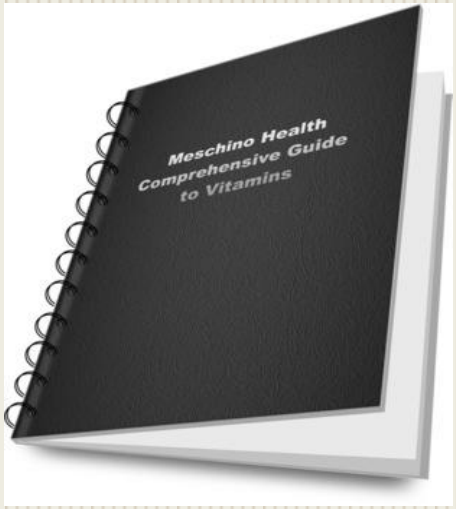
www.meschinohealth.com

Meschino Health Comprehensive Guide to Minerals



Authored by: Dr. James Meschino

Table of Contents

About the Meschino Health Comprehensive Guide to Herbs

The Meschino Health Comprehensive Guide to Vitamins is one of four eBooks on nutrients written by Dr. James Meschino:

1. Meschino Health Comprehensive Guide to Vitamins
2. Meschino Health Comprehensive Guide to Herbs
3. Meschino Health Comprehensive Guide to Minerals
4. Meschino Health Comprehensive Guide to Accessory Nutrients and Essential Oils

All four books were written to both educate and provide an easy to use quick reference to answer important questions regarding nutrients. Users of the guide can quickly find which health conditions the nutrient can impact, proper dosage, possible effects of a deficiency or the effect any potential toxicity associated with the nutrient. Finally any drug-nutrient Interactions associated with the nutrient.

More eBook and eQuick Guides

Meschino Health is excited to be able to provide tools and resources to help you achieve your healthy living objectives. Sharing the Healthy Living message and helping anyone who is interested in living a healthy happy life is what Meschino Health is all about. Visit www.MeschinoHealth.com to learn the latest a science based research on diet and supplementation that can prevent and treat health conditions often associated with aging. New eBooks and eGuides are added every month and can be downloaded free of charge.

Meschino Health Natural Health Assessment

Welcome to the Nutrition, Lifestyle and Anti-aging Assessment.

The most powerful health assessment on the internet

- Easy to Complete Online Questionnaire
- Your Personal Health Assessment is generated Instantly and can be downloaded to your computer
- The Meschino Health Assessment is a 15 to 20 page comprehensive report complete with diet, lifestyle and supplement considerations that are specific to your profile.

The Meschino Health Assessment is a free service created by Dr. James Meschino. The feedback in your report is based on your answers to the questions in the Health Assessment, and highlights the dietary, lifestyle and supplementation practices that are best suited to your circumstances, according to currently available scientific studies

The Meschino Health Assessment is a Free Service

Why take it?

We all know that we should eat better, exercise more and change some of our less then desirable lifestyle habits. Did you know that 7 out of 10 North Americans are taking some form of nutritional supplements to augment their diet? While that might sound like good news, the downside is that many people are guessing at what supplements to take! So which one should you take? Better yet, what does eating better look like?

You need a plan.

But where would you even begin to find a health assessment that takes into account your personal health status, diet, lifestyle activities and family health history-before recommending a plan of action?

Where? Right here.

Boron

General Features

Boron is a trace mineral that is essential for the growth of plants. In recent years it has received much attention for its role as a supplement that may help maintain bone mineral density in postmenopausal women, preventing osteoporosis. Whether Boron is an essential nutrient for humans is still under debate. Hence, there is no recommended daily allowance (RDA) for Boron at this time.[1]

Some recent evidence suggests that Boron may act as a cofactor to convert Vitamin D to its most active form (1,25 dihydroxy vitamin D3) in the kidneys. Preliminary evidence suggests that 3 mg of Boron supplementation reduces magnesium and calcium loss and may double the production of estrogen in postmenopausal women. It may also increase testosterone in these women.[2]

Supplementation Studies and Clinical Applications

1. **Osteoporosis (Postmenopausal Women)**

   In twelve postmenopausal women a Boron supplementation of 3 mg reduced loss of calcium and magnesium, and significantly increased serum estrogen and testosterone within eight days of beginning Boron supplementation.[3]

   In this study urinary calcium loss was reduced by 44 percent and blood levels of 17 beta-estradiol, the most biologically active estrogen, doubled.[2]

   Subsequent studies indicate that Boron itself can enhance and mimic some of the effects of estrogen on calcium metabolism in postmenopausal women.[4]

2. **Arthritis**

   Since the mid 1970s, Boron has been used to treat osteoarthritis, rheumatoid arthritis and juvenile arthritis, using daily doses of 6-9 mg. Preliminary studies demonstrate very good results in placebo–controlled trials. The mechanism of action remains unknown for this application.[5,6]

Dosage Ranges

1. Postmenopausal Osteoporosis: 3 mg per day.[2]
2. Arthritis: 6-9 mg per day.[5,6]

Side Effects and Toxicity

At usual supplemental levels of intake, Boron has shown no toxicity in human studies. Some women experienced increased hot flashes and night sweats (postmenopausal) or a worsening of their symptoms with 2.5 mg of Boron supplementation. These women may have to discontinue use.[7]

