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Prevention of Osteoporosis

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PREVENTION OF OSTEOPOROSIS

INTRODUCTION

At a given age, bone mass is determined by the amount of bone accumulated by the end of skeletal growth, the so called peak bone mass, and by the amount of bone lost subsequently. Thus, optimization of peak bone mass through a favourable conjunction of environmental factors could be considered as an efficient long-term prevention of osteoporosis in the elderly. Similarly measures preventing or attenuating accelerated bone loss during later life are important strategies in the prevention of osteoporosis. Besides influencing bone gain or loss, lifestyle interventions have additional extraskeletal health benefits.

BONE MASS ACCUMULATION

Peak bone mass is a significant determinant of fracture risk later in life (Fig. 1). During puberty, bone mass more than doubles. A gender difference begins to be expressed as a consequence of a more prolonged growth period in males, possibly due to the delay in pubertal maturation. Thus, males are accumulating more bone, mostly by greater bone size development. Peak bone mass is achieved for most parts of the skeleton by the end of the second decade.

R. Rizzoli

The factors contributing to the large variance in bone mass are genetics, race, gender, dietary intakes, endocrine factors, mechanical forces, or the exposure to deleterious influences. Genetic influence is detectable well before puberty with bone growth following a track throughout puberty. Nutritional intakes are able to modulate this genetic potential, with effects starting as early as *in utero*. A lower femoral neck BMD has been recorded in prepubertal former preterm girls. Furthermore, prepubertal girls seem to express benefits in bone mass long after the cessation of vitamin D supplements given during the first year of life. Calcium supplementation favourably influences bone mineral mass accumulation, particularly in the peripheral skeleton (Tab 1). Calcium supplements in prepubertal girls appear to hasten the occurrence of menarche. Protein intakes in children and adolescents are influencing bone growth and bone mass accumulation. In prepubertal boys, the favourable effects of calcium supplements are mostly detectable in those with a lower protein intake. Mechanical forces, like regular weight bearing physical exercise positively influence bone mass accrual. Environmental factors seem to affect bone accumulation at specific times during infancy and adolescence. Exposure to risk factors, various endocrine or nutritional disorders can impair peak bone mass attainment. A particular attention should be paid to avoid these deleterious influences.

AGE-RELATED BONE LOSS

After menopause, sex hormone deficiency is associated with increased remodelling rate, and negative bone balance, leading to accelerated bone loss and micro-architectural defects. Thus, thinner bone cortex together with an increment in cortical porosity, a destruction of trabecular tridimensional structure through thinning and perforation, and modifications of intrinsic tissue properties, account for age-dependent bone mineral loss, and increased bone fragility. Nutrition (calcium and/or protein insufficiency), lack of physical exercise and a series of so-called risk factors (smoking, disuse, toxics, drugs, etc) also play a role in aging-associated bone loss.

Figure 1: Fracture Risk and Aging

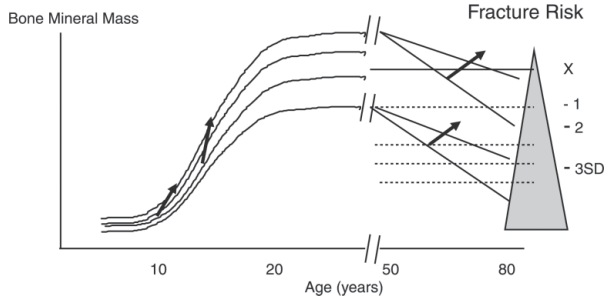

Table 1: Daily Intakes Recommendations (from: Brown & Josse, CMAJ 2002)

Age Class	Calcium (mg/d)	Vitamin D (IU/d)
Prepubertal children	800 (B)	
Adolescents	1300 (B)	
Women + Men 19–50	1000 (A/C)	400 (D)
Women > 50	1500 (A)	800 (A)
Pregnancy/Lactation	1000 (A)	400 (D)

A: RCTs + Consensus; B: RCTs (≠ Level 1) + Consensus;
C: Non-RCT ± Cohort + Consensus; D: Any Lower Level + Consensus

According to age and gender, these factors could differently affect the various bone sites and even bone envelops at the same skeletal site, with various effects on bone strength. Moreover, their influence is modulated by genetic background. The correction of these abnormalities attenuates bone loss and can reduce thereby fracture risk. Calcium and vitamin D supplements reduce falls and fracture risk. Undernutrition is often observed in the elderly. It appears to be more severe in patients with hip fracture than in the general aging population. Protein undernutrition can favour the occurrence of hip fracture by increasing the propensity to fall as a result of muscle weakness and/or by decreasing bone mass. Thus, a sufficient protein intake is mandatory for bone health. Whereas a gradual decline in calorie intake with age can be considered as an adequate adjustment to the progressive reduction in energy expenditure, the parallel reduction in protein intake may be detrimental for maintaining the integrity and function of several organs or systems, including skeletal muscles and bone. Besides bone, other systems can be damaged by protein undernutrition, and benefit from protein replenishment. Dietary protein, carbohydrate and fat enhance memory performance in the elderly. Similarly, regular physical exercise has extraskeletal health benefits, for instance on the cardio-vascular system.

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