

Do We Need to Be Concerned about Bone Mineral Density in Vegetarians and Vegans?

Sue A Shapses^{1,2}

¹Department of Nutritional Sciences, and the Center for NEx-Metabolism at the NJ-IFNH, Rutgers University, New Brunswick, NJ, USA; and ²Department of Medicine, Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ, USA

Vegetarian diets continue to gain popularity due to concerns about environmental sustainability and belief that it is a healthier diet that can prevent chronic disease (1–3). In addition, there are large populations that adhere to a vegetarian or vegan diet due to cultural or religious reasons (4). Vegetarian food intake patterns vary because some exclude all or some types of animal products such as meat, seafood, eggs, and dairy, whereas others do not. Self-identified vegetarians in survey studies like NHANES may be vegan (no animal products) or vegetarian (which typically indicates the inclusion of some animal products like dairy). Distinguishing between different types of vegetarians is important because evidence suggests such differences can impact bone density and quality.

Osteoporosis is associated with low bone mineral density (BMD) and is prevalent in 5% of men and 25% of women aged >65 y in the USA (5–6). Osteoporosis is responsible for >8.9 million fractures worldwide (5–6), and increases morbidity and mortality, resulting in a large economic burden. Therefore, identifying and addressing factors associated with poor bone health is a public health imperative. Meta-analyses of the literature suggest that vegetarians and vegans have lower BMD (7–8), but do not consistently have higher risk of fractures (8).

In an article published in this issue of *The Journal of Nutrition*, Karavasiloglou et al. (9) provide 1 possible reason for this discrepancy. Consistent with other reports (7–8), adults from the 2007–2010 NHANES surveys who self-identified as vegetarians (including vegans) had significantly lower BMD compared with nonvegetarians. However, further analysis indicated that the lower BMD at the hip (total femur and femoral neck) was attributed to smaller body size when corrected for anthropometrics (BMI and waist circumference) (9). This was not the case for lumbar spine BMD in vegetarians, which remained significantly different from nonvegetarians after adjustment for anthropometric variables. If the bone quality was also compromised, it would lead to collapsed vertebrae and increased spinal fracture risk in vegetarians but there is no evidence for this in the literature. Also, and importantly, the small lumbar spine BMD difference (9) was of low clinical significance since it was <0.05 g/cm² (and <3%) between groups (10). Hence, the lower BMD in vegetarians does not explain the absence of higher fracture risk in this population.

The NHANES survey in 2007–2010 indicates that 2.3% of the US population were vegetarians (9, 11), yet trends indicate that the number of persons who self-identify as vegetarian has increased to 5–6% in recent years (3). The science is not clear as to why a vegetarian diet with plenty of dairy products and fruits and vegetables (F&V) would reduce BMD. It has been hypothesized that the protein quality of foods in the vegetarian compared with an omnivorous diet results in a less favorable amino acid profile and bioavailability (12). However, studies comparing plant with animal protein have not consistently found differential effects on BMD or bone mineral content (13). Although the study by Karavasiloglou et al. (9) did not examine food components, others have defined the foods consumed in this same NHANES 2007–2010 population of vegetarians and nonvegetarians (11). Both groups consumed similar amounts of dairy products, eggs, seafood, and F&V, yet when controlled for energy intake, the intake of whole and total grains as well as F&V were higher in vegetarians; and not surprisingly, vegetarians consumed more soy, whole grains and legumes, and less meat, solid fats, and added sugars (11). However, because a vegetarian diet typically contains eggs and dairy products and the vegan diet does not, the diet quality and variability between individuals adhering to these different diets can vary greatly. This is also because both can contain variable amounts and types of fat (e.g., fatty acids with varying degrees of saturation, etc.) and protein sources (e.g., tofu, tempeh, pulses). Further, micronutrient intakes differ among various types of vegetarians and can be lower in those who are strictly vegan, perhaps negatively impacting bone. These differences in food intake may explain the higher fracture risk in vegans, but not all vegetarians (8). The lack of studies specifically examining different types of populations who reduce or eliminate animal products in the diet are needed to establish reliable population-based guidelines.

The finding of lower body size in vegetarians in the Karavasiloglou et al. (9) study could at least partially explain why there is not a greater risk for fracture in vegetarians compared with omnivores despite having lower BMD. However, because low BMI is a risk factor for fractures (5), all persons in a low body weight category consuming any type of diet should be monitored for osteoporosis. The authors (9) noted the limitation of their study that vegans could not be analyzed separately due to the low number surveyed. Given that there may be greater fracture risk in this group, future population-based studies specifically examining vegans are needed. Also, future studies require examination of bone quality using techniques such as computed tomography which can more accurately

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Address correspondence to SAS (e-mail: shapses@rutgers.edu).

Abbreviations used: BMD, bone mineral density; F&V, fruits and vegetables.

predict fracture risk, and a study specifically addressing fragility fractures (rather than total fractures) should be conducted. Furthermore, because there is a scarcity of studies examining how the vegetarian diets affect skeletal growth and BMD in children (14), this population should be considered in future studies. Although intervention studies suggest that plant-based diets may reduce chronic disease risk, most do not completely eliminate meat products. Future studies addressing how plant-based diets affect bone health will be important because of the increasing numbers of vegetarians and vegans worldwide. In addition, the small sample size in previous studies and heterogeneity in study designs has complicated the interpretation, such as type of vegetarian diet and fracture type.

Understanding both the benefits and risks of long-term adherence to vegetarian and vegan diets will require ongoing attention from the research community to ultimately advise on public health policy in the prevention of osteoporosis and other chronic diseases.

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