

## Strontium & Bone Health

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### Key Points

- *Strontium is currently under research, as a drug, related to its benefit in fracture reduction for postmenopausal women.*
- *Strontium does not have an accepted biological role in human nutrition nor is it considered an essential nutrient.*
- *Dietary (food) consumption of strontium is approximately 1 to 5 mg per day, compared to pharmacological consumption of 1 to 2 grams.*
- *Strontium intake is not without side effects.*
- *Osteoporosis is not a deficiency of a single substance—calcium, vitamin D, or strontium.*
- *Dietary supplementation should focus on those substances that are known to support a specific condition and on compounds with known biological value.*

### Dietary Supplement or Drug?

Strontium has recently come into vogue as a “natural” dietary supplement for bone health. While research is currently being carried out both in Europe and the United States regarding strontium, the research is limited to pharmaceutical/drug studies on the specific compound strontium ranelate.<sup>1</sup> Results of these studies indicate that strontium ranelate may improve bone density in osteoporosis or osteopenia, however, the drug is approved for *post-menopausal women only*.<sup>1</sup> The reported effective treatment dose is 1 gram to 2 grams/day.<sup>1,2</sup>

A number of dietary supplement manufacturers and resellers have begun offering strontium as a dietary supplement and are utilizing specific drug research as proof of the efficacy of non-prescription strontium salts. However, these dietary supplements do not contain the form of strontium as utilized in current research, but typically as either strontium carbonate or citrate. *Research is lacking on the efficacy of strontium in these forms or as a dietary supplement.* Interestingly, one reported murine study of strontium carbonate conducted by Matsumoto reported *decreased* bone formation. It was suggested that strontium carbonate negatively impacted bone growth through an inhibitory action on chondroblasts and bone ossification.<sup>3</sup> Another early strontium carbonate study demonstrated the onset of rickets when the compound was fed to growing rats. The author’s conclusion was that continuous feeding of strontium in *young* rats induced “typical rickets” even though the diet was sufficient in both calcium and vitamin D.<sup>4</sup> The same rickets effect was seen in Turkish children, reported in 1996, and related to consumption of food where elevated strontium content in the soil is noted.<sup>5</sup> Strontium is “natural” in the sense that it is an element commonly found in soil and water. Non-radioactive strontium, while of low toxicity, is generally considered a food contaminant and has no currently known biological role.<sup>6</sup>

### A Trace Mineral without Deficiency Concerns

The effect of strontium on bone is likely related to its similarity to calcium, a mineral with a known biological value. Strontium is structurally similar to calcium and can *replace calcium in the bone mineral matrix*. A key difference is that calcium (as an essential nutrient) is homeostatically controlled, while strontium is not. Strontium is not alone as a mineral with “bone seeking” activity.<sup>7</sup> Lead is well absorbed from the gut, is incorporated into bone, and increases bone density.<sup>8</sup> Lead, of course, is also a natural element found in the soil, yet does not have a biological role in human health.

As an element found in water and soil, strontium is a trace mineral in the diet. The average total body store (primarily in bone) for strontium in humans is estimated to be 300 to 400 mg. The average daily intake of strontium from the diet is estimated at *only 1 to 5 mg*. In contrast, calcium accounts for approximately 2% to 4% of body weight. The average female body contains about 1,000 to 1,200 **grams** of calcium, 99% of which is found in bones and teeth. Calcium intake data taken from the National Health and Nutrition Examination Survey (NHANES) indicate that the mean dietary calcium intake among adults in the U.S. is 800 mg/day, *well below the recommended intake for adults* of 1,000 to 1,200 mg/day. Calcium deficiency is also a common concern worldwide. For example, Pasco, et al. reported that 76% of Australian women aged 20 to 54 years, 87% of older women, and 82% of lactating women had *total daily* calcium intakes that were below the recommended dietary intake (RDI) even when calcium supplements were included.<sup>9</sup>

Regarding vitamin D, utilizing data from the same NHANES study it has been estimated that the mean dietary vitamin D intake among women is only 148 IU/day, well below recommended intakes of 400 IU or more. Strontium may also interfere with serum vitamin D levels.<sup>10</sup> Strontium, as with lead and aluminum, has been reported to block renal synthesis of 1,25-dihydroxyvitamin D.<sup>11</sup> This should raise at least the concern regarding clinical and sub-clinical vitamin D deficiency—a common concern worldwide.<sup>12</sup>

With such a concern regarding inadequate calcium and vitamin D intake, does it make sense to use strontium daily as a dietary supplement *at 4 to 7 times the total body stores*? Or may it be more advantageous to focus on improving the intake of the known and essential bone minerals and vitamin D? There are likely many unanswered questions regarding the non-pharmacological use of strontium. Due to the lack of safety research, its use as a dietary supplement should likely be called into question. Proponents of non-prescription strontium state the benefits with use are due to the mineral, and not the specific form as used in pharmacological studies. There are no current studies to back that claim.