As well, the increase in estrogen levels may be of concern in regards to increasing risk of breast and other reproductive cancers. Thus, many authorities suggest limiting Boron supplementation in postmenopausal women to a maximum of 1 mg per day.[8]

Drug-Nutrient Interaction

There are no well-known drug nutrient interactions for Boron.[9]

Pregnancy and Lactation

During pregnancy and lactation, the only supplements that are considered safe include standard prenatal vitamin and mineral supplements. All other supplements or dose alterations may pose a threat to the developing fetus and there is generally insufficient evidence at this time to determine an absolute level of safety for most dietary supplements other than a prenatal supplement. Any supplementation practices beyond a prenatal supplement should involve the cooperation of the attending physician (e.g., magnesium and the treatment of preeclampsia.)

References: Pregnancy and Lactation

1. Encyclopedia of Nutritional Supplements. Murray M. Prima Publishing 1998.
2. Reavley NM. The New Encyclopedia of Vitamins, Minerals, Supplements, and Herbs. Evans and Company Inc. 1998.
3. The Healing Power of Herbs (2nd edition). Murray M. Prima Publishing 1995.
4. Boon H and Smith M. Health Care Professional Training Program in Complementary Medicine. Institute of Applied Complementary Medicine Inc. 1997.

---

1. Hendler S. The Doctors's Vitamin and Mineral Encyclopedia. New York, NY: Simon and Schuster; 1990. p. 114-6.
2. Neilson FH, Hunt CD, Mullen LM, Hunt JR. Effect of dietary Boron on mineral, estrogen, and testosterone metabolism in postmenopausal women. FASEB J 1987:1;394-7.
3. Neilson FH. Boron: an overlooked element of potential nutritional importance. Nutrition Today. 1988:23;4-7.
4. Nielson FH, Gallagher SK, Johnson LK, Nielson EJ. Boron enhances and mimics some of the effects of estrogen therapy in postmenopausal women. J Trace Elem Exp Med 1992; 5:237-46.
5. Travers RL, Rennie GC, Newnham RE. Boron and arthritis: the results of a double-blind pilot study. J Nutr Med 1990;1:127-32.
6. Newnham RE. Arthritis or skeletal fluorosis and Boron. Int Clin Nutr Rev 1991;11:68-70.
7. Nielsen FH, Penland JG. Boron supplementation of peri-menopausal women affects boron metabolism and indices associated with macromineral metabolism, hormonal status and immune function. J Trace Elements Exp Med 1999; 12:251-61.
8. Healthnotes 1998-2002. Available from: URL: http://www.healthnotes.com
9. Murray M. Encyclopedia of Nutritional Supplements. Rocklin, CA: Prima Publishing; 1996. p. 193.

Calcium

General Features

Calcium is the most abundant mineral in the body. It makes up approximately 2 percent of the body weight with 99 percent of it incorporated into the hard tissue, bones, and teeth. The other one percent is present in the blood and extracellular fluids and within cells of soft tissue where it regulates many important metabolic functions. In addition to building and maintaining bones and teeth, Calcium is necessary for muscle contraction, blood clotting (stimulates the release of thromboplastin from platelets, facilitates conversion of prothrombin to thrombin), cell membrane transport functions, release of neurotransmitters, synthesis and secretion of protein, hormones and intracellular enzymes, nerve transmission and regulation of heart beat. The proper balance of Calcium, sodium, potassium and magnesium ions maintains muscle tone and controls irritability and the muscle membrane's electrical potential.

Calcium is present in bones in the form of hydroxyapatite crystals, composed of Calcium phosphate, Calcium carbonate, magnesium, zinc, sodium and fluoride. These salt crystals are arranged around a framework of softer protein material (organic matrix). The hydroxyapatite crystal provides strength and rigidity to the softer protein matrix of bone. The same crystals are present in the enamel and dentin of teeth; however, the Calcium from teeth is generally not reabsorbed into the bloodstream in times of need or in conjunction with low circulation levels of estrogen, progesterone, or testosterone. Bone Calcium can be reabsorbed into the blood stream, weakening the skeleton and increasing susceptibility to osteoporotic fractures (often seen in the spine and neck of the femur).

Blood levels of Calcium are maintained within a fixed range by various feedback mechanisms. A significant increase in serum Calcium can cause cardiac or respiratory failure and a hypocalcemic state leads to tetany (involuntary muscle spasm that can cause asphyxia and death from spasm of airway musculature).

Absorption and Metabolism

Calcium is absorbed primarily via active transport in the duodenum (some via passive diffusion). Active transport requires the assistance of vitamin D. The body normally absorbs 30-40 percent of ingested Calcium, but it can be as low as 10 percent from inorganic sources such as vegetables or grains with a high content of phytic or oxalic acid. Parathyroid hormone (PTH) increases Calcium absorption by increasing the conversion of vitamin D to its active form. In general, factors that increase Calcium absorption include: serum levels of vitamin D, PTH, lactose, intestinal acidity, and possibly fat intake. Factors that hinder Calcium absorption include: oxalic acid (chocolate, spinach, beet tops, collard greens, etc.) but this is not of great concern as dietary Calcium is usually far greater than dietary oxalate. The same is true for phytic acid found in whole grains (e.g., wheat bran and whole wheat). Low serum levels of vitamin D and/or PTH decrease Calcium absorption.

