

Osteoporosis

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1 What are bones made of and what are they for?

Bones consist of protein (collagen) and minerals (mainly calcium and phosphorus) in the form of crystalline hydroxyapatite. They are very sturdy and form the skeleton*, the structure needed for movement and for the protection of certain organs (the cranium protects the brain), to support the weight of the body and to maintain the level of calcium in the body at a constant value**.

* Ossification starts in the 8th week of pregnancy. The skeleton of a new-born baby comprises 300 bones and that of an adult 206 or 207 (some bones knit together in the intervening years).

** The level of calcium in the blood (calcemia) must remain constant. If the intake of calcium is very inadequate the body draws on the reserve constituted by the bones.

2 Why and how can one lose bone?

To maintain its strength bone is in a permanent state of destroying itself and constructing itself anew thanks to two types of cells, osteoclasts that resorb bone and osteoblasts that reconstruct it*. This remodelling of bone takes place under the influence of many factors (vitamin D, sex hormones, thyroid and parathyroid hormones, diet etc) but, like all other organs, bone is subjected to a process of aging (reduction in the level of activity of the bone cells) which accelerates the loss of bone and weakens it in the course of time.

* Throughout life man “remakes” the skeleton 4 or 5 times.

3 How does bone mass develop?

Three phases can be distinguished:

- **rapid bone growth** phase: from birth to the age of 18-20 years. This phase provides the maximum development of bone mass, depending essentially on genetic factors (about 2/3), on sex hormones (at puberty), on diet (calcium and proteins above all) and on various factors associated with lifestyle. Adolescence is the key period: in the course of 10 years the adolescent acquires 50 % of the adult bone mass.
- **plateau phase**: to about 30 years of age. In the absence of illness and with sufficient calcium- rich food and physical exercise the level of bone mass obtained by the age of 20 is maintained for about 12 years.
- **bone loss phase**: until life ends. Loss of bone (osteopenia) is a physiological phenomenon and is inescapable. It starts at around 30 years of age. In men it is a slow and uniform process (- 0.5% per year). In contrast, in women it accelerates after the menopause* as a result of the increase in activity of the osteoclasts linked to the reduction in sex hormones.

* 3-5% per year for the first 2 or 3 years after the menopause, then 1-2% per year for the next 10 years and then 0.5-1% thereafter.

4 What is osteoporosis?

Osteoporosis is an illness of the skeleton associated with a diminution of the density of the bones and disturbance of their internal architecture. The bones become thinner, more porous and more fragile and they risk breaking. This silent, painless disease is very common. It affects women primarily (30% of women after menopause suffer from it) but men, too, are not spared as they grow older.

5 What are the main risk factors?

Osteoporosis is a multi-factorial disease. It depends to a large extent on endogenous factors on which it is difficult to take action (genetics, sex, age, corpulence, hormone status, race, age at

puberty...) and external factors, which are more readily modified (diet, physical activity, lifestyle, alcohol, tobacco...).

The risk of osteoporosis is less for black women, Asiatic women and people who are short. It is higher in cases of late puberty, amenorrhoea, heavy consumption of alcohol and tobacco, in cases of endocrine, gastro-intestinal or neoplastic disturbance and also with certain medication (corticosteroids, anti convulsants, heparin, thyroid hormones...).

6 Is prevention possible?

Osteoporosis is not fatal and prevention is possible at all ages. Even if nothing can be done about genetic factors, action can be taken against external factors:

- primary prevention seeks to maximize peak bone mass. Studies show that an increase in peak bone mass of 10% reduces the risk later in life of fractures caused by osteoporosis by 50%.
- secondary prevention aims at reducing bone loss to avoid reaching the danger zone for fractures.

Prevention is based on a collection of measures involving adequate physical activity, substitute hormone treatment for menopausal women (which may be an option for certain women) and a number of nutritional factors (calcium, protein, vitamin D...).

7 What is the role of calcium?

In primary prevention the intake of dietary calcium plays a major role, 70% coming from dairy products (see References)

- observational studies show that in children and adolescents there is a positive association between calcium intake and gain in bone mass (this relationship is particularly clear before the onset of puberty.) The benefits of a high level of calcium consumption in childhood are retained throughout the rest of one's life. Thus when the consumption of milk has been significant in childhood and adolescence women between

the ages of 29 and 40 retain in general a higher bone mass and have a lower risk of fractures after 50.

