Let's Excel Together

CANADIAN ACADEMY OF SPORTS NUTRITION

Lecture 59:

Minerals

Part 2

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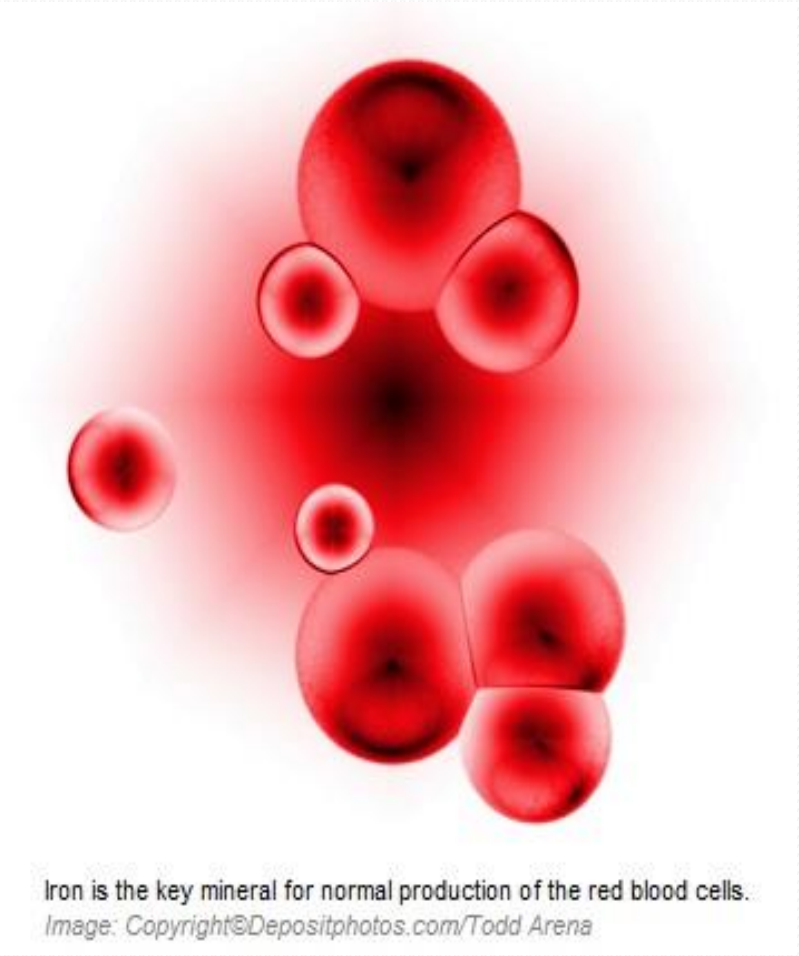
Minerals To Be Discussed:

- Iron
- Magnesium
- Manganese

Iron:

- **Iron is an essential mineral and critical element in the function of all cells.**
- **It is best known for its role in blood formation.**
- **The major role of iron is to carry oxygen.**



Iron is the key mineral for normal production of the red blood cells.
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Iron is a component of:

- **hemoglobin (oxygen – carrying protein in the blood).**
- **myoglobin (oxygen – carrying protein in the muscles).**
- **many enzymes such as cytochrome system in mitochondria and catalase (the first line of defence of the body against damages caused by free radicals).**

Absorption of Iron:

- **Iron is absorbed from the upper part of the small intestine into the blood. It is a slow process and may take up to 4 hours.**

- **An average and well-nourished person has about 4 grams of iron in the body.**

- **Approximately 70% of iron is in hemoglobin, 10% in myoglobin, and 20% in enzymes and iron stores.**

Distribution of Iron in the Body (mg):

	Average man (80 kg)	Average woman (60 kg)
Hemoglobin	2500	1700
Myoglobin/Enzymes	500	300
Transferrin iron	3	3
Iron stores (liver, bone marrow, and spleen)	600 – 1000	0 – 300

- **Iron absorption takes place mainly in the upper part of the small intestine and is influenced by few factors and physiologic states.**

- **Heme iron has better absorption rate than non – heme iron, 60% - 75% versus 5% – 7%.**

- **To maintain a normal hemostasis, the amounts of daily dietary absorption of iron in men and women are 1 mg and 1.4 mg, respectively.**

The Rate of Iron Absorption in Certain Foods:

Iron in vegetables (non-heme)	5%
Egg iron	12%
Liver iron	50%
Heme iron	60% – 75%

Factors that increase iron absorption are:

- a) Physiologic states such as pregnancy and breastfeeding.
- b) During infancy, childhood, and adolescence due to rapid growth.
- c) Iron deficiency anemia.
- d) Blood loss.
- e) Vitamin C.
- f) Vitamin A.

