

Bones: Calcium & Beyond

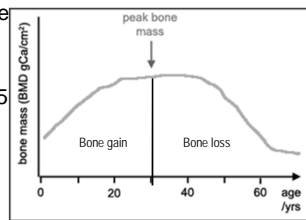
Sandy van Calcar PhD, RD
Senior Metabolic Dietitian
Waisman Center
University of Wisconsin-Madison

Bone Basics

- Bones are the foundation of our skeleton
- Bone is a dynamic tissue
 - Formation- building up of bone by osteoblasts
 - Resorption- broken down by osteoclasts
- Collagen – forms matrix for mineralization

Bone Basics

- During growth, formation exceeds resorption
- Although bone length stops after puberty, bone continues to accumulate
- Peak bone mass is achieved around age 35 and is influenced by exercise and nutrition



Exercise: weight bearing activity

What is the benefit?

- Improves peak bone mass during growth
- Plays a role in supporting bone mass gain from age 20-30
- Supports maintenance of bone mass later in life.

Some examples

- Jogging/running
- Soccer/ tennis/ basketball
- Weight lifting
- Gymnastics
- Climbing stairs
- Dancing

Dietary factors related to bone development

- Calcium
 - 99% of the body's calcium is in bone
 - Released from bone if blood levels are low
- Phosphorus
 - With calcium, mineralizes bone
- Vitamin D
 - Active form = 1,25 dihydroxyvitamin D
 - Improves calcium absorption from intestine
 - Role in osteoblast and osteoclast functioning

Dietary factors related to bone development

- Protein
 - Forms the bone matrix = collagen
- Vitamin K
 - Cofactor for an enzyme required for osteoblast activity
- Zinc
 - Role with many enzymes and hormones

Concerns with bones and Galactosemia

- DXA scans show poor/delayed bone mineralization
- Low levels of growth factors/enzymes related to bone formation and resorption (Panis et al, Bone, 2004)
 - Formation = osteocalcin, bone alkaline phosphatase
 - Resorption = NTX and CTX from collagen breakdown

Why are bone differences noted?

- Hormonal differences (IGF-1, estrogen)
- Abnormal collagen formation
 - Uridine diphosphate galactose?
- Nutrition Factors
 - Adequate phosphorus intake in galactosemia, but inadequate calcium intake in ~ 75% (Rutherford et al, Br Diet Assn J, 2002)
 - Low vitamin D levels

Calcium - Requirements

Age Range	Calcium (mg/day)
0 to 6 mo.	200
7 to 12 mo	260
1 to 3 years	700
4 to 8 years	1000
9 to 18 years	1300
Adults	1000 (> 70 yrs = 1200)

Calcium - Sources

Food	Amount	Calcium (mg)
Dairy Products	1 cup	More than 250
Fortified dry cereals	1 oz	236 - 1043
Soy Formula	1 cup	170
Soy milk, fortified	1 cup	300
Sardines	3 oz	325
Tofu, firm	½ cup	250
Orange juice, fortified	¾ cup	200 - 260
Salmon, canned with bone	3 oz	181
Leafy greens	½ cup	74 - 178

- Calcium from green leafy vegetables is not well absorbed.

Vitamin D - Requirements

Age	Vitamin D µg/day
Infants	10 (400 IU)
1-3 years	15 (600 IU)
4-8 years	15 (600 IU)
9-18 years	15 (600 IU)
19-70 years	15 (600 IU)
> 70 years	20 (800 IU)

- Requirements for vitamin D were increased in 2010 by the National Research Council
- Vitamin D levels in Infant formulas, supplements and fortified foods are being adjusted to meet new standards

Vitamin D - Sources

Food	Amount	IU
Cod liver oil	1 T	1,360
Sockeye Salmon	3 oz	794
Mackerel	3 oz	388
Tuna fish, canned	3 oz	154
Fortified rice milk	1 cup	120
Fortified Orange Juice	1 cup	100
Fortified Soy Milk	1 cup	120
Soy Formula	1 cup	100

- The best source of Vitamin D is the sun but for those living in northern climates, too little exposure during winter.
- Sun blockers decrease vitamin D production.

Calcium and Vitamin D intake for Galactosemia

- Without dairy products, consuming enough calcium and vitamin D is challenging
- Use fortified formulas, soy milk, rice milk
- Supplements are often required to ensure adequate intake.

Supplement Study: 40 children with galactosemia

- Ages 3-17 (Paris et al, Bone, 2006)
- Blind, placebo controlled trial
 - 750 mg calcium + 10 µg vit D + 1 mg vit K OR Placebo
 - Testing completed at baseline, 1 yr and 2yr
- Results: Significant improvement in various growth factors, enzymes in treated group
- Bone Mineral Density improved with supplements, but only in pre-pubertal children

Choosing a calcium supplement

- There are several forms of calcium available:
 - Calcium carbonate is the most concentrated form of calcium
 - Calcium citrate is more easily absorbed
- Avoid calcium sources made from bone meal, dolomite, or oyster shell. These preparations may not be absorbed as efficiently or may contain contaminants.

Choosing a Calcium Supplement

- Taking calcium with meals will increase absorption.
- Calcium is most efficiently absorbed if taken in doses of 500-600 mg or less several times a day.
- Supplements may contain lactose fillers.
 - Check the ingredient list.
- Look for supplements with calcium + vitamin D

Importance of a general multivitamin and mineral supplement

- Picky eaters, those not taking formula or fortified beverages
- Look at vitamin D, zinc, vitamin K
- Calcium will be low in general supplements
- Check for lactose fillers

Can you get too much calcium or vitamin D?

Age	Vitamin D		Calcium
0 to 6 mo	1000 IU	25 mcg	
7 to 12 mo	1500 IU	38 mcg	1500 mg
1 to 3 years	2500 IU	63 mcg	2500 mg
4 to 8 years	3000 IU	75 mcg	3000 mg
9 to 18 years	4000 IU	100 mcg	2500 mg
Adults	4000 IU	100 mcg	2000 mg

Monitoring Bone Health

- Labs:
 - Total 25-OH Vitamin D
 - Check levels even if intake is adequate
 - Goal: Levels: 35 – 50 ng/ml
 - Calcium, phosphorus
 - Electrolytes, BUN, creatinine
 - TSH
 - 24 hour urinary calcium
- DXA scan: Begin age 8 to 10 years

Good Resources

- Visit Office of Dietary Supplements, National Institutes of Health website
 - ods.od.nih.gov/Factsheets/vitaminD
 - ods.od.nih.gov/Factsheets/calcium