



DIET QUALITY AND BONE HEALTH

Strong bones to maintain mobility and independence

While the social and economic burden of bone diseases is growing at an alarming rate, health professionals deplore the lack of prophylactic tools and the fact that less than 10% of women with fragility fractures receive any osteoporosis therapy due to several side effects. This is why they strongly advocate implementing new strategies of proven scientific and clinical value. Food has multiple assets for good compliance and research in nutrition over the past 30 years. This has led to an exciting progress supporting the hypothesis that, by modulating specific targets in the body, dietary intervention can help to achieve optimal bone health. Despite the traditional focus on calcium and vitamin D, a growing body of evidence has contributed to stress the putative bone sparing properties of a diet high in nutrient-dense foods (fruit, vegetables and whole grains), thanks to their high content in nutrients endowed with various biological properties).

This newsletter provides new insights on the extraordinary potential of fruit and vegetables for bone health.

Indeed, according to the HELENA study, in adolescents, although an overall dietary score or index is not associated with bone mineral content, specific components such as fruit or nuts may contribute to a higher bone mass.

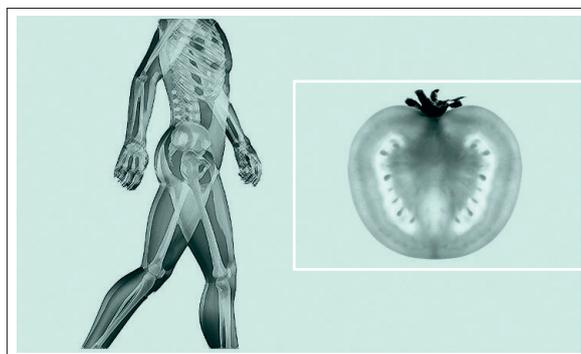
In the CHANCES project, carried out in 140,775 older adults, the consortium on health and ageing (involved in the follow-up of five cohorts) highlighted the beneficial effect of a moderate or high adherence to a Mediterranean diet on the risk of fracture.

More recently, a meta-analysis of 10 studies published in the literature confirmed that a higher consumption of vegetable-based diet intake was associated with a decreased incidence of osteoporosis. Modulation of the bone remodeling process, as well as improved calcium absorption and body inflammatory status could probably explain such benefits.

In conclusion, we can infer from those studies that population measures to encourage fruit, vegetable and whole grain consumption provide new opportunities for health professionals and have the potential to lower the burden of fracture.

V. Coxam

Research Director – INRA, France



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Mediterranean diet, diet quality, and bone mineral content in adolescents

C. Julian

Faculty of Health Science, University Isabel I, SPAIN

Different dietary patterns are currently being evaluated in adults for osteoporosis prevention and to lower future hip fractures risk^{1,2}. The Women's Health Initiative study and a Swedish cohort observed an association between a higher adherence to a Mediterranean diet - characterized by high intakes of fruit and vegetables, legumes, nuts, cereal grains and unsaturated fat, and low intakes of saturated fat and meat products- and a lower risk for hip fractures. However, in children and adolescents, the limited studies using data-driven dietary pattern approaches have found no consistent associations.



The aim of this study was to assess the associations between the Mediterranean Diet Score for Adolescents (MDS-A) and the Diet Quality Index for Adolescent (DQI-A) with bone mineral content (BMC) measured with dual-energy X-ray absorptiometry (DXA) at different bone sites – total body less head (TBLH), femoral neck (FN), lumbar spine (LS) and hip – among 179 Spanish adolescents. The DQI is based upon principles of balance and variation, considering that all foods and food groups may contribute to a healthy diet.

The MDS-A and DQI-A were calculated based on two 24-h dietary recalls from the HELENA* cross-sectional study. In addition, the associations between the diet scores and the BMC outcomes were analyzed using logistic regression models adjusting for several confounders (i.e. sexual maturation, family affluence scale, maternal education level, total lean mass and physical activity).

Mediterranean Diet Score for Adolescents (MDS-A) and bone mineral content

Results showed that only fruit and nuts and cereal and roots were found to provide significant odds ratios (ORs) with regard to BMC:

- When following the ideal MDS-A, the risk of having low FN BMC reduced by 32%, but this association lost significance when adjusting for lean mass and physical activity;
- For every 1-point increase in the **fruit and nut** and the **cereal and root components**, the risk of having low FN and BMC reduced by 67% and 56%, respectively.

