Nut Consumption and Osteoporosis

Prof. Jordi Salas-Salvadó

PROF. JORDI SALAS-SALVADÓ
IN COLLABORATION WITH
POSTDOCTORAL RESEARCHER
DR. HÉCTOR VÁZQUEZ-LORENTE

Professor, Human Nutrition Unit (URV, IISPV, CIBERobn), and Chairman of the INC World Forum for Nutrition Research Dissemination.

Nut consumption may support bone health by providing essential nutrients that enhance bone mineral density and content, potentially reducing the risk of osteoporosis. However, further human clinical trials are needed to confirm these benefits in human populations as current evidence is primarily observational.

Osteoporosis is a skeletal disorder characterized by a reduction in bone mineral density (BMD) and bone mass content (BMC), which subsequently deteriorates bone quality and structure. This condition compromises bone strength, thereby elevating the risk of fractures.[1] As the global population ages, the annual incidence of hip fractures is projected to double between 2018 and 2050, becoming a significant public health concern, as fractures are responsible for disability and increased mortality, especially in older people. The etiology of osteoporosis is multifactorial, encompassing factors such as aging, genetic predisposition, hormonal imbalances, certain somatic diseases, prolonged immobilization, reduced physical activity, and nutritional and dietary habits, the latter being one of the main contributors.[2]

Recent research has increasingly emphasized the beneficial role of dietary habits, and specifically the consumption of nuts, in the prevention and management of osteoporosis. Among the most widely consumed nuts globally are peanuts, walnuts, almonds, hazelnuts, cashews, pistachios, macadamias, Brazil nuts and pecans.[3] These nuts are rich in essential nutrients, including calcium, magnesium, selenium, phosphorus and vitamin K, among others, which are crucial for maintaining bone health and reducing the risk of fractures.[4] Notably, some of these nutrients have been shown to help prevent osteoporosis, particularly in postmenopausal women. For instance, resveratrol, found in peanuts, has demonstrated osteoprotective properties[5] and exhibits inhibitory effects on osteoporosis.[6] Additionally, other important constituents of walnuts, such as flavonoids, phenolics and n-3 polyunsaturated fatty acids (PUFAs), play a role in regulating various bone functions, including differentiation, apoptosis and bone resorption.[7]

In relation to the effects of nut consumption on osteoporosis in animal models, Brazil nuts, which are a significant dietary source of selenium with high bioavailability, have been shown to modulate BMD in rats. Dietary selenium intake from Brazil nuts appears to be associated with higher BMD and a reduced risk of osteoporosis and hip fractures.[8] Additionally, areca nuts, which are rich in phenolic compounds and possess antioxidant properties, demonstrated a protective effect against bone loss by inhibiting the release of reactive oxygen species and bone resorption in an induced osteoporosis mouse model.[9] Furthermore, physiologically relevant doses of pistachios and mixed nuts increased tibial BMD in rats; however, these studies did not conclusively determine whether the

observed tibial differences resulted from enhanced bone formation or reduced resorption mechanisms. If these effects are confirmed in human studies, the consumption of nuts could be recommended as a therapeutic strategy to increase BMD and thereby mitigate age-related bone loss.[10]

However, despite the growing interest in the impact of nut consumption on osteoporosis, studies conducted in humans remain limited and the role of nuts in osteoporosis is currently not well understood. This stands in stark contrast to the case of prunes, for which there is an ample body of research linking consumption to bone health.[11,12] Most existing research on the link between nuts and osteoporosis is observational; therefore, causality cannot be attributed to the possible relationship. Nevertheless, some evidence suggests that the risk of low BMC is lower in adolescents who occasionally consume nuts.[13] In a cross-sectional study, nut intake was associated with increased BMD and t-score values of the lumbar spine, which also seemed to protect postmenopausal women from osteoporosis. These findings may be partly attributable to the phytate-rich components of nuts,[14] as phytates appear to offer protection against fracture risk in women with osteoporosis risk factors.[15] Additionally, it has been shown that dietary patterns including high intakes of nuts were associated with better BMD and BMC in humans.[16] A well-balanced dietary pattern that emphasizes nut consumption during adolescence has been shown to be associated with bone health during this critical period, with positive effects potentially extending into young adulthood.[17] Moreover, adherence to a traditional Mediterranean diet, which is characterized by a high intake of nuts, has been associated with a lower risk of hip fractures. This may partly explain the observed geographical variation in hip fracture incidence across Europe, where the highest rates are found in Northern Europe and the lowest in Mediterranean countries.[18] Consequently, there is a need for potential food-based strategies to improve bone health, with a focus on increasing nut consumption.[19]

> *"Integrating nuts into a balanced diet and overall healthy dietary pattern may serve as a potential strategic element in the management of bone health in humans."*

In summary, integrating nuts into a balanced diet and overall healthy dietary pattern may serve as a potential strategic element in the management of bone health in humans. This approach offers a natural and nutrient-rich method to enhance bone quality and strength, potentially reducing the risk of osteoporosis. However, clinical trials involving human populations, particularly among individuals at risk of osteoporosis, are necessary to validate and reinforce this research question, as the majority of existing studies are observational and therefore cannot establish causality.

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