Lecture 54:

Vitamins

Part 1

Copyright Protection:

- **Vitamins are micronutrients essential for the body.**
- **They are organic compounds involving in many chemical and physiological reactions in the body.**
- **Human body cannot make vitamins by itself, except for some vitamins B that are manufactured in the intestine by normal flora.**

- **Vitamins themselves cannot generate energy and calories. However, they have key roles in generating energy and calories from macronutrients.**

- **They involve in energy production, metabolism of macronutrients (carbohydrates, proteins, and fats), body metabolism, digestion, growth, immunity etc.**

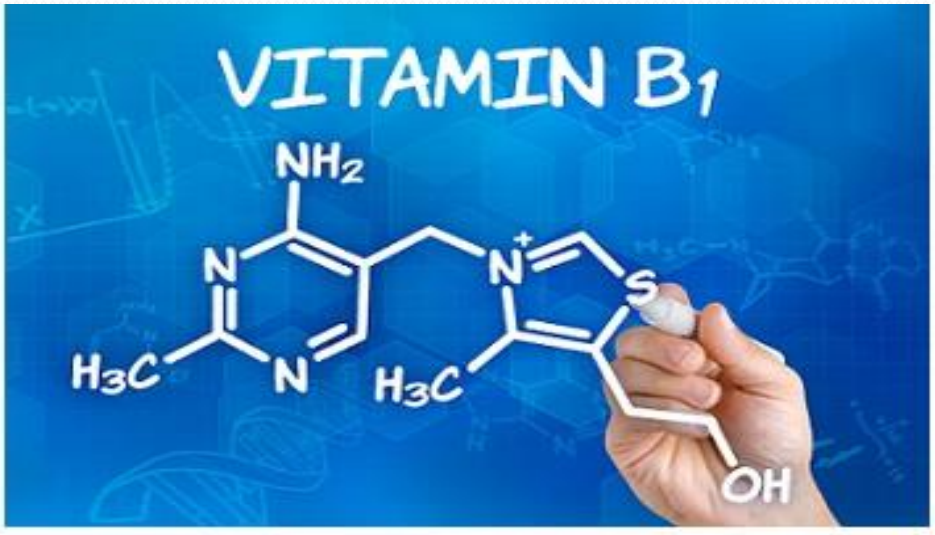
- **Vitamins have been categorized into two groups: water soluble and fat soluble. Water soluble vitamins are B and C. Fat soluble vitamins are A, D, E and K.**

Vitamins To Be Discussed:

- Vitamin B1
- Vitamin B2
- Vitamin B5

Vitamin B1 (Thiamine):

Vitamin B1 is a water soluble vitamin that has an important role in the metabolism of carbohydrates, proteins, and fats.



Vitamin B1: *Copyright©Depositphotos.com/Boris Zerwann*

Functions of Vitamin B1:

- a) It plays a role in peripheral nerve conduction by helping the development of the myelin sheath, which covers the nerve.

- b) By acting as the coenzyme thiamine pyrophosphate (TPP), vitamin B1 has a crucial role in metabolizing glucose and generating energy (ATP).

- c) It is required for metabolizing alcohol.

- **d) It helps with the synthesis of acetylcholine and gamma-aminobutyric acid (GABA). They are important neurotransmitters for normal brain function.**

Food Sources and Absorption:

- **Foods high in vitamin B1 are yeast, wheat germ, organ meat, pork, beef, whole grains, legumes, nuts, and avocado. Milled rice and grains contain less thiamine.**

- **It is destroyed by cooking, especially boiling.**

- **Thiamine is absorbed well from the small intestine and stored in the liver, kidneys, and heart.**

- **The total thiamine storage of the body of an average person is about 28 mg with the highest concentrations in the liver, kidneys, heart, brain and skeletal muscles.**

- **Excessive thiamine is eliminated largely via urine and a trivial amount by sweating.**

- **Tea, coffee (regular and decaffeinated), raw fish, and shellfish contain thiaminases, which destroy this vitamin. Alcohol, smoking, and sugar deplete the body from thiamine.**

Athletic Benefits of Vitamin B1:

- **a) It may delay fatigue and exhaustion in a prolonged training session.**
- **b) It may aid with jet lag.**
- **c) It may help decrease the production of lactic acid.**

Non – Athletic Benefits of Vitamin B1:

The following conditions may benefit from thiamine:

- **a) Beriberi disease.**
- **b) Anemia.**
- **c) Chronic fatigue syndrome.**
- **d) Alzheimer's disease.**
- **e) Depression.**
- **f) Motion sickness (prevention).**
- **g) Fibromyalgia.**
- **h) Multiple sclerosis.**

- **i) Alcoholism.**
- **j) Hangover.**
- **k) Neuropathies.**
- **l) Canker sore.**
- **m) Cardiomyopathy.**
- **n) Heart failure.**
- **o) Diabetes.**
- **p) As an insect repellent.**
- **q) Infections.**
- **r) Neuromuscular diseases.**

Deficiency of Vitamin B1:

- **Most cases of thiamine deficiency are the result of poor dietary intake.**
- **Manifestations of thiamine deficiency appear when dietary daily intake is less than 0.3 mg/1000 calories.**

Initial stages:

- Anorexia.
- Irritability.
- Poor short-term memory.

