

Calcium in the Reproductive Years 6.7.06

Background

Calcium, the most abundant mineral in the human body, performs an essential role in bone and tooth formation, blood clotting, muscle contraction, nerve transmission and in the regulation of energy metabolism.¹ The intake of calcium from dietary or supplement sources and its absorption, retention and metabolism have critical consequences throughout the lifespan.

Calcium is one of the seven key micronutrients. The March of Dimes states that negative consequences of deficiencies among women and children are best documented for these seven micronutrients.² A large percentage of American women do not meet the dietary recommendations, otherwise known as adequate intake (AI) for calcium.³ An even higher proportion of adolescent girls have an inadequate calcium intake.⁴ This is of added concern due to their increased calcium requirements for growth.⁵ To maintain positive calcium balance, adequate intake of bioavailable, naturally calcium-rich or fortified foods, calcium supplements or a combination of these is needed (Table 1).

Milk and dairy products are the most common source of dietary calcium, providing about 72 percent of the calcium in the average American diet in 2000.⁶ When dairy products are restricted, alternative calcium sources can be used such as calcium-fortified foods and/or calcium supplements (Table 1). However, women should be aware that the calcium from such sources may not be as well absorbed or utilized when it is consumed alone. The package of nutrients in dairy foods – calcium, phosphorus, magnesium, potassium, protein, and vitamin D – ensure optimal absorption and utilization by the body for bone health and other physiological processes.

Women might eliminate or minimize their consumption of dairy products due to concerns regarding milk allergy, intolerance or aversion, cultural or dietary practices, fat content and related weight control issues, as well as philosophical or religious beliefs, ethical objections or environmental concerns about dairy farming practices. They may minimize or eliminate consumption of calcium supplements due to their size, perceived gastrointestinal symptoms such as constipation and diarrhea, or due to the belief that they may increase kidney stone formation. In most cases, nutrition education to remove any misperceptions, and individualized assessment of the woman's tolerance for calcium-containing foods, will empower her to make healthy dietary choices including appropriate amounts of dietary calcium. Dietary calcium supplements and/or fortified foods can be used as secondary sources if intake from milk and dairy products is inadequate.

Dietary constituents can affect the bioavailability and absorption of calcium as well as the renal conservation, including retention and excretion, and metabolism of calcium. Vitamin D is of particular importance, because it maximizes calcium absorption. Calcium excretion is increased by excessive sodium and protein intake.³ (See Table 2) The bioavailability of plant-based calcium varies with the presence of dietary components such as phytate and oxalate. This is generally not a concern in a healthy, varied diet. The effects of fiber, caffeine and fat are variable and generally small.⁷ Regular calcium intake above 2500 mg per day poses a potential risk because of interaction with minerals such as iron, zinc, magnesium, phosphorus or aluminum.³

Table 1: Dietary Sources of Calcium ^{1, 8}

Food	Approximate Calcium Content Mg/1 cup
*Dairy	
Yogurt, plain, non-fat	450
Calif. Milk 1% low fat	348
Calif. Milk, 2% reduced fat	317
Calif. Milk, fat-free	285
Calif. Whole milk	276
Cheddar cheese	205 mg / 1 ounce
Mozzarella cheese, part skim	185 mg / 1 ounce
Frozen yogurt	210
Ice cream	170
Cottage cheese	150
**Non-Dairy	
Breakfast cereals and bars, calcium-fortified <i>Fortification is variable, read product labels</i>	200-1,000
Sardines, canned with bones	372 mg / 3 ounces
***Plant based milks products, e.g. soy, rice, almond, calcium fortified <i>Fortification and bioavailability are variable; read product labels</i>	150-400
Tofu, processed with calcium	520
Juice, calcium-fortified	300
Salmon, pink canned with bones	205 mg / 3 ounces
Breakfast cereal, calcium-fortified, instant, cooked	190
Collard greens, cooked	358
Turnip greens, cooked	196
Bok Choy, cooked	158

*In California, reduced fat milk is fortified with nonfat milk solids, which provides additional calcium and protein

**Calcium fortified products do not replace other important nutrients in dairy products including protein, vitamin D and vitamin B1, magnesium, riboflavin and vitamin A.

***Plant based milk products such as soy; rice and almond milk are not nutritionally equivalent to animal milk. Read specific labels for information on calcium and vitamin D.

