

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

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### **Lecture 04 - Role of Micronutrients**

Hello everyone. Let us start today's session that will be predominantly on role of micronutrients in our body. So, here in this lecture I will give you a brief idea of various fat-soluble vitamins that is A, D, E and K. Water soluble vitamins like B and C, few minerals that are important for our health and well being and the idea of trace elements. In this lecture I will give you the basic concept of all these things, but the specific requirement in the adolescent age group will be discussed in the subsequent lectures. So, here are few keywords like vitamins, minerals, night blindness, rickets, anemia, and scurvy, you will have an idea in this lecture.

Let us start with vitamin A. The parent compound of vitamin A is called the all-trans-retinol. It has a beta ionone ring attached with isoprenoid chain and the aldehyde derivative that is called retinal, the carboxylic acid derivative that is the retinoic acid. So, in our body this retinol, retinal, and retinoic acid, they are required and usually we get it from the foods of animal origin.

And most of the foods of plant origin they actually contain a pigment called carotene. Now, there are certain sources like animal source and plant source. In animal source you will get vitamin A in red meat, liver, whole milk and dairy products, but at the plant source those are the carrots, ripe papaya, mango, green vegetables, pumpkin, peaches, apricots and vegetable oils those are rich in carotenes. Now, here you can see that it is not always true that for getting vitamin A you have to buy all the time the costly vegetables or fruits. In India you can see that ripe papaya and pumpkin they are also rich source of Vitamin A and the cost of these papaya and pumpkin is not very much in our country.

So, you can get easily the vitamin A from plant source. And plant source are usually identified by their high color or the deep yellow color or deep orange color. And nowadays there is a concept of fortified food where vitamin A is supplemented through a food like banaspati, margarine or milk. And many of the time whenever in the area where vitamin A is deficient in the general population we can use these food materials. Now, the function.

Vitamin A has a very important role in growth and repair of epithelial tissue. So, if we want to get a healthy skin, mucous membrane, teeth, skeletal and soft tissue we have to have vitamin A from our diet. The formation of rhodopsin is also helped by the vitamin A. And this rhodopsin is usually we get it from the retinal cells of eye and they help in visualizing the subjects in low light.

Also, Vitamin A is helpful in reproduction. In males it maintains the epithelial integrity of the epididymis, prostate, and seminal vesicles, and that is required for spermatogenesis. And in female also it is required for growth of the fertilized ova and also production of steroid hormones. Vitamin A is also helpful in the cognitive function because it is implied in the myelination of neurons and also it maintains the neuronal plasticity. And nowadays after this COVID-19 era we are all aware that if we want to prevent various viral infections then we have to improve our immunity. As we are thinking that we have to improve our immunity then definitely you have to take certain elements or certain nutrients through our food and vitamin A is one of them.

Vitamin A is helpful in both type of immunity that is in innate immunity and adaptive immunity. Innate immunity maintains the integrity of the mucosal barriers and also it helps in the functions of neutrophil, macrophages and natural killer cells. Whereas, in the adaptive immunity it specifically help in the development of T and B lymphocytes. Now what is the daily requirement? Here also I am telling that this is just the idea of how much you have to take, but the specific age group in adolescence that will be discussed in our special lectures that is on nutrition and you will be beneficial on taking the classes of those lectures. Now the daily requirement is increased in infectious diseases, hyperthyroidism, and alcoholism and renal disease.

And the requirement this is recommended by ICMR that 600 micrograms of retinol or 4800 micrograms of beta carotene is required. And it should be means there should be a conversion ratio of 1 is to 8. Because whenever that beta carotene will go inside our body that will produce retinol and usually 4800 microgram of beta carotene will produce 600 microgram of retinol in our body. But whether there is any side effects or any severe effect if we take more vitamin A. Yes, there are certain features you will be getting or there are certain symptoms you will be getting.

If there is Hypervitaminosis A means if you take excess amount of vitamin A in your body. Like there will be raised intracranial pressures, headaches, blurring of vision, nausea, hair loss and irritability. And if there is chronic high intake then that will lead to osteoporosis. Now, if there is deficiency, predominantly the ocular manifestations occur. The ocular manifestations are night blindness, conjunctival xerosis, bitot's spot, corneal xerosis and keratomalacia.

