13 Nutrition

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The Community and Nutrition Programs

Connections between nutrition and health have probably been understood, at least to some degree, among all people of all places and times. For example, around 400 BC Hippocrates said, "Let food be your medicine and medicine be your food." Understanding the physiological needs of our cells helps us understand why it is that food has such an impact on overall health. In this chapter we introduce nutrition by examining how cells use different nutrients and then discuss disease conditions that are tied to nutritional problems.

Nutrition and Health in the Community

The nutritional status of people in our communities is a concern not only for quality of life, but also for economics (treating illness costs far more than preventing it). Various public health agencies are striving to prevent nutritional deficiencies and improve overall health. In the U.S., the government supplies a variety of resources such as state assistance, WIC (Women Infant and Child), and so forth. In addition, there have been many government agencies and voluntary health and scientific associations, such as the American Heart Association, that focus on life style and dietary factors that prevent chronic and life-threatening diseases. The U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (USDHHS) developed dietary guidelines in 1977 that were compiled and displayed as the food guide pyramid. The food guide pyramid was revised as "My Pyramid," but this new chart is confusing to most people. Harvard School of Public Health developed an alternative healthy eating pyramid (shown at left) based on long-term nutritional studies. This pyramid differs from the old USDA pyramid in several key aspects: for example, exercise is at the bottom to remind us of its important role in our health. Also, not all carbohydrates are at the bottom (white bread, white rice, and potatoes are now at the top with sugars), and not all oils are at the top (plant oils are at the bottom). Other resource, such as the Recommended Daily Allowance (RDA) have helped people become more aware of nutritional needs, yet obesity and chronic health problems continue to rise.

Nutritional Requirements

Our bodies have certain nutritional needs and if they are not met will cause catabolism of its own fats, carbohydrates and proteins. Molecules are continuously broken down, so we must replace them. Food molecules, essential fatty acids and essential amino acids are particularly important in replacing these molecules. Vitamins (Vital Emines) and minerals are not used as energy, but are essential in enzyme reactions. Living tissue is kept alive by using the expenditure of ATP, found in the break down of food. Foods energy value is measured in kilocalories. 1 kilocalorie is equal to 1000 calories.

Carbohydrates

Macronutrient

An energy-yeilding nutrient. Macronutrients are those nutrients that together provide the vast majority of metabolic energy to an organism. The three main macronutrients are carbohydrates, proteins, and fat.

Micronutrients
Microminerals or trace elements, are dietary minerals needed by the human body in very small quantities (generally less than 100mg/day) as opposed to macrominerals which are required in larger quantities.

Functions

Glucose it is the most easily used by the body. It is a simple carbohydrate that circulates in the blood and is the main source of energy for the muscles, central nervous system, and is the ONLY source of energy for the brain.

Carbohydrates are made of organic compounds carbon, hydrogen, and oxygen.

There are three sizes of carbohydrate and they are distinguished by a classification of two that is, *Simple carbohydrates* (mono saccharides and disaccharides) and *complex carbohydrates* (polysaccharides). Polysaccharides are the most abundant carbohydrate in the body along with glycogen.

The break down of polysaccharides goes as follows: Polysaccharides are digested into monosaccchorides including glucose which goes into the intestinal epithelium and into the bloodstream. The molecules of glucose are taken by glucose transporters and delivered into the cells of the body. While glucose is in the cells it can be oxidized for energy or provide substrates to other metabolic reactions or of course into glycogen for storage.

A. Monosaccharides = Single carbohydrate unit, such as, Glucose, Fructose, and Galactose.

B. Disaccharides = Two single carbohydrates bound together these are Sucrose, Maltose, and Lactose.

C. Polysaccharides = Have many units of monosaccharides joined together such as, Starch and Fiber.

Proteins

Functions

Protein forms hormones, enzymes, antibodies; it is part of fluid and electrolyte regulation, the buffering effect for pH, and transporter of nutrients. A good example of a protein is the oxygen carrying hemoglobin found in red blood cells.

Proteins are made of carbon, hydrogen, oxygen, and nitrogen, an inorganic molecule, the thing that clearly distinguishes them form the other macronutrients.

A. Amino acids are the building blocks of proteins.

B. Polypeptide a group of amino acids bonded together 1000 or more.

The body requires amino acids to produce new body protein (protein retention) and to replace damaged proteins (maintenance) that are lost in the urine.

Proteins are relatively large molecules made of amino acids joined together in chains by peptide bonds. Amino acids are the basic structural building units of proteins. They form short polymer chains called peptides or longer poly-peptides which in turn formstructures called proteins. The process of protein synthesis is controlled by an mRNA template. In this process tRNA transfers amino acids to the mRNA to form protein chains.

