

USANA Technical Bulletin

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Silicon

Technical Background

- Silicon is an element found predominantly in bones and joints. The specific role of silicon in the human body is still not clearly understood. Although a strict biochemical function for silicon remains undefined, research strongly suggests that silicon is required by humans.¹
- Several roles for silicon have been defined, largely on the basis of animal studies. Its most important functions appear to be in the growth and development of bone, cartilage, and connective tissue, where it plays both a metabolic and structural role.²
- In bone, silicon is localized in the active growth areas, where it is thought to promote growth and hasten mineralization.^{3,4}
- A recent study found that men and pre-menopausal women with higher dietary silicon intake had higher bone mineral density.⁵ Some speculate that silicon deficiencies may be involved in osteoarthritis and osteoporosis.^{1,6}
- Silicon appears to be required for the synthesis of collagen, the protein matrix found in connective tissue and cartilage and the single most abundant protein in the human body. In cartilage and connective tissues, silicon is a component of proteoglycan complexes that interlace with collagen and contribute to structural integrity.

Sources and Recommended Intake

- The richest sources of dietary silicon include hard drinking water, coffee, whole grains, cereal products, plant fiber, leafy green vegetables, and root vegetables.⁷
- Food refining (principally grain processing) reduces silicon content. Silicate additives (e.g. silicon dioxide) are frequently added to prepared foods as anti-caking or antifoaming agents, but much of this material is not bioavailable.¹
- No Recommended Dietary Allowance (RDA) has been set for silicon.⁸ Estimates for a human requirement range from 5 mg to 20 mg/day. If the silicon is highly bioavailable, the requirement may be as low as 2-5 mg/day.¹ Dietary analyses indicate that the average daily silicon intake is 40 mg/day for men, 19 mg/day for women.⁹
- Silicon compounds are non-toxic when taken orally. Magnesium trisilicate, used in over-the-counter antacids, has been used safely for over 40 years, and there have been no reports of adverse reactions related to ingestion of silicate food additives.¹

Abstracts

Jugdohsingh R, Tucker KL, Qiao N, Cupples LA, Kiel DP, Powell JJ. Dietary silicon intake is positively associated with bone mineral density in men and premenopausal women of the Framingham Offspring cohort. J

Bone Miner Res. 2004 Feb;19(2):297-307. Epub 2003 Dec 16. The role of dietary silicon in bone health in humans is not known. In a cross-sectional, population-based study (2847 participants), associations between dietary silicon intake and BMD were investigated. Dietary silicon correlated positively and significantly with BMD at all hip sites in men and premenopausal women, but not in postmenopausal women, suggesting that increased silicon intake is associated with increased cortical BMD in these populations. **INTRODUCTION:** Osteoporosis is a burgeoning health and economic issue. Agents that promote bone formation are widely sought. Animal and cellular data suggest that the orthosilicate anion (i.e., dietary silicon) is involved in bone formation. The intake of silicon (Si, approximately 30 mg/day) is among the highest for trace elements in humans, but its contribution to bone health is not known. **MATERIALS AND METHODS:** In a cross-sectional, population-based study, we examined the association between silicon intake and bone mineral density (BMD) in 1251 men and 1596 pre- and postmenopausal women in the Framingham Offspring cohort (age, 30-87 years) at four hip sites and lumbar spine, adjusting for all potential confounding factors known to influence BMD and nutrient intake. **RESULTS:** Silicon intake correlated positively with adjusted BMD at four hip sites in men and premenopausal women, but not in postmenopausal women. No significant association was observed at the lumbar spine in any group. Categorical analysis by Si intake, or energy-adjusted Si intake, supported these findings, and showed large differences in BMD (up to 10%) between the highest (> 40 mg Si/day) and lowest (< 14 mg Si/day) quintiles of silicon intake. A significant association at the lumbar spine in men was also observed. Further analyses indicated that some of the effects seen for moderate consumption of alcoholic beverages on BMD might be attributed to Si intake. **CONCLUSIONS:** These findings suggest that higher dietary silicon intake in men and younger women may have salutary effects on skeletal health, especially cortical bone health, that has not been previously recognized. Confirmation of these results is being sought in a longitudinal study and by assessment of the influence of silicon intake on bone markers in this cohort.

References

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