### **Not without Adverse Effects**

“Natural” strontium proponents claim that strontium is safe. But the use of strontium as a pharmacological agent is not without possible side effects. Reports have commented on an increased risk of venous thromboembolism, pulmonary embolism, and elevated serum creatine kinase. The long-term adverse effects of strontium on bone (osteomalacia, pathological fractures, etc.) are unknown.<sup>13</sup> The safety of strontium supplementation during pregnancy, lactation, or with children may also be a potential concern, especially because animal studies and studies in children have reported the onset of rickets when dietary intake of strontium is high.<sup>4-6</sup> Strontium is also excreted through breast milk. Due to the requirement for high calcium intake during the period of bone development, the absorption and retention of strontium is higher in children than in adults. Consequently, children are more at risk than adults from exposures to excess stable strontium.<sup>6</sup>

It may be concluded that the use of strontium as a non-pharmacological dietary supplement is without current support in the literature. Drug studies on a specific drug compound (strontium ranelate) cannot be extrapolated to prove safety or efficacy for the use of other compounds (strontium as carbonate or citrate). In addition, proof of safety for dietary intakes of these strontium salts—literally hundreds of times a typical intake from food and water and several times above total body store—are lacking. The use of the drug strontium ranelate is limited to postmenopausal women while dietary supplement companies and consumers may not limit the use within a single patient population.

## A Case for Nutrition and Lifestyle

Osteoporosis and osteopenia are multi-factorial conditions. The use of single compounds, whether it is calcium, vitamin D, or strontium, will not prevent these conditions. While nutrient deficiencies such as calcium and vitamin D are common,<sup>14,15</sup> patients are not likely experiencing a strontium deficiency syndrome. The focus should therefore be made on bone health nutrients with known biological roles and known dietary deficiencies and the positive lifestyle changes associated with bone health.

**“...All postmenopausal women can benefit from non-pharmacologic interventions to reduce the risk of fracture, including a balanced diet with adequate intake of calcium and vitamin D, regular exercise, measures to prevent falls or to minimize their impact, smoking cessation, and moderation of alcohol intake...”** Delaney MF. Strategies for the prevention and treatment of osteoporosis during early postmenopause. *Am J Obstet Gynecol* 2006;194(2 Suppl):S12-23.

**“...Maintaining adequate calcium intake during childhood and adolescence is necessary for the development of peak bone mass, which may be important in reducing the risk of fractures and osteoporosis later in life. Optimal calcium intake is especially relevant during adolescence, when most bone mineral accretion occurs. Because of the influence of the family's diet on the diet of children and adolescents, adequate calcium intake by all members of the family is important...”** Greer FR, et al. Optimizing bone health and calcium intakes of infants, children, and adolescents. *Pediatrics* 2006;117(2):578-85.

Pharmacological osteoporosis medications depend on an adequate nutrient intake. Therefore, comprehensive bone mineral support along with vitamin D should remain the primary recommendations of proper bone nutrition and health.<sup>16</sup>

It must be remembered that bones are more than calcium. In addition, a number of trace minerals are required. Several trace elements, particularly copper, manganese, and zinc, are essential in bone metabolism as cofactors for specific enzymes.<sup>17</sup> In clinical practice, deficiencies in these additional minerals and other bone factors may impede the benefits of supplementation. For supplemental support, microcrystalline hydroxyapatite compound (MCHC) is an excellent, *comprehensive bone nutrient compound*.<sup>18</sup> MCHC, in addition to calcium, contains phosphorus, magnesium, fluoride, zinc, silicon, manganese, and other trace minerals in the same physiological proportions found in healthy bone. MCHC also contains certain organic factors—intact proteins and bone growth factors—having activity related to bone nutrition and health.<sup>19</sup>

### Nutritional & Lifestyle Factors Associated with Bone Health Concerns

- Poor nutrition
- Low calcium intake
- Low trace minerals
- Low vitamin D status
- Sedentary lifestyles
- Smoking, excess alcohol intake, and caffeine consumption
- Stress and depression
- Imbalanced diets (i.e., high protein diets)
- Blood sugar imbalance
- Certain medications

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