Nutrition Basics Module Script

DECEMBER 2022

Nutrition Basics

Welcome to the module one Nutrition Basics.

What is Nutrition?

What is nutrition? The American Medical Association's Council on Food and Nutrition defines nutrition as: "The science of food, the nutrients and the substances therein, their action, interaction, and balance in relation to health and disease, and the process by which the organism ingests, digests, absorbs, transports, utilizes and excretes food substances"

So, what does that actually mean? Nutrition is about food and what food is made of, and it also includes how food works in our bodies: how we eat, digest, and use the food inside our bodies.

Definitions

Let's start with some basic definitions.

A nutrient is a chemical substance in food that contributes to health. Food provides both the energy and nutrients that our bodies need to carry out necessary functions. A food contains a variety of nutrients, and each food provides different ones.

There are 3 things that make a nutrient essential:

1) If left out of the diet, a decline in health will follow.
2) If restored before permanent damage occurs, health should be regained.
3) A specific biological function must be identified. An example of a non-essential nutrient is alcohol, although some people get some of their energy intake from it, removing alcohol from the diet will not cause any health problems or deficiencies.

Digestion

We'll start our look at nutrition by investigating how we get the food we eat from our plate into our cells. We do this through the process of digestion. Digestion is the process that breaks down larger molecules by both mechanical and chemical methods to produce smaller molecules that can be absorbed.

What do we mean by mechanical and chemical methods? A mechanical method would be chewing our food, where the contact with our teeth helps to break down food into smaller pieces. A chemical method would include the secretion of hydrochloric acid in the stomach.

The digestive process occurs along the entire GI tract, from the mouth to the anus. Next, we'll take a look at each step in this process in more detail.

The Digestive Process

The digestive process begins before you begin to eat. Heating foods, chopping, and marinating them are all examples of how we begin to break down food before it even gets in our mouths.

The start of our digestive system is the mouth. Here, we chew food, breaking it into smaller pieces and mixing it with saliva, which contains enzymes that help break down molecules.

When we swallow, food passes from the mouth through the esophagus to the stomach. The stomach secretes hydrochloric acid and enzymes to continue to break food down. The stomach also churns food together, exposing it to the acid and enzymes. The resulting soupy mass of food is called chyme. Chyme is usually ready to leave the stomach about 2 to 4 hours after a meal.

The Digestive Process, Cont.

The small intestine is made up of 3 sections: the duodenum, the jejunum, and the ileum.

There really is nothing small about the small intestine. It was given the name because of its narrow diameter of about 1 inch. The small intestine is about 10 feet long!

The majority of digestion is completed in the duodenum and jejunum. Both enzymes and muscular contractions help with the process, mixing the food and breaking it down as it travels through the small intestine. A meal stays in the small intestine for about 3 to 10 hours.

The Digestive Process, Cont.

The large intestine, also called the colon, is made up of 5 parts: the cecum, the ascending colon, transverse colon, descending colon, and the sigmoid colon. The large intestine participates somewhat in digestion, but about 95% of digestion has occurred before food reaches the colon. Food remains in the colon for 24-72 hours before being eliminated as feces.

Absorption (Missing Slide)

Absorption is the process by which nutrient molecules are absorbed by the GI tract and enter the bloodstream. This process occurs mostly in the small intestine, but the stomach and large intestine are also involved to some extent. The efficiency of the small intestine is due to its large surface area. The walls of the small intestine are folded to increase the surface area, shown in figure 1. In addition, all along the walls there are villi: small finger like projections that further increase the surface area, this is shown in figure 2 and 4. Along the cells of the villi are microvilli, even smaller projections, shown in figure 3.

This system of folds and projections increases the surface area of the small intestine to 600 times beyond that of a simple tube.

