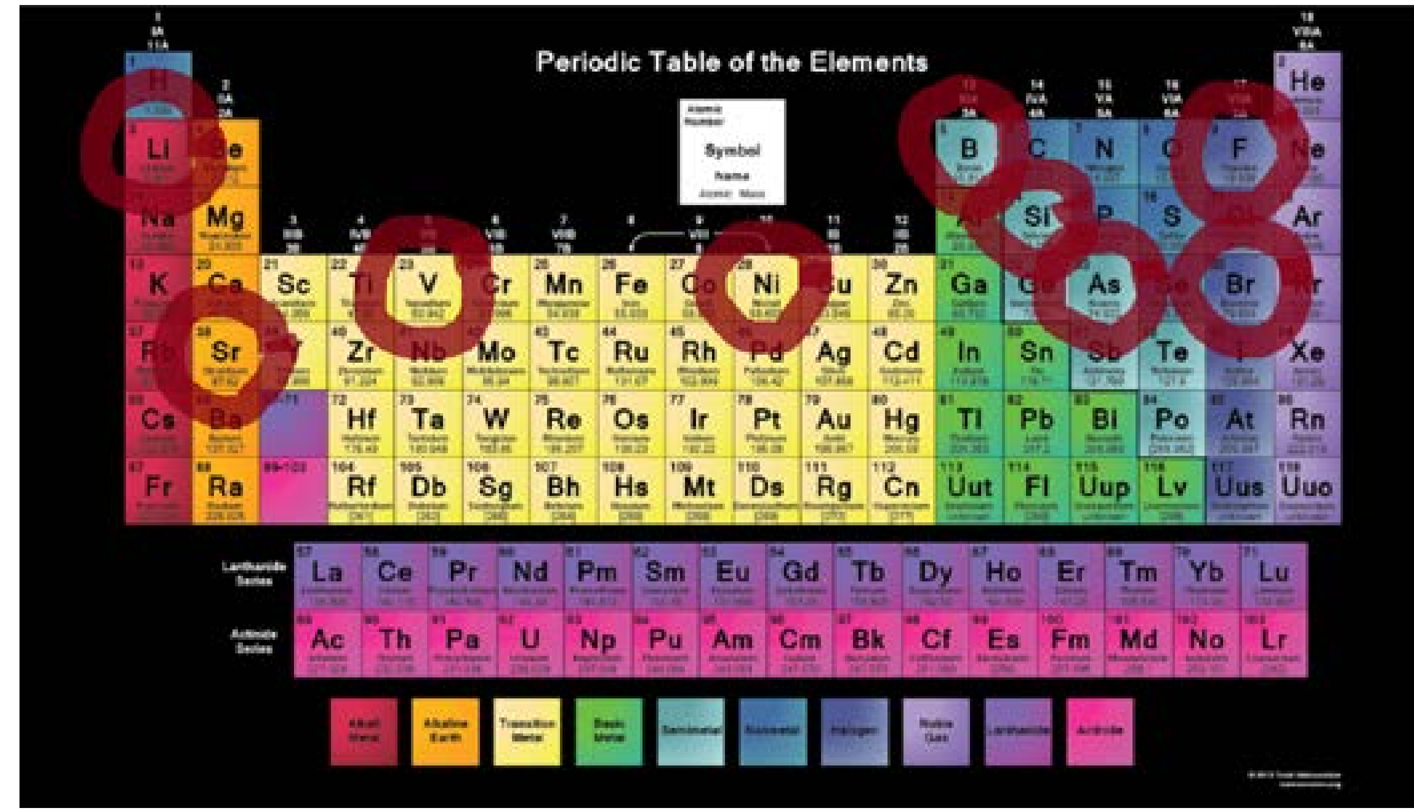
Selenium required for peroxidase (antioxidant proteins)

Zinc required for several enzymes such as carboxypeptidase, liver alcohol dehydrogenase, carbonic anhydrase

Ultratrace minerals

Ultratrace minerals are an as yet unproven aspect of human nutrition, and may be required at amounts measured in very low ranges of μg/day. Many ultratrace elements have been suggested as essential, but such claims have usually not been confirmed. Definitive evidence for efficacy comes from the characterization of a biomolecule containing the element with an identifiable and testable function. These include:

Bromine Arsenic Nickel Fluorine Boron Lithium Strontium Silicon Vanadium



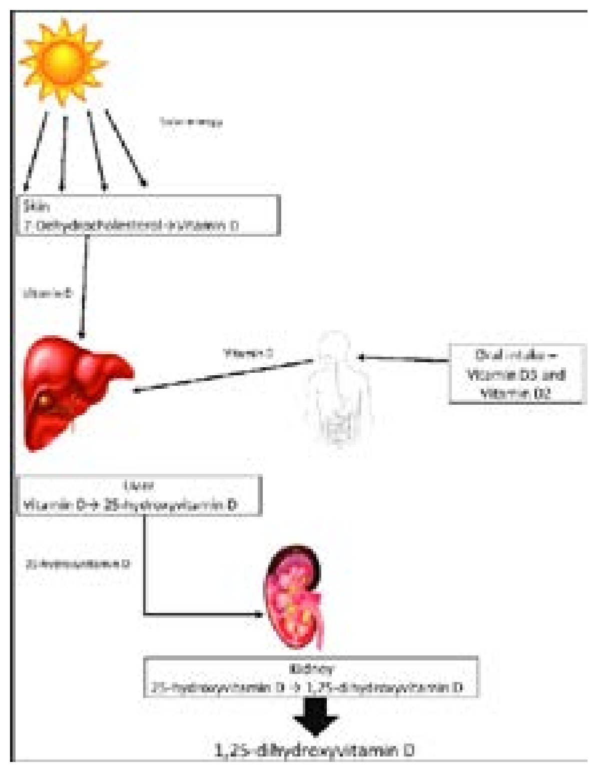
Vitamins

Except for vitamin D, vitamins are essential nutrients, necessary in the diet for good health. Vitamin D can be synthesized in the skin in the presence of UVB radiation. (Many animal species can synthesize vitamin C, but humans cannot.) Certain vitamin-like compounds that are recommended in the diet, such as carnitine, are thought useful for survival and health, but these are not "essential" dietary nutrients because the human body has some capacity to produce them from other compounds. Moreover, thousands of different phytochemicals have recently been discovered in food (particularly in fresh vegetables), which may have desirable properties including antioxidant activity; experimental demonstration has been suggestive but inconclusive. Other essential nutrients not classed as vitamins include essential amino acids, essential fatty acids, and the minerals discussed in the preceding section.

Vitamin deficiencies may result in disease conditions: goiter, scurvy, osteoporosis, impaired immune system, disorders of cell metabolism, certain forms of cancer, symptoms of premature aging, and poor psychological health (including eating disorders), among many others.

Excess levels of some vitamins are also dangerous to health. The Food and Nutrition Board of the Institute of Medicine has established Tolerable Upper Intake Levels (ULs) for seven vitamins.

-Wikipedia



Other substances

Alcohol (ethanol)

Pure ethanol provides 7 calories per gram. For distilled spirits, a standard serving in the United States is 1.5 fluid ounces, which at 40% ethanol (80 proof), would be 14 grams and 98 calories.Wine and beer contain a similar range of ethanol for servings of 5 ounces and 12 ounces, respectively, but these beverages also contain non-ethanol calories. A 5-ounce serving of wine contains 100 to 130 calories. A 12-ounce serving of beer contains 95 to 200 calories. According to the U.S. Department of Agriculture, based on NHANES 2013-2014 surveys, women ages 20 and up consume on average 6.8 grams/day and men consume on average 15.5 grams/day. Ignoring the non-alcohol contribution of those beverages, the average ethanol calorie contributions are 48 and 108 cal/day. Alcoholic beverages are considered empty calorie foods because other than calories, these contribute no essential nutrients.

