

Course Name: Adolescent Health and Well-being: A Holistic Approach

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Lecture:03

Lecture 03 - Role of Macronutrients

Hello everyone.

Let us start today's session that will be predominantly on various types of macronutrients and their role in our body. In this session I will try to cover carbohydrate, protein, fat and their function in our body. Dietary fiber what is their role and also water as a important component of our diet or as a important component of our body. There are few keywords you will find in this lecture carbohydrate, protein, fat, dietary fibers and limiting amino acids.

Let us start with carbohydrate because majority of our energy we usually get from carbohydrate. In the Indian scenario most of the people they consume 60 to 70 percent of carbohydrate in their diet. Chemically carbohydrates are polyhydroxy aldehydes or ketones and based on the chemical nature carbohydrate can be classified into two type. One is simple carbohydrate and another one is complex carbohydrate. Simple carbohydrate that includes monosaccharide, disaccharide and oligosaccharides whereas, the complex carbohydrate that means, the polysaccharides. Monosaccharides is the simplest form, but it is the fundamental building blocks of carbohydrate. Easiest example is glucose or most available example is the glucose, but there are another term that is hexose that means, it contains 6 carbon atoms in their molecules. What are those? Those are glucose, fructose and galactose. Few organs are like brain and RBC they depends entirely on the glucose for energy and they collect this glucose from the bloodstream. Xylitol, sorbitol and mannitol those are the sweeteners and usually they are used in the diabetic food. The another advantage of these monosaccharides are they are less likely to result in dental caries.

Here are certain sources of monosaccharides like glucose in sweets, ice creams, fructose in honey and fruits, galactose milk and dairy products, xylose in wine and beer whereas, mannose you will get it in fruits. Now, here the disaccharides. Disaccharides is nothing, but

the combination of 2 monosaccharide unit. Here are certain example like sucrose, lactose and maltose. Sucrose is the combination of glucose and fructose and mostly common disaccharide in our diet. Usually, we get sucrose from table sugar, fruits, vegetables and cereals whereas, we get lactose in the combination of 2 molecule of galactose, we find it mostly in the dairy products. Now, the maltose which is the combination of 2 molecule of glucose and we get it in the malt sugar and usually it is available in the germinating grains and as well as in the fermentation product of wheat and barley. Next is Oligosaccharides. The name came from the term oligo and the oligo means very few. Oligosaccharides are made up of 3 to 8 monosaccharide units and these monosaccharide units are joined by the covalent bonds. Depending of the number of the monosaccharide these oligosaccharides can be classified again into 3 like trisaccharides, tetrasaccharides, pentasaccharides. And here is the example, raffinose is trisaccharide, stachios is the tetra saccharide and varbascos is the pentasaccharides. Where you will get these oligosaccharides? We will get these oligosaccharides in leeks, onions, garlic and legumes.

Next is the polysaccharides. Poly means more or many. So, it comprises of several monosaccharide units and usually that is more than 10. Easiest example to remember is starch which is the combination of many glucose units and usually we get the starch in the cereals, potatoes, beans and tubers. There is a term called resistant starch, what is that? That is not digested in the small intestine, but are fermented by the bacteria in the large intestine. But this resistant starch actually very much helpful in the colonic function. Another example of polysaccharide is glycogen which is the primary storage polysaccharide in our body. Cellulose, chitin, pectin these are also polysaccharides, but they are actually the structural components of plants and animals and they are not digestible by the human beings.

Here in this introductory lecture I will tell the function of carbohydrate in general. But in my subsequent lectures, I will tell the specific functions of carbohydrate in the adolescent age group. Let us see what it actually does in our body. It is the predominant source of energy and usually 1 gram of the carbohydrate gives rise to 4 kilocalorie of energy when it burns out or after digestion. Carbohydrate in diet that prevent the breakdown of proteins and fats and it is required for the synthesis of glycolipids, mucopolysaccharides and glycoproteins. These carbohydrates mainly the glycogen is the storage form and during the time of our fasting, usually we get the glucose from this glycogen and this glycogen is stored in our liver. Carbohydrate in diet that prevent loss of electrolytes like sodium as well as water and when the carbohydrate is there in our diet that ensures the palatability and taste. Now how much carbohydrate we should take? The amount of carbohydrate that should provide the sufficient energy, supply essential sugars and it should prevent ketosis. Carbohydrate must provide 50 percent of the calorie intake in our body and the other half of the calorie that should come from the proteins and fats. Predominantly we should take the complex carbohydrate because whenever you are taking the simple carbohydrate that will increase your blood sugar immediately or that will increase your blood sugar very easily. That is why we tell to the diabetic people that take as much as possible the complex

carbohydrate and usually it is recommended that simple sugar should not constitute more than 10 percent of your total energy intake.