Table 2: Some Cofactors that Influence Calcium Balance

Factor	Source	Effect on Calcium Balance	Comments and Recommendations
Vitamin D	Sunlight, fortified liquid dairy products, fish oil and fatty fish	Enhances calcium absorption	
Sodium	Table salt and other sodium products in food	Increases calcium excretion	<ul style="list-style-type: none"> • May be a concern when sodium intake is high and calcium intake is low.⁹
Protein	Primarily in meats, beans and nuts, dairy products and breads & cereals food groups	Increases calcium excretion	<ul style="list-style-type: none"> • Protein is generally not a concern if calcium intake is adequate. • Excessive intake of animal protein and a low calcium intake can exacerbate a calcium deficiency.
Fiber	Wheat bran only	Decreases calcium absorption	<ul style="list-style-type: none"> • Large amounts of wheat bran decrease bioavailability.¹ • Generally not a concern in a healthy varied diet.
Oxalic acid	A component of plant food, e.g. rhubarb, spinach, mustard greens, beets and beet greens, sweet potatoes, plantains, cocoa and chocolate, tea. ³	Decreases calcium absorption	<ul style="list-style-type: none"> • Oxalic acid may combine with calcium, iron, sodium, magnesium or potassium to form less soluble salts known as oxalates. However, this is generally not a concern in a healthy, varied diet. • Oxalic acid in tea may decrease the bioavailability of the calcium in the milk added to it.¹⁰ • Some herbal teas contain oxalic acid but this is generally not a concern.¹⁰

**Table 2 continued:
Some Cofactors that Influence Calcium Balance**

Factor	Source	Effect on Calcium Balance	Comments and Recommendations
Aluminum	Aluminum-containing antacids	Decreases calcium absorption	<ul style="list-style-type: none"> • Long term, excessive use of aluminum-containing antacids decreases calcium absorption.⁷ • Calcium carbonate antacids, not exceeding the daily recommended dose, are best for the perinatal woman requiring antacids.

Benefits of Adequate Calcium

- Promotes maternal, fetal and infant bone mineral health.¹¹
- Lowers risk of osteoporosis in later life by helping young women achieve optimal peak bone mass. Adequate calcium during the pubertal years is especially important.⁵
- May reduce or prevent hypertension, including pregnancy-induced hypertension (PIH). This is of greater significance in women with low calcium intake.^{3, 11, 12, 13}
- May decrease mobilization of lead from maternal bones, if maternal lead exposure has occurred.¹¹
- May be an anti-obesity nutrient, involved in weight management.¹⁴
- May have protective effect against colon cancer.¹⁵
- May provide relief from premenstrual syndrome (PMS).¹⁶

Recommendations for Calcium

Physiologically adaptive processes, that are largely independent of maternal calcium intake, characterize pregnancy and lactation. Hormonal changes increase calcium absorption, providing the calcium necessary for fetal growth and breast milk production without requiring an increase in maternal calcium intake.¹¹ Thus, the Adequate Intake, a Dietary Reference Intake value is the same for all teens and all women, regardless of reproductive status. The AI is set to prevent primary calcium deficiency and to promote maximum bone density throughout the lifespan (Table 3).

Table 2: Calcium, Adequate Intake*³

Life Stage Group	(mg/day)
Females, regardless of reproductive status:	
• 9-18 years of age	1,300
• 19-50 years of age	1,000
• Older than 50	1200

*Intakes at this level have a low probability of inadequacy.

The importance of calcium as a public health issue is addressed by the U.S. Department of Health and Human Services, Healthy People 2010 objective to increase calcium intake.

Calcium Related Healthy People 2010 Objective

19-11 Increase the proportion of persons ages 2 years and older who meet dietary recommendations for calcium.

Target 75 %

Baseline

- Women 9-19 years 19%
- Women 20-49 years 40%

Consequences of Excessive Calcium

For all people over one year of age, the upper limit (UL) of calcium is 2,500 mg (62.5mmol) per day. For most women, a high intake of calcium from food sources is probably safe.³ Excessive calcium intake from supplements, generally from antacids, may result in hypercalcemia (Table 4). This may aggravate the formation of kidney stones and kidney function or milk alkali syndrome, otherwise known as MAS.¹⁷

Calcium Absorption and Renal Retention

Factors that may play a role in calcium absorption and retention include hormones, drugs, physical activity, age, medical factors, race and genetics. The importance of these factors continues to be studied and, in some cases, is controversial.⁴ Most factors are generally not a concern when a healthy, varied diet is consumed.³ Supplement absorption varies with the elemental calcium compound. Calcium may hinder the effectiveness of some medications, including some antibiotics. One must follow directions for taking medications to obtain optimal therapeutic results.

Table 4: Calcium Supplements

Topic	Discussion
Calcium Supplements	<ul style="list-style-type: none">• Form<ul style="list-style-type: none">○ Pills, caplets, chews and in liquid form in beverages• Recommendation<ul style="list-style-type: none">○ Use a calcium supplement fortified with vitamin D and/or phosphorus if sources of these nutrients are limited in the diet.• Cost<ul style="list-style-type: none">○ Calcium carbonate is the least expensive source of elemental calcium.¹⁸○ Calcium citrate and calcium malate may have increased absorption, but not so great as to justify the higher cost.• Warnings<ul style="list-style-type: none">• Due to potential heavy metal contamination, particularly lead, avoid supplements containing coral, oyster shell, bone meal or dolomite.¹⁹• There is no standardized testing for coral calcium content or safety.²⁰• Some calcium supplement manufacturers do not have the resources to conduct standardized testing.