Following absorption, Calcium enters the bloodstream and is transported to body tissue. The major site of deposition is bone.[1] Unabsorbed Calcium (approximately 60-70 percent of intake levels) is excreted in fecal matter, but may provide a protective role in regards to colon cancer prevention by binding to bile acids and other sterols and blocking their conversion to cancer-causing secondary sterols (lithocholic acid, deoxycholic acid).[2,3]

Daily Calcium Requirement (NIH Recommendations)

Age Group and Gender	Calcium (mg)
Under 6 months	400
6–12 months	600
1–10 years	800
11-24 years Male and Female	1200-1500
25–50 years Male and Female	1000
Postmenopausal Women not taking estrogen replacement (ERT)	1500
Postmenopausal Women taking ERT	1000
65+ years Postmenopausal Women taking or not taking ERT	1500
50-64 years Men	1000
65+ years Men	1500[4]

Calcium Preparations and Bioavailability

The bioavailability of various forms of Calcium supplements has been evaluated using radio-isotope and other studies. The following is a summary of the key findings to date:

Type	Absorptive Fraction of Calcium in Normal Subjects
Milk	Approximately 33% on empty stomach
Calcium Carbonate	Approximately 31% on empty stomach
Calcium Citrate	Approximately 40% on empty stomach
Calcium Gluconate	Approximately 26.6% on empty stomach
Calcium Lactate	Approximately 34.5 % on empty stomach
Tricalcium Phosphate	Approximately 25.2% on empty stomach
Calcium Citrate-malate	Approximately 34.9% on empty stomach
Calcium Chloride	Approximately 36.4% on empty stomach
Average Diet	Approximately 32% on empty stomach[3]

It is best to take Calcium supplements with food to capitalize upon the other potential benefits regarding bone/health and blood pressure regulation, as well as the improved bioavailability of Calcium that occurs with meals (e.g. Calcium carbonate absorption is enhanced by approximately 10 percent when ingested with meals).[3]

Supplementation Studies and Clinical Applications

1. Osteoporosis

   Currently one in four women and one in eight men over 50 have osteoporosis. Nearly one-third of all women and one-sixth of all men will fracture their hips in their lifetimes. Women's mortality rates from osteoporatic fractures are greater than the combined mortality rates from cancer of the breast and ovaries. Up to 20 percent of women and 34 percent of men who fracture a hip die in less then a year from complications secondary to these fractures (e.g., pneumonia).[5]

A large number of clinical trials have shown that Calcium supplementation slows the rate of bone loss after menopause and in conjunction with resistance training, can also increase bone mineral density even in women not taking hormone replacement therapy. Very strict protocols have been established regarding strength training and the accretion of bone density for this age group.[4,5,6]

In general, a variety of Calcium supplements (carbonate, citrate, citrate-malate, chloride, gluconate, lactate, Microcrystalline Hydroxyapatite Concentrate (MCHC)) have demonstrated an ability to retard age-related bone loss. The key factors appear to be to meet the NIH Calcium intake recommendations from food and/or supplementation, ingest supplements with meals, perform weight bearing or weight resistance exercise 4-6 times per week, and ensure adequate serum Vitamin D levels. All of these factors enhance Calcium absorption and/or Calcium retention in bone.[4-7]

2. **High Blood Pressure**

Various clinical studies indicate that Calcium supplementation (e.g. Calcium carbonate – 1500 mg per day) can reduce blood pressure to a significant degree in sodium-sensitive hypertensive patients. Most of these trials were 8-12 weeks in duration and used 1000-1500 mg of Calcium carbonate or citrate.[8,9,10] This subject is currently under intensive study to clarify the potential of Calcium supplementation as a natural intervention for specific cases of hypertension.

Calcium supplementation (1000-2000 mg per day, Calcium carbonate) may also help to prevent pregnancy-induced hypertension or function to reverse existing hypertension during pregnancy. This function is also presently under review.[11,12]

Dosage Ranges

Most young adults and adult North Americans lack 500-800 mg per day of Calcium to match the NIH recommended intake levels. Calcium supplementation represents a viable way to meet the recommendation in many cases.[4,5]

Osteoporosis Prevention and Management: meet the NIH recommended intake levels for Calcium, based upon age and gender.[4]

Hypertension: sodium-sensitive hypertensive patients may try 800-1,500 mg of Calcium supplementation (8-12 week trial period) to test response.[9,10,11]

Side Effects and Toxicity

It is generally acknowledged that Calcium intake up to a total of 2000 mg per day appears to be safe in most individuals. The efficiency of Calcium absorption decreases as intake increases, thereby providing a protective mechanism to lessen the chances of Calcium intoxication. This adaptive mechanism can, however be overcome by a Calcium intake of greater than 4000 mg per day.[4] High intake of Calcium may increase soft-tissue calcification (4000+ mg or in combination with hyperparathyroidism). In 1981, the FDA cautioned the public to limit its intake of Calcium supplements derived from dolomite or bone meal because of the potentially high lead levels in these Calcium supplements.[1]