The whole term is called xerophthalmia that is the manifestation of vitamin A starting from night blindness to keratomalacia. That night blindness is the first symptom of vitamin A deficiency. That means, you will feel that in the night time you are not able to see or in the

evening time you are not able to see. So, that is the night blindness and that is mainly occur due to the vitamin A deficiency. But there are also some extra ocular manifestation like follicular hyperkeratosis, anorexia and growth retardation.

That means, inhibition of growth. And deficiency also leads to morbidity and mortality because the respiratory and the intestinal infections. I have already told that vitamin A is helpful in development of your immunity. If there is lack of vitamin A, the immunological system will become poor and there will be more frequent respiratory and intestinal infections. Next comes vitamin D.

The specialty of this vitamin is that it can be synthesized in the body from the provitamin. It is synthesized from 7-dehydrocholesterol at the skin surface on exposure to sunlight. That is why in our custom that in the childhood or the newborn baby they should be exposed to the sunlight for few hours in the day time. So, that this vitamin A can be developed under the surface of the skin. Now what is the function of vitamin D? Vitamin D has major functions on intestine, bone, kidneys.

So, in intestine it helps to absorb the calcium and phosphorus. Whereas, in the bone it stimulates mineralization, enhances bone resorption and also the collagen maturation. In kidney it has a vital function, that it increases the resorption of phosphates and resorption of calcium. And all over this vitamin D is helpful in normal growth and development. Let us see the sources of vitamin D.

We can get vitamin D from cod liver oil, fish, dairy products and whole eggs. Now see the daily vitamin D requirements it depends on the age of the person. If the child who is less than 12 months of age he or she needs 400 International unit per day. In 1 to 70 years it is 600 international units and if the person is more than 70 years then the requirement is 800 international units. Daily requirement of vitamin D increased in pregnancy and lactation.

And if there is deficiency of vitamin D in our body then the children will suffer from rickets and adults will suffer from osteomalacia. Next comes vitamin E. So, first we will discuss about the fat soluble vitamins then we will go towards the water soluble vitamins. So, vitamin E is the generic name of a group of closely related and naturally occurring fat soluble compound that is the tocopherol. It has significant role in reproduction and as well as it acts as an antioxidant.

If we see the source of vitamin E we can get vitamin E from wheat germ oil this is the richest source, also we will get vitamin E from corn oil and soybean. There is also animal sources of vitamin E like egg yolk, liver and milk, but these are the poorer sources of vitamin E. Next is vitamin K. Vitamin K, this vitamin name of this vitamin K has come from a German word that is Koagulation. And as the name suggests it is the anti-hemorrhagic factor, it is synthesized by the intestinal bacteria.

So, where you will get vitamin K, you will get vitamin K in green leafy vegetables, sprouts, cabbage, fermented dairy products, soybean, kiwi fruits and grapes. The requirement of vitamin D that is 60 microgram per day in case of 9 to 13 years of age and 75 microgram in case of 14 to 18 years of age. That this requirement is increased if the person is on anticoagulants and if the person has the bleeding disorder. If the person is taking a prolonged antibiotic then there is a chance that the person will develop the vitamin K deficiency. Because already I have told that vitamin K is synthesized from the intestinal flora.

And if you are taking a prolonged antibiotic that is more than 7 to 10 days then these intestinal flora get decreased or they get inhibited their functions get inhibited. Then the synthesis of vitamin K is also decreased. So, there is the deficiency of vitamin K occurs. Now what are the functions? It is an essential substrate and that is synthesis of various clotting factors like whenever it stops excessive bleeding and also it help in the formation of blood clots. Vitamin K is important to maintain the bone density and it reduces the risk of fracture.