There are twenty standard amino acids used by cells in making proteins. Vertebrates, including humans, are able to synthesize 11 of these amino acids from other molecules. The remaining nine amino acids cannot be synthesized by our cells, and are termed "'essential amino acids'". These essential amino acids must be obtained from foods.

The **9 Essential Amino Acids** have the following names: **H**istidine, **I**soleucine, **L**eucine, **L**ysine, **M**ethionine, **P**henylalanine, **T**hreonine, **T**ryptophan, **V**aline

You can remember these with this saying “Hey It's Like Lovely Material; Please Touch The Velvet”.

The **11 Non-essential Amino Acids** are as follows:

Alanine, **A**rginine, **A**spartic acid, **C**ysteine, **C**ystine, **G**lutamic acid, **G**lutamine, **G**lycine, **P**roline, **S**erine, T**ryosine**

How about this memory device, "Almost Always Aunt Cindy Can Get Great Gum Popping Sounds Together"

The 20 Amino Acids and What They Do!

Amino Acid	Abbrev.		Remarks
Alanine	A	Ala	Very abundant, very versatile. More stiff than glycine, but small enough to pose only small steric limits for the protein conformation. It behaves fairly neutrally, can be located in both hydrophilic regions on the protein outside and the hydrophobic areas inside.
Cysteine	C	Cys	The sulfur atom binds readily to heavy metal ions. Under oxidizing conditions, two cysteines can join together in a disulfide bond to form the amino acid cystine. When cystines are part of a protein, insulin for example, this stabilises tertiary structure and makes the protein more resistant to denaturation; disulphide bridges are therefore common in proteins that have to function in harsh environments including digestive enzymes (e.g., pepsin and chymotrypsin) and structural proteins (e.g., keratin). Disulphides are also found in peptides too small to hold a stable shape on their own (eg. insulin).

Aspartic acid	D	Asp	Behaves similarly to glutamic acid. Carries a hydrophilic acidic group with strong negative charge. Usually is located on the outer surface of the protein, making it water-soluble. Binds to positively-charged molecules and ions, often used in enzymes to fix the metal ion. When located inside of the protein, aspartate and glutamate are usually paired with arginine and lysine.
Glutamate	E	Glu	Behaves similar to aspartic acid. Has longer, slightly more flexible side chain.
Phenylalanine	F	Phe	Essential for humans. Phenylalanine, tyrosine, and tryptophan contain large rigid aromatic group on the side chain. These are the biggest amino acids. Like isoleucine, leucine and valine, these are hydrophobic and tend to orient towards the interior of the folded protein molecule.
Glycine	G	Gly	Because of the two hydrogen atoms at the α carbon, glycine is not optically active. It is the smallest amino acid, rotates easily, adds flexibility to the protein chain. It is able to fit into the tightest spaces, e.g., the triple helix of collagen. As too much flexibility is usually not desired, as a structural component it is less common than alanine.
Histidine	H	His	In even slightly acidic conditions protonation of the nitrogen occurs, changing the properties of histidine and the polypeptide as a whole. It is used by many proteins as a regulatory mechanism, changing the conformation and behavior of the polypeptide in acidic regions such as the late endosome or lysosome, enforcing conformation change in enzymes. However only a few histidines are needed for this, so it is comparatively scarce.
Isoleucine	I	Ile	Essential for humans. Isoleucine, leucine and valine have large aliphatic hydrophobic side chains. Their molecules are rigid, and their mutual hydrophobic interactions are important for the correct folding of proteins, as these chains tend to be located inside of the protein molecule.
Lysine	K	Lys	Essential for humans. Behaves similarly to arginine. Contains a long flexible side-chain with a positively-charged end. The flexibility of the chain makes lysine and arginine suitable for binding to molecules with many negative charges on their surfaces. E.g., DNA-binding proteins have their active regions rich with arginine and lysine. The strong charge makes these two amino acids prone to be located on the outer hydrophilic surfaces of the proteins; when they are found inside, they are usually paired with a corresponding negatively-charged amino acid, e.g., aspartate or glutamate.
Leucine	L	Leu	Essential for humans. Behaves similar to isoleucine and valine. See isoleucine.
Methionine	M	Met	Essential for humans. Always the first amino acid to be incorporated into a protein; sometimes removed after translation. Like cysteine, contains sulfur, but with a methyl group instead of hydrogen. This methyl group can be activated, and is used in many reactions where a new carbon atom is being added to another molecule.
Asparagine	N	Asn	Similar to aspartic acid. Asn contains an amide group where Asp has a carboxyl.
Proline	P	Pro	Contains an unusual ring to the N-end amine group, which forces the CO-NH amide sequence into a fixed conformation. Can disrupt protein folding structures like α helix or β sheet, forcing the desired kink in the protein chain. Common in collagen, where it often undergoes a posttranslational