After nutrients are absorbed by the villi, they enter the bloodstream and begin to circulate in the body one of two ways. Most nutrients go from the small intestine to the portal vein, which leads directly to the liver. This allows the liver to process the nutrients before they begin

circulating through the rest of the body. Other nutrients are absorbed into the lymphatic system and enter the bloodstream via the left subclavian vein in the neck.

Calories and Energy Containing Nutrients

Now we are going to move on to looking at the make-up of foods. We'll start by investigating calories and macronutrients, also known as the energy containing nutrients.

Energy and Calories

A calorie is defined as the amount of energy needed to raise 1 kg of water 1 degree centigrade. The amount of energy in a food is measured using a bomb calorimeter, a process of burning a food in a chamber to determine the amount of heat given off. This heat energy is converted to calories.

This energy in the food can also be "burned" in our bodies to give us the energy that we need.

Uses of Food Energy

There are 3 main categories that make up our use of food energy. Basil metabolic rate, or BMR, is made up of the basic body functions required for life, this includes things such as breathing and heart muscle contractions. BMR is also known as resting energy expenditure. This will vary depending on age, gender, body size, health, and special factors (for example: pregnancy, lactation, and growth).

Physical activity is the category for energy expenditure due to movement. It can range from standing up to running a marathon. This will vary from person to person and day to day.

The thermic effect of food, or TEF is the energy needed for the digestive system to complete the digestion and absorption of meals.

Link: https://www.myplate.gov/

How Many Calories in Food?

A macronutrient is a nutrient that supplies energy. There are 4 macronutrients.

They vary on the amount of energy they supply. Carbohydrates and protein each provide 4 calories per gram. Fat provides 9 calories per gram.

It is important to note that alcohol does contain energy itself, in addition to the calories from what it is mixed with. Alcohol alone provides 7 calories per gram.

Carbohydrates

The first macronutrient that we will talk about is carbohydrates.

Carbohydrate Functions

Carbohydrates are the main source of energy in the diet for most people and should provide more than 50% of energy intake. Carbohydrate molecules are broken down to glucose, which is the main energy source for red blood cells, the brain, and the central nervous system. Adequate intake of carbohydrates also prevents the breakdown of protein from muscle tissues and fatty acids from fat cells to create glucose when there is not enough.

Carbohydrate Storage

If we eat more carbohydrates than we need for energy, our bodies convert them to store in the cells. Some excess carbohydrates are converted to glycogen to be stored in liver and muscle tissues. Glycogen stored in the liver can be converted back into glucose to help blood sugar levels remain steady. Muscle glycogen cannot, but it can be used by muscles, especially during high intensity and endurance exercise.

The remainder of excess carbohydrates are metabolized to triglycerides and stored as body fat.

Carbohydrates

The carbohydrate group consists of 3 major categories: sugars, starches, and fiber.

Sugars

Monosaccharides and disaccharides are considered simple sugars, meaning that they require little or no digestion before they can be used by body. Monosaccharides are made up of just one molecule.

Disaccharides are made up of 2 molecules. Sucrose, also known as table sugar, is made up of glucose and fructose bonded together. Lactose is the main sugar in milk. Maltose is less commonly consumed. Sugar alcohols are often used in sugar free products. Sugar alcohols are not completely absorbed, and therefore don’t provide as much energy as sugar, however, they are partially absorbed and provide about 2 calories per gram. Sugar alcohols are not the same as sugar substitutes such as Equal or Splenda.

It is also important to note that when consumed in larger amounts, sugar alcohols can have a laxative effect so they should be consumed in moderation.

Sugar Consumption

Sugar is the most commonly used food additive in America. The average American consumes 82 grams of sugar per day, which is about 6.5 tablespoons or 2.5 cans of soda. Major sources of sugar in the diet include soft drinks, sweetened drinks, breakfast cereals, cookies/pastries/cakes, juice drinks, ice cream, and frozen desserts.

Sugar and Hyperactivity

Meta analyses, or a review of multiple research studies, shows that less than 1% of the population is sensitive to sugar intake, meaning that intakes of sugar may increase activity.