Table 4 (continued): Calcium Supplements

Topic	Discussion
Percentage of elemental calcium content in various compounds	<ul style="list-style-type: none"> • Calcium carbonate – 40% • Calcium phosphate – 38% • Calcium citrate – 21% <p>Note: Bioavailability is not equivalent to the percent of calcium in a supplement.</p>
Elemental calcium calculation ²¹	<p>mg of calcium x % elemental calcium = mg elemental calcium</p> <p>Example:</p> <ul style="list-style-type: none"> ○ 1 dose = 500 mg of calcium citrate ○ Calcium citrate is 21% elemental calcium <p>500 mg x .21 (21%) = 105 mg of elemental calcium per dose of calcium citrate</p>
Factors affecting calcium bioavailability ⁴	<ul style="list-style-type: none"> • Other foods / beverages ingested • Form and solubility of the calcium compound • Amount of stomach acid secreted • Disintegration time of the supplement (minutes) • Dissolution rate (percentage of supplement's ability to dissolve in solution)
Optimize calcium bioavailability	<ul style="list-style-type: none"> • Iron and calcium supplements should not be taken at the same time • In healthy individuals, absorption of calcium carbonate and calcium citrate supplements appears to be about the same • Take ≤500 mg per dose
Potential complications when taking calcium supplements	<ul style="list-style-type: none"> • Constipation –prevent by consuming additional fluids • Difficulty swallowing – prevent by using another form of calcium supplement or calcium fortified foods or liquids

Nutrition Assessment of Calcium Intake

Perinatal nutrition assessment should include a calcium assessment.

Table 5: Calcium Nutrition Assessment

Assessment Area	Assessment Data
Anthropometric	Height, weight, weight gain pattern
Biochemical	<ul style="list-style-type: none"> • There are no good biochemical tests for calcium adequacy • Routine testing is not indicated for the healthy perinatal woman
Clinical	<ul style="list-style-type: none"> • Age • Medical conditions affecting calcium balance <ul style="list-style-type: none"> ○ Intake, i.e. disordered eating, milk allergy, lactose intolerance ○ Gastrointestinal factors, i.e. heartburn, constipation, gastric surgery, autoimmune disease i.e. Crohn's disease ○ Medications, i.e. Iron, antacids, antibiotics ○ Complementary and alternative medicine practices • Vitamin D source
Dietary practices and patterns	<ul style="list-style-type: none"> • Calcium sources, including foods, beverages and supplements (Tables 1 and 4) • Therapeutic or restrictive diet, e.g. vegan, milk-free, lactose-free • Calcium bioavailability factors (Table 2) • Lactose sensitivity • Fluid intake • Lead intake

Nutrition Education

Everyone requires calcium for growth and development, health maintenance and the prevention of chronic disease. Women of childbearing age can improve both perinatal and lifelong health by ensuring adequate calcium intake. Encourage the following practices:

- Consume adequate calcium
 - Eat a healthy, varied diet
 - Consume calcium rich and calcium-fortified foods and beverages at every meal to ensure adequate intakes (Table 1)
 - Use calcium fortified foods or take calcium supplements to meet AI (Tables 3 and 4)
- Increase absorption of calcium
 - Consume a regular source of vitamin D or ensure adequate sunlight exposure
 - Avoid use of aluminum containing antacids
 - Take supplements as directed
- Prevent loss of calcium
 - Avoid excess sodium intake
- NOTE regarding supplements:
 - If taking excessive antacids due to gastrointestinal symptoms, encourage discussion of symptoms and treatment alternatives with health care provider

Referral

When there is an identified need for consultation, assessment, intervention, therapy or resources refer to the appropriate health care professionals who have expertise in nutrition and health. Multidisciplinary interventions contribute to improved short term and long term health outcomes.

- Medical Nutrition Therapy Specialist (RD)
- Behavioral Medicine Specialist (LCSW, MSW, MFCC, MD, PhD)
- Healthcare Provider (MD, DO, PA, CNP, CNM)
- Lactation Specialist (CLC, IBCLC, CLE)
- Women, Infants and Children (WIC) Supplemental Nutrition Program
- Childhood Lead Poisoning Branch

Resources

Steps to Take, Comprehensive Perinatal Service, Program Guidelines for Enhanced Health Education, Nutrition, and Psychosocial Services. CA Department of Health Services, 2001²² (22):

- Foods rich in calcium

- You may need extra calcium
- Lactose intolerance
- Heartburn: should you use antacids?

Useful web sites

- Calcium Information Resource: <http://www.calciuminfo.com/>
- National Institute of Child Health and Human Development <http://www.nichd.nih.gov/milk/>
- The National Osteoporosis Foundation <http://www.nof.org>
- The American Dietetic Association: <http://eatright.org>
- United States Department of Health and Human Services “Girl Power” health promotion website <http://www.girlpower.gov/>
- Dairy Council of California <http://www.mealsmatter.org>
- National Women’s Health Information Center <http://www.4woman.gov/>
- Quack Watch (Coral Calcium) <http://www.quackwatch.org/01QuackeryRelatedTopics/DSH/coral.html>
- California Department of Health Services, Office of Women’s Health <http://www.dhs.ca.gov/director/owh/default.htm>

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