

Effects Of Milk Consumption On Adolescents' Bone Health: A Systematic Review

Michael Klooster, Health Sciences Department

Introduction

Children from birth through adolescence may suffer from bone growth deficiency. This causes problematic issues with bone health, bone density and the inhibition of bone growth hormone stimulation. These issues can lead to different chronic diseases such as juvenile osteoporosis and rickets, where bones aren't strong enough to protect the body's vital organs but flimsy and soft due to low vitamin D and calcium. In a study of vitamin D deficiency, they show the symptoms that children could face: irritability, sleepiness, delayed response, bone changes, or fractures can be symptoms of vitamin D deficiency.^{1,2} The rate of infants with vitamin D deficiency was recorded in the same study that in the United States, 47% of African American infants and 56% of Caucasian infants have vitamin D deficiency. But over 90% of infants in Iran, Turkey, and India have vitamin D deficiency.^{1,2} Milk has ingredients that help support the decreased chance of developing such chronic diseases with calcium, vitamin D and phosphorus.

Studies in the past have shown that milk consumption helps decrease the risk of chronic diseases by providing necessary tools to build healthy bones in children and adolescents. One study explained the important effects of milk in bone health by saying milk consumption in adolescence is an effective way to build healthy bones.³

The purpose of this study was to measure how the consumption of milk affected the levels of bone growth, bone density, and increase the protection against chronic diseases. The findings of the present study are expected to be useful as empirical data for establishing strategies for promoting healthy bone growth during adolescence.

Methods

Primary sources were gathered in January and February of 2025 from the search engine of PubMed and CINAHL. The advanced search terms used were ((Adolescents AND milk consumption with bone development OR bone mineral density AND calcium OR vitamin D intake on the bone growth hormone.)) The search was narrowed down to 13 screened articles after applying more restrictive search terms for the articles desired for the paper. Relevant data was taken from 8 of these articles and summarized in the extraction table. Important definitions for this study are relating the measurements of the bone mineral density (BMD), body mass index (BMI), and bone mineral content (BMC). BMD is the measurement of calcium in certain bones.⁴ BMI is the scientific way to measure someone's body fat percentage and weight. BMC is the measurement of bone mass in a certain bone to help determine the bone's strength and resistance to bone breaks.^{5,6}

Acknowledgements

Special thanks to Professor Gerald Schafer of the Health Sciences Department in helping with the creation of this research and poster.

