Lecture 55:

Vitamins

Part 2

Copyright Protection:

Vitamins To Be Discussed:

- Vitamin B6
- Vitamin B7
- Vitamin B9

Vitamin B6 (Pyridoxine):

- **Vitamin B6 is a water soluble vitamin and refers to a family of compounds that include pyridoxine, pyridoxal, pyridoxamine, and their 5` - phosphate derivatives.**

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Vitamin B6, in the form of pyridoxal phosphate (PLP), acts a coenzyme for more than 100 enzymes involved in:

- **metabolism of amino acids.**
- **synthesis of heme and neurotransmitters.**
- **metabolism of glycogen, lipids, steroids, and other vitamins.**
- **conversion of tryptophan to vitamin B3.**

Functions of Vitamin B6:

- a) It involves in the metabolism of amino acids and lipids.
- b) It promotes production of neurotransmitters especially gamma aminobutyric acid (GABA) in the brain.
- c) It is required for the conversion of tryptophan to vitamin B3 and arachidonic acid to prostaglandin E2.

- **d) As a coenzyme, it has a key role in the production of melatonin, serotonin, and dopamine.**
- **e) It helps maintain sodium and potassium balance.**
- **f) It promotes the production of red blood cells.**
- **g) It is required for maintaining optimal levels of magnesium inside the cells**

- **h) It is important for the absorption of amino acids from the intestine and their transfer into the cells.**

- **i) It facilitates the breakdown of glycogen into glucose in the liver and muscles.**

- **j) It regulates the metabolism of acetylcholine, norepinephrine, and histamine.**

- **k) It has a key role in liver detoxification.**

- **l) It is necessary for the conversion of homocysteine to cystathionine.**

Food Sources and Absorption:

- **Plants:** Pyridoxine
- **Animal sources:** PLP and pyridoxamine phosphate.

- The best animal sources of vitamin B6 are **organ meats, especially the liver.** Fish, chicken and egg yolks are good sources as well.

- **Plant sources are wheat germ, whole grains, legumes, nuts, potatoes, prunes, bananas, cauliflower, collard greens, mustard greens, bell peppers, mushroom, cabbage, avocado, and spinach.**

- **It is also produced in the intestine by floral bacteria.**

- **B6 is very sensitive to ultraviolet and heat, it is easily destroyed by sunlight and cooking.**

Athletic Benefits of Vitamin B6:

- **a) Supports glycogen breakdown in glucose to generate energy.**
- **b) Aids building muscles by involving in the metabolism of amino acids and synthesis of natural steroid hormones.**
- **c) May prevent from muscle spasms and cramps by increasing the bioavailability of magnesium.**

- **d) May be beneficial in pre – competition anxiety.**

- **e) Vitamin B6 in conjunction with vitamins B9 and 12 are the most important cofactors in the conversion of creatine into creatine phosphate (CP).**

Non – Athletic Benefits of Vitamin B6:

- a) Anemia.
- b) Autism.
- c) Asthma.
- d) Age – related cognitive decline.
- e) Carpal tunnel syndrome.
- f) Canker sore.
- g) Depression and anxiety.
- h) Dysmenorrhea.
- i) Morning sickness.

- **j) Premenstrual syndrome (PMS).**
- **k) Postpartum blue.**
- **l) Muscle fatigue and soreness.**
- **m) Schizophrenia.**
- **n) Vertigo.**
- **o) Fibrocystic breast disease.**
- **p) Parkinson`s disease.**
- **q) High homocysteine levels.**
- **r) Kidney stones of calcium oxalate type.**

- **s) Gestational diabetes.**
- **t) Water retention.**
- **u) Female infertility.**
- **v) Overdose with barbiturate medications.**
- **w) Carbon monoxide toxicity.**
- **x) Epilepsy.**
- **y) Skin problems, such as psoriasis, dermatitis, dandruff, and acne, especially premenstrual.**
- **z) Irradiation therapy.**

Deficiency of Vitamin B6:

- **Symptoms of vitamin B6 deficiency appear when dietary daily intake is less than 0.2 mg or blood level of PLP is less than 20 nmol/L.**

- **They include fatigue, muscle weakness, irritability, depression, confusion, anemia, seborrhea, inflammation of the tongue, neuropathy, convulsions, and personality changes.**

Low levels of vitamin B6 in the blood are associated with:

- **Inflammation.**
- **Elevated levels of C – reactive protein (CRP).**
- **Increased blood levels of homocysteine.**
- **Increased risk of cardiovascular disease.**

The contributing factors to deficiency of vitamin B6 are:

- **a) Alcoholism.**
- **b) Asthma.**
- **c) Elderly people.**
- **d) Depression.**
- **e) Poor digestion.**
- **f) Birth control pills.**
- **g) Hormone replacement therapy.**