Chronic stages:

- Neuropathy.
- Muscle weakness and wasting.
- Swelling.
- Enlargement of the heart and eye problems.

People at risk for thiamine deficiency are:

- a) Alcoholism.
- b) Chronic illnesses such as cancer.
- c) Chronic use of diuretics.
- d) Prolonged hyperemesis gravidarum (prolonged and excessive vomiting during pregnancy).
- e) After a bypass surgery for obesity.
- f) Poor diet and malabsorption.
- g) Heavy coffee drinkers.

Dosage and Side Effects:

- **The RDA for thiamine for adults is 1.2 mg per day.**
- **It is added to all multivitamins and B - Complex.**
- **The performance daily intakes (PDIs) for athletes and physically active adults are 50 – 300 mg.**
- **Although anaphylaxis has been reported after high doses of vitamin B1, no side effects and toxicity have been recorded from either food or supplements at higher doses.**

Interactions:

- **a) Diuretics: they reduce blood levels of thiamine.**
- **b) Digoxin: it may decrease uptake of thiamine by the heart.**
- **c) Phenytoin: this medication may lower blood levels of thiamine.**
- **d) Flavonoids (rutin and quercetin) and polyphenols (tannic acid, caffeic acid and chlorogenic acid): they may decrease blood levels of thiamine.**

Vitamin B2 (Riboflavin):

- **Vitamin B2 is a water soluble vitamin that plays an important role in the metabolism of carbohydrates, fat and protein, and in the production of energy (ATP).**

Functions of Vitamin B2:

- **a) It has a key role in metabolizing carbohydrates, fat and protein.**
- **b) It helps with homocysteine metabolism, reducing the risk of heart disease.**
- **c) It plays a role in metabolizing drugs and steroids.**
- **d) It aids the liver to detoxify toxins.**

- **e) By being a part of FAD (flavin adenine dinucleotide) and FMN (flavin mononuclesotide), it acts as a coenzyme in the production of energy.**

- **f) It is required for the activation of vitamins B6 and B9.**

- **g) It assists with recycling of glutathione, a natural antioxidant produced by the liver.**

Food Sources and Absorption:

- **The best food source of vitamin B2 is brewer`s yeast.**
- **Other foods rich in vitamin B2 are dairy products, lean meat, fish, eggs, legumes, and green leafy vegetables (asparagus, broccoli, spinach and collard greens).**
- **A small amount of vitamin B2 is produced by the intestinal bacteria (probiotics) in the body.**

- **Dietary vitamin B2 is absorbed well from the small intestine. Even though there is a small amount of vitamin B2 in the liver and kidneys, vitamin B2 is not usually stored in the body.**

- **Excess amount of vitamin B2 is eliminated in the urine, giving a yellowish green discoloration to the urine.**

- **Vitamin B2 is extremely sensitive to light (especially ultraviolet light). This is why milk should be protected from exposing to sunlight. It is stable to heat and is not lost much by cooking.**

Athletic Benefits of Vitamin B2:

- a) May improve endurance.
- b) Helps delay fatigue and exhaustion.
- c) May help with jet lag.

Non – Athletic Benefits of Vitamin B2:

The following conditions may benefit from vitamin B2:

- **a) Chronic fatigue syndrome.**
- **b) Migraine headache.**
- **c) Cataracts.**
- **d) Keratoconus.**
- **e) Burning eyes and excessive tearing.**
- **f) Eye strain syndrome.**
- **g) Canker sores.**

- **h) Neonatal jaundice.**
- **i) Parkinson`s disease.**
- **j) Preeclampsia.**
- **k) Sickle cell anemia.**
- **l) Acne.**
- **m) Eczema.**
- **n) Alcoholism.**
- **o) Liver detoxification.**
- **p) Weight management**

Deficiency of Vitamin B2:

- **Signs and symptoms of vitamin B2 deficiency appear when daily dietary intake drops to below 0.6 mg.**

- **They include inflammation and redness of the tongue (magenta tongue), inflammation of the corners of the mouth (angular stomatitis), cracks at the corners of the mouth (cheilosis), seborrhea, eye fatigue, burning and dry eyes, and decreased energy level.**

Dosage and Side Effects:

- **The RDA for vitamin B2 for adults is 1.2 mg.**
- **The usual daily doses of vitamin B2 vary depending on the conditions for which it is used. For example, for preventing migraine, it is used 400 mg daily.**
- **The performance daily intakes (PDIs) for athletes and physically active adults are 30 – 300 mg.**

Higher doses of vitamin B2 are needed in the following conditions:

- **a) Athletes and exercisers.**
- **b) Women who take birth control pills.**
- **c) Women who are under hormonal replacement therapy (HRT).**
- **d) Stress.**
- ***Vitamin B2 does not cause any serious side effects. However, very high doses may cause itching, numbness, burning or prickling sensations, yellow or orange colored urine, and sensitivity to light.***

Interactions:

The following medications may lower blood levels of vitamin B2:

- **a) Tricyclic antidepressant medications (such as amitriptyline and doxepin).**
- **b) Antipsychotic Medications (such as chlorpromazine or thorazine).**
- **c) Sulfonamides.**
- **d) Probenecid.**
- **e) Methotrexate.**
- **f) Phenytoin.**
- **g) Thiazide diuretics**

Vitamin B5 (Pantothenic Acid):

- **Vitamin B5 is water soluble vitamin involved in the production of energy, metabolism of carbohydrates and fat, and synthesis of steroid hormones.**

- **It is famous as the "anti – stress vitamin", as it is highly important for normal function of the adrenal glands.**

Functions of Vitamin B5:

- **a) It is a constituent of coenzyme A (CoA), which, in the forms of acetyl – CoA and succinyl – CoA, involves in the Krebs cycle, leading to the production of energy (ATP).**

- **b) It is required for synthesizing the neurotransmitter acetylcholine.**

- **c) It activates the cortex of the adrenal glands to produce cortisol to fight stress. This is why it is called as the "anti – stress vitamin".**

- **d) It is highly important for optimal production of steroid hormones by the adrenal glands. This is why it is called among athletes and exercisers as the "steroid – producing vitamin".**

- **e) It helps the body uses other vitamins especially vitamin B2.**

- **f) In the form of CoA, it is crucial for the synthesis of fatty acids, cholesterol, and phospholipids.**

Food Sources and Absorption:

- **Brewer's yeast, fish and liver are the best sources of vitamin B5.**

- **Other food sources are egg yolks, chicken, legumes, whole grains, yogurt, cheese, royal jelly, avocado, broccoli, cauliflower, mushroom, sweet potatoes, green beans and alfalfa. Small amounts of vitamin B5 are produced by the intestinal flora.**

- **Vitamin B5 is absorbed from the small intestine. Its absorption is sodium – dependent (active diffusion), though a small amount could be absorbed without sodium help (passive diffusion).**

- **The body cannot absorb all dietary vitamin B5, and as dietary intake increases, the absorption may decrease. This is due to saturation of the active transport system.**

Deficiency of Vitamin B5:

- **Even though deficiency of vitamin B5 is unlikely, people with dysbiosis (imbalance of good and bad bacteria in the intestine), chronic consumers of antibiotics, teenagers, heavy alcohol drinkers and poor dieters are at risk for developing of vitamin B5 deficiency.**

- **The symptoms may include fatigue, sleep disturbances, nausea, impaired coordination, a decrease in stomach acid, abdominal cramps, recurrent upper respiratory infections, and exacerbation of allergies.**

Athletic Benefits of Vitamin B5:

- **a) Helps recover from overtraining syndrome.**

- **b) Aids the body cope with the stress of training, competition, and pre – competition anxiety.**

- **c) Enhances resistance of the body against infections.**

- **d) Supports building muscles by boosting the production of normal steroids of the body.**

Non – Athletic Benefits of Vitamin B5:

- a) High levels of LDL and triglyceride.
- b) Wound healing especially if combined with vitamin C.
- c) Diabetic foot.
- d) Diabetic neuropathy (especially if combined with alpha – lipoic acid).
- e) Rheumatoid arthritis.
- f) Bruxism (nighttime teeth grinding).

- **g) Adrenal exhaustion.**
- **h) Alzheimer's disease.**
- **i) Psoriasis.**
- **j) Acne.**
- **k) Systemic lupus erythematous (SLE).**
- **l) Asthma.**
- **m) Insomnia.**
- **n) Allergies.**
- **o) Chronic constipation.**

Dosage and Side Effects:

- **The recommended daily intake for vitamin B5 for adults is 5 mg. The recommended doses during pregnancy and breastfeeding are 6 mg and 7 mg, respectively.**

- **A dose of 25 – 50 mg a day is considered safe.**

- **The performance daily intake (PDI) of vitamin B5 in athletes and physically active adults is 50 – 200 mg. For therapeutic purposes, it could be taken up to 500 mg a day.**

A very high dose of vitamin B5 (more than 8 – 10 grams a day) for several weeks could cause diarrhea.

People with the following conditions should be careful when taking vitamin B5:

- **a) Panic disorder.**
- **b) Hemophilia.**
- **c) Bleeding disorders.**

Interactions:

- a) **Tetracycline**: vitamin B5 interferes with the absorption of this antibiotic and they should be taken 2 – 4 hours apart.
- b) **Anti – Alzheimer medications**: vitamin B5 may increase the effectiveness of these medications.
- c) **Blood thinners**: vitamin B5 may increase the effectiveness of these medications and may cause bleeding.

Homework:

- 1) Describe the athletic benefits of vitamin B1.
- 2) Describe the athletic benefits of vitamin B5.