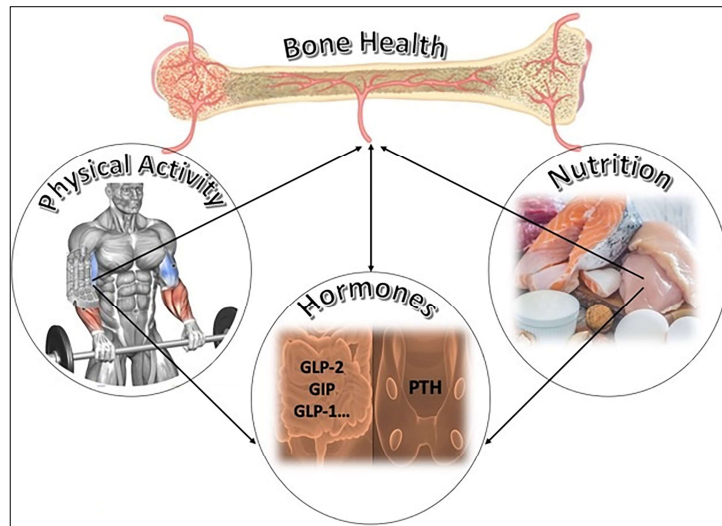


Figure 1. Illustration of bone health factors.¹²

References

1. Sizar O, Khare S, Goyal A, Givler A. Vitamin D Deficiency. In: *StatPearls*. StatPearls Publishing; 2025. Accessed February 13, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK532266/>.
2. Palacios C, Gonzalez L. Is vitamin D deficiency a major global public health problem? *J Steroid Biochem Mol Biol*. 2014;144PA:138-145. doi:10.1016/j.jsbmb.2013.11.003
3. Lee JH, Ha AW, Kim WK, Kim SH. The Combined Effects of Milk Intake and Physical Activity on Bone Mineral Density in Korean Adolescents. *Nutrients*. 2021;13(3):731. doi:10.3390/nu13030731
4. Torres-Costoso A, López-Muñoz P, Ferri-Morales A, Bravo-Morales E, Martínez-Vizcaino V, Garrido-Miguel M. Body Mass Index, Lean Mass, and Body Fat Percentage as Mediators of the Relationship between Milk Consumption and Bone Health in Young Adults. *Nutrients*. 2019;11(10):2500. doi:10.3390/nu11102500
5. Vogel KA, Martin BR, McCabe LD, et al. The effect of dairy intake on bone mass and body composition in early pubertal girls and boys: a randomized controlled trial. *Am J Clin Nutr*. 2017;105(5):1214-1229. doi:10.3945/ajcn.116.140418
6. Moore LL, Bradlee ML, Gao D, Singer MR. Effects of Average Childhood Dairy Intake on Adolescent Bone Health. *J Pediatr*. 2008;153(5):667-673. doi:10.1016/j.jpeds.2008.05.016
7. Matkovic V, Goel PK, Badenhop-Stevens NE, et al. Calcium supplementation and bone mineral density in females from childhood to young adulthood: a randomized controlled trial. *Am J Clin Nutr*. 2005;81(1):175-188. doi:10.1093/ajcn/81.1.175
8. Cheng S, Lytykainen A, Kröger H, et al. Effects of calcium, dairy product, and vitamin D supplementation on bone mass accrual and body composition in 10-12-y-old girls: a 2-y randomized trial. *Am J Clin Nutr*. 2005;82(5):1115-1126. doi:10.1093/ajcn/82.5.1115
9. Kim SH, Kim WK, Kang MH. Effect of milk and milk products consumption on physical growth and bone mineral density in Korean adolescents. *Nutr Res Pract*. 2013;7(4):309-314. doi:10.4162/nrp.2013.7.4.309
10. Lee JH, Ha AW, Kim WK, Kim SH. The Combined Effects of Milk Intake and Physical Activity on Bone Mineral Density in Korean Adolescents. *Nutrients*. 2021;13(3):731. doi:10.3390/nu13030731
11. Uenishi K, Nakamura K. Intake of dairy products and bone ultrasound measurement in late adolescents: a nationwide cross-sectional study in Japan.
12. *Frontiers In Endocrinology (Potential Key Factors of Bone Homeostasis and Remodeling)*. Accessed April 9, 2025. <https://www.frontiersin.org/journals/endocrinology/articles/10.3389/fendo.2021.704647/full>

Results

This review includes three cross-sectional studies, two randomized controlled trials, one double-blind randomized controlled trial, one case report, and one double-blind placebo-control led intervention. One study found that healthy milk consumption for adolescents increased BMD and BMC in bones specifically reducing the risk of osteoporosis in later years of life.⁸ Another study showed the importance of consuming the correct volume of milk to positively affect BMD of bones in adolescents, the volume of milk was a daily intervention of ~2 cups servings of milk/day.⁵ Another study showed the specific effects of calcium on the bone mass in pubertal growth, the results findings showed that ~830 mg/d intake of calcium positively influences bone mass amongst adolescents in pubertal growth.² Another study was able to demonstrate that calcium and nutrients picked up through food (milk) are more beneficial for adolescents' bone growth than tablets with the same ingredients.^{6,8} Another study showed that physical activity goes along with milk consumption for the increase of healthy bones in adolescents through high levels of BMD and low levels of BMI.^{9,10}

Discussion

Overall, this review found significant benefits in drinking the correct prescribed volumes of milk during the age of adolescence for healthy BMD, BMI and BMC.^{4,6,10,11} The studies that were evaluated showed that physical activity and adequate calcium intake are also associated with healthier BMD and BMC in adolescents.^{7,8,10} Four of the eight studies evaluated were randomized-controlled studies. Of the rest of the studies, two were cross-sectional studies and two were case reports. The randomized-controlled studies showed strength in their findings due to the populations being randomized.^{5,7-9} Limitations of the cross-sectional studies and the case reports were that the data was collected through self-administered surveys and questionnaires.^{4-6,11} Future studies should focus on gaining data through interviews and tests of different types of dairy/milk products. More studies need to be conducted on the effects of body fat/lean mass from milk consumption.

The eight studies evaluated showed that the correct milk consumption can help positively affect the health of bones in adolescents through strengthening adolescents' BMD, BMC, and BMI. However, there needs to be more substantial research conducted on the specific contents of milk which yields healthier bones in adolescents.