Phytochemicals

Phytochemicals such as polyphenols are compounds produced naturally in plants (phyto means “plant” in Greek). In general, the term identifies compounds that are prevalent in plant foods, but are not proven to be essential for human nutrition, as of 2018. There is no conclusive evidence in humans that polyphenols or other non-nutrient compounds from plants confer health benefits, mainly because these compounds have poor bioavailability, i.e., following ingestion, they are digested into smaller metabolites with unknown functions, then are rapidly eliminated from the body. While initial studies sought to reveal if dietary supplements might promote health, one meta-analysis concluded that supplementation with antioxidant vitamins A and E and beta-carotene did not convey any benefits, and may increase risk of death. Vitamin C and selenium supplements did not impact mortality rate. Health effect of non-nutrient phytochemicals such as polyphenols were not assessed in this review.

-Wikipedia

Global Nutrition Challenges

The challenges facing global nutrition are child malnutrition, disease, obesity, and vitamin deficiency.

Child malnutrition

According to UNICEF, in 2011, 101 million children across the globe were underweight and one in four children, 165 million, were stunted in growth.[94] Simultaneously, there are 43 million children under five who are overweight or obese.[3] Nearly 20 million children under five suffer from severe acute malnutrition, a life-threatening condition requiring urgent treatment.

According to estimations at UNICEF, hunger will be responsible for 5.6 million deaths of children under the age of five this year.[2] These all represent significant public health emergencies.[90] This is because proper maternal and child nutrition has immense consequences for survival, acute and chronic disease incidence, normal growth, and economic productivity of individuals.

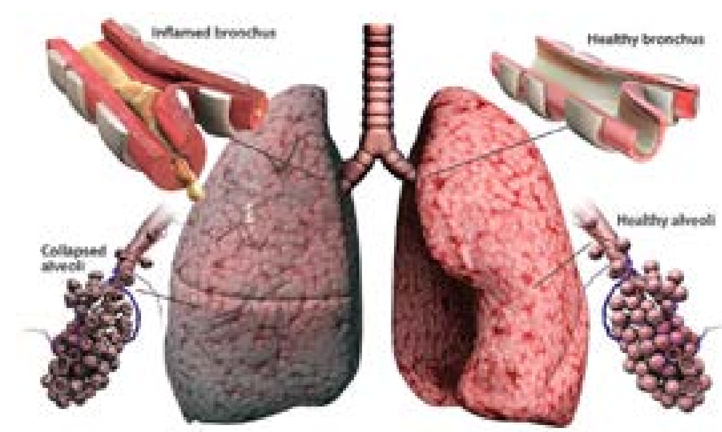
Childhood malnutrition is common and contributes to the global burden of disease.[96] Childhood is a particularly important time to achieve good nutrition status, because poor nutrition has the capability to lock a child in a vicious cycle of disease susceptibility and recurring sickness, which threatens cognitive and social development.[2] Undernutrition and bias in access to food and health services leaves children less likely to attend or perform well in school.

Disease

The most common non-infectious diseases worldwide, that contribute most to the global mortality rate, are cardiovascular diseases, various cancers, diabetes, and chronic respiratory problems, all of which are linked to poor nutrition. Nutrition and diet are closely associated with the leading causes of death, including cardiovascular disease and cancer. Obesity and high sodium intake can contribute to ischemic heart disease, while consumption of fruits and vegetables can decrease the risk of developing cancer.

Food-borne and infectious diseases can result in malnutrition, and malnutrition exacerbates infectious disease. Poor nutrition leaves children and adults more susceptible to contracting life-threatening diseases such as diarrheal infections and respiratory infections.[2] According to the WHO, in 2011, 6.9 million children died of infectious diseases like pneumonia, diarrhea, malaria, and neonatal conditions, of which at least one third were associated with undernutrition.

diabetes



chronic obstructive pulmonary disease

cardiovascular disease

Undernutrition

UNICEF defines undernutrition "as the outcome of insufficient food intake (hunger) and repeated infectious diseases. Under nutrition includes being underweight for one's age, too short for one's age (stunted), dangerously thin (wasted), and deficient in vitamins and minerals (micronutrient malnutrient). Under nutrition causes 53% of deaths of children under five across the world. It has been estimated that undernutrition is the underlying cause for 35% of child deaths. The Maternal and Child Nutrition Study Group estimate that under nutrition, "including fetal growth restriction, stunting, wasting, deficiencies of vitamin A and zinc along with suboptimum breastfeeding—is a cause of 3.1 million child deaths and infant mortality, or 45% of all child deaths in 2011".