Drug-Nutrient and Other Interactions

Dietary factors such as alcohol, caffeine, sodium and a high protein diet can increase Calcium loss from the body. However, studies show that these factors can be compensated for by ingestion of 250-500 mg of additional Calcium in most instances.[4,5,13,14]

Drug-Nutrient Interactions

The following drugs have been shown to deplete Calcium or reduce its absorption into the body:
EDTA[14]

1. Tetracycline[15]
2. Aminoglycosides[16]
3. Amphotericin B[17]
4. Anticonvulsants[18,19,20]
5. Salicylates (ASA etc.)[21]
6. Bile Sequestrants (cholestyramine)[22]
7. Colchicine[23]
8. Corticosteroid drugs[24,25]
9. Cimetidine[26,27]
10. Isoniazid[28]
11. Loop diuretics[29]
12. Magnesium and Aluminum Antacids[30]
13. Potassium-Sparing Diuretics[31]
14. Digoxin (animal studies only)[32]

Drugs that are interfered with if taken at the same time as Calcium

1. **Fluoroquinolone Antibiotics**
   Calcium can decrease absorption of these drugs and, therefore, Calcium supplements and dairy products should not be taken within two hours of ingesting these drugs.[33,34]
2. **Levothyroxine**
   Calcium carbonate can decrease drug absorption if taken at the same time.[35]

Nutrient – Nutrient Interactions

Iron: high doses of Calcium can reduce iron absorption.[36]

Zinc: high doses of Calcium can reduce zinc absorption.[37]

Pregnancy and Lactation

During pregnancy and lactation, the only supplements that are considered safe include standard prenatal vitamin and mineral supplements. All other supplements or dose alterations may pose a threat to the developing fetus and there is generally insufficient evidence at this time to determine an absolute level of safety for most dietary supplements other than a prenatal supplement. Any supplementation practices beyond a prenatal supplement should involve the cooperation of the attending physician (e.g., magnesium and the treatment of preeclampsia.)

References: Pregnancy and Lactation

1. Encyclopedia of Nutritional Supplements. Murray M. Prima Publishing 1998.
2. Reavley NM. The New Encyclopedia of Vitamins, Minerals, Supplements, and Herbs. Evans and Company Inc. 1998.
3. The Healing Power of Herbs (2nd edition). Murray M. Prima Publishing 1995.
4. Boon H and Smith M. Health Care Professional Training Program in Complementary Medicine. Institute of Applied Complementary Medicine Inc. 1997.

---

1. Standard Textbooks of Nutritional Science:
- Shils M, Shike M, Olson J, Ross C. Modern Nutrition in Health and Disease. 9th ed. Baltimore, MD: Lippincott Williams & Wilkins; 1993.
- Escott-Stump S, Mahan LK, editors. Food, Nutrition and Diet Therapy. 10th ed. Philadelphia, PA: W.B. Saunders Company; 2000.
- Bowman B and Russell RM, editors. Present Knowledge in Nutrition, 8th ed. Washington, DC:.ILSI Press; 2001.
- Kreutler PA, Czajka-Narins DM, editors. Nutrition in Perspective. 2nd ed. Upper Saddle River, NJ: Prentice Hall Inc.; 1987.
2. McKeown-Eyssen GE, Bright-See E. Dietary factors in colon cancer: international relationships. Nutr Cancer 1984; 6:160-70.
3. Levenson, D, Backman, R. A review of Calcium preparations. Nutr Reviews 1994;52:221-32.
4. National Institutes of Health Consensus Conference. NIH consensus development panel on optimal calcium intake. JAMA. 1994;272:1942-8.
5. Osteoporosis Society of Canada. Clinical practice guidelines for the diagnosis and management of osteoporosis. Can Med Assoc J 1996;155:1113-33.
6. Nelson ME, Fiatarone MA, Morganti CM, Trice I, Greenberg RA, Evans WJ. Effects of high intensity strength training on multiple risk factors for osteoporatic fractures: a randomized controlled trial. JAMA 1994;272:1909-14.
7. Murray TM. Prevention and management of osteoporosis: consensus statements from the Scientific Advisory Board of the Osteoporosis Society of Canada. 4. Calcium nutrition and osteoporosis. *Can Med Assoc J* 1996;155(7):935-9.
8. McCarron DA, Morris CD. Blood pressure response to oral calcium in persons with mild to moderate hypertension: a randomized double-blind placebo-controlled crossover trial. Ann Intern Med 1985; 103:825-33.
9. Meese RB, et al. The inconsistent effects of Calcium supplements upon blood pressure in primary hypertension. Am J Med Sci 1987;294:219-24.
10. Belizan JM, Villar J, Pineda O, et al. Reduction of blood pressure with Calcium supplementation in young adults. JAMA 1983;249:1161-5.
11. Belizan JM, et al. Calcium supplementation to prevent hypertensive disorders of pregnancy. N Engl J Med 1991;325:1399-405.
12. Knight KB, Keith RE. Calcium supplementation on normotensive and hypertensive pregnant women. Am J Clin Nutr 1992;55:891-5.
13. Heaney RP. Protein intake and bone health: the influence of belief systems on the conduct of nutritional science. Am J Clin Nutr 2000;73(1):5-6.
14. Hotz J, et al. Behaviour of gastric secretion in acute EDTA-hypocalcemia in Man. Verh Dtsch Ges Inn Med 1971;77:501-4.