Diet Quality Index for Adolescence (DQI-X) and bone mineral content

Similarly, we observed associations between some DQI-A components:

- For every 1-point increase in the **bread and cereal equilibrium or adequacy**, the risk of having low hip BMC reduced by 2%;
- For every 1-point increase in the **fruit adequacy component**, the risk of having low TBLH and LS BMC slightly decreased, but this association lost significance when adjusting for lean mass and physical activity;
- For every 1-point increase in the **fat and oil equilibrium**, the risk of having low TBLH BMC decreased by 2% when adjusting for lean mass and physical activity.

Fruit and nut intakes improve femoral neck bone mineral content

In conclusion, these findings show that an overall dietary score or index is not associated with BMC in Spanish adolescents. However, some dietary components like fruit and nut intakes may contribute to a higher FN BMC. Efforts to improve specific components of the diet from adolescence may prevent future diseases related to bone health.



* Healthy Lifestyle in Europe by Nutrition in Adolescence

Based on: Julian, C., Huybrechts, I., Gracia-Marco, L. et al. Osteoporos Int (2018) 29: 1329. <https://doi.org/10.1007/s00198-018-4427-7>

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Mediterranean diet and hip fracture incidence among older adults: the CHANCES project

V. Benetou and colleagues

Department of Hygiene, Epidemiology and Medical Statistics, School of Medicine, National and Kapodistrian University of Athens, Greece & Hellenic Health Foundation, GREECE

Prevention of hip fractures is a public health priority for the middle-aged and elderly populations worldwide. The role of dietary patterns in the promotion of bone health and the prevention of hip fractures has generated considerable interest among researchers.

Mediterranean diet and health

Traditional Mediterranean diet (MD), is characterised by the high intake of vegetables, fruit, legumes and cereals (mainly in unprocessed forms); the low intake of meat and meat products and low to moderate intake of dairy products; the moderate to high intake of fish; the high intake of unsaturated added lipids, particularly in the form of olive oil and the moderate intake of wine¹. Adherence to MD has been consistently associated with reduced total mortality and reduced incidence and mortality from cardiovascular diseases and cancer, whereas similar associations have been also reported for other chronic diseases, such as diabetes mellitus type 2 and neurodegenerative diseases².



Mediterranean diet and hip fractures

There is growing evidence that MD may also reduce hip fracture incidence. In 2013, a cohort study from eight European countries reported that higher adherence to MD was associated with lower hip fracture risk. In 2016, two large prospective cohort studies from different geographical locations also reported an inverse association between the MD and hip fracture incidence.

We have explored the hypothesis that higher adherence to MD is associated with lower hip fracture risk in a large sample of older adults living in Greece, Sweden and the US.

CHANCES: 5 cohorts - 140,775 adults aged ≥60 years old followed

The Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES*) provided a unique opportunity to investigate the specific hypothesis using harmonized data³. Five prospective cohorts with relevant data were included in this analysis. A total of 140,775 adults (116,176 women), aged ≥60 years old, were followed-up experiencing 5,454 hip fractures. Diet was assessed at baseline by validated, cohort-specific, food-frequency questionnaires and hip fractures were ascertained through patient registers or telephone interviews/questionnaires. Adherence to MD was evaluated by a MD score, on a 10-point scale, modified to be applied also to non-Mediterranean populations⁴.

Increased adherence to MD was associated with lower hip fracture risk

A two-point increase over 10 in the MD score (MDS) was associated with a significant 4% decrease in hip fracture risk. In categorical analyses, hip fracture risk was lower among men and women with moderate (MDS: 4-5) and high (MDS: 6-9) adherence to the MD score compared with those with low adherence (MDS: 0-3). The observed association was evident for both sexes (although marginally among men) after controlling for body mass index, physical activity, smoking status, educational level and other important confounders and homogeneous across the cohorts.

