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Vitamin D status is critical for osteoporosis prevention

Editorial

In PRISM 2/2005, we drew your attention to the importance of vitamin D for good health beyond its role in bone metabolism. Research has shown that, north of latitude 40° (i.e. north of Madrid, Rome, Istanbul), there is not enough sunlight in winter to provide sufficient amounts of vitamin D. This puts many Europeans in a quasi-permanent suboptimal state, unless they consume vitamin-D-rich foods or supplements.

One of the conditions associated with a vitamin D deficiency is osteoporosis (known as the "silent epidemic" because it usually has no symptoms until a fracture occurs). Osteoporosis affects about 75 million people in Europe, the USA and Japan alone. According to the International Osteoporosis Foundation [1], the total direct cost of osteoporotic fractures in Europe in the year 2000

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An alliance of the European food supplement industry

(without the cost of rehabilitation, which can be as much as 2.5 times greater) was more than 30 billion Euros. This figure is expected to more than double by 2050. People with broken bones suffer severe pain and disability. For most of them, this means a loss in quality of life and independence. But for 24% of women and 33% of men, hip fracture leads to death within the following year.

Osteoporosis can be largely prevented (or at least delayed) by optimizing physical activity, sunlight exposure and nutrition. Although osteoporotic fractures usually do not occur in women until after the menopause (and after the age of 80 in men) preventive measures need to start early in life to ensure that an adequate peak bone mass is reached at adolescence. It is gradually becoming clear that current recommendations for dietary intakes of vitamin D are probably too low to ensure optimal health. Until researchers find the optimal dose, many specialists recommend taking a supplement containing 20µg (800IU) vitamin D3 (possibly together with 1000–1200mg calcium). Vitamin D3 (cholecalciferol) is the form produced naturally in humans from sunlight exposure, and is more beneficial than vitamin D2 (ergosterol) from plant sources.

Unless osteoporosis prevention and treatment becomes a priority for governments and healthcare providers, the growing number of fractures will have a serious impact on society, not just in terms of people's quality of life, but also in regard to increased expenditure for health care, rehabilitation and nursing. At last, osteoporosis research in Europe is beginning to receive the attention it deserves (as shown by the number of papers recently published, some of which are summarised in this issue of PRISM).

A. Bowley

1. http://www.osteofound.org/advocacy_policy/eu_policy_project/pdf/indicators_of_progress.pdf


NUTRITION AND BONE HEALTH

Women in northern Europe need more vitamin D

Survey

Concerned about the growing number of hip fractures in Europe (+25% over 4 years) the European Union sponsored a study of vitamin D status in 199 adolescent girls and 221 elderly community-dwelling women living in Denmark, Finland, Ireland and Poland. The serum concentrations of 25-hydroxyvitamin D (an indicator of an individual's intake and cutaneous production of vitamin D) were measured in February and March. At the same time, lifestyle parameters (including sun exposure, dietary intakes of vitamin D and calcium, and use of supplements) were recorded.

More than one-third of the adolescent girls had serum 25-hydroxyvitamin D levels below 25nmol/l and almost all (92%) were below 50nmol/l (chosen by

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the investigators as the lowest acceptable level). Two-thirds of the women had levels below 50nmol/l.

Conclusion

During winter, the vitamin D status of girls and elderly women in northern Europe is poor. To improve this situation, it will be necessary to investigate the determinants that have the largest effect. Additional vitamin D intake through supplementation or food fortification is recommended.

Source

Andersen R, Mølgaard C, Skovgaard LT et al. Teenage girls and elderly women living in northern Europe have low winter vitamin D status. Eur J Clin Nutr 2005; 59: 533–541.

Supplementation reduces falls in elderly women

Intervention

The risk of falling with subsequent bone fracture is increased in the elderly. Possible causes include muscle and bone weakness resulting from vitamin D and calcium deficiencies. To evaluate the effect of supplementation on the incidence of falls leading to hospital admission, Larsen et al. compared two prevention programmes in 9605 community-dwelling residents aged over 65 years for 3.5 years. They offered participants a choice of taking a daily supplement of 1000mg calcium and 400IU vitamin D3, home safety inspection with dietary and health advice, both or no intervention.