> "The Maternal and Child Nutrition Study Group estimate that under nutrition, "including fetal growth restriction, stunting, wasting, deficiencies of vitamin A and zinc along with suboptimum breastfeeding - is a cause of 3.1 million child deaths and infant mortality, or 45% of all child deaths in 2011".

When humans are undernourished, they no longer maintain normal bodily functions, such as growth, resistance to infection, or have satisfactory performance in school or work. Major causes of under nutrition in young children include lack of proper breast feeding for infants and illnesses such as diarrhea, pneumonia, malaria, and HIV/AIDS. According to UNICEF 146 million children across the globe, that one out of four under the age of five, are underweight. The number of underweight children has decreased since 1990, from 33 percent to 28 percent between 1990 and 2004. Underweight and stunted children are more susceptible to infection, more likely to fall behind in school, more likely to become overweight and develop non-infectious diseases, and ultimately earn less than their non-stunted coworkers. Therefore, undernutrition can accumulate deficiencies in health which results in less productive individuals and societies

Many children are born with the inherent disadvantage of low birth weight, often caused by intrauterine growth restriction and poor maternal nutrition, which results in worse growth, development, and health throughout the course of their lifetime.[90] Children born at low birthweight (less than 5.5 pounds or 2.5 kg), are less likely to be healthy and are more susceptible to disease and early death.[2] Those born at low birthweight also are likely to have a depressed immune system, which can increase their chances of heart disease and diabetes later on in life.[2] Because 96% of low birthweight occurs in the developing world, low birthweight is associated with being born to a mother in poverty with poor nutritional status that has had to perform demanding labor.[2]

Stunting and other forms of undernutrition reduces a child's chance of survival and hinders their optimal growth and health.[98] Stunting has demonstrated association with poor brain development, which reduces cognitive ability, academic performance, and eventually earning potential.[98] Important determinants of stunting include the quality and frequency of infant and child feeding, infectious disease susceptibility, and the mother's nutrition and health status.[98] Undernourished mothers are more likely to birth stunted children, perpetuating a cycle of undernutrition and poverty.[98] Stunted children are more likely to develop obesity and chronic diseases upon reaching adulthood.[98] Therefore, malnutrition resulting in stunting can further worsen the obesity epidemic, especially in low and middle income countries.[98] This creates even new economic and social challenges for vulnerable impoverished groups.[98]

Data on global and regional food supply shows that consumption rose from 2011 to 2012 in all regions. Diets became more diverse, with a decrease in consumption of cereals and roots and an increase in fruits, vegetables, and meat products.[99] However, this increase masks the discrepancies between nations, where Africa, in particular, saw a decrease in food consumption over the same years.[99] This information is derived from food balance sheets that reflect national food supplies, however, this does not necessarily reflect the distribution of micro and macronutrients.[99] Often inequality in food access leaves distribution which uneven, resulting in undernourishment for some and obesity for others.[99]

Undernourishment, or hunger, according to the FAO, is dietary intake below the minimum daily energy requirement.[53] The amount of undernourishment is calculated utilizing the average amount of food available for consumption, the size of the population, the relative disparities in access to the food, and the minimum calories required for each individual.[53] According to FAO, 868 million people (12% of the global population) were undernourished in 2012.[53] This has decreased across the world since 1990, in all regions except for Africa, where undernourishment has steadily increased.[53] However, the rates of decrease are not sufficient to meet the first Millennium Development Goal of halving hunger between 1990 and 2015.[53] The global financial, economic, and food price crisis in 2008 drove many people to hunger, especially women and children. The spike in food prices prevented many people from escaping poverty, because the poor spend a larger proportion of their income on food and farmers are net consumers of food.[100] High food prices cause consumers to have less purchasing power and to substitute more-nutritious foods with low-cost alternatives.[101]