- **h) Peptic ulcer.**
- **i) Pregnancy.**
- **j) Smoking.**
- **k) Medications: isoniazid, gentamycin, penicillamine, hydralazine, reserpine, theophylline, and cyclosporine.**

Dosage and Side Effects:

Age or Conditions	RDA for vitamin B6
Male, 14 – 50 years old	1.3 mg
Male, over 50 years old	1.5 mg
Female,14 – 50 years old	1.2 mg
Female, over 50 years old	1.5 mg
Pregnancy, any age	1.9 mg
Breastfeeding, any age	2.0 mg

- **The performance daily intake (PDI) in athletes and physically active adults is 20 – 200 mg.**

- **The safe upper limit for vitamin B6 is 100 mg per day, although no side effects have been reported with high dietary intakes.**

Larger doses of vitamin B6 (250 – 500 mg per day) would be needed in the following conditions:

- **Carpal tunnel syndrome.**
- **Multiple sclerosis.**
- **Parkinson`s disease.**
- **Epilepsy.**
- **Neuropathies.**
- **Carbon monoxide poisoning.**
- **Drug overdose with barbiturates.**

Interactions:

- **a) L – dopa: vitamin B6 interferes with the action of this medication. If you are taking this medication, do not take vitamin B6.**

- **b) Amiodarone: vitamin B6 may increase amiodarone – induced photosensitivity.**

- **c) Anti – epilepsy medications (phenobarbital and phenytoin): vitamin B6 decreases their effectiveness by increasing their liver metabolism.**

- **d) Aspirin and NSAIDs: vitamin B6 may increase the risk of bleeding.**

- **e) Anticoagulants or blood thinners (Coumadin, heparin, and Plavix): vitamin B6 may increase the risk of bleeding.**

- **f) Ginkgo biloba: vitamin B6 may increase the risk of bleeding.**

Vitamin B7 (Biotin):

- **Known also as vitamin H and Co - Enzyme R.**

- **The popularity of biotin comes from the fact that it has a "hair – stimulating effect", promoting hair growth and slowing down the progression of graying hairs.**

Functions of Biotin:

- **a) It is important for the synthesis of fatty acids.**
- **b) It assists with the catabolism of the branched – chain amino acids (BCAAs): leucine, isoleucine, and valine.**
- **c) It participates in gluconeogenesis (production of glucose from non – carbohydrate substances).**
- **d) It may help maintain normal blood sugar level.**

Food Sources and Absorption:

- **Food sources of biotin include organ meats such as liver and kidney, soy, beans, carrots, tomato, onion, cabbage, Swiss chard, yeast, and egg yolk.**

- **Raw egg white contains a protein named avidin, which strongly binds with biotin in the stomach and reduces its absorption.**

- **Cooking inactivates or destroys the avidin. So, cooked egg white does not affect the absorption of biotin.**

Benefits of Biotin:

Biotin may be beneficial in the following conditions:

- **a) Hair loss and graying hairs.**
- **b) Brittle nails.**
- **c) Diabetes.**
- **d) Peripheral neuropathies.**
- **e) Cradle Cap (Seborrheic Dermatitis).**
- **f) Dermatitis and eczema.**
- **g) Fatty liver.**

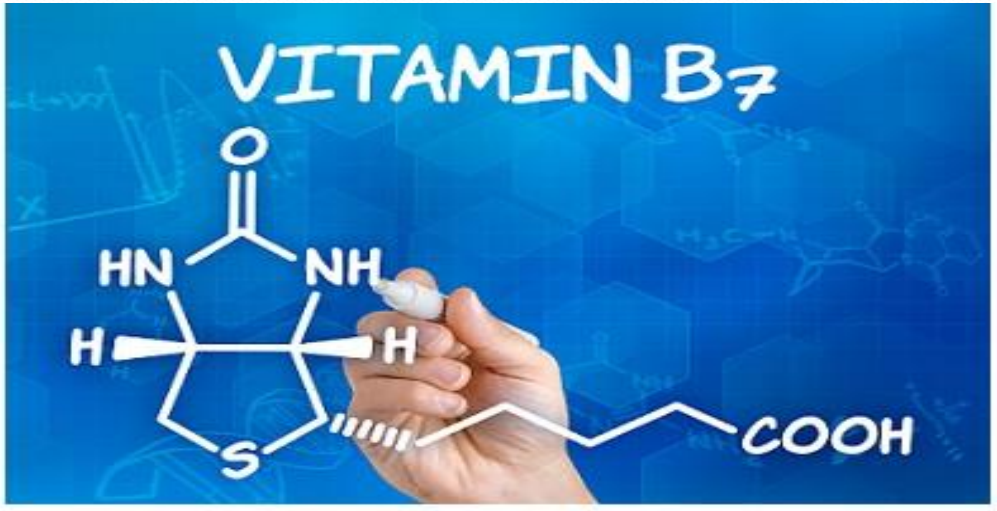
Deficiency of Biotin:

Symptoms of biotin deficiency are:

- **Dry and flaky skin.**
- **Fatigue.**
- **Thin hairs.**
- **Loss of appetite.**
- **Nausea.**
- **numbness and tingling.**
- **Depression.**
- **Hallucination.**
- **Impaired coordination.**

The contributing factors to deficiency of biotin are:

- **a) Alcoholism.**
- **b) Inflammatory bowel disease (IBD).**
- **c) Long term use of antibiotics.**
- **d) Long term use of anti – epilepsy medications.**



Vitamin B7:

Dosage and Side Effects:

- **No RDA has been established for biotin. However, the suggested dietary daily intake of biotin for adults is 30 mcg.**

- **The performance daily intake (PDI) for athletes and physically active adults is 500 – 1000 mcg. Some clinicians may use up to 5000 mcg of biotin per day.**

- **Treatment of biotin deficiency requires higher doses of biotin, using up to 10 mg (10,000 mcg) per day. There are no side effects with biotin even in larger amounts.**

Interactions:

- **a) Antibiotics: they may lower blood levels of biotin.**
- **b) Anti – seizure medications (phenobarbital, phenytoin, carbamazepine, valproic acid, and primidone): they may reduce biotin levels in the body.**
- **c) Cholesterol – lowering medications: biotin may decrease their effectiveness.**
- **d) Alpha – lipoic acid (ALA): it may reduce the absorption of biotin.**

Vitamin B9 (Folic Acid):

- **Folic acid is a water soluble vitamin that plays an important role in the synthesis of DNA and RNA, and amino acids, and formation of red blood cells.**

- **It is famous as the "pregnancy vitamin" because of its widely use in pregnancy and its ability to prevent the baby from developing birth defects in the nervous system.**

- **Para – aminobenzoic acid (PABA; vitamin B10) is a part of the structure of folic acid.**

- **This is why folic acid is sometimes referred to as "vitamin within a vitamin".**

Functions of Folic Acid:

- **a) It is required for the synthesis of DNA and RNA.**
- **b) It is necessary for the formation of red blood cells.**
- **c) It acts as a coenzyme for the synthesis of methionine, which is the precursor for SAMe (S – adenosylmethionine).**

- **d) As the coenzyme THFA (tetrahydrofolic acid), it helps with the metabolism of proteins.**
- **e) It plays an important role in the development of the central nervous system.**
- **f) It helps reduce blood levels of homocysteine.**
- **g) It is important in the production and quality of sperms and the maturation of ovum.**

Food Sources and Absorption:

- **The highest concentrations are found in green leafy vegetables (such as spinach, kale, beet greens, and chard), brewer`s yeast, nuts, and the liver.**

- **They contain more than 100 mcg of folic acid per 100 grams.**

Green leafy vegetables are excellent sources of vitamin B9.

- **Other food sources are legumes, asparagus, broccoli, sweet potatoes, okra, artichoke, parsnips, citrus fruits, pineapple, bananas, cantaloupe, and berries.**

- It also is produced in the body by intestinal bacteria. Folic acid is easily destroyed by heating.

- Approximately 50% of dietary folic acid is absorbed from the upper part of the small intestine. Total amount of folic acid in an average person is about 10 mg, with the liver containing the largest store.

- About 200 mcg of folic acid is needed to maintain its store in the body. The body store is enough for only 4 – 6 months.

Athletic Benefits of Folic Acid:

- **a) Along with vitamins B6 and B12, folic acid is highly important for the conversion of creatine into phosphocreatine (CP), maximizing the benefits of creatine monohydrate.**

- **b) In conjunction with vitamins C and B12, folic acid helps with the metabolism of proteins.**

- **c) May delay fatigue and exercise– induced exhaustion.**

Non – Athletic Benefits of Vitamin Folic Acid:

- a) Prevention of birth defects, such as spina bifida, meningocele, encephalocele, anencephaly, cleft palate, and harelip.
- b) Abnormal Pap smear.
- c) Depression.
- d) Schizophrenia.
- e) Anemia.
- f) Periodontal disease.
- g) Cervical cancer.
- h) Cervical dysplasia

- **i) Dementia.**
- **j) Gout.**
- **k) Breast cancer.**
- **l) Colon cancer (prevention).**
- **m) Atherosclerosis.**
- **n) High homocysteine levels.**
- **o) Chronic fatigue syndrome.**
- **p) Skin problems, such as psoriasis, acne, seborrheic dermatitis, vitiligo, and ulcers.**
- **q) Inflammatory bowel disease (IBD).**