			modification to hydroxyproline. Uncommon elsewhere.
Glutamine	Q	Gln	Similar to glutamic acid. Gln contains an amide group where Glu has a carboxyl. Used in proteins and as a storage for ammonia.
Arginine	R	Arg	Functionally similar to lysine.
Serine	S	Ser	Serine and threonine have a short group ended with a hydroxyl group. Its hydrogen is easy to remove, so serine and threonine often act as hydrogen donors in enzymes. Both are very hydrophilic, therefore the outer regions of soluble proteins tend to be rich with them.
Threonine	T	Thr	Essential for humans. Behaves similarly to serine.
Valine	V	Val	Essential for humans. Behaves similarly to isoleucine and leucine. See isoleucine.
Tryptophan	W	Trp	Essential for humans. Behaves similarly to phenylalanine and tyrosine (see phenylalanine). Precursor of serotonin.
Tyrosine	Y	Tyr	Behaves similarly to phenylalanine and tryptophan (see phenylalanine). Precursor of melanin, epinephrine, and thyroid hormones.

Dietary proteins fall into two categories: complete proteins and incomplete proteins. Complete proteins include ample amounts of all essential amino acids. What I can eat that will include these great complete proteins include meat, fish, poultry, cheese, eggs, and milk. Incomplete proteins contain some but not all of the essential amino acids required by the human body. Examples of incomplete proteins include legumes, rice, and leafy green vegetables. Someone who chooses a vegan lifestyle must be careful to combine various plant proteins to obtain all the essential amino acids on a daily basis, but it can be accomplished.

Ingested proteins are broken down into amino acids during digestion. They are then absorbed by the villi of the small intestine and enter the blood stream. Our cells use these amino acids to assemble new proteins that are used as enzymes, cell receptors, hormones, and structural features. Each protein has its own unique amino acid sequence that is specified by the nucleotide sequence of the gene encoding that protein (see Genetics and Inheritance). If we are deficient in even a single amino acid then our cells cannot make the proteins they require.

Lipids

Macronutrient

Provide 9 Kcalories per gram; it is an energy-yielding nutrient

Functions are stored energy (adipose tissue), organ protection, temperature regulator, insulation such as myelin that covers nerve cells, lipid membrane around cells, and emulsifiers to keep fats dispersed in body fluids.

Lipids are made of organic molecules carbon, hydrogen, and oxygen. Fats consist of glycerol fatty acids joind by an ester bond.

- **A.** Triglycerides composed of three fatty acids and one glycerol molecule.
- **B.** Saturated fatty acid fatty acid with carbon chains fully saturated with hydrogen.
- **C.** Monounsaturated fatty acid fatty acid that has a carbon chain with one unsaturated

double bond.

- **D.** Polyunsaturated fatty acid a fatty acid that has two or more double bonds on the carbon chain.

Essential fatty acids part of the polyunsaturated fatty acids

- **E.** Linoleic acid and essential polyunsaturated fatty acid, it first double bond is a t the 6th carbon this is why it can be called Omega 6.
- **F.** Linolenic acid an essential polyunsaturated fatty acid, it first double bond is at the 3rd carbon this is why it can be called Omega 3, and is the main member of the omega-3 family.
- **G.** Eicosapentaenoic acid (EPA) , is derived form linolecin acid and is the main fatty acid found in fish, also called omega 3.
- **H.** Docosahexaenoic acid (DHE), is an omega 3 fatty acid is synthesized in body from alph-linolenic acid and is present in fish. DHA is present in retina and brain.

Nonessential

- **I.** Sterols serve a vital function in the body and are produced by the body and are not essential nutrients, this structure of a lipid is cholesterol. This is a waxy substance that doesn't look like a triglyceride it doesn't have a glycerol backbone or fatty acids but because it is impermeable in water it is a lipid.
- **J.** CIS- Trans Fatty acids hydrogenation makes monounsaturated and polyunsaturated fatty acids go from a state of their original form that is *cis* to a *trans* form. Addition of hydrogens ions will cause vegetable oil to harden. Additionally, they may stimulate cholesterol synthesis, and are potentially carcinogenic.

Absorption process of triglycerides. This is the fat that your body deals with most of the time. They are absorbed with the transport of chylomincres into the lymphatic system which in turn will pour into the blood stream at the thoracic duct. Once it enters the blood stream the chylomicrons take the triglycerides into the cells. The triglycerides that are on the outer part of the chylomicrons are broken down by lipoprotein lipase. Lipoprotein lipase can be found on the walls of capillaries. It is this enzyme that will break it into fatty acids and monoglycerides. The fatty acids are taken by the body's cells while the monoglycerides are taken to the liver to be processed.