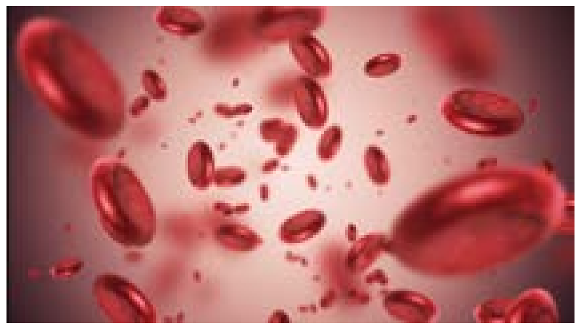
Adult overweight and obesity

Malnutrition in industrialized nations is primarily due to excess calories and non-nutritious carbohydrates, which has contributed to the obesity epidemic affecting both developed and some developing nations.[102] In 2008, 35% of adults above the age of 20 years were overweight (BMI ≥ 25 kg/m2), a prevalence that has doubled worldwide between 1980 and 2008.[103] Also 10% of men and 14% of women were obese, with a BMI greater than 30.[104] Rates of overweight and obesity vary across the globe, with the highest prevalence in the Americas, followed by European nations, where over 50% of the population is overweight or obese.[104]

Obesity is more prevalent amongst high income and higher middle income groups than lower divisions of income.[104] Women are more likely than men to be obese, where the rate of obesity in women doubled from 8% to 14% between 1980 and 2008.[104] Being overweight as a child has become an increasingly important indicator for later development of obesity and non-infectious diseases such as heart disease.[95] In several western European nations, the prevalence of overweight and obese children rose by 10% from 1980 to 1990, a rate that has begun to accelerate recently.[2]

Vitamin and mineral malnutrition

Vitamins and minerals are essential to the proper functioning and maintenance of the human body.[105] There are 20 trace elements and minerals that are essential in small quantities to body function and overall human health.[105]



Iron deficiency is the most common inadequate nutrient worldwide, affecting approximately 2 billion people.[106] Globally, anemia affects 1.6 billion people, and represents a public health emergency in mothers and children under five.[107] The World Health Organization estimates that there exists 469 million women of reproductive age and approximately 600 million preschool and school-age children worldwide who are anemic.[108] Anemia, especially iron-deficient anemia, is a critical problem for cognitive developments in children, and its presence leads to maternal deaths and poor brain and motor development in children.[2] The development of anemia affects mothers and children more because infants and children have higher iron requirements for growth.[109] Health consequences for iron deficiency in young children include increased perinatal mortality, delayed mental and physical development, negative behavioral consequences, reduced auditory and visual function, and impaired physical performance.[110] The harm caused by iron deficiency during child development cannot be reversed and result in reduced academic performance, poor physical work capacity, and decreased productivity in adulthood.[3] Mothers are also very susceptible to iron-deficient anemia because women lose iron during menstruation, and rarely supplement it in their diet.[3] Maternal iron deficiency anemia increases the chances of maternal mortality, contributing to at least 18% of maternal deaths in low and middle income countries.[111]

Vitamin A plays an essential role in developing the immune system in children, therefore, it is considered an essential micronutrient that can greatly affect health.[2] However, because of the expense of testing for deficiencies, many developing nations have not been able to fully detect and address vitamin A deficiency, leaving vitamin A deficiency considered a silent hunger.[2] According to estimates, subclinical vitamin A deficiency, characterized by low retinol levels, affects 190 million pre-school children and 19 million mothers worldwide.[112]

The WHO estimates that 5.2 million of these children under five are affected by night blindness, which is considered clinical vitamin A deficiency.[113] Severe vitamin A deficiency (VAD) for developing children can result in visual impairments, anemia and weakened immunity, and increase their risk of morbidity and mortality from infectious disease.[114] This also presents a problem for women, with WHO estimating that 9.8 million women are affected by night blindness.[115] Clinical vitamin A deficiency is particularly common among pregnant women, with prevalence rates as high as 9.8% in South-East Asia.[112]

Estimates say that 28.5% of the global population is iodine deficient, representing 1.88 billion individuals.[116] Although salt iodization programs have reduced the prevalence of iodine deficiency, this is still a public health concern in 32 nations. Moderate deficiencies are common in Europe and Africa, and over consumption is common in the Americas.[90] Iodine-deficient diets can interfere with adequate thyroid hormone production, which is responsible for normal growth in the brain and nervous system. This ultimately leads to poor school performance and impaired intellectual capabilities.[2]

> “experts promote exclusive breastfeeding, rather than using formula, which has shown to promote optimal growth, development, and health of infants.”