Comment [c1]: Could not find other authors.

Comment [c2]: Could not find other authors.

Comment [c3]: Could not find other authors.

Comment [c4]: Could not find other authors.

15. Lambs L, Brion M, Berthon G. Metal ion-tetracycline interactions in biological fluids. Part 3 formation of mixed-metal ternary complexes of tetracycline, oxytetracycline, doxycycline and minocycline with Calcium and Magnesium, and their involvement in the bioavailability of these antibiotics in blood plasma. Agents Actions 1984;14(5-6):743-50.
16. Kelnar CJ, et al. Hypomagnesaemic hypocalcaemia with hypokalaemia caused by treatment with high dose gentamicin. Arch Dis Child 1978;53(10):817-20.
17. Amphotericin B depletes Sodium, Calcium, Potassium, Magnesium. Physicians' Desk Reference. 53rd ed. Montvale, NJ: Medical Economics Company Inc.; 1999. p. 1038.
18. Shafer RB, Nuttall FQ. Calcium and Folic Acid absorption in Patients Taking Anticonvulsant Drugs. J Clin Endocrinol Metab 1975;41(06):1125-9.
19. Foxx MC, et al. The effect of anticonvulsants phenobarbital and diphenythydantoin on intestinal absorption of Calcium. Acta Physiol Lat Am 1978;29(4-5):223-8.
20. Winnacker JL, Yeager H, Saunders JA. Rickets in children receiving anticonvulsant drugs. Biochemical and hormonal markers. Am J Dis Child 1997; 31(3):286-90
21. Kato Y, et al. Hypocalcemic action of the several types of salicylic acid analogues. Shika Kiso Igakkai Zasshi 1989;31(1):89-94.
22. Watkins DW, Khalafi R, Cassidy MM, Vahouny GV. Alterations in Calcium, Magnesium, Iron, and Zinc metabolism by dietary cholestyramine. Dig Dis Sci 1985;30(5):477-82.
23. Frayha RA, et al. Acute colchicine poisoning presenting as symptomatic hypocalcaemia. Br J Rheumatol 1984;23(4):292-5.
24. Reid IR, Ibbertson HK. Evidence for decreased tubular reabsorption of calcium in glucocorticoid-treated asthmatics. Horm Res 1987;27(4):200-4.
25. Adachi JD, Ioannidis G. Calcium and Vitamin D therapy in corticosteroid-induced bone loss: what is the evidence? Calcif Tissue Int 1999;65(4):332-6.
26. Ghishan FK, Walker F, Meneely R, et al. Intestinal Calcium transport: effect of cimetidine. J Nutr 1981; 111(12):2157-61.
27. Edwards H, Zinberg J, King TC. Effect of cimetidine on serum calcium levels in an elderly patient. Arch Surg 1981;116(8):1088-9.
28. Brodie MJ, et al. Effect of osoniazid on Vitamin D metabolism and hepatic monooxygenase activity. Clin Pharmacol Ther 1981;30(3):363-7.
29. Beermann B. Thiazides and loop-diuretics therapeutic aspects. Acta Med Scand Suppl 1986;707:75-8.
30. Weberg R, Berstad A, Aaseth J, Falch JA. Mineral-metabolic side effects of low-dose antacids. Scand J Gastroenterol. 1985;20(6):741-6.
31. Hanze S, et al. Studies of the effect of the diuretics furosemide, ethacrynic acid and triamterene on renal magnesium and calcium excretion. Klin Wochenschr 1967;45(6):313-4.
32. Kupfer S, Kosovsky JD. Effects of cardiac glycosides on renal tubular transport of calcium, magnesium, inorganic phosphate and glucose in the dog. J Clin Investig 1965;44:1143.
33. Marchbanks CR. Drug-drug interactions with fluoroquinolones. Pharmacotherapy 1993;13(2 Pt 2):23S-28S.
34. Sahai J, Healy DP, Stotka J, et al. The influence of chronic administration of calcium carbonate on the bioavailability of oral ciprofloxacin. Br J Clin Pharmacol. 1993;35(3):302-4.
35. Singh N, Singh PN, Hershman JM. Effect of calcium carbonate on the absorption of levothyroxine. JAMA 2000;283(21):282-5.
36. Hallberg L, Rossander-Hulthen L, Brune M, Gleerup A. Inhibition of haem-iron absorption in man by calcium. Br J Nutr 1993;69(2):533-40.
37. Wood RJ, Zheng JJ. High dietary calcium intakes reduce zinc absorption and balance in humans. Am J Clin Nutr 1997;65(6):1803-9.