More Info on Lipids:

- 1. Lipids are structural components found in every cell of the human body. That is they form the lipid bilayer found in individual cells. They also serve as the myelin sheath found in neurons.
- 2. Lipids provide us with energy, most of that energy is in the form of triacylglycerols.
- 3. Both lipids and lipid derivatives serve as vitamins and hormones.
- 4. Lipophilic bile acids aid in lipid solubility

Vitamins and Minerals

We all need micronutrients in small quantities to sustain health. Micronutrients include dietary minerals and vitamins. While all minerals and vitamins can be obtained through food, many people do not consume enough to meet their micronutrient needs and instead may take a supplement.

Microminerals or trace elements include at least iron, cobalt, chromium, copper, iodine, manganese, selenium, zinc, and molybdenum. They are dietary minerals needed by the human body in very small quantities (generally less than 100mg/day) as opposed to macrominerals which are required in larger quantities. (Note that the use of the term "mineral" here is distinct from the usage in the geological sciences.)

Vitamins

Vitamins are organic compounds that are essential for our body to function properly. Most vitamins are obtained from what you consume, because the body is unable to manufacture most of the essential vitamins that you need to survive. Here are types of vitamins and their roles:

Vitamin	Food Sources	Functions	Problems When Deficient	Problems With Taking Too Much
A (retinol)	Ingested in a precursor form. Found in animal sources such as milk and eggs. Also found carrots and spinach (contain pro vitamin A carotenoids).	Vitamin A is a fat-soluble vitamin. It helps cells differentiate, also lowering your risk of getting cancer. Vitamin A helps to keep vision healthy. It is required during pregnancy. Vitamin A also influences the function and development of sperm, ovaries and placenta and is a vital component of the reproductive process.	Night blindness, impaired growth of bones and teeth	Headache, dizziness, nausea, hair loss, abnormal development of fetus
B1 (thiamine)	Found in wheat germ, whole wheat, peas, beans, enriched flour, fish, peanuts and meats.	Vitamin B1 is a water-soluble vitamin that the body requires to break down carbohydrates, fat and protein. The body needs vitamin b in order to make adenine triphosphate (ATP). Vitamin B1 is also essential for the proper functioning of nerve cells.	Beriberi, muscular weakness, enlarged heart	Can interfere with the absorption of other vitamins
B2 (riboflavin)	Found in milk cheese, leafy green vegetables, liver, soybeans yeast and almonds. Exposure to light destroys riboflavin.	Vitamin B2 is a water-soluble vitamin that helps the body process amino acids and fats. Activated vitamin B6 and folic acid helps convert carbohydrates to adenosine triphosphate (ATP). Sometimes vitamin B2 can act as an antioxidant.	Dermatitis, blurred vision, growth failure	Unknown
B3 (niacin)	Found in beets, brewer's yeast, beef liver, beef kidney,	Vitamin B3 is required for cell respiration and helps release the energy in carbohydrates, fats,	Pellagra, diarrhea, mental disorders	High blood sugar and uric acid,

	pork, turkey, chicken, veal, fish, salmon, swordfish, tuna, sunflower seeds, and peanuts.	and proteins. It helps with proper circulation and healthy skin, functioning of the nervous system, and normal secretion of bile and stomach fluids. It is used in the synthesis of sex hormones, treating schizophrenia and other mental illnesses, and as a memory-enhancer.		vasodilation
C (ascorbic acid)	Found citrus fruits such as oranges, grapefruit and lemon.	Vitamin C is an essential water-soluble vitamin. It is needed to make collagen. Vitamin C also aids in the formation of liver bile which helps to detoxify alcohol and other substances. Evidence indicates that vitamin C levels in the eye decrease with age and this may be a cause of cataracts. Vitamin C has been reported to reduce activity of the enzyme, aldose reductase, which helps protect people with diabetes. It may also protect the body against accumulation or retention of the toxic mineral, lead.	Scurvy, delayed wound healing, infections	Gout, kidney stones, diarrhea, decreased copper
D	Produced by the human body during exposure to the ultraviolet rays of the sun.	Vitamin D is a fat-soluble vitamin that helps maintain blood levels of calcium. Vitamin D is necessary for healthy bones and teeth. Vitamin D plays a role in immunity and blood cell formation and also helps cells differentiate this lowers your chance of getting cancer.	Lack of Vitamin D results in rickets for children and osteomalacia for adults.	Calcification of soft tissue, diarrhea, possible renal damage
E	Found in vegetable oils, nuts, and green leafy vegetables. Fortified cereals are also an important source of vitamin E in the United States.	Vitamin E is an antioxidant that protects cell membranes and other fat-soluble parts of the body, such as LDL cholesterol (the "bad" cholesterol), from damage.	Unknown	Diarrhea, nausea, headaches, fatigue, muscle weakness
K	Found in kale, collard greens, spinach, mustard greens, turnip greens and Brussels	Vitamin K by helping transport Ca, vitamin K is necessary for proper bone growth and blood coagulation.	Easy bruising and bleeding	Can interfere with anticoagulant medication