The supplementation program was followed by 50.3% and the environmental and health program by 46.4%. Women who took calcium and vitamin D had a 12% lower risk for severe falls.

Conclusion

This result supports the hypothesis that vitamin D and calcium supplementation can prevent falls leading to acute hospitalization in community-dwelling elderly females in a northern European region.

Source

Larsen ER, Mosekilde L, Foldspang A. Vitamin D and calcium supplementation prevents severe falls in elderly community-dwelling women: a pragmatic population-based 3-year intervention study. Aging Clin Exp Res 2005; 17: 125–132.

Supplementation improves vitamin D status in Irish women

Survey

Hill et al. assessed vitamin D status during late summer and late winter/early spring in 59 apparently healthy, free-living, postmenopausal Irish women aged between 51 and 69 years.

Serum levels of 25-hydroxyvitamin D were significantly lower ($P < 0.001$) in February/March 2002 than in August/September 2002 or February/March

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2003. Women who took a supplement containing vitamin D had higher levels than non-users. Vitamin D status was inadequate (25-hydroxyvitamin D <40nmol/l) in 17–36% of women during late winter, and in 4% during late summer. Mean daily intake of vitamin D from food sources alone was 3.2µg; from food plus vitamin D supplements it was 5.8µg.

Conclusion

In winter, suboptimal vitamin D status is common in postmenopausal Irish women. Vitamin D status could be improved, even in summertime, by taking a supplement.

Source

Hill T, Collins A, O'Brien M, et al. Vitamin D intake and status in Irish postmenopausal women. Eur J Clin Nutr 2005; 59; 404–410.

Vitamin D important for preventing osteoporotic fractures

Review

In the course of evolution, as humans moved to temperate climates, they developed a lighter skin colour to allow adequate production of vitamin D from sunlight. More recently, however, bone quantity, quality, and fracture resistance have declined following development of sedentary lifestyles. Osteoporosis occurs after the reproductive years, so there is no way that natural selection could have adapted human biology to prevent it.

Osteoporosis can be largely prevented by optimizing physical activity, the factors of environment related to vitamin D and nutrition. The role of vitamin D3 in osteoporosis was conclusively established with four randomised, placebo-controlled clinical trials, which demonstrated that supplementation with 20µg (800IU) vitamin D3 daily prevents approximately 30% of hip and non-vertebral fractures in adults older than 65 years. Intakes less than this, as well as supplementation with vitamin D2 (the form found in plants), are ineffective. The lowest average serum 25-hydroxyvitamin D concentration in any study demonstrating fracture reduction was 74nmol/L. Thus, 25-hydroxyvitamin D levels in older adults should exceed this amount.

Conclusion

Higher dietary amounts of vitamin D than those currently recommended may be needed to ensure optimal health (including balance and muscle strength) and lessen the risk of bone fractures in the elderly. Supplementation with vitamin D3 (possibly together with calcium) can help to provide vitamin D in an amount closer to the human biological requirement.

Source

Vieth R. The role of vitamin D in the prevention of osteoporosis. Ann Med 2005; 37: 278–285.

Bone biomarkers show fracture risk

Review

To establish whether biochemical markers of bone remodeling can be used to determine the effectiveness of osteoporosis prevention and treatment, Weisman and Matkovic reviewed relevant papers published between 1966 and 2004. They found that six markers of bone remodeling are positively correlated with bone mineral density and fracture risk, and that calcium supplementation has significant effects on levels of nine biomarkers (the markers of bone resorption urinary hydroxyproline, urinary pyridinoline, urinary deoxypyridinoline, urinary amino terminal crosslinked telopeptide, and urinary and serum carboxy terminal crosslinked telopeptide; the markers of bone formation serum procollagen type I carboxy and amino terminal peptides, osteocalcin, and bone-specific alkaline phosphatase).

Conclusion

Bone biomarkers can be helpful in studies of calcium supplementation to determine fracture risk.

Source

Weisman SM, Matkovic V. Potential use of biochemical markers of bone turnover for assessing the effect of calcium supplementation and predicting fracture risk. Clin Ther 2005; 27: 299–308.

Calcium supplements increase bone mass in adolescent boys

Intervention

One potential strategy for reducing the risk of osteoporotic fractures is to increase peak bone mass in young people. To study the effect of calcium intake on bone accretion in late adolescence, Prentice et al. gave a daily supplement of 1000mg calcium or a placebo for thirteen months to 143 boys aged 16–18 years, and measured bone growth and mineral accretion.

