

## Is caffeine a risk factor for bone loss in the elderly?<sup>1,2</sup>

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Dietary caffeine acutely increases urinary calcium loss (1), and these losses are not entirely compensated for in the 24 h after caffeine consumption (2). Overall, the evidence indicates that younger individuals can increase their calcium absorption to compensate for the urinary losses, whereas the elderly are less adaptable (3). It is not surprising that most cross-sectional studies of elderly populations showed no association of caffeine consumption with bone loss or bone mineral density because so many genetic and lifestyle factors are now known to affect bone health. Previous prospective studies of elderly populations yielded conflicting results regarding caffeine and bone loss. Although Cummings et al (4) included caffeine consumption among the risk factors for hip fracture, Lloyd et al (5) were unable to find any association of caffeine with bone loss in a 2-y prospective study of 112 postmenopausal women. Similarly, Hannan et al (6) did not find that caffeine (or calcium intake) was associated with bone loss in the Framingham study population.

The interaction of caffeine intake with calcium on bone loss was reported by Harris and Dawson-Hughes (7). These investigators found that bone loss from the spine and total-body bone mineral density occurred only in postmenopausal women who had both low calcium intakes (440–744 mg/d) and high caffeine intakes (450–1120 mg/d). The following year, this same research team showed that response to calcium supplementation is influenced by vitamin D receptor gene (*VDR*) genotype (8), with the rate of loss at the femoral neck being reduced by calcium only in the *BB VDR* subgroup. In retrospect, it is probably not surprising that in this issue of the Journal Rapuri et al (9) report that caffeine's effect on bone loss is also associated with *VDR* genotype.

The new findings of Rapuri et al (9) cause us to re-interpret the results of previously published studies. Rapuri et al found that caffeine intakes of >300 mg/d were associated with bone loss in 96 women in a 3-y prospective study. Caffeine, however, was only associated with increased bone loss in women with the *tt VDR* genotype. This subgroup contained only 5 of the 33 women (15%) with higher caffeine intakes. Bone loss in this subgroup exceeded 3%/y at all 5 sites examined (spine, femoral neck, trochanter, total body, and total femur), although significantly so at only 3 sites, probably because of the low number of subjects in the group. In the total group, only 11 of the 96 women had the *tt VDR* genotype, and 6 of these 11 were apparently protected by their lower intake of caffeine. Unfortunately, the sample size was too small to test the interaction of dietary calcium with caffeine and genotype. The low incidence of the susceptible genotype helps to explain the lack of association seen in several previous

prospective studies. Only 5 of the 96 women had significant bone loss with higher caffeine intakes, and this small percentage would not be detectable in studies not considering genotype.

What can we tell our patients about dietary recommendations to prevent osteoporosis in the increasingly complex scenario of diet-gene interactions? Making dietary recommendations to prevent osteoporosis is becoming increasingly difficult as we learn more about the genetics of osteoporosis (10). However, the studies of Harris and Dawson-Hughes (7) and Krall et al (8) show that adequate dietary calcium seems to counteract much of the negative effects of higher caffeine consumption. The findings of Rapuri et al (9) are also consistent with previous reports suggesting that a moderate caffeine intake is not associated with increased bone loss. Until we can know an individual's genotype, as well as diet-gene interactions, we must make recommendations based on the assumption that each person may have a genetic susceptibility to osteoporosis. On the basis of the studies conducted to date, it seems prudent to recommend both adequate dietary calcium and a moderate caffeine consumption for elderly individuals. Moderate caffeine consumption seems likely to be ≤300 mg, ≈16 oz (473 mL) brewed coffee, 32 oz (946 mL) brewed tea, or 6, 12-oz (355-mL) cans of most caffeinated soft drinks (3). ☛

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