Active kids may appear to eat more sugar, but because they expend more energy, they eat more calories in general, so the proportion of sugar in their diet is similar to less active children.

Active kids may appear to eat more sugar, but because they expend more energy, they eat more calories in general, so the proportion of sugar in their diet is similar to less active children.

Overall, there has been no data to support a link between sugar and hyperactivity on population level.

Starches

Starches are considered complex carbohydrates with Oligosaccharides containing 3 to about 10 sugar molecules. Polysaccharides are made up of many sugar molecules, up to 1000 or greater. Starches are found in plant foods such as grains, legumes, and starchy vegetables.

Food manufacturers can bond starch molecules together to make them more stable, this is known as modified food starch and is used in baby foods, salad dressings and puddings. Fiber is the final form of carbohydrates.

Fiber

Fiber is not broken down by the digestive system, therefore, fiber is not a source of energy. The two types of fiber are insoluble and soluble fibers.

Insoluble fiber does not dissolve in water because of the way it is bonded. In general, it is not digested by bacteria in the large intestine. Cellulose and hemicellulose are types of insoluble fiber and often found in the structural parts of the plant, such as the skin of an apple or the bran layer of grains. The body uses this type of dietary fiber to increase stool bulk and improve movement in the digestive system.

Soluble fibers dissolve or swell when in water. They can be metabolized by bacteria in the large intestine. Pectin is found in fruits and vegetables, usually between cell walls to hold cells together. This type of dietary fiber can help lower blood cholesterol and blood glucose levels.

Dietary Fiber Recommendations

Adults need about 25-30 grams of dietary fiber per day, although the average daily intake in the US is about 16-18 grams. Children need their age plus 5 grams per day. Inadequate intakes of fiber can lead to constipation, diverticulitis, and other GI disorders.

Whole Grains

Whole grains are a good source of fiber. A whole grain contains all three parts of the seed: bran, endosperm, and germ. The bran and germ contain most of the vitamins, minerals, fiber, and protein found in the grain seed. Refined grains have been stripped of the bran and germ, thus leading to a loss of nutrients and fiber. Some nutrients, such as iron, thiamine, niacin and riboflavin are added back into refined grains, known as enrichment.

However, some nutrients cannot be added back, including magnesium, vitamin B6, zinc, vitamin E and fiber, making whole grains a much healthier option than refined grains.

When choosing whole grain products, the first ingredient should include the word “whole.”

Link: http://www.wholegrainscouncil.org/

Fats

The next macronutrient we will be discussing is fats.

Building Blocks: Amino Acids

Fatty acids are the building blocks of fats. The basic structure of a fatty acid is a chain of carbons with hydrogen at either end. The structure of the fatty acids determines whether a fat will be liquid or solid at room temperature. If a fat is liquid at room temperature it is unsaturated, and if a fat is solid at room temperature, it is saturated.

Fatty acids are the building blocks of fats. The basic structure of a fatty acid is a chain of carbons with hydrogen at either end. The structure of the fatty acids determines whether a fat will be liquid or solid at room temperature. If a fat is liquid at room temperature it is unsaturated, and if a fat is solid at room temperature, it is saturated.

Saturated Fatty Acids

Saturated fatty acids are characterized by having no double bonds between the carbons in the chain. Because of their structure, saturated fatty acids are usually solid at room temperature. Common sources of saturated fats include butter, animal fats, whole milk, coconut, and palm kernel oils. High intakes of saturated fats in the diet have been linked to high blood cholesterol levels and an increased risk of cardiovascular disease.

Unsaturated Fatty Acids

Unsaturated fatty acids can be divided into two categories: cis and trans. The difference has to do with how the double bond effects the structure of the molecule. Cis fatty acids can be further categorized as either mono or polyunsaturated fatty acids.

