

# DAIRY'S ROLE IN ADOLESCENT BONE HEALTH

## Building Strong Healthy Bones for Life

According to the United States Department of Agriculture, 9 out of 10 teenage girls and 7 out of 10 teenage boys do not get enough calcium. During the peak bone building years from 9 to 18, a daily calcium intake of 1,300 mg is recommended. Doctors and dietitians agree that dairy foods are the best source of calcium, and research indicates that adolescents who eat dairy foods have stronger bones and better overall nutrient profiles.

### Follows Government and Health Organization Recommendations

- A report by the American Academy of Pediatrics (AAP) recommends drinking three 8-oz glasses of milk per day (or the equivalent) to achieve the recommended adequate intake of calcium and vitamin D in children 4 to 8 years of age, and four 8- to 10-oz glasses of milk (or the equivalent) to achieve the adequate calcium and vitamin D intake for adolescents. The AAP suggests getting calcium from dairy foods first such as milk, flavored milk, cheese and yogurt, with an emphasis on low-fat or fat-free varieties, to help build strong bones and reduce the risk of fractures and osteoporosis later in life. The report also stresses the importance of parental role modeling, physical activity and the call for pediatricians to regularly check their patients' calcium intake.

American Academy of Pediatrics, Optimizing bone health and calcium intakes of infants, children, and adolescents. *Pediatrics*. 2006; 117 (2): 578-585.

- The 2005 Dietary Guidelines for Americans and MyPyramid acknowledge the important role of dairy foods in the diet and recommend Americans get 3 cups per day of low-fat or fat-free milk or milk products. Dietary Guidelines for Americans, 2005 (6<sup>th</sup> edition), [www.healthierus.gov/dietaryguidelines](http://www.healthierus.gov/dietaryguidelines).
- The 2004 Surgeon General's Report on Osteoporosis and Bone Health recognizes that most Americans do not consume adequate levels of calcium and recommends lifestyle changes for all Americans through regular physical activity and consumption of calcium- and vitamin D-rich foods, such as milk, cheese or yogurt, each day.

U.S. Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General, 2004.

### Contains Unique Nutrient Package

- A longitudinal study of 52 Caucasian children followed from ages 2 to 8 years found that greater intakes of energy, phosphorus, protein and magnesium resulted in significantly higher bone mineral content (BMC) and bone mineral density (BMD). Greater intakes of calcium and zinc also significantly increased BMC. In addition, children's bone mineral indexes at ages 6 and 8 years were strongly correlated. Authors concluded that many nutrients are related to bone health; therefore, children should consume a varied and nutrient-dense diet through adolescence when peak bone mass is accrued.

Bounds W, et al. The relationship of dietary and lifestyle factors to bone mineral indexes in children. *Journal of the American Dietetic Association*. 2005; 105: 735-741.

- Almost all processed fluid milk in the United States is fortified with vitamin D to obtain the standardized amount of 400 IU per quart, making milk one of the primary sources for this nutrient. Vitamin D promotes the absorption of calcium and enhances bone mineralization. The important effects vitamin D has on bone health throughout the lifecycle, including during fetal development was discussed by the Nutrition and Bone Health Working Group at the American Society for Bone and Mineral Research Annual Meeting. It was noted that children born to mothers who have low vitamin D levels have significantly reduced bone mineral content at age 9 years. In addition, vitamin D deficiency jeopardizes the attainment of peak bone mass in youth and increases bone loss in adults – both of which increase the likelihood of osteoporosis later in life.

Holick M. The Influence of vitamin D on bone health across the life cycle. *Journal of Nutrition*. 2005; 135: 2726S-2727S.

- A prospective study randomly assigned 28 boys ages 13 to 17 years to consume, in addition to their habitual diet, three servings per day of either 1 percent milk or unfortified juice while participating in a 12-week resistance-training program. Adolescent boys in the milk group had significantly greater increases in bone mineral density (BMD) and a better overall nutrient profile with significantly higher intakes of protein, fat, vitamin A, vitamin D, riboflavin, calcium, phosphorous and magnesium, than the boys in the juice group. Volek JS, et al. Increasing fluid milk favorably affects bone mineral density responses to resistance training in adolescent boys. *Journal of the American Dietetic Association*. 2003; 103:1353-1356.
- A cross-sectional study of a random sample of 649 girls ages 12 to 14 years found that those who drank milk had the highest bone mineral density (BMD) compared to those who drank little or no milk. After accounting for factors that could affect BMD, such as Tanner Stage, weight, bone age and School Physical Activity Score, the results indicated that milk was the only food group with a significant positive effect on BMD. The combined effect of several nutrients in milk, including calcium, protein and vitamin D, was associated with improved BMD. Du XQ, et al. Milk consumption and bone mineral content in Chinese adolescent girls. *Bone*. 2002; 30: 521-528.