Because it helps in the carboxylation of osteocalcin. So, if you think that if you summarize that what is the function of vitamin K that it is definitely the main function is the prevention of bleeding. And also it is helpful in regulation of cell growth, cell proliferation, intercellular communication and neuronal development. And another important factor or another important function of vitamin K is it prevents the aging. And the osteocalcin that again helpful in the prevention of cardiovascular diseases.

So, if there is deficiency then it will it can produce the haemorrhagic disease of newborn. Usually in the diet of the adult we get sufficient amount of vitamin K, but in the childhood and infancy and even in the pregnancy if there is deficiency of the Vitamin K there is a chance that there is deficiency in the newborn. And in that case, the newborn will develop hemorrhagic disease. Next we will talk about vitamin B complex. We tell this B complex because it includes lots of vitamin B, vitamin B 1, 2, 3, B 6.

So, we will get an idea of those vitamin B one by one. First we will see then what is vitamin B1 that is the thiamine, that is the chemical name of this vitamin B1 is thiamine. Where you will get, you will get it in whole grain cereals, wheat, bengal gram, yeast, pulses, oil seeds, nuts and especially the ground nut. And definitely there are the animal sources, meat, fish, eggs, but it is smaller in amount. And for infant, milk is an important source of thiamine.

And Indian people in our country they get 60 to 85 percent of their total supply of thiamine from cereals. And if there is deficiency of vitamin B1 in our diet that will produce beriberi or Wernick's encephalopathy. Now, comes vitamin B2, the chemical name of this B 2 is riboflavin. And the sources of vitamin B2 is milk, egg, liver, kidney and green leafy vegetables. Meat and fish also contain, but the smaller amount, but one important thing that how can you increase the content of vitamin B2 that is the germination.

Germination increases the riboflavin content of pulses and cereals that is why we tell that germinated pulse or cereals that is more nutritious for our health. And if there is deficiency then angular stomatitis occur that means, there is a ulcer around your mouth or there may be glossitis. But these angular stomatitis usually occurs frequently in malnourished children. And not only children sometimes this angular stomatitis we use as an index of malnutrition or index of prevalence of malnutrition in an area. Next comes vitamin B3, the chemical name of this B3 is Niacin.

The vitamin B3 is actually derived from an essential amino acid that is tryptophan. So, it is the precursors of vitamin B3 and usually, we get B3 from liver, kidney, meat, poultry, fish, legumes and groundnut. Milk is poor source of niacin, but it is a rich source of tryptophan that is why if you take or if you consume milk in adequate amount your body will get tryptophan not directly by the vitamin B3. But the tryptophan will be converted to vitamin B3 and you will get it.

The deficiency of vitamin B3 in your diet may lead to pellagra. Pellagra is the disease condition which is characterized by diarrhoea, dementia and dermatitis. In diarrhea there will be GI upsets, loose motions, in dermatitis there will be skin infections and in the dementia that means, forgetfulness. So, you can see that vitamin B3 has an immense role in our body not only the physical health, but it is also important for well being of our mental health. Another two important vitamin B, 1 is B6 another is folate. If there is deficiency of B6 then the peripheral neuritis occurs, these are some nerve conditions, disease condition of the nerves.

And you get vitamin B6 from milk, liver, meat, egg yolk, fish, legumes, and vegetables. Now, the folate is very very important vitamin B and the source is also the same like vitamin B6. And it has been seen that over cooking of the food material that may destroy the folic acid. If there is a deficiency then it will lead to megaloblastic anemia, there is one type of anemia and the glossitis, cheilosis, GI disturbance, loose motion, nausea, vomiting and another important thing is neural tube defects in the newborn. It is been seen that in the pregnancy in the first trimester if there is deficiency of vitamin B9 or folate in the diet then there is a chance.

So, there is a risk of neural tube defects in the newborn. So, not only during the whole life cycle you will take the folate, you have to take increased amount of folate during the time of pregnancy. Next important is vitamin B12 the chemical name of this vitamin B12 is cobalamin. And in our country where the people who are mainly vegetarian we usually find that their diet is deficient in vitamin B12. Because usually vitamin B12 we do not get from vegetable origin.