Supplementation resulted in greater bone mineral content of the whole body, the lumbar spine and the hip, and was associated with greater height, lean mass and lumbar spine bone area. The effects might have been due to faster growth.

Conclusion

Calcium supplementation can increase skeletal growth in adolescent boys. Follow-up studies are needed to show if this is due to faster growth or an effect on skeletal size that persists into adulthood. (These authors previously reported a similar effect in adolescent girls: Stear SJ, Prentice A, Jones SC et al. *Am J Clin Nutr* 2003; 77: 985–992).

Source

Prentice A, Ginty F, Stear SJ et al. Calcium supplementation increases stature and bone mineral mass of 16- to 18-year-old boys. J Clin Endocrinol Metab 2005; 90: 3153–3161.

Supplements to prevent osteoporosis not used adequately

Survey

The use of calcium and vitamin D supplements lowers the risk of osteoporotic fractures, which cost \$17 billion in the USA in 2001. Available evidence suggests that osteoporosis is widely underdiagnosed and undertreated. To establish the adequacy of supplementation in the general population, Ness et al. analysed the records of 617 women and 383 men over the age of 60 years seen at an internal medicine practice. They defined adequate supplementation according to the guidelines of the National Osteoporosis Foundation and the National Institutes of Health.

Osteoporosis or osteopenia was documented in 207 women and 21 men. Only 25 (6.5%) of the men used adequate doses of calcium, and only 8 (2.1%) used adequate doses of vitamin D. A third of the women (199) used adequate doses of calcium, and 83 (21.7%) used adequate doses of vitamin D.

Conclusion

Calcium and vitamin D are greatly underutilized in the general population of older adults attending an internal medicine clinic. Men in particular take inadequate doses.

Source

Ness J, Aronow WS, Newkirk E et al. Underutilization of calcium and vitamin D by older adults in a large general internal medicine practice. Am J Ther 2005; 12: 113–116.

PREVENTION OF CANCER

High intakes of vitamin D and calcium may prevent breast cancer

Intervention

Breast-tissue density is one of the strongest breast-cancer risk indicators, and may provide important clues about breast cancer etiology and prevention. Berube et al. evaluated the association between intakes of vitamin D and calcium (from food and supplements) to breast density in 777 premenopausal and 783 postmenopausal women.

In premenopausal women, total intakes of vitamin D and calcium were inversely related to breast density. Increments in daily total intakes of 400IU vitamin D and 1000mg calcium were associated with an 8.5% lower mean breast density. Among the postmenopausal women, intakes of vitamin D and calcium were not associated with breast density.

Conclusion

Higher intakes of vitamin D and calcium from food and supplements are associated with lower levels of breast density in premenopausal women. Increasing intakes of vitamin D and calcium may therefore represent a safe and inexpensive strategy for breast cancer prevention.

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Source

Berube S, Diorio C, Masse B et al. Vitamin D and calcium intakes from food or supplements and mammographic breast density. Cancer Epidemiol Biomarkers Prev 2005; 14: 1653–1659.

PREVENTION OF CARDIOVASCULAR DISEASE

Nutritional supplement promotes cardiovascular health**Intervention**

To measure the effects of a daily nutritional supplement on risk factors and clinical parameters, Carrero et al. treated 60 male patients with peripheral vascular disease and intermittent claudication for twelve months. Half of them consumed 500mL/d of a fortified dairy product containing low amounts of eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), oleic acid, folic acid, and vitamins A, B6, D and E in addition to their regular diet. The other half (controls) consumed 500mL/d of semiskimmed milk with added vitamins A and D.

Plasma concentrations of EPA, DHA, oleic acid, folic acid, and vitamins B-6 and E increased significantly after supplementation; plasma concentrations of total cholesterol and apolipoprotein B (ApoB; a component of LDL and VLDL, and an indicator of atherosclerosis risk) decreased, while total homocysteine decreased in those patients with high initial concentrations. Walking distance before the onset of claudication and ankle-brachial pressure index values also improved.