Current scientific knowledge provides some biologic credibility by which adherence to a MD pattern might reasonably decrease hip fracture risk. Dietary constituents of the key food groups consumed in moderate to high amounts in MD such as vitamins, phytochemicals, antioxidants, minerals and fiber, polyphenols, omega-3 fatty acids have been associated with beneficial effects on bone health and/or fracture prevention. Pathways of actions mainly work through the bone remodeling process (e.g. induction of osteoblast activity or inhibition of osteoclast activity), the absorption of calcium and body's inflammatory response⁵. Additionally, nutrient-nutrient interactions and food synergies between the individual components of a pattern consumed as whole foods have shown to exist possibly conferring an advantageous biologic activity.

In this large sample of older adults, increased adherence to MD was associated with lower hip fracture risk. Taking into account the established beneficial effects of MD to survival and prevention of major chronic diseases, adhering to a Mediterranean diet might have the additional benefit of reducing hip fracture risk.

Based on: Benetou, V., Orfanos, P., Feskanich, D. et al. Mediterranean diet and hip fracture incidence among older adults: the CHANCES project. *Osteoporosis Int* (2018) 29:1591-1599.

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Vegetable-based diets and the risk of osteoporosis in postmenopausal women

Osteoporosis - a chronic disease reflected by low bone mineral density (BMD) and a microstructural deterioration of bone tissue - is a common health problem in elderly people reaching up to 55% of the subjects aged above 55 years¹. Previous studies showed that postmenopausal women undergo a 40-50% decrease in their bone mass due to hormonal changes². Vegetable-based diet, as well as fruit, grains and other plant-based foods could be a protective factor for such a condition³. Although numerous studies evaluated the association between vegetable-based diet intake and the risk of postmenopausal osteoporosis, outcomes remain inconsistent. To assess this correlation between vegetable-based diet intake and postmenopausal osteoporosis, a team of Chinese researchers performed a meta-analysis of the updated literature.

This review reported 10 articles (4 case-controls and 6 cross-sectional studies), and included 14,247 subjects aged ≥ 55 years. Pooled odds ratios (ORs) with 95% confidence intervals were calculated.

Vegetable intake decreases the risk of osteoporosis in postmenopausal women

According to those 10 studies, postmenopausal women with the highest vegetable intake had a 27% lower risk of osteoporosis than those who have a low consumption. Significant benefits were found on subgroup analyses of case-control studies (OR=0.61), but not on subgroup analyses of cross-sectional studies (OR=0.82).

When subgroup analyses were stratified by the site of osteoporosis occurrence, positive results were found in the pooled results of:

- 2 studies that performed measurements in the femoral region (OR=0.57)

- 3 studies that performed measurements in the lumbar spine (OR=0.55).

However, the 2 studies that assessed the calcaneus and the lumbar and/or femoral region didn't show positive effects (OR=0.85 and OR=1.04, respectively).

Subgroup analyses were also stratified by investigation method for osteoporosis. The risk reduction of osteoporosis associated with vegetable intake was significant in 8 studies that used Dual energy X-ray absorptiometry (DEXA) as measurement method. However, the 2 studies that used Standardized Quantitative Ultrasound (QUS) didn't show statistically significant associations.

How vegetable-based diets lower osteoporosis risk?

Vegetable-based diets contain a series of different polyphenols, particularly flavones that stimulate the regulatory machinery involving osteoprotegerin (OPG) which plays a vital role in bone metabolism by inhibiting osteoclastogenesis and bone resorption⁴.

Vegetable-based diets are also an important source of potassium and magnesium which decrease load of dietary acids and consequently, stimulate osteoblasts functioning and inhibit osteoclasts activity. This will therefore increase bone formation and decrease bone resorption⁵.

Besides, vegetable-based diets contain large amounts of vitamin C, vitamin K and other nutrients proven to play important roles in the synthesis of bone matrix, and thus endowed with bone sparing properties⁶.

Altogether, this meta-analysis confirms that higher consumption of vegetables is associated with a lower risk of osteoporosis in postmenopausal risk.



Based on: Zeng LF, et al. Can increasing the prevalence of vegetable-based diets lower the risk of osteoporosis in postmenopausal subjects? A systematic review with meta-analysis of the literature. *Complement Ther Med.* 2019 Feb;42:302-311.

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