Vitamin B 12 with usually found in liver, kidney, meat, fish, eggs and cheese. It has an immense role or immense function in our body like red cell formation, DNA synthesis, growth and repair of new cells. And its absorption in the intestine that required a specific

factor which is known as the intrinsic factor. So, in case of specific anemia which is called pernicious anemia where there is lack of intrinsic factor it also associated with vitamin B12 deficiency. And if the deficiency occur for a long time in our diet that may produce megaloblastic anemia.

But initially if we take high content of folate then it can mask the deficiency of vitamin B12. But when the features of vitamin B12 will come then already the time get delayed and already there is a much damage hampered in our body. So, you have to think about that your diet should provide adequate amount of vitamin B12. So that you can prevent lots of damage in your body. Now comes the vitamin C, vitamin C is another water soluble vitamin and it is important antioxidant.

And also you know some of you definitely know that vitamin C is very much helpful to improve your immunity. Because during the time of COVID we are all aware or have become aware that many of the diseases we can prevent by taking the nutrients the proper nutrient in our diet. And one of that is vitamin C, you will get the vitamin C from fresh fruits and green leafy vegetables. It is not that all the time you have to take a very costly food. Because you can see that guava is a fruit that is not very costly in our country.

But it is a rich source of vitamin C, germinating pulse that also contains a good amount of vitamin C. And amla is the richest source of vitamin C in our country. But you should aware of that if there is a deficiency of vitamin C then it can occur scurvy. But nowadays the scurvy is not very much prevalent because it is been well known from long back that if you take vitamin C from in your diet then you can stop the formation of scurvy, you can stop the development of scurvy. So, what are the different features you will be getting if there is scurvy, that is the bleeding gums,, subcutaneous bruising or bleeding into the skin or joints there will be delayed wound healing, anaemia, and extreme general weakness.

So, you will be getting these types of features if your diet is deficient in vitamin C. Now, the concept of minerals. The minerals, usually the major minerals that are required in our body that is the calcium, phosphorus, sodium, potassium and magnesium. And there is a term that trace elements, these are required by the body in a very minute quantity that is few milligrams per day. And the iron, iodine, fluorine, zinc, copper, cobalt these are the example of trace elements.

Let us have an idea that what does calcium do in our body. Calcium helps in the formation of bones and teeth and also in helping coagulation, contraction of muscles, cardiac action, and helping milk production. It has also a role in relay of electrical and chemical messages and it helps in metabolism of enzymes and hormones. So, where will you get you will get calcium, in milk and milk products, egg, and fish. Now, sodium, sodium is abundantly found in the body fluids. It is added to our food by adding the cooking salt that is the sodium chloride.

Sodium is lost from our body through urine and sweat and the depletion of sodium chloride that causes the muscle cramps. So, the adult requirement is as per the recommendation of WHO that is 5 grams per day. And it is been shown in different studies that 10 gram of salt per day has definite tendency to raise the blood pressure. Potassium and magnesium are also important. Potassium is vasoactive agent and usually found in fruits and vegetables.

Magnesium, that is also important for our health, usually we find magnesium in whole grains and dark leafy vegetables, also in the milk and yogurt. The magnesium deficiency occurs in chronic alcoholism, cirrhosis of liver and toxemia of pregnancy as well as in the protein energy malnutrition and malabsorption syndrome. Now, comes the importance of iron. Iron's main function is the oxygen transport or the cell respiration.

How it does that thing? It help in the formation of hemoglobin. So, it helps in the oxygen transport. It also helps in brain development and function, and regulation of the body temperature. And also it is helpful in catecholamine metabolism. There are two types of iron, one is heme iron another is non-heme iron. The heme iron is mainly the animal source iron that is the liver, meat, poultry and fish and these are readily available.

But the non-heme iron that is the source are mainly the green leafy vegetables and cereals and legumes, jaggery, dried foods. The bioavailability is very poor for non-heme iron. Phytates, phosphates, tannins and oxalates, carbonates and dietary fiber, they decrease the absorption of non-heme iron. Here are my references.

If you want to learn more then you can go through these books. Here I am ending the session. Thank you all and enjoy learning.