

BONE

Serum 25-hydroxyvitamin D level modulates BMD response to dietary calcium

Osteoporosis can be prevented by simple lifestyle changes; for example, increased calcium intake (either from diet or supplements) can improve BMD. Nevertheless, the confounding effects of vitamin D deficiency—which is associated with reduced calcium absorption—are poorly characterized. This issue has now been addressed by Bischoff-Ferrari and colleagues, who found that serum 25-hydroxyvitamin D concentration modulates an individual's response to dietary calcium intake.

The recommended 'optimal' daily calcium intake varies widely from country to country. The US Institute of Medicine, for example, currently recommends 1 g per day for adults aged 19–59 years, and 1.2 g per day for those >50 years of age. Although recommendations strive to improve calcium intake, this strategy will not be beneficial unless adequate levels are absorbed from the gut. Vitamin D increases calcium absorption, and some evidence suggests that high serum levels of 25-hydroxyvitamin D (the best indicator of a person's vitamin D status) correlate with high levels of calcium absorption. Bischoff-Ferrari *et al.*, therefore, evaluated the relationship between 25-hydroxyvitamin D concentration and the effects of dietary calcium on total hip BMD in a cohort of adults enrolled in a large, population-based study.

The National Health and Nutrition Examination Survey III (NHANES III) acquired representative information on the health and nutritional status of the civilian, noninstitutionalized, US population during 1988–1994. Bischoff-Ferrari *et al.* selected a subgroup of the NHANES III population for whom data were available on areal BMD of the total hip, dietary calcium intake and serum 25-hydroxyvitamin D concentration. Individuals with a history of radial or hip fractures were excluded, as were those who used calcium supplements. The study group comprised 4,958 women and 5,003 men (mean age 47.1 years).



Serum 25-hydroxyvitamin D concentration was measured by radioimmunoassay, and the study participants assigned to one of three 25-hydroxyvitamin D categories: <50 nmol/l, 50–74 nmol/l and >75 nmol/l. Daily calcium intake was assessed by 24 h dietary recall on one or more occasions. Total areal BMD was measured by dual-energy X-ray absorptiometry. Other parameters included in the analysis were degree of smoking, BMI, estrogen use, caloric intake, and level of physical activity.

Moderate variations in day-to-day intake of dietary calcium were observed, although men generally had a higher intake than women (mean 827 mg versus 724 mg, respectively). Levels of serum 25-hydroxyvitamin D were also higher in men than women (mean 67.4 nmol/l versus 57.8 nmol/l, respectively). Calcium intake and serum 25-hydroxyvitamin D concentration were both generally lower in black and Mexican American individuals than in white people. Furthermore, calcium intake and serum 25-hydroxyvitamin D levels decreased with age. Physical activity was examined as a potential modifier. Men were more likely to undertake physical exercise than were women: 27% of women were deemed 'physically inactive', compared with just 17% of their male counterparts. Individuals who undertook little or

no physical exercise had lower serum 25-hydroxyvitamin D concentrations than those who were physically active.

The researchers calculated the standardized, mean BMD for each 25-hydroxyvitamin D category by quartiles of sex-specific calcium intake. For women, a high calcium intake was associated with increased BMD when 25-hydroxyvitamin D concentrations were <50 nmol/l. By contrast, no such association was observed for women whose serum 25-hydroxyvitamin D concentration was ≥50 nmol/l or for men (regardless of 25-hydroxyvitamin D concentration). The benefits of high calcium intake were greater for women aged <50 years or >70 years with low 25-hydroxyvitamin concentrations than for women aged 50–69 years with low 25-hydroxyvitamin D concentrations.

The results presented by Bischoff-Ferrari and colleagues suggest that women with low serum 25-hydroxyvitamin D levels could benefit from increased dietary calcium intake, whereas women whose levels were >50 nmol/l might not necessarily receive additional benefits if their dietary calcium intake exceeds 566 mg per day. Indeed, too much calcium can be detrimental to health. An additional approach to osteoporosis prevention might be, therefore, to address the issue of vitamin D deficiency, either with supplements or by increased consumption of vitamin D-rich foods.

Bischoff-Ferrari *et al.* conclude that serum 25-hydroxyvitamin D concentration is an important modifier of the BMD response to dietary calcium in women, but not in men. The results of their study strongly advocate correction of vitamin D deficiency as an important part of any osteoporosis prevention program.

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