	sprouts. Also found vegetable oils such as soybean, canola, cottonseed, and olive. Additionally, the normal flora of the large intestine produce vitamin K, which our body is able to absorb and use			
Folic acid	Found in many vegetables including, broccoli, peas, asparagus, spinach, green leafy types. Also found in fresh fruit, liver and yeast.	Coenzyme needed for production of hemoglobin and formation of DNA.	Megaloblastic anemia, spina bifida	May mask B12 deficiency
B12	Found in meat, fish, eggs and milk but not in vegetables.	Vitamin B12 is needed to make red blood cells. Supplements can help some types of anemia.	Pernicious anemia	Unknown
B6 (pyridoxine)	Found in cereals, yeast, liver, and fish.	Vitamin B6 is a coenzyme in amino acid synthesis.	Rare to be deficient, convulsions, vomiting, seborrhea, muscular weakness	Insomnia, neuropathy

Fat soluble vitamins A, D, E, K

With fat soluble vitamins you need the presence of fat in your diet to absorb them, this is because the bile will not be secreted to help with emulsification and therefore the fat vitamins will not be broken down for absorption. Fat soluble vitamins are stored in organs such as the liver, spleen, and other fatty tissues in the body. Because of this excessive amounts of fat-soluble vitamins can accumulate in the body resulting in toxicity, but this rarely comes form excessive dietary intake but rather form improper use of vitamin supplements.

Minerals

Minerals are atoms of certain chemical elements that are essential for body processes. Minerals are *inorganic*, meaning that they are not man-made. They are either produced by our body, or we obtain them by eating certain foods that contain them. They are ions found in blood plasma and cell cytoplasm, such as sodium, potassium, and chloride. In addition, minerals represent much of the chemical composition of bones (calcium, phosphorus, oxygen). They also contribute to nerve and muscle activity (sodium, potassium, calcium). Minerals serve several many other functions as well. There are 21 minerals considered essential for our bodies. Nine of the essential minerals in the body account for less than .01% of your body weight. Because of the small amount of these minerals that our body needs, we call them *trace minerals*. The 12 most important minerals and their functions are listed below:

Mineral	Source	Use in the body
Calcium (Ca)	Calcium can be found in dairy products, dark green vegetables and legumes.	It contributes to bone and teeth formation. In addition, calcium also contributes to nerve and muscle action, and blood clotting.
Chloride (Cl)	Chloride is mainly found in table salt.	It plays a role in the acid-base balance, stomach acid formation, and body water balance.
Copper (Cu)	Copper can be found in seafood, nuts, and legumes.	It participates in the synthesis of hemoglobin and melanin.
Flourine (F)	Flourine is evident in flouridated water, tea, and seafood.	It accounts for the maintenance of teeth, and perhaps the maintenance of bone as well.
Iodine (I)	Iodine is a component in iodized salt, marine fish and shellfish.	Although a very small amount is needed for our body, according to some, iodine still plays a role in our body's function. It can also be found in seaweed. It is needed for the thyroid hormone.
Iron (Fe)	Iron can be found in green leafy vegetables, whole grains foods, legumes, meats, and eggs.	It is needed for composition of hemoblogin, myoblobin, and certain enzymes.
Magnesium (Mg)	Magnesium is found in whole grains foods, and in green leafy vegetables.	It is the coenzyme found in several enzymes.
Phophorus (P)	Phosphorus can be found in meat, poultry, and whole grain foods.	It serves as components of bones, teeth, phospholipids, ATP, and nucleic acids.
Potassium (K)	Potassium is widespread in the diet, especially in meats and grains.	It deals with muscle and nerve function, and also is a major component of intracellular fluid.
Sodium (Na)	Sodium is found in table salt, is a major component of water and also widespread in the diet.	It participates in the functioning of muscles and nerves.
Sulfur (S)	Sulfur is found in meat and diary products.	It is a component of many proteins.
Zinc (Zn)	Zinc is found in whole grain foods, meats, and seafood.	It is a component of many enzymes.

Nutritional Disorders

Body Mass Index became popular during the early 1980s as obesity started to become a discernible issue in prosperous Western society. BMI provided a simple numeric measure of a person's "fatness" or "thinness", allowing health professionals to discuss the problems of over- and under-weight more objectively with their patients. However, BMI has become controversial because many people, including physicians, have come to rely on its apparent numerical "authority" for medical diagnosis – but that has never been the BMI's purpose. It is meant to be used as a simple means of classifying sedentary (physically inactive) individuals with an average body composition.[1] For these individuals, the current value settings are as follows: a BMI of 18.5 to 25 may indicate optimal weight; a BMI lower than 18.5 suggests the person is underweight while a number above 25 may indicate the person is overweight; a BMI below 15 may indicate the person has an eating disorder; a number above 30 suggests the person is obese (over 40, morbidly obese).