Infant and young child feeding

Improvement of breast feeding practices, like early initiation and exclusive breast feeding for the first two years of life, could save the lives of 1.5 million children annually.[117] Nutrition interventions targeted at infants aged 0–5 months first encourages early initiation of breastfeeding.[3] Though the relationship between early initiation of breast feeding and improved health outcomes has not been formally established, a recent study in Ghana suggests a causal relationship between early initiation and reduced infection-caused neo-natal deaths.[3] Also, experts promote exclusive breastfeeding, rather than using formula, which has shown to promote optimal growth, development, and health of infants.[118] Exclusive breastfeeding often indicates nutritional status because infants that consume breast milk are more likely to receive all adequate nourishment and nutrients that will aid their developing body and immune system. This leaves children less likely to contract diarrheal diseases and respiratory infections.[2]

Besides the quality and frequency of breastfeeding, the nutritional status of mothers affects infant health. When mothers do not receive proper nutrition, it threatens the wellness and potential of their children.[2] Well-nourished women are less likely to experience risks of birth and are more likely to deliver children who will develop well physically and mentally.[2] Maternal undernutrition increases the chances of low-birth weight, which can increase the risk of infections and asphyxia in fetuses, increasing the probability of neonatal deaths.[119] Growth failure during intrauterine conditions, associated with improper mother nutrition, can contribute to lifelong health complications.[3] Approximately 13 million children are born with intrauterine growth restriction annually.[120]

Anorexia nervosa

The lifetime prevalence of anorexia nervosa in women is 0.9%, with 19 years as the average age of onset.[citation needed] Although relatively uncommon, eating disorders can negatively affect menstruation, fertility, and maternal and fetal well-being. Among infertile women suffering from amenorrhea or oligomenorrhea due to eating disorders, 58% had menstrual irregularities, according to preliminary research in 1990.