- **g) Minerals, such as copper, manganese, and cobalt.**
- **h) Citrus fruits.**
- **i) Heme iron (in red meats).**
- **j) Proteins.**
- **k) Hydrochloric acid.**

Factors that decrease iron absorption are:

- **a) Calcium.**
- **b) Antacids.**
- **c) Hypochlorhydria (low stomach acidity).**
- **d) Soy protein.**
- **e) Oxalate.**
- **f) Phytates (in whole grains, soy protein, and walnuts).**
- **g) Fiber.**
- **h) Phosphates (in soft drinks).**

- **i) Polyphenols (in cocoa and coffee).**
- **j) Tannic acid (in back tea and coffee).**
- **k) Non – heme iron (from plants and vegetables).**
- **l) Zinc.**
- **m) Magnesium.**
- **n) IP-6 (inositol hexaphosphate).**
- **o) Vitamin E.**

Food Sources of Iron:

- **There are two types of iron in foods: heme iron (animal sources) and non-heme iron (plant sources).**

- **Heme iron is found only in red meat, shellfish, fish and poultry.**

- **Non-heme iron is found mostly in fruits, vegetables, dried beans, nuts, grain products, and milk and eggs.**

Benefits of Iron:

- a) Iron deficiency anemia.
- b) Celiac disease.
- c) Dermatitis herpetiformis.
- d) Canker sore.
- e) Female infertility.
- f) As a support during pregnancy, breastfeeding, and postpartum.
- g) Alzheimer's disease.
- h) Heavy menstruation.
- i) Anorexia nervosa.
- j) Vegetarians and vegans.

Dosage:

Age group/Conditions	RDA for Iron
Men, 19 years and older	8 mg
Women, 19 – 50 years old	18 mg
Women, 51 years and older	8 mg
Women, 19 – 50 years, pregnant	27 mg
Women, 19 – 50 years, breastfeeding	9 mg
Vegetarians: - Adult men - Adult women, premenopausal - Adult women on birth control pills - Teenagers, girls - Girls on birth control pills	 14 mg 33 mg 11 mg 26 mg 12 mg

- **Iron is usually added to many multivitamins – multiminerals.**

- **It is also available in multiple preparations. They include ferrous sulfate, extended release, ferrous fumarate, ferrous gluconate, ferrous succinate, ferrous lactate, chelated iron, and polysaccharide iron.**

- **Though they provide different amounts of elemental iron, they are generally all absorbed well.**

- **The typical dosage of iron is up to 300 mg of elemental iron per day in divided doses.**
- **It should be taken on an empty stomach for better absorption.**
- **To enhance absorption, you may take iron with 250 – 500 mg of vitamin C.**

The Amounts of Elemental Iron in Some Iron Products:

	Tablet (elemental iron in mg per tablet)	Elixir (elemental iron in mg per one teaspoon)
Ferrous Sulfate	325 (65) 195 (39)	300 (60) 90 (18)
Extended Release	525 (105)	-
Ferrous Fumarate	325 (107) 195 (64)	100 (33)
Ferrous Gluconate	325 (39)	300 (35)
Polysaccharide Iron	150 (150) 50 (50)	100 (100)

- **Iron causes gastrointestinal disturbances such as nausea, vomiting, diarrhea, constipation, stomach upset, esophagitis (inflammation of the esophagus), and black tarry stools.**

- **Ferrous gluconate and ferrous fumarate cause fewer side effects than ferrous sulfate.**

- **Chelated iron is easily tolerated and has the least side effects, while ferrous sulfate produces more side effects.**

Iron supplementation should be avoided in the following conditions:

- a) Thalassemia.
- b) Sickle cell anemia.
- c) Polycythemia.
- d) Hemochromatosis.
- e) Active rheumatoid arthritis.
- f) Porphyria.
- g) Hemosiderosis.
- h) Sideroblastic anemia.