Comment [c5]: Could not find other authors.

Comment [c6]: Could not find other authors.

Comment [c7]: Could not find other authors.

Comment [c8]: Could not find other authors.

Comment [c9]: Could not find other authors.

Comment [c10]: Could not find other authors.

Comment [c11]: Could not find other authors.

Comment [c12]: Could not find other authors.

Chromium

General Features

Chromium is an essential trace element required for maintenance of normal glucose metabolism. The function of chromium is directly related to the function of insulin, as chromium enhances (potentiates) the activity of insulin. Some human studies demonstrate that chromium supplementation results in improvement of glucose intolerance. Thus, it may have important applications for diabetics, hypoglycemic patients, and in Syndrome X (the metabolic syndrome).

Insulin-chromium interactions are not restricted to glucose metabolism. Animal and human studies indicate that chromium stimulates amino acid transport into the cells with a corresponding increase in protein synthesis.

Only the trivalent state of chromium is biologically active (nutritional chromium). By contrast the hexavalent form of chromium used as metal alloys by industry (industrial chromium) can be extremely toxic.

The chromium concentration of most body tissue decreases steadily as we age. As well, increasing impairment of glucose tolerance throughout normal pregnancy has been amply documented, and the changes in chromium concentration in the plasma may reflect decreased glucose tolerance or may actually reflect deficiency.

Concentration of chromium in the hair is ten times higher than in blood, and hair concentration has been suggested as a means of assessing chromium status.

Absorption and Metabolism

The exact mechanism of chromium absorption is not known, but it is not simple diffusion. Chromium is transported in the plasma in combination with transferrin. Unlike other metals, once chromium is absorbed, it is almost entirely excreted in the urine. Thus, daily intake is important to optimize chromium's functions in the body. Generally speaking, absorption of inorganic chromium found in food and water appears to be only about one percent. Organically-bound chromium (e.g., GTF-chromium, chromium-chelates found in many supplements) permits a bioavailability of 10-25 percent.

The total amount of chromium found in the body averages less than 6 mgs. The hair, spleen, kidney and testes contain the highest concentrations.[1,2]

Recommended Daily Allowance (Chromium)

There is no official RDA for chromium, but the following recommendations have been suggested:

Age Group	Dosage (mcg)
0 – 6 mths	10 - 40
6 – 12 mths	20 - 60
1 – 3 yrs	20 - 80
4 – 6 yrs	30 - 120
7 years and older	50 – 200[3]

Supplementation Studies and Clinical Applications

1. Glucose Intolerance

   More than 15 controlled studies demonstrate that chromium supplementation has a positive effect on impaired glucose tolerance, by potentiating the action of insulin. This has important implications for hypoglycemics and Type II diabetics.[4]

   In clinical studies in non-insulin dependent diabetes mellitus (NIDDM), supplementation with chromium has been shown to decrease fasting glucose levels, improve glucose tolerance, lower insulin levels, decrease total cholesterol and triglycerides, and increase HDL-cholesterol levels.[5-8] In most of these studies, subjects ingested a minimum of 200 mcg of chromium from a supplement, daily.

2. Cholesterol and Triglyceride Lowering

   Chromium supplementation has been shown to lower cholesterol and triglycerides in both diabetic and non-diabetic subjects. Many forms of chromium have demonstrated this effect, but the value appears to be only in those with low initial chromium nutritional status. The typical changes are a 10 percent reduction in total cholesterol and triglycerides and a two percent increase in HDL.[9-14]

   These are significant changes as every one percent decrease in total cholesterol corresponds to a 2-3 percent reduction in heart disease and stroke. Every one percent increase in HDL-cholesterol levels carries a 2-4 percent decrease in risk of cardiovascular disease.[15]

3. Body Fat Reduction and Lean Mass Gains

   Chromium supplementation has been shown to facilitate reductions in body fat and increase lean muscle mass. Lean mass gains have been especially noteworthy in subjects taking chromium supplements in conjunction with resistance training, in both young males and females.

   However, even in older and elderly subjects chromium supplementation has produced significant reductions in body fat and moderate increases in muscle mass compared to placebo.

   Typical doses for weight loss and lean mass gains have used 200-400 mcg per day. Additional studies are underway to determine the degree to which chromium may be helpful as a weight loss and anabolic aid.[2,16,17,18] Presumably chromium is effective in these applications due to its ability to increase insulin sensitivity, thereby lowering plasma insulin levels. Higher insulin levels tend to convert more carbohydrates into fat and insulin resistance decreases protein synthesis in muscles and amino acid uptake.[2]

Dosage Ranges

1. Glucose Intolerance: 200-400 mcg per day
2. Cholesterol and Triglyceride: 200-1,000 mcg per day
3. Weight Loss and Lean Mass Gains: 200-400 mcg per day[2]
4. Type-II Diabetics: 500 mcg of chromium, taken twice per day has been shown to decrease glycosylated hemoglobin, glucose, insulin and cholesterol variables[19]

   NB: Chromium supplementation has been shown to reverse corticosteroid–induced Diabetes (200-1000 mcg).[20]