- **r) Infertility (both in men and women).**
- **s) Restless leg syndrome.**
- **t) Lung cancer (prevention).**
- **u) Down`s syndrome.**
- **v) Preeclampsia.**
- **w) Sickle cell anemia.**
- **x) Epilepsy.**
- **y) Celiac disease.**
- **z) Chronic hemolytic anemias.**

Deficiency of Folic Acid:

- **When dietary intake of folic acid is less than 100 mcg per day, the folic acid store would be sufficient for only 4 – 6 months followed by developing symptoms of folic acid deficiency.**

- **They include anemia, fatigue, irritability, loss of appetite, inflammation of the tongue, depression, impaired judgment, and paranoia.**

The contributing factors to deficiency of folic acid are:

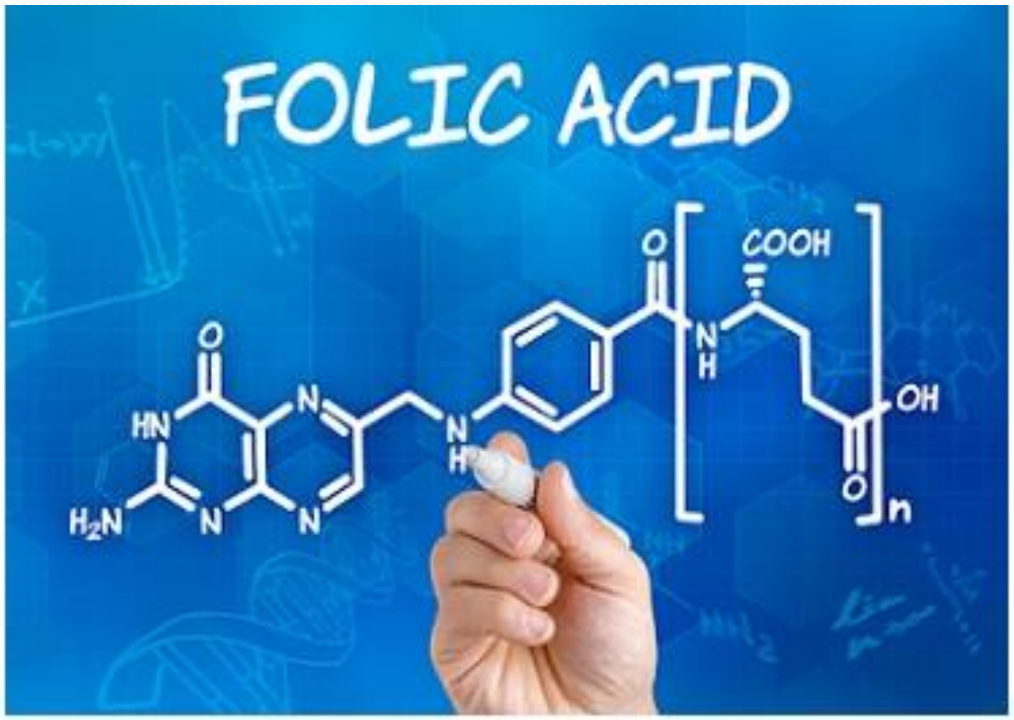
- a) Alcoholism.
- b) Old age.
- c) Poor diet.
- d) Malabsorption.
- e) Celiac disease.
- f) Crohn`s disease.
- g) Pregnancy.
- h) Breastfeeding.
- i) Psoriasis.
- j) Diabetic neuropathy of the GI tract.

- **k) Dialysis.**
- **l) Birth control pills.**
- **m) High doses of vitamin C (more than 2000 mg per day).**
- **n) Congestive heart failure.**
- **o) Medications: sulfasalazine, pyrimethamine, triamterene, cholestyramine, phenformin, metformin, barbiturates, phenytoin, primidone, tetracycline, methotrexate, and nitrofurantoin.**
- **p) Leukemia.**
- **q) Lymphoma.**
- **r) Liver disease.**

Dosage and Side Effects:

- **The RDA for folic acid in adults is 400 mcg.**
- **It is increased during pregnancy and breastfeeding to 600 mg and 500 mg per day, respectively.**
- **The performance daily intake (PDI) for athletes and physically active adults is 800 – 1200 mcg.**

- **Up to 2000 mcg of folic acid per day usually has no side effects. However, very higher doses may cause insomnia, irritability, stomach upset, diarrhea, and skin eruptions.**



Folic Acid: *Copyright©Depositphotos.com/Boris Zerwann*

Interactions:

- **a) Anti – seizure medications (phenobarbital, phenytoin, and primidone): folic acid may decrease their effectiveness.**
- **b) Methotrexate: folic acid may decrease the effectiveness of this medication.**
- **c) Pyrimethamine: folic acid may decrease the effectiveness of this medication.**

Homework:

- 1) Describe the athletic benefits of vitamin B6.
- 2) Describe the athletic benefits of vitamin B9.