Unsaturated Fatty Acids

Monounsaturated fatty acids have only one double bond. In general, they remain liquid at room temperature. Monounsaturated fats are sometimes known as "good" fats because they can help reduce LDL, or bad, cholesterol.

It is important to remember that monounsaturated fat still contributes 9 calories per gram, so although it may have health benefits, it still needs to be consumed in moderation. Monounsaturated fats can be found in olive, canola and peanut oils, avocados, peanut butter and nuts and seeds.

Polyunsaturated Fatty Acids

Polyunsaturated fatty acids have more than one double bond. They generally remain liquid at room temperature and even when chilled. Polyunsaturated fatty acids can be found in soybean, corn and safflower oil, fatty fish and some nuts and seeds.

Trans Fatty Acids

Trans fatty acids are naturally occurring in small amounts in cow's milk and animal products. However, the primary source of them in our diet is from their commercial creation by transforming liquid oils into a more solid form. This is done because it makes foods more shelf stable and also to use as a substitute for saturated fats. However, recent research has discovered that trans fats also raise LDL cholesterol and lower HDL cholesterol and may be as much of a risk factor for cardiovascular disease as saturated fats.

Trans fatty acids can be found in fried foods, store bought baked goods such as cookies, cakes and crackers, and margarines and shortenings. Recent federal regulations require trans-fat to be included on the nutrition facts label if the item contains more than 0.5g trans-fat per serving. If there is some trans-fat but less than 0.5 g per serving, the label can read 0g trans-fat. To ensure that there is no trans-fat in a product, look for partially hydrogenated oils in the ingredients list.

Essential Fatty Acids

The location of the double bond in the polyunsaturated fatty acids known as omega 3 and omega 6 means that they cannot be synthesized in the body. Because both play valuable roles in the body and are needed to maintain health, they are considered essential.

Essential fatty acids are not needed in large amounts; they should make up about 5% of our total energy intake. Signs of essential fatty acid deficiency include itchy, flaky skin, diarrhea, infections, decreased growth and wound healing, and anemia.

Essential Fatty Acids

Linoleic acid is the most common omega 6 fatty acid. It works in the body to constrict blood vessels, promote blood clotting and inflammation. Sources of linoleic acid include safflower, corn and soybean oil, and nuts and seeds such as sunflower seeds, pine nuts and pecans.

Alpha-linoleic acid is the most common omega 3 fatty acid. It works in the body to dilate blood vessels, discourages blood clotting, and reduces inflammation. Research has found that diets higher in omega 3 fatty acids are associated with reductions in cardiovascular disease risk. Alpha linoleic acid can be found in flaxseed and canola oil, walnuts and tofu.

Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are also omega 3 fatty acids. They are commonly found in fatty fish such as salmon, herring, and tuna. In the typical western diet, intakes of omega 6 fatty acids are much higher than omega 3s.

Triglyceride Structure

In foods, fats and oils are usually found in the form of triglycerides. This is also true for fats inside the body. Triglycerides consist of a glycerol molecule with 3 fatty acids "tails" bonded, one to each of the 3 carbons. Esterification is the process of bonding a fatty acid to the glycerol molecule. If only 1 fatty acid is bonded, it is known as a monoglyceride. Once all 3 carbons have a fatty acid bonded to it, the molecule is a triglyceride.

Triglycerides

Triglycerides serve as an energy source for our body. They are also the major energy storage form in our bodies, and they accumulate in our fat storage sites known as adipose tissue. Adipose cells can expand to store more energy, and if we still have more fat to store, our bodies can produce more adipose cells. Thus, the energy storage capacity of our body is virtually limitless. Adipose tissue also provides insulation and protection for organs such as the kidneys. Triglycerides are also responsible for carrying fat soluble vitamins and helping with their absorption. Triglycerides are found in fats, oils, butter, margarine, snack foods and nuts and seeds.