Side Effects and Toxicity

Trivalent chromium (nutritional chromium) has a very large safety range and there have been no documented signs of chromium toxicity in any of the nutritional studies at levels up to 1 mg (1,000 mcg) per day.[21]

Some patients have reported increased dream vividness and decreased sleep requirements with chromium supplementation taken at 7:30 p.m., daily (50 mcg).[22]

At levels of intake between 1,200 mcg and 3,400 mcg of chromium picolinate a case of anemia, liver dysfunction and other problems appeared after four to five months.[23]

Drug-Nutrient Interactions

Chromium supplementation may enhance the effects of drugs for diabetes (e.g., insulin, blood-sugar lowering agents) and possibly lead to hypoglycemia. Therefore, diabetics taking these medications should supplement chromium only under the supervision of their attending physician.

Doses of glyburide (a hypoglycemic sulfonylurea drug used to lower blood sugar in type II diabetics) will need to be lowered if chromium supplementation is initiated, in most cases.

Insulin-dependent diabetics may also be required to lower their insulin dosage if chromium supplementation is implemented.[24]

1. Corticosteroid drugs - may increase urinary loss of chromium.[21]
2. Insulin (Type-I Diabetics) - chromium can potentiate the action of insulin, thus affecting insulin dose requirements (do not supplement with chromium without cooperation of attending diabetic physician).[25]

Nutrient-Nutrient Interactions

1. Refined Sugars: excess sugar intake has been shown to increase urinary loss of chromium.[26]
2. High Carbohydrate Diet: high carbohydrate consumption has been shown to increase the urinary loss of chromium.[27]

Pregnancy and Lactation

During pregnancy and lactation, the only supplements that are considered safe include standard prenatal vitamin and mineral supplements. All other supplements or dose alterations may pose a threat to the developing fetus and there is generally insufficient evidence at this time to determine an absolute level of safety for most dietary supplements other than a prenatal supplement. Any supplementation practices beyond a prenatal supplement should involve the cooperation of the attending physician (e.g., magnesium and the treatment of preeclampsia.)

References: Pregnancy and Lactation

1. Encyclopedia of Nutritional Supplements. Murray M. Prima Publishing 1998.
2. Reavley NM. The New Encyclopedia of Vitamins, Minerals, Supplements, and Herbs. Evans and Company Inc. 1998.
3. The Healing Power of Herbs (2nd edition). Murray M. Prima Publishing 1995.
4. Boon H and Smith M. Health Care Professional Training Program in Complementary Medicine. Institute of Applied Complementary Medicine Inc. 1997.

