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## Relationships of Calcium to Skeletal Health and Potential Adverse Effects

**John JB Anderson**

Gillings School of Global Public Health,  
University of North Carolina, NC, USA

### Abstract

Recent reports have suggested that calcium supplements have not been effective in reducing skeletal fractures in older adults. In addition, several other current articles have not been able to demonstrate that calcium supplements or high total calcium intakes are related to coronary artery calcification, although other reports disagree. Yet, other manuscripts have linked high calcium intakes to renal stones, and no disagreement exists about this rather rare finding. The objective of this commentary is to review these issues by citing major publications over the last few years.

**Corresponding author:** John JB Anderson

✉ [jjb\\_anderson@unc.edu](mailto:jjb_anderson@unc.edu)

Professor of Nutrition Emeritus, Gillings  
School of Global Public Health, University of  
North Carolina, Chapel Hill, NC 27599-7461,  
USA.

**Tel:** +919-966-5527

**Fax:** +919-966-7216

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### Introduction

Calcium has been long established as an essential micronutrient needed in fairly large amounts on a daily basis. The current Recommended Dietary Allowances (RDAs) for adults are in the range of 1000 to 1200 mg per day published by a committee of the Institute of Medicine (IOM), an increase over the adult RDAs of 800 mg per day up to approximately 1980 [1]. In other nations and the World Health Organization (WHO), the recommendations may be as low as 500 mg per day. Median U.S. adult intakes range between 900 and 1300 mg per day, with approximately 50% of adults taking calcium supplements [2]. Acceptable adult intakes of total calcium from foods and supplements may be as low as 600 mg per day, but balance study data suggest that 700 to 800 mg per day may be most optimal [3]. Concerns arise when intakes are too low (<600 mg per day) or too high (>1400 mg per day). Insufficient intakes typically contribute to suboptimal skeletal development, i.e., bone mass, whereas excessive intakes may result in soft tissue calcification and renal stones. The relation between calcium intake and soft tissue calcification, specifically coronary artery calcification, remains controversial [4].

The purpose of this article is to review the current findings of recent research investigations and summary guidelines relevant to the issues of bone mass, soft tissue calcification, and renal stones, particularly of older adults.

### Calcium Intake and Bone Mass and Bone Fractures

A recent longitudinal bone study has shown that calcium intakes

of older adults [5] do not need to be much higher than 800 mg per day for optimal bone density measurements and low fracture rates, whereas intakes greater than 1200 mg per day result actually result in a greater rate of fractures. Another cross-sectional report of U.S. National Health and Nutrition Examination Survey data for 2005-2006 demonstrated that bone measurements of 50 to 80 year-olds were not related across a wide range of mean calcium intakes by quintiles from low to high total intakes of approximately 500 to 1200 mg per day [6].

Two recent meta-analyses also reported that calcium supplements had essentially no benefit in terms of reducing skeletal fractures [7] or in improving bone mass or density [8]. These two reports published in the BMJ have amassed a powerful argument against both supplements and high intakes of calcium from foods in a varied diet [9].

A U.S. Preventive Services Task Force report [10] has commented that supplements of calcium and vitamin D are not recommended for the prevention of fractures. The Task Force recommends getting calcium from foods, including fortified foods.

In summary, a general consensus now supports the benefit of consuming a balanced diet that contains sufficient amounts of calcium. Food choices selected need to provide the recommended amount of calcium each day.

### Calcium Intake and Soft Tissue Calcification

Excessive calcium intakes from all sources, both dietary and

supplemental, have been suggested by some, but clearly not all, investigators to increase the risk of coronary artery calcification (CAC) and calcifications in other soft tissues, especially the brain. A direct linkage between total calcium intake and CAC has been difficult to establish, despite the fact that almost 50% of older adults, i.e., beyond 50 years, have some CAC established by computed tomography [11].

Prospective investigations are needed to establish a diet calcium-CAC link or not. If a direct link does exist, it likely contributes to potential calcifications in the brain, kidneys, and other soft tissues.

## Calcium Intake and Renal Stones

Renal stones have long been associated with high calcium intakes, including supplements, even though other factors contribute to kidney stones. Most stone-formers develop hypercalciuria because of excessive intestinal calcium absorption or because of familial contributions that enhance renal calcium excretion. The Women's Health Initiative (WHI) is the latest major report showing an increase in renal stones in WHI women subjects taking calcium supplements, but the numbers who reported having stones were small [12]. A link between renal stone formation and vascular calcification has also been suggested [13]. Low-calcium intakes of individuals living in arid parts of the world, however, have also been reported to have renal stones, which suggest that specific genetic factors may increase risk independently of calcium intake.

## Calcium Intake and Mortality from All Causes

Because of the long-term consumption patterns of diets containing total calcium amounts greater than 1400 mg per day

from foods and supplements, women (not men) are at increased risk of death from all causes, including cardiovascular disease with the exception of stroke [14]. Further investigation of this important relationship is needed, but the suggestion that more calcium, especially from supplements, is better for bone health and possibly other aspects of health is not supported by recent evidence.

A recent prospective study of older adults in Australia, however, provided data suggesting that calcium intakes of up to 1348 mg per day were associated with lower risks for fractures, cardiovascular diseases, and all-cause mortality [15]. Calcium intake was assessed by a food frequency instrument. Supplemental calcium data were not collected so that total calcium intake could not be calculated. This report of a large number of older men and women is not in accord with the findings of elderly Swedish subjects [5] and other reports [9].

## Conclusion

Excessive calcium intakes from all sources (foods, supplements) that are beyond the recommended amounts, i.e., RDAs, are now considered by many investigators to increase the risk of adverse effects, i.e., soft tissue calcifications and renal stones, which may in turn increase the risk of mortality. Research information regarding adverse effects of calcium supplements and high calcium consumption from food sources remains limited, but a cautious approach to promoting health suggests that calcium should be obtained from a variety of foods, including low-fat dairy products and fortified food sources, and that calcium supplements should not be consumed except when recommended by a physician after a careful assessment of each patient who is suspected of having a deficient intake. If calcium intakes need to be increased, calcium-rich foods should be considered first, i.e., "foods first."

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