Let us come to the proteins. Proteins is a nitrogen containing macronutrients and it supply the essential and non-essential amino acids. Depending on the requirement of our body it can be classified into essential, non essential and conditionally essential. So, who are the essential amino acid? When we call that these amino acids are essential. These will not be produced in the body and have to be supplied in the diet whereas, the nonessential AA can be manufactured within the body and it is not to be supplied in diet. Conditionally essential that amino acids which become essential if their precursors are deficient. Let us have a look on the example. Essential amino acids are the histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. These are very important to be remembered. And the conditionally essential amino acids are the cysteine and tyrosine whereas, the non-essential amino acids are arginine, alanine, aspartic acid, asparagine, glutamic acid, glutamine, glycine, proline and serine.

Now, dietary protein again can be classified according to their nutritional value. One is the complete protein, complete protein that contains all the essential amino acids. Mostly it includes the animal protein that means, the protein you will be getting from meat, eggs and fish. The incomplete protein that usually deficient in one or more essential amino acids and usually the proteins we get from the plant origin are the incomplete protein like legumes and lentils. Next is the functions of protein. It comprises of the major lean body mass. So, the muscles they are mainly made up of the proteins. The structural components of body like hair and nails they are also made up of proteins. Few enzymes, hormones, antibodies, clotting factors, connective tissue have a protein as their structural component. Protein acts as a buffer and also maintain the acid base balance. During the starvation, if there is no carbohydrate then definitely the protein will break down and protein also can give you the energy like 1 gram of protein will give 4 kilo calorie of energy. And whenever you will add protein in your diet that will induce the satiety.

So, if the person wants to decrease their weight or the persons who are obese they should eat more proteins rather than taking more carbohydrates. Because when you are taking proteins along with the carbohydrate it will increase your satiety very quickly and for a prolong time you will feel full. So, you need not eat more frequently or you need not eat whatever you are getting around you. The daily intake of protein here in this lectures I will tell the overall requirement of protein, carbohydrate and fats and the specific requirements for adolescents I will discuss in our subsequent lectures. The dietary recommendation of the protein is 1 gram per kg of the body weight. There is a term that is supplementary action of protein. In Indian diet khichdi is the mixture of rice and dal. We prefer to give khichdi to our children, we prefer to give khichdi to the adults even the adults who are malnourished. Whenever we are in a hurry or in today's life where both the parents are busy in their work. Then we try to prepare such meal that is very easily made. So, one important or very frequently made meal whichever taken in our country is the khichdi that is the rice and dal combination, but there is a scientific reason why we use to take this rice

and dal together. Here comes the idea of supplementary action of protein or you can say that the limiting actions of amino acids. Cereals protein are deficient in lysine and threonine. The pulse protein they are deficient in methionine. So, when you are combining this rice and dal then the deficiency is abolished. And you will be getting all the essential amino acid. That is the idea of supplementary action of protein.

Next is fats or lipids. So, it is highly energy providing nutrient and chemically these are insoluble in water. Fatty acids are esters or carboxylic acid with hydrocarbons in the side chain. It is derived from phospholipids and also from triglycerides. Triglycerides constitute majority of the fat content of the human body about 90 to 95 percent. Now, the classification according to their structure. First is the simple lipids, here the name suggest that it is nothing, but the esters of alcohol and fatty acids. In the right hand side you can see that here is the structure of triglyceride. Here you can see, this one is the glycerol molecule and these three are the fatty acids. So, triglycerides are that esters of fatty acids with glycerol. Another example is wax that is the ester of long chain fatty acids with long chain alcohol.

Next is the complex lipids. Complex lipids contain the chemical molecules like phosphates, carbohydrate and protein groups. Phospholipid is the combination of phosphate group with the alcohol and fatty acids. Here is the structure of phospholipid and here is the molecule of phosphate group. Again another example is glycolipid that contain carbohydrate group in addition to alcohol and fatty acid. Here is the structure of glycolipid and you can see that one sugar or carbohydrate molecule is attached with this preliminary structure. The image shows the structure of glycolipid.

Now, the derived lipids. These are formed by the hydrolysis of simple and complex lipids. They may contain the complex structure and the hydrocarbon ring in their structure. Example is like sterols. These are derived lipids with cyclopentano ring structure. And other example like cholesterol, carotenoids, the fat soluble vitamins like A, E and K these are the derived lipids.

Now, according to the number of hydrogen atoms and bonds we can divide fat or fatty acids into 4 types. One is monounsaturated fatty acids. Nowadays these are called the healthy fatty acids you should consume in different oils like nuts, cannula oil, olive oil and mustard oil. Whereas, the polyunsaturated fatty acids these are mostly liquid state at room temperature like safflower oil and vegetable oil. Here comes the idea of essential fatty acids. Essential fatty acids which are required for our body that is alpha-linolenic acid that is the omega 3 fatty acids and the linoleic acid that is omega 6 fatty acids. If you see the sources of omega 3 and omega 6 you will find that several oils, we use for cooking they are rich source of essential fatty acids. Like omega 3 fatty acids present in salmon, canola and flaxseed oil and omega 6 usually it is found in safflower oil, sunflower oil and also the corn oil. So, here comes a questions that what type of oil we should take? Actually you should take the combination of all these means not that you should take only one type of oil, you can take the mixture of mustard oil and olive oil or mustard oil and canola oil or mustard oil and sunflower oil. Then you will be getting the combination of the monosaturated

unsaturated fatty acids and polyunsaturated fatty acids and that will be helpful or that will be beneficial for our good health.