1. Standard Textbooks of Nutritional Science:
   - Shils M, Shike M, Olson J, Ross C. Modern Nutrition in Health and Disease. 9th ed. Baltimore, MD: Lippincott Williams & Wilkins; 1993.
   - Escott-Stump S, Mahan LK, editors. Food, Nutrition and Diet Therapy. 10th ed. Philadelphia, PA: W.B. Saunders Company; 2000.
   - Bowman B, Russell RM, editors. Present Knowledge in Nutrition, 8th ed. Washington, DC:.ILSI Press; 2001.
   - Kreutler PA, Czajka-Narins DM, editors. Nutrition in Perspective. 2nd ed. Upper Saddle River, NJ: Prentice Hall Inc.; 1987.
2. Fisher J. The Chromium Program. New York, NY: Harper and Row; 1990.
3. Murray M. Encyclopedia of Nutritional Supplements. Rocklin, CA: Prima Publishing; 1996. p. 194-8.
4. Mertz W. Chromium in human nutrition: a review. J Nutr 1993;123:626-33.
5. Abraham AS, Brooks BA, Eylath U. The effects of Chromium supplementation on serum glucose and lipids in patients with and without non-insulin dependent diabetes. Metabolism 1992;41:768-71.
6. Mossop RT. Effects of Chromium (III) on fasting blood glucose, cholesterol, and cholesterol HDL levels in diabetics. Centr Afr J Med 1983;29:80-2.
7. Rabinowitz MB, Gonick HC, Levin SR, et al. Effect of Chromium and yeast supplements on carbohydrate metabolism in diabetic men. Diabetes Care 1983;6:319-27.
8. Anderson RA. Chromium, glucose tolerance, and diabetes. Biological Trace Element Research 1992;32:19-24.
9. Lee NA, Reasner CA. Beneficial effect of Chromium supplementation on serum triglyceride levels in NIDDM. Diabetes Care 1994;17:1449-52.
10. Offenbach E, Pistunyer F. Beneficial effect of Chromium-rich yeast on glucose tolerance and blood lipids in elderly patients. Diabetes 1980;29:919-25.
11. Press RI, Geller J, Evans GW. The effect of Chromium picolinate on serum cholesterol and apolipoprotein fractions in human subjects. Western J Med 1993;152:41-5.
12. Wang MM, Fox EA, Stoecker BJ, Menendez CE, Chan SB. Serum cholesterol of adults supplemented with brewer's yeast or Chromium Chloride. Nutr Res 1989;9:989-98.
13. Roeback JR, Hla KM, Chambless LE, Fletcher RH. Effects of Chromium supplementation on serum high-density lipoprotein cholesterol levels in men taking beta-blockers. Annals Int Med 1991;115:917-24.
14. Lefavi RG, Wilson GD, Keith RE, Anderson RA, Blessing DL, Hames CG, et al. Lipid-lowering effect of a dietary Chromium (III) Nicotinic Acid complex in male athletes. Nutr Res 1993;13:239-49.
15. Lavie CJ, O'Keefe JH, Blonde L, et al. High-density lipoprotein cholesterol: recommendations for routine testing and treatment. Postgrad Med 1990;87(7):36-44,47,51
16. McCarthy MG. Hypothesis: Sensitization of insulin-dependent hypothalamic glucoreceptors may account for the fat-reducing effects of Chromium Picolinate. J Optimal Nutr 1993;21:36-53.
17. Evans GW, Pouchnik DJ. Composition and biological activity of chromium-pyridine carbosylate complexes. J Inorganic Biochemistry 1993;49:177-87.
18. Katts GR, Ficher JA, Blum K. The effects of Chromium Picolinate supplementation on body composition in different age groups. Age 1991;14(4):138 (Abstract #40).
19. Anderson RA, Cheng N, Bryden NA, Polansky MM, Cheng N, Chi J et al. Elevated intakes of supplemental Chromium improves glucose and insulin variables in individuals with type 2 diabetes. Diabetes 1997; 11:1786-91.
20. Revina A, et al. Reversal of corticosteroid-induced diabetes mellitus with supplemental Chromium. Diab Med 1999; 16(2):164-7.
21. Anderson RA. Chromium, as an essential nutrient for humans. Regul Toxicol Pharmacol 1997;26(Suppl Pt 2): 35S-41S.
22. Schrauzer GN, Shrestha KP, Flores MP. Somatopsychological effects of Chromium supplementation. J Nutr Med 1992;3:43-8.
23. Cerulli J, Grabe DW, Gauthier I, Malone M, McGoldrick MD. Chromium Picolinate toxicity. Ann Pharmacother 1998;32:438-41.
24. Healthnotes 1998-2002. Available from: URL: http://www.healthnotes.com.
25. Studies presented at the Annual Scientific Sessions of the American Diabetes Association, San Francisco, CA, 1996.
26. Kozlovsky AS, Moser PB, Reiser S, Anderson RA. Effects of diets high in simple sugars on urinary chromium losses. Metabolism 1986;35(6):515-8.
27. Anderson RA, Bryden NA, Polansky MM. Urinary Chromium excretion and insulinogenic properties of carbohydrates. Am J Clin Nutr 1990;51(5):864-8.

Copper

General Features

The human body contains 75-150 mg of copper, with the greatest concentration found in the liver, brain, heart and kidneys. Copper is an essential trace mineral involved in several key enzymatic reactions in the body. Copper is required for iron absorption and a copper deficiency results in iron deficiency anemia. It is also required for hemoglobin synthesis. Copper is required as a cofactor for Lysyl Oxidase, which is required in the cross linking of collagen and elastin. Thus, copper deficiency results in poor collagen integrity, which can contribute to easy rupture of blood vessels, osteoporosis, and bone and joint abnormalities. Poor copper status may also adversely affect blood lipid levels and immune system function.[1]

Copper is required for the function of superoxide dismutase (SOD), a vital intracellular antioxidant enzyme. SOD is also activated by zinc and manganese in different areas of the cell.[2]

Copper is also required by the enzyme tyrosinase, which is the enzyme that is involved in hair keratinization and pigmentation.[1]

Absorption and Metabolism

Copper is absorbed from the stomach and upper small intestine. Zinc interferes with copper absorption to some degree, but can be overcome by the right ratio of zinc to copper, which is approximately 10:1 (this is very applicable to multiple vitamin and mineral supplements). However, many experts do not recommend supplementation of more than 3 mg of copper on any given day.[1,3]

Approximately 30 percent of dietary copper is absorbed. Following the absorption of copper the liver stores the mineral or releases it as copper-protein complex known as ceruloplasmin, which accounts for 95 percent of copper in the blood. Albumin protein binds the remaining 5 percent.

The average diet provides about 2 mg of copper per day, which is considered adequate and safe.

In Wilson's Disease, chronic copper toxicity develops due to an inherited problem with lack of copper excretion and a decrease in ceruloplasmin levels. Copper gradually accumulates with resulting tissue necrosis (especially in the liver), mental deterioration, tremor, and loss of coordination. These patients are treated with a low copper diet and drugs such as penicillamine that binds to copper and carries it out of the body.[1]

Recommended Daily Allowance (Copper)

Age Group	Dosage (mg)
0-6 mths	0.4-0.6
6-12 mths	0.6-0.7
1-3 yrs	0.7-1.0
4-6 yrs	1.0-1.5
7-10 yrs	1.5-2.5
11 yrs and older	1.5-3.0[3]

Copper Deficiency

Copper deficiency, if severe, manifests as anemia, cardiovascular lesions, degeneration of the nervous system, skeletal defects, loss of taste acuity and hair abnormalities.