Conclusion

Daily supplementation with cardiovascular health-promoting nutrients improved clinical outcomes and reduced risk factors in men with peripheral vascular disease and intermittent claudication. This study provides new evidence for the potential role of nutrition in cardiovascular health.

Source

Carrero JJ, Lopez H, Salmeron LM et al. Daily supplementation with (n-3) PUFAs, oleic acid, folic acid, and vitamins B-6 and E increases pain-free walking distance and improves risk factors in men with peripheral vascular disease. J Nutr 2005; 135: 1393–1399.

Blood pressure can be lowered with folic acid**Intervention**

By reducing high plasma levels of homocysteine, folic acid supplements can help to prevent cardiovascular disease. An independent risk factor for cardiovascular disease is arterial stiffness. To investigate the effect of folic acid supplementation on blood pressure and arterial stiffness, Williams et al. enrolled 41 healthy young men with normal or high-normal blood pressure in

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a randomized, placebo-controlled, double-blind, crossover study. Participants took either 5mg folic acid or a matching placebo daily for three weeks. After a 4-week washout period, the supplements were reversed.

Folic acid significantly reduced brachial pulse pressure and increased arterial compliance without changing mean arterial pressure. The responses did not significantly correlate with plasma homocysteine or folate concentrations, and were independent of methylenetetrahydrofolate reductase (MTHFR) gene mutations. (MTHFR regulates the folate-dependent breakdown of homocysteine).

Conclusion

Folic acid is a safe and effective supplement that targets large artery stiffness and may prevent high systolic blood pressure.

Source

Williams C, Kingwell BA, Burke K et al. Folic acid supplementation for 3 wk reduces pulse pressure and large artery stiffness independent of MTHFR genotype. Am J Clin Nutr 2005; 82: 26–31.

NUTRITION IN PREGNANCY AND LACTATION

Women start folic acid supplements too late in pregnancy**Survey**

Relton et al. assessed the use of folic acid supplements in 450 women attending at the first antenatal clinic appointment at eighteen weeks of pregnancy.

Most women (89%) had taken folic acid, but only 48% had taken it before four weeks of gestation (i.e. during the critical periconceptual period). Younger and more socio-economically deprived women were much less likely to take them.

Conclusion

Future strategies should promote prenatal folic acid supplementation in women under the age of 24, in women of low socio-economic status, and in those with a family history of neural tube defects.

Source

Relton CL, Hammal DM, Rankin J et al. Folic acid supplementation and social deprivation. Public Health Nutr 2005; 8: 338–40.

Nutritional supplements may lower risk of Down's syndrome

Survey

To study the association between the use of nutritional supplements during the first month of pregnancy and the occurrence of Down's syndrome in the offspring, Czeizel and Puho compared 781 subjects with Down's syndrome and matched controls who had no defect, 22'843 subjects with other congenital abnormalities and 38'151 population controls with no defect.

Mothers who took large daily doses of folic acid (6mg) and iron (150–300mg ferrous sulfate) had a significantly lower risk of giving birth to an infant affected with Down's syndrome. Use of antioxidant vitamins in the first month of pregnancy was rare.

Conclusion

Pharmacologic doses of folic acid and iron appear to have a preventive effect against Down's syndrome.

Source

Czeizel AE, Puho E. Maternal use of nutritional supplements during the first month of pregnancy and decreased risk of Down's syndrome: case-control study. Nutrition 2005; 21: 698–704.

NUTRITION AND MENTAL HEALTH

Supplementation slows cognitive decline in elderly

Survey

Earlier studies to assess the effect of antioxidant supplementation on cognitive decline have provided conflicting results. To resolve this, Maxwell et al. examined the effect of supplementation (vitamin C, E or multivitamins) on cognitive decline (decrease in Modified Mini-Mental State score of 10 points or more) over five years in 894 elderly Canadians who had no evidence of dementia at baseline.

Those who reported taking vitamin E and C supplements and/or multivitamins at baseline experienced significantly less cognitive decline.

Conclusion

The findings suggest that antioxidant vitamins might prevent cognitive decline, but this needs to be confirmed with randomized controlled trials.

Source

Maxwell CJ, Hicks MS, Hogan DB et al. Supplemental use of antioxidant vitamins and subsequent risk of cognitive decline and dementia. Dement Geriatr Cogn Disord 2005; 20: 45-51.