Magnesium:

- **Magnesium is an important essential mineral in the body.**
- **Being the fourth most abundant mineral in the body, magnesium is required for normal cellular function, muscle relaxation, protein synthesis, and energy release.**
- **It is an important cofactor for more than 300 enzyme systems.**

- **Magnesium helps regulate the body temperature and adapt to stress.**

- **This is why it is considered as the "anti – stress mineral".**

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Food Sources of Magnesium:

Foods rich in magnesium are:

- **Dark green leafy vegetables.**
- **Legumes.**
- **Seeds.**
- **Nuts especially almonds, pecans and Brazilian nuts.**
- **Fish.**
- **Dark chocolate.**
- **Avocado.**
- **Whole grains.**

Absorption of Magnesium:

- **Approximately 40% – 50% of dietary magnesium is absorbed, mainly in the middle and last parts of the small intestine.**

- **Vitamin D enhances the absorption of magnesium, while oxalate, alcohol, caffeine, diets high in protein and fat, phosphorous, and high doses of calcium, and phytic acid decrease absorption of magnesium.**

- **The ratio of calcium to magnesium is highly important in magnesium absorption.**

- **For optimal absorption, the best ration of calcium to magnesium is 2 to 1.**

- **Vitamin B6 increases the transport of magnesium into the cells.**

- **The total body magnesium in an average person is 25 grams (1000 mmol), of which about 65% is in the bones and teeth. The remaining 35% is in the blood, brain, heart, and body fluids.**

- **The normal level of magnesium in the blood is 1.7 – 2.4 mg/dl (0.7 – 1 mmol/L), of which 30% is bound to proteins and 15% is complexed to phosphate and other anions.**

Athletic Benefits of Magnesium:

- a) Plays an important role in protein synthesis.
- b) May help relieve pre – completion anxiety.
- c) May prevent muscle spasms and cramps during intense training or competition.
- d) Supports the body against the stress of exercise.
- e) Reduces post – exercise exhaustion.

Non – Athletic Benefits of Magnesium:

- a) Migraine.
- b) Tension and cluster headaches.
- c) Cardiac arrhythmia.
- d) Congestive heart failure (CHF).
- e) Pregnancy – induced hypertension.
- f) Fibromyalgia.
- g) Dysmenorrhea (painful menstruation).
- h) Dyspareunia (painful intercourse).
- i) Premenstrual syndrome (PMS).

- **j) Kidney stones.**
- **k) Osteoporosis.**
- **l) Anxiety.**
- **m) Mitral valve prolapse (MVP).**
- **n) Insomnia.**
- **o) Chronic fatigue syndrome.**
- **p) Hypertension.**
- **q) Asthma.**
- **r) Glaucoma.**
- **s) Raynaud`s disease.**

- **t) Diabetes.**
- **u) ADHD (attention - deficit hyperactivity disorder).**
- **v) Sickle cell anemia.**
- **w) Epilepsy.**
- **x) Autism.**
- **y) Alcohol withdrawal and preventing hangover (when combined with vitamin B1).**

Dosage and Side Effects:

The RDAs for magnesium are:

- **Men:** 400 – 420 mg
- **Women:** 310 – 320 mg

- **Women would need 350 – 360 mg a day during pregnancy and breastfeeding periods.**

- **Athletes may consider taking 600 – 1000 mg per day for optimum protein synthesis and muscle contraction.**

- **The most common side effect of magnesium is diarrhea.**

- **Some people may experience diarrhea even in lower doses.**

- **Magnesium supplementation should be avoid or should be under the supervision of a doctor in the following medical conditions, as they may be associated with hypermagnesemia (increased blood levels of magnesium):**

- **a) Renal failure.**
- **b) Severe burns.**
- **c) Sepsis (systemic infection).**

- **d) Low function thyroid.**
- **e) Adrenal insufficiency.**
- **f) Lithium therapy.**
- **g) Cardiac arrest.**
- **h) Trauma.**
- **i) Hypothermia.**

Interactions:

- a) **Aminoglycosides (such as gentamicin, kanamycin, and streptomycin):** they may aggravate muscle – relaxing effect of magnesium, causing severe muscle weakness. Avoid taking magnesium at the same time with these antibiotics.

- b) **Quinolones, Fluoroquinones, and Tetracylines:** magnesium may reduce the absorption of these antibiotics. They should be taken 2 – 4 hours apart.