Another term comes that is the trans fat or trans unsaturated fatty acids and these are actually not at all healthy for our body. Like the vegetable oils which are unsaturated fats and can be converted to solid or semi solid forms by the process of hydrogenation. So, you should avoid this trans fat or trans unsaturated fatty acids whenever you are consuming the diet. Many of the packaged food nowadays they provide the level that there is less trans fat or zero trans fat. So, whenever you are consuming the diet you should think that you have to take less trans fats or trans unsaturated fatty acids. And also you should avoid the saturated fatty acids if the person has overweight or obesity. Usually, we get this saturated fatty acids, meat, dairy products, butter, ghee, coconut oil and palm oil, but definitely these fatty acids are all the rich source of energy. If the person is suffering from malnutrition or if the person is suffering from a chronic disease where he is requiring more amount of energy that time you have to take more amount of saturated fatty acids which will give extra energy, which you will not get in the carbohydrate protein and unsaturated fatty acids.

Now what is the function of lipids? As I have already told that 1 gram of lipid when burn out it will give you 9 kilo calorie of energy. So, definitely it will give you the majority of the energy that is the 60 percent of the total body energy. It provides essential fatty acids like alpha linoleic acid and linolenic acid. It also forms the precursors of sterole synthesis and structural components of the tissues. Fats add taste and palatability of the food. So, whenever we take too much of oily foods, foods which are made up in the restaurants or outside street food; they all contain more amount of fat that is why it becomes more palatable or tastier to us. The fatty acids make hormones that regulate the immune system and central nervous system.

How much fat you will take? The dietary intake of fat it should provide the sufficient quantity of essential fatty acids. The dietary intake of fat that should provide that will be in such a way you have to take the fat that all the essential fatty acids should be there. The amount of saturated fat, trans fat and cholesterol that should be kept minimum that I have already discussed, it will be harmful for your health. And all these fat that is saturated, trans fat and cholesterol; they are associated with high risk of coronary artery disease and it is been proved in different researches in all over the country.

Next is dietary fibers. If I do not tell about dietary fiber, then it will be inadequate to give you an idea that what type of diet or what type of macronutrient you will take. You have to take dietary fiber along with carbohydrate, protein and fat. What is dietary fiber, actually you should have that idea also. It is the indigestible part of plant material that is the non starch polysaccharides. And depending on the solubility in water they can be divided into two types. One is soluble fibers and another is insoluble fibers. The soluble fibers, they are actually dissolved in water and they are fermented in the large intestine. For example, pectin, gums and mucilage whereas, the sources of soluble fibers are vegetables, legumes and plant extracts. Now, the insoluble fiber. those are insoluble in water and also not well

fermented in the intestine. Examples are the cellulose, hemicellulose and lignin. The source of dietary fiber which are insoluble fiber like whole cereals in wheat bran.

Now, what are the benefits of dietary fiber? Whenever you are taking food try to consume more and more dietary fiber along with your meal, along with other nutrient like carbohydrate protein and fat. Because it will add bulk to the diet and it will reduce your appetite. So, the person who are undernourished, they can take more amount of food, but the person who want to decrease their weight or who want to decrease the obesity they have to take the diet in such a way that they feel full in their stomach and they do not take additional meal in between the major meals. So, one of the important thing is that you can take dietary fiber along with your meals. Try to intake more and more dietary fibers because it lowers the absorption of glucose and cholesterol by trapping them and reducing the risk of diabetes and heart disease. The beneficial effects is also there because it will help to regulate the blood pressures. And another important beneficial effect is that it can help in constipation because it will increase the bulk of the stool. So, easily there is the passage of stool in the intestine. And it is being recommended that 25 to 35 gram per day of dietary fiber can reduce the risk of heart disease. And it has been proved that if you take more dietary fiber then definitely it has a beneficial effect on blood pressure and heart disease.

Next is the water. Why we need to know about water? Why we cannot stay without water? Because 70 percent of our body structure is made up of water. So, whenever you are thinking that you need to eat something that time the meal is important, but along with that you have to take water all through the day. Humans cannot survive without water and fluids beyond 10 days. And this water is not like you have to take the plain water, you can take other fluids also. But this intake of fluids or intake of water that depends on different individual. Because the need of water intake that also depends on body weight, climatic conditions and level of activity. On an average one must consume approximately 30 ml per kg of body weight, but there is no fixed recommendation. As I have already told if there is hot and humid climate that time you have to take more water. Your bodily demand will be more, but in case of cold climate, bodily demand of water is less. So, you can take less water. Usually in case of hot and humid climate 5 to 6 litre of water per day is required. And in case where there is not that much hotness or humidity or other way around you can take 3 to 4 litres of water per day.

Here are my references.

If you want to study more you can go through these textbooks and also different composition tables of ICMR.

Now, I am ending my session.

Thank you and Enjoy learning.