### **Builds Peak Bone Mass**

- A previous randomized, double-blind, placebo-controlled trial of 144 8-year-old prepubertal girls found that supplementing 850 mg daily of calcium phosphate extracted from milk for 48 weeks resulted in greater accumulation of bone mineral mass compared to girls in a placebo group. A follow-up study conducted 3½ years later in 116 of these girls found that the increased bone mineral content (BMC) remained, indicating BMC achieved in childhood may have an effect on overall bone mass later in life. Bonjour JP, et al. Gain in bone mineral mass in prepubertal girls 3.5 years after discontinuation of calcium supplementation: a follow-up study. *Lancet*. 2001; 358 (9289): 1208-1212.
- A cross-sectional study of 494 healthy subjects found that postmenarchal girls had obtained BMD in the trabecular distal forearm similar to adults by 14 years of age, and BMD in the cortical distal forearm was similar to adults by 16 years of age. Study authors concluded that the years between 11 and 16 are critical for bone development due to the substantial bone mineralization taking place. Gunnes M. Bone mineral density in the cortical and trabecular distal forearm in healthy children and adolescents. *Acta Pediatrics*. 1994; 83: 463.
- This cross-sectional study looked at bone mass measurements of 265 premenopausal, Caucasian females ages 8 to 50 years. Results indicated that as much as 45 percent of the body's total skeletal mass is formed during adolescence, and peak adult bone density is reached in some bones in late adolescence. Matkovic V, et al. Timing of peak bone mass in Caucasian females and its implication for the prevention of osteoporosis. *Journal of Clinical Investigation*. 1994; 93: 799.

### **Creates Stronger Bones**

- This longitudinal study examined the association between calcium intake and bone mineral content of 151 non-Hispanic white girls by measuring dietary intake and bone mineral content from ages 5 to 11. Results showed that calcium intake over time positively affected bone mineral content accrual during middle childhood. Fiorito LM, et al. Girls calcium intake is associated with bone mineral content during middle childhood. *Journal of Nutrition*. 2006; 136: 1281-1286.
- A study of 50 children ages 3 to 13 years found those who avoided drinking milk for prolonged periods of time had low dietary calcium intake, low bone mineral density and sustained more fractures than children who consumed milk. Goulding A, et al. Children who avoid drinking cow's milk are at increased risk for prepubertal bone fractures. *Journal of the American Dietetic Association*. 2004; 104: 250-253.

- Three hundred fourteen Caucasian females with an average age of 11 were followed for seven years. Subjects were enrolled in either a randomized, double-blinded, placebo-controlled clinical trial with calcium supplementation or an observational study of a group accustomed to higher intake of dairy foods. Hip, spine and forearm measurements were obtained between the ages of 15 to 18. Results indicated that calcium supplementation and dairy product intake increased bone mineral density of the hip and forearm more so than taking the placebo. In addition, females who consume dairy foods had a higher bone mineral density of the spine while those who took the calcium or placebo did not experience the same effect.  
Matkovic V, et al. Nutrition influences skeletal development from childhood to adulthood: a study of hip, spine, and forearm in adolescent females. *Journal of Nutrition*. 2004; 134: 701S-705S.
- The Saskatchewan Bone Mineral Accrual Study (BMAS), a longitudinal study of bone growth in Caucasian children ages 8 to 14 found that subjects who consumed more beverages that were low in nutrients (eg. cola and noncola carbonated beverages; noncarbonated sugar-based beverages) had lower intake of fluid milk. In girls low nutrient-dense beverages correlated with lower bone mineral content.  
Whiting SJ, et al. Factors that affect bone mineral accrual in the adolescent growth spurt. *Journal of Nutrition*. 2004; 134 (3S): 696S-700S.
- This study evaluated data from 3251 non-Hispanic, white women age  $\geq 20$  years enrolled in the third National Health and Nutrition Examination Survey. The bone mineral content (BMC) of women ages 20 to 49 was 5.6 percent lower in those who had low milk intake ( $<1$  serving milk/day) during childhood than in those who had high milk intake ( $>1$  serving milk/day). Low milk intake during adolescence and childhood was associated with a 3 percent reduction in hip BMC and bone mineral density (BMD) and a 2-fold greater risk of fracture, respectively. In conclusion, women with low milk intake during childhood and adolescence have less bone mass and are at greater risk for fractures as adults.  
Kalkwarf HJ, et al. Milk intake during childhood and adolescence, adult bone density, and osteoporotic fractures in US women. *American Journal of Clinical Nutrition*. 2003; 77(1): 257-65.
- Twenty-one white females ages 12 to 15 years were studied at high and low dietary calcium intakes using a crossover design. An additional 14 adolescent females from a previous study who were examined at only one calcium intake were also included in the data analysis. Results indicated that adolescent females need to consume at least 1,300 mg of calcium each day in order to achieve the maximum amount of calcium the body can hold (maximum calcium retention). The researchers also noted that calcium intakes of as much as 1,200 mg per day only resulted in 57 percent of maximum calcium retention.  
Jackman LA, et al. Calcium retention in relation to calcium intake and postmenarcheal age in adolescent females. *American Journal of Clinical Nutrition*. 1997; 66: 327.
- Results from this 18-month randomized intervention trial among 80 12-year-old girls found that increased milk consumption significantly enhanced bone mineral accumulation. Those who were in the milk group consumed on average an additional 300 mL (slightly more than one cup) of either whole or reduced-fat milk every day had greater increases in bone mineral density (BMD) and bone mineral content (BMC), but did not gain weight or fat mass compared to the control group.  
Cadogan J, et al. Milk intake and bone mineral acquisition in adolescent girls: randomized, controlled intervention trial. *British Medical Journal*. 1997; 315: 1255.
- A one-year randomized control study of 48 white girls ages 9 to 13 years found that those who increased their calcium intake to 1200 mg per day by including more milk, cheese or yogurt had significant gains in bone mineral density (BMD) compared to girls who did not adjust their calcium intake. Increased consumption of dairy products resulted in improved calcium, phosphorus, vitamin D and protein intakes and was not associated with an increase in overall fat intake, weight gain or body fat.  
Chan G, et al. Effects of dairy products on bone and body composition in pubertal girls. *Journal of Pediatrics*. 1995; 126: 551.

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