- intervention studies on children and adolescents with calcium supplements also show a positive effect on bone mass*. Furthermore with calcium from milk products the beneficial effect on the bone persists for years after the higher level of consumption ceases (which is not the case for calcium supplementation in tablet form).

* These are results from studies with supplements varying between 300 and 800 mg/day over 1 to 3 years. The effects on bone are even more remarkable when the usual consumption of calcium from food is low. They also depend on age, stage reached in puberty, protein intake and physical activity.

In secondary prevention calcium serves to limit the loss of bone.

- after menopause it slows the loss of bone density and thereby reduces the risk of fractures and, at the same time, supports a major effect of perimenopausal hormone substitute treatments.
- at an older age the combination of calcium + vitamin D shows a reduction in bone loss, an increase in bone reconstitution and above all a reduction in the number of fractures of the neck of the femur or hip (even after the age of 80).
- In sum, there are enough scientific data to show that calcium plays a major role in reducing the risk of osteoporosis at all stages of life. In fact, 68 epidemiological studies have been published, 17 on children and adolescents, 40 on adults and 11 on the elderly. Three-quarters of these reports show a (beneficial) link between high levels of calcium intake and bone health. In addition 52 intervention studies show (with two exceptions, both involving adults) that increasing the intake of calcium results in a greater increase in bone mass during the period of growth, a lesser loss of bone mass or a decreased risk of fractures.

8 What is the role of proteins?

Proteins have a positive effect on bone mineral density*. Proteins stimulate the production of IGF-1, a growth factor that, in turn, stimulates bone formation. Many studies have shown a

positive association between the consumption of proteins and increase in bone mass (an effect that is even more pronounced when the intake of calcium is sufficient). Furthermore the risk of fractures linked to osteoporosis is less among people with a high consumption of protein**.

It has been possible to show, even among elderly people who have been victims of fractures of the femur, that a supplement of 20 g of milk protein every day increases the production of growth factor IGF-1 and slows the rate of bone loss.

High protein intakes can increase calcium excretion via urine at short term . Calcium excretion would occur under influence of sulphur containing amino acids that are present mainly in animal but also in plant proteins. The higher calcium excretion due to intake of protein depends on the level of calcium intake. Fear of a potential negative effect of protein on urinary calcium excretion is only valid when calcium intake is too low to balance the loss of calcium via excretion. It is also clear that an inadequate protein intake is detrimental to bone health. People with higher protein intake should consequently also increase their calcium intake. Therefore, a balanced diet including dairy products could be a good solution to maximize the calcium balance. The potential disadvantage of a higher calcium excretion caused by milk proteins is compensated by the many advantages that calcium, phosphorus, vitamin D and possibly other compounds of milk have on bone health.

In summary, proteins act on the formation of bone via a number of different factors and retard bone resorption. Proteins are essential for bone health.

* Recent studies on man do not show vegetable proteins to be superior to animal proteins in this respect; they tend to suggest the contrary.

** A diet low in protein is common amongst elderly people who suffer fractures. The shortage of protein is associated with loss in bone mineral density. It worsens the risk of fracture by weakening the muscles, thus increasing the number of falls and reducing the protective effect of soft tissues.

9 What is the role of vitamin D?

Vitamin D stimulates the absorption of calcium during digestion and improves laying down of bone. A positive association exists between the uptake of vitamin D and the gain in bone mass in the period of growth. Vitamin D associated with calcium is extra important during secondary prevention (reducing bone loss) in the elderly*.

* Vitamin D is provided by certain foods (fish liver oils, fatty fish, egg yolk, butter, full fat milk products and enriched milk products) but about 2/3 of the supply is produced by the skin under the influence of UV light. In the elderly a low level of vitamin D, associated with low levels of calcium, results in hyperparathyroidism that, in turn, results in an increase in bone resorption.

10 What role for dairy products?

Different studies show that the consumption of milk or milk products around the time of puberty increases the gain in bone mass significantly and is