- **c) Bisphosphonates (such as tiludronate and alendronate): magnesium may decrease the absorption of these medications. They should be taken minimum 2 hours apart.**

- **d) Diuretics (such as furosemide and hydrochlorothiazide): they may lower blood levels of magnesium.**

- **e) Potassium – sparing diuretics (such as spironolactone and triamterene): they may increase blood levels of magnesium.**

- **f) Calcium Channel Blockers (such as nifedipine, diltiazem, and verapamil): magnesium may increase their effectiveness, and your blood pressure may drop too low.**

- **g) Levothyroxine: magnesium – containing antacids have also calcium that can reduce the absorption of levothyroxine. They should be taken at least 4 hours apart.**

- **h) Labetalol: magnesium increases effectiveness of this medication, leading to abnormal drop of heart rate and blood pressure.**

- **i) Amphotericin B: it may lower magnesium levels.**
- **j) Corticosteroids: they may lower magnesium levels.**
- **k) Insulin: it may lower magnesium levels.**

Manganese:

- **Manganese is an essential mineral that is required for bone formation, healthy connective tissues, fertility, metabolism of proteins, and normal brain function.**

- **Not being a popular mineral among public and athletes, manganese is a cofactor for many enzymes in the body.**

Food Sources and Absorption of Manganese:

- Foods high in manages are nuts, whole grains, alfalfa, wheat germ, leafy green vegetables, seeds, and legumes.

- An average person has about 20 mg manganese in total in the body, of which approximately 50% is in the bones, and the remaining 50% is in the liver, pancreas, pituitary gland, kidneys, and adrenal glands.

- The absorption of dietary manganese is about 20% - 25% and is affected by many factors.

Manganese deficiency could lead to:

- impaired growth and skeletal development
- infertility
- disordered metabolism of carbohydrates and fats
- skin eruption.

Factors that increase the absorption of manganese:

- a) Alcohol.
- b) Lecithin.

Factors that decrease the absorption of manganese:

- a) High doses of calcium, iron, magnesium and phosphorus.
- b) Zinc.
- c) Caffeine.
- d) Soy protein.

Functions of Manganese:

- **a) Is a component of the enzyme SOD (superoxide dismutase), which is a potent antioxidant in the body.**
- **b) Has a key role in normal development of the bones and connective tissues.**
- **c) Helps metabolize glucose by acting a cofactor in glycolysis.**
- **d) Aids protein metabolism.**

- **e) Helps the body use vitamin C, vitamin B1, biotin, and choline easily by activating certain enzymes.**

- **f) May help the body produce blood clotting factors.**

- **g) By activating glutamine synthetase, it helps the body produce glutamine, which is an important amino acid in the body and the primary source of fuel for the intestinal cells.**

- **h) Is important for normal brain development and function.**

Athletic Benefits of Manganese:

- **a) May help recover rapidly from strains and sprains.**
- **b) May speed up healing from sports injuries.**
- **c) May aid reduce post – exercise exhaustion.**
- **d) Accelerates healing process in Osgood – Schlatter disease.**

Manganese is an important mineral in healing sports injuries.

Non – Athletic Benefits of Manganese:

The following medical conditions may benefit from manganese:

- **a) Tardive dyskinesia.**
- **b) Osteoporosis.**
- **c) Diabetes.**
- **d) Hypoglycemia.**
- **e) Arthritis.**
- **f) Epilepsy.**
- **g) Premenstrual syndrome (PMS).**

Dosage and Side Effects:

- **No RDA has been established for this mineral.**

- **The adequate intake (AI) levels for manganese are**
- **Men: 2.3 mg a day**
- **Women: 1.8 mg a day**

- **It is usually added to many multivitamins – multiminerals. The recommended safe dosage for non – athletes is 3 – 5 mg a day.**

- **The tolerable upper limit for manages is 11 mg a day.**
- **For athletes who train actively, the performance daily intake (PDI) is 15 – 45 mg daily.**
- **When suffering from sports injuries, you may take 50 – 100 mg a day for only one week, and then reduce it to 15 – 45 mg a day.**
- **Manganese toxicity may manifest as loss of appetite, weakness, apathy, manic episode, Parkinson – like symptoms, psychosis, and pneumonia – like symptoms.**

Interactions:

The following medications may interfere with the absorption of manganese. Thus, they should be taken minimum 2 hours apart.

- **a) Tetracyclines and quinolones.**
- **b) Magnesium – containing laxatives.**
- **c) Calcium – containing antacids.**

Homework:

- **1) Describe how magnesium could benefit athletes.**

- **2) Describe the factors that decrease iron absorption.**