In physiology the term “weight” is used interchangeably with “mass”. For a given body shape and given density, the BMI will be proportional to weight e.g. if all body weight increase by 50%, the BMI increases by 50%.

BMI is defined as the individual's body weight divided by the square of their height. The formulas universally used in medicine produce a unit of measure that is not dimensionless; it has units of kg/m2. Body mass index may be accurately calculated using any of the formulas below.

SI units

$$\mathrm{BMI} = \frac{weight\ (\mathrm{kg})}{height^2 (\mathrm{m}^2)}$$

US units

$$\mathrm{BMI} = 703 \cdot \frac{weight\ (\mathrm{lb})}{height^2\ (\mathrm{in}^2)}$$

UK mixed units

$$\mathrm{BMI} = 6.35 \cdot \frac{weight\ (\mathrm{stone})}{height^2\ (\mathrm{m}^2)}$$

BMI	Weight Status
Below 18.5	Underweight
18.5 - 24.9	Normal
25.0 - 29.9	Overweight
30.0 and Above	Obese

The U.S. National Health and Nutrition Examination Survey of 1994 indicates that 59% of American men and 49% of women have BMIs over 25. Extreme obesity — a BMI of 40 or more — was found in 2% of the men and 4% of the women. There are differing opinions on the threshold for being underweight in females, doctors quote anything from 18.5 to 20 as being the lowest weight, the most frequently stated being 19. A BMI nearing 15 is usually used as an indicator for starvation and the health risks involved, with a BMI <17.5 being one of the criteria for the diagnosis of anorexia nervosa.

Anorexia nervosa: is a psychiatric diagnosis that describes an eating disorder characterized by low body weight and body image distortion with an obsessive fear of gaining weight. Individuals with anorexia often control body weight by voluntary starvation, purging, vomiting, excessive exercise, or other weight control measures, such as diet pills or diuretic drugs. It primarily affects young adolescent girls in the Western world and has one of the highest mortality rates of any psychiatric condition, with approximately 10% of people diagnosed with the condition eventually dying due to related factors.[1] Anorexia nervosa is a complex condition, involving psychological, neurobiological, and sociological components.[2]

Bulimia nervosa: commonly known as bulimia, is generally considered a psychological condition in which the subject engages in recurrent binge eating followed by an intentional purging. This purging is done in order to compensate for the excessive intake of the food and to prevent weight gain. Purging typically takes the form of vomiting; inappropriate use of laxatives, enemas, diuretics or other medication; and excessive physical exercise.

Metabolism

Absorptive and post absorptive stage of metabolism

The body has two phases to it metabolic cycle. The first is known as the absorptive stage. This stage happens 3-4 hours after a typical meal. during this phase nutrients are absorbed by the body. In other words this is the stage where energy is stored into macromolecules. During the post-absorptive stage the nutrients are not being absorbed instead this is the stage where it is being mobilized.

Insulin

The changes in the body that occur between the absorptive an post-absorptive state are triggered by the changes in the plasma concentration of insulin. Insulin encourages the synthesis of energy storage molecules. When plasma glucose levels in the bloodstream increase during the absorptive stage insulin is secreted from the pancreas. When the plasma glucose levels decrease that begins the post-absorptive phase. Insulin acts on several different tissues in the body and influences almost every major aspect of energy metabolism. Insulin supports and promotes all aspects of the absorptive phase by helping store energy in all tissues. It also inhibits the reactions of the post-absorptive phase. Insulin also affects the transport of nutrients across the membrane of ALL body cells except for those located in the liver and CNS. Insulin also has a part in growth where it needs to be present in the blood stream in order for the hormones to effect normally.

Epinephrine and sympathetic nervous activity on metabolism

The sympathetic system and epinephrine suppress insulin and stimulate glycogen secretion. This effects the post absorptive phase by making metabolic adjustments. During the post absorptive phase plasma glucose levels decrease and cause an increase of glycogen secretion. It also acts directly on glucose receptors in the CNS. This causes a rise in epinephrine secretion by the adrenal medulla. The rise in epinephrine creates a cascade event where the body sends signals to all the tissues (except skeletal muscles)to switch to the post absorptive phase.