Nutrition literacy

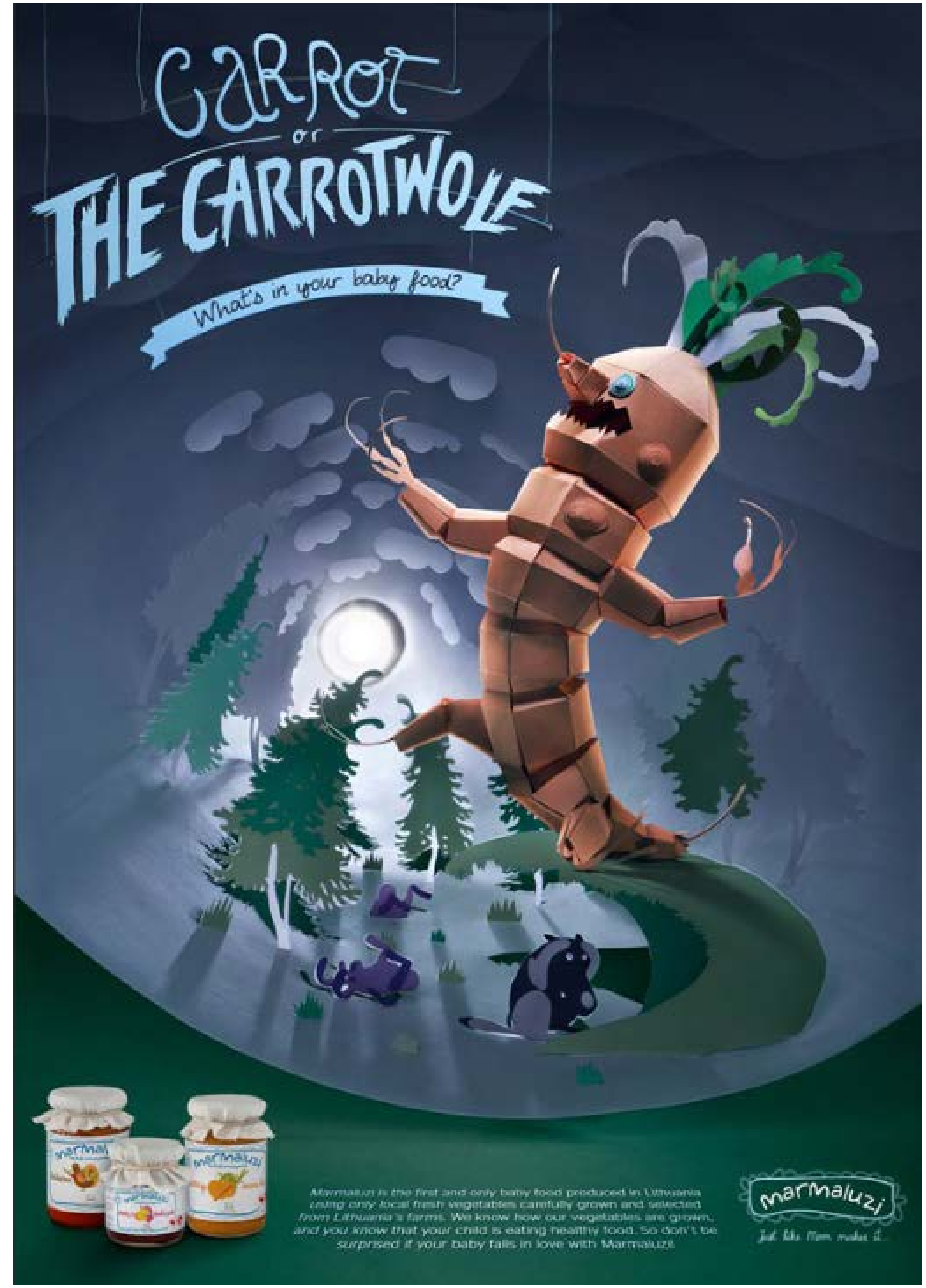
The findings of the 2003 National Assessment of Adult Literacy (NAAL), conducted by the US Department of Education, provide a basis upon which to frame the nutrition literacy problem in the U.S. NAAL introduced the first-ever measure of "the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions" – an objective of Healthy People 2010[122] and of which nutrition literacy might be considered an important subset. On a scale of below basic, basic, intermediate and proficient, NAAL found 13 percent of adult Americans have proficient health literacy, 44% have intermediate literacy, 29 percent have basic literacy and 14 percent have below basic health literacy. The study found that health literacy increases with education and people living below the level of poverty have lower health literacy than those above it.

Another study examining the health and nutrition literacy status of residents of the lower Mississippi Delta found that 52 percent of participants had a high likelihood of limited literacy skills.[123] While a precise comparison between the NAAL and Delta studies is difficult, primarily because of methodological differences, Zoellner et al. suggest that health literacy rates in the Mississippi Delta region are different from the U.S. general population and that they help establish the scope of the problem of health literacy among adults in the Delta region. For example, only 12 percent of study participants identified the My Pyramid graphic two years after it had been launched by the USDA. The study also found significant relationships between nutrition literacy and income level and nutrition literacy and educational attainment[123] further delineating priorities for the region.

These statistics point to the complexities surrounding the lack of health/nutrition literacy and reveal the degree to which they are embedded in the social structure and interconnected with other problems. Among these problems are the lack of information about food choices, a lack of understanding of nutritional information and its application to individual circumstances, limited or difficult access to healthful foods, and a range of cultural influences and socioeconomic constraints such as low levels of education and high levels of poverty that decrease opportunities for healthful eating and living.

The links between low health literacy and poor health outcomes has been widely documented[124] and there is evidence that some interventions to improve health literacy have produced successful results in the primary care setting. More must be done to further our understanding of nutrition literacy specific interventions in non-primary care settings[123] in order to achieve better health outcomes.

-Wikipedia



9770971730008