Cholesterol

Cholesterol is a type of lipid that is part of a group known as sterols, these lipids differ from the others due to their multi-ringed structure. Animal products are the only dietary sources of cholesterol, and the body makes about two thirds of our total daily body exposure to cholesterol. In other words, dietary cholesterol does not affect blood cholesterol as much as the body’s own production does.

Cholesterol is used to form parts of some important hormones, including estrogen, testosterone, and an active form of the vitamin D hormone. It is also used to make bile acids, which are needed for fat digestion. Lastly, cholesterol is an important structural component of cell membranes, and is used in particles in the blood to transport fat molecules.

In the blood, cholesterol takes several different forms that vary in structure and function. Very low-density lipoprotein is cholesterol surrounded by a shell of protein and lipids and is used to transport cholesterol made by the body. Low density lipoprotein is made primarily of cholesterol and known as “bad” cholesterol because a higher blood concentration of LDL cholesterol is a risk factor for heart disease. If too much LDL cholesterol is in the blood, it can start to build up on the walls of your arteries, increasing your risk for heart disease.

High density lipoprotein consists mostly of protein and is known as “good” cholesterol because a higher blood concentration is linked to a decreased risk for heart disease. HDL helps remove cholesterol from the blood and prevent fatty buildup.

Dietary Fat Intakes

Dietary fat provides 9 calories per gram. Total daily fat intake should make up about 20-35% of the total calories in the diet. Only about 1/3 of the cholesterol in our body comes from food,

the rest is made in the body. As with all foods, foods higher in cholesterol such as eggs should be eaten in moderation, but do not need to be restricted from the diet. Saturated and trans fats have negative effects on our blood cholesterol levels, increasing LDL cholesterol and decreasing HDL cholesterol. Total intake of saturated and trans fats combined should not be more than 10% of total daily calories.

Dietary Fat Intakes

The rest of our fat intakes should come from unsaturated fats. Omega 6 fatty acids can decrease total cholesterol and LDL cholesterol. They do not have a large effect on HDL cholesterol, but by decreasing LDL they improve the LDL:HDL ratio, which decreases cardiovascular risk factors.

Omega 3 fatty acids decrease blood triglycerides and may have an effect on LDL cholesterol. Monounsaturated fatty acids, when replacing saturated fatty acids in the diet, can reduce total cholesterol and LDL cholesterol.

Protein

The final macronutrient we will be discussing is protein.

Amino Acids

Amino acids are the building blocks of proteins. All 20 amino acids are needed by the body to build proteins for things such as DNA and RNA, collagen, and blood cells.

Protein and Amino Acids

Amino acids contain nitrogen in the form of an amine group. These amine groups can be transferred from one protein to another to give the body access to the amino acids it needs to make specific proteins. For example, the amino acid tyrosine can be made from the amino acid phenylalanine.

However, not all amino acids can be made by the body in adequate amounts. The amino acids that cannot be made by the body at all or in adequate amounts are known as essential amino acids. Because the most complete source of these amino acids is animal products, these are the amino acids that are likely to be concerns in vegetarian and vegan diets.

Essential Amino Acids

There are 9 essential amino acids, which are Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, and Valine.

Nonessential Amino Acids

The remaining amino acids are considered nonessential. That does not mean that they do not carry out important functions in the body, but rather that we do not need to obtain them from

food because they can be synthesized in the body. We do still consume these amino acids when we eat protein containing foods.

Protein and Amin Acids

Dietary sources of protein are classified as complete or incomplete, based on the variety of amino acids they provide. Complete proteins provide all amino acids needed by the body. These come from animal sources such as meat, poultry, fish, and dairy products.

Incomplete proteins lack at least one amino acid. Plant sources such as grains, nuts, and beans are generally incomplete. A vegetarian diet can still provide all amino acids if they make sure to consume a variety of plant-based foods. For example, beans contain the amino acids that are missing from rice, so combining beans and rice makes a complete protein source.