Case Study

Diabetes

With insulin having such an effect throughout the body you can understand why a lack of proper insulin control can effect the body. With insulin deficient people they have a uptake of glucose into muscle and fat tissues and an increase of releasing glucose into the bloodstream. With the uptake of glucose in the muscles it causes them to use their alternate energy. This will produce muscle wasting, weakness and weight loss. The can be tested as hyperglycemia in the blood. These effects are caused by abnormally high plasma glucose levels and although hyperglycemia has a suppressive effect on glucagon secretion, glucagon secretion is often elevated in people with diabetes because the glucose permeability of alpha cells in the pancreas is insulin dependent. Diabetes is the seventh leading cause of death in the United States. Their are two different types of diabetes, Type I and Type II. Type I also known as insulin dependent diabetes Mellitus (IDDM) occurs mostly in children as it is a result of of the destruction of B cells within the body. Treatment for this type of diabetes is insulin injection therapy and if left untreated can cause death by ketoacidosis or dehydration shock. Type II also known as non-insulin dependent diabetes (NIDDM) appears usually after the age of 40 and accounts for the majority of diabetes cases. The cause of NIDDM is usually a reduction in target cell responsiveness to insulin.

Calories, Exercise, and Weight

Energy Balance and Body Weight

Energy is measured in units called calories. A calorie is the amount of energy that is needed to raise the temperature of 1 gram of water by one degree Celsius. Because a calorie is such a small amount, scientists use a larger unit to measure intake, called a *kilocalorie*. A kilocalorie is also referred to often as a capital "C" *Calorie*, and is equal to 1000 calories. When we "count" calories, we are actually counting the big Calories.

The old saying, "you are what you eat" is very much true. According to scientists, the average adult consumes 900,000 calories per year. Most people tend to take in more calories than their body needs. An intake of 12 extra calories a day, or around 5% excess in calories, yields an annual increase of 12 extra pounds of body weight. The more developed countries tend to consume more calories than others because of the increasing availability and dieting habits of eating refined foods with little nutrition in them and lots of saturated fat. In our society, there is a huge emphasis put on a person's image and how thin they are, and less emphasis put on what's most important--the nutrition our body receives. While our body do need calories every day to keep us going, we need to watch the amount of calories we consume in order to maintain good health and proper body weight.

Our Caloric intake is linked directly to our health status. Being *overweight* is generally defined as being 15-20% above ideal body weight, while *obesity* is defined as being more than 20% above it. People who weigh 10% less than ideal are considered *underweight*. This is less common in the more developed countries. In less developed countries such as South Africa, being underweight is quite common because they lack the nutrition to maintain good health.

How do we gain weight? When we consume more calories than our body can burn in a day, the excess energy is stored in specialized cells as fat. It is also important to know that the three classes of nutrients have different Caloric contents. Carbohydrates and proteins contain only four Calories per gram, while fat contains about nine. Because of this, it is essential that we watch our amount of fat intake. If we continuously feed our body more calories than is needed, our body will produce more fat cells, to story the excess energy. This contributes to gaining weight.

It is more difficult for chronically overweight persons to lose weight than normal-weight persons. This is because they are constantly fighting the body's own weight-control system, which responds as if the excess weight were normal. Our body is capable of measuring how much we intake, and maintaining our weight. When an overweight person goes on a diet, and consumes less calories, their body will respond as if they are starving, and try to save energy where it can to make up for the decrease in received calories.

Maintaining a healthy body weight

To maintain a stable body weight, our consumption of calories needs to be equal to the amount of calories we use in a day. You can determine your daily energy needs by determining your *basal metabolic rate (BMR)*. Your BMR is the energy your body needs to perform essential activities. Some examples of essential activities are breathing, and maintaining organ function. Your metabolic rate can be influenced by your age, gender, muscular activity, body surface area and enviromental tempature.

Physical Activity: An efficient way to use calories

Although the BMR stays about the same, we can dramatically change the amount of calories we burn in a day by participating in physical activity. It is important to note that heavier people do more work per hour than normal-weight people, for the same level of activity. We must spend about 3,500 Calories to lose one pound of fat. The best approach to weight loss, recommended by nutritionists, is to reduce the Caloric intake by a small amount each day while gradually increasing your amount of physical activity.

BMR: Determining how many calories we need

There are several factors that influence the BMR. Each person's body has different needs. BMR needs vary with gender and body composition. Muscle tissue consumes more energy than fat tissue. Typically, males need more calories than females, because they generally have more muscle tissue. Males use up calories faster than women. BMR also varies with your age as well. As we age, our body needs less and less calories. In addition, some health conditions can contribute to our needed calories. Health conditions such as fever, infections, and hyperthyroidism are examples of health conditions that lower your BMR. Our stress level effects our needed calorie intake as well. So does our increase or decrease in consumption, and our rate of metabolism, which varies with individual genetics.

Calculating Your BMR

Here are the steps to determining your BMR, or, the amount of energy your body needs to perform essential activities:

1. First calculate your weight into kilograms. This is obtained by dividing the number of pounds by 2.2.
2. For Males: multiply your weight in kilograms by 1.0. For Females: multiply your weight in kilograms by 0.9.
3. This number approximates the number of Calories you consumer per hour. Now multiply this number by 24 to estimate how many Calories you need per day to support basic metabolic functions.
4. The end result is your personal basal metabolic rate!

Glossary

Amino acids
: The building blocks of protein in the body. There are nine essential amino acids that are not manufactured by the body and must come from the diet.

Anabolism
: Refers the cumulative metabolic intracellular, molecular processes by which every cell repairs

itself and grows.(synthesizing).

Anorexia
A common eating disorder characterized by an abnormal loss of the appetite for food

antioxidants
Compounds that protect against cell damage inflicted by molecules called oxygen-free radicals, which are a major cause of disease and aging.

Bulimia Nervosa
Eating disorder characterized by binge eating followed by an intentional purging.

Catabolism
The opposite of Anabolism. The metabolic process that breaks down molecules into smaller units. It is made up of degradative chemical reactions in the living cell.

Cirrhosis of the liver
An irreversible advanced scarring of the liver as a result of chronic inflammation of the liver. Can be caused by alcoholism or obesity.

Complete Proteins
Proteins that contain ample amounts of all of the essential amino acids

Deamination
When an amino acid group breaks off an amino acid that makes a molecule of ammonia and keto acid.

Diverticulosis
A diet low in dietary fiber increases the risk, this is the pouches called diverticula formation on the outer portion of the large intestine.

Gastric Bypass Surgery
An operation where a small gastric pouch is created and the remainder of the stomach bypassed

Incomplete Proteins
Proteins that contain some but not all of all of the essential amino acids required by the body

Ipecac
A drug used to induce vomiting

Kwashiorkor
A childhood form of malnutrition caused by general lack of protein or deficiency in one or more amino acids. Appearance of a person with this is a swollen belly due to inadequate production of albumin, which causes the blood to have a lower osmotic pressure, resulting in more fluids escaping from the plasma.

Marasmus
malnutrition cause by a lack of kcalorie intake. Appearance of a person with this is a skeletal one.

Malnutrition
An imbalanced nutrient and or energy intake.

Obesity
A condition in which the natural energy reserve in fatty tissue increased to a point where it is thought to be a risk factor for certain health conditions or increased mortality

Peptide
Two or more amino acids linked together by a bond called a peptide bond.

Polypeptide
A string of amino acids linked together by peptide bonds. A protein is an example of a polypeptide.

Starvation
A severe reduction in vitamin, nutrient, and energy intake, and is the most extreme form of malnutrition

Review Questions

1. Nonessential amino acids

A) are stored in the body
B) are only needed occasionally
C) can be produced in the body
D) can be taken in supplements

2. Micronutrients include

A) minerals and vitamins
B) lipids and fatty acids
C) amino acids and proteins
D) vitamins and minerals

3. The body requires amino acids to

A) produce new red blood cells
B) produce new protein
C) replace damaged red blood cells
D) replace damaged protein
E) A and C
F) B and D

4. The function of lipids

A) store energy
B) organ protection
C) temperature regulator

D) emulsifiers
E) all of the above

5. This vitamin is a vital component of the reproductive process and lowers the risk of getting cancer

A) B12
B) Folic Acid
C) Niacin
D) Thiamine
E) Retinol

6. This vitamin is needed to make red blood cells

A) B1
B) B2
C) B6
D) B12

7. This participates in the synthesis of hemoglobin and melanin

A) Copper
B) Chloride
C) Calcium
D) Iron
E) Iodine

8. I go to visit my grandmother and see that she has multiple bruises- from this I may assume that

A) she has a vitamin A deficiency
B) she is old and just clumsy
C) she has a vitamin K deficiency
D) she has scurvy
E) she has rickets

9. As a pirate I may get scurvy because

A) I am not getting enough vegetables on the ship
B) I am not getting enough fruit on the ship
C) I am eating too much fish on the ship
D) I am getting too much sun on the ship
E) I am drinking too much rum on the ship

10. I am taking anticoagulant medication and it doesn't seem to be working, this could be because

A) I have too much vitamin A
B) I have too much B12
C) I have too much sodium
D) I have too much vitamin E
E) I have too much vitamin K

References

- Van De Graaff (2002) *Human Anatomy 6th ed.* McGraw-Hill Higher Education
- Windmaier, P.W. Raff, H. Strang, T.S. (2004) *Vander, Sherman, & Luciano's Human Physiology, the Mechanisms of Body Function 9th ed.* Mcgraw-Hill
- Starr & McMillan (2001) *Human Biology 6th ed.* Thomson-Brooks/cole.
- Spurlock, Morgan (2004) *Super Size Me* Hart Sharp Video

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