Previously it was thought that you needed to eat these complementary proteins together in order to get the benefit, but the newer thought is that as long as a variety of plant foods are eaten throughout the course of the day, a vegetarian can get all the essential amino acids.

Recommended Intakes

Protein provides 4 calories per gram. Intake of protein should make up about 10-15% of total calories. This amounts to about 0.8-1 g of protein per kg of body weight for adults.

Some populations have higher protein needs including infants and children who can need as much as 2.2g/kg body weight, decreasing until the child is fully grown. Pregnant and lactating women also have higher protein needs. Physical stress, including illness and injury, also increase protein needs.

Protein Intakes

If excess protein is consumed, it is converted first to glucose through a process known as gluconeogenesis, and then to triglycerides to be stored as body fat. If carbohydrate intake is low, stored protein can be converted to glucose to help maintain appropriate blood sugar levels.

Stress and protein Intakes

Physical stress such as injuries, burns, fevers and infections causes an increase in protein losses. In these situations, protein intakes should be increased to help the healing process. A common misconception is that weightlifting, and body building creates the need for much higher protein intakes. In fact, protein intake beyond what the body needs will not help build muscle mass, and rather is stored as fat.

Protein Deficiencies

In the US, most people consume more than enough protein. However, protein deficiencies are seen in third world countries. Protein deficiency increases the risk for problems such as

infection, diarrhea, edema or swelling due to water retention, decreased muscle mass, growth retardation and delayed sexual maturation. There are 2 main forms of protein deficiency, kwashiorkor, and marasmus.

Kwashiorkor

Kwashiorkor is protein deficiency but adequate total calorie intake. This can happen in countries where the main foods are plant based. It is characterized by edema with muscle wasting, which results in the appearance of a large stomach and very thin limbs. Kwashiorkor leads to an increased risk of infection, diarrhea, and iron deficiency.

Marasmus

Marasmus is protein deficiency and total calorie deficiency. This occurs in areas where starvation is common. People suffering from marasmus do not have edema but do have the muscle wasting and will look thin overall. Marasmus can also occur as the result of wasting syndromes such as cancer, HIV/AIDS and anorexia in which people cannot or do not consume or absorb adequate protein and calories.

Test your knowledge…

Now is time to test your knowledge!

Question 1

Question 1: Where does the majority of the digestion of food occur?

A. Stomach B. Small intestine C. Large Intestine D. Mouth.

Answer: B. The majority of digestions occurs in the small intestine.

Question 2

Question 2: Calorie needs are based on which of the following?

A. Basal metabolic rate B. Physical activity level C. Thermogenesis D. All of the above

Answer: D. Calorie needs are based on all of the above.

Question 3

Question 3: All nutrients that are stripped from a refined grain can be added back with a process called "enrichment".

A. True B. False

Answer: B. False. Nutrients including magnesium, vitamin B6, zinc, vitamin E and fiber cannot be added back to grains through the enrichment process.

Question 4

Question 4: What proportion of the body's cholesterol is obtained from the diet?

A. 1/5 B. 1/3 C. 1/4 D. 1/2

Answer: B. the proportion of the body's cholesterol that is obtained from the diet is 1/3. The other 2/3 of cholesterol is synthesized by the body.

Question 5

Question 5: Which of the following is a complete protein?

A. Tofu B. Black bean C. Salmon D. Peanut

Answer: Salmon is the only complete protein listed. Animal proteins are the only complete proteins.

Quiz Results

Quiz Results

This Completes the Module

This completes the module Nutrition Basics, presented by the Minnesota Department of Health, WIC program.

Minnesota Department of Health - WIC Program 85 E 7th Place, PO BOX 64882, ST PAUL MN 55164-0882; 1-800-657-3942, health.wic@state.mn.us, www.health.state.mn.us; To obtain this information in a different format, call: 1-800-657-3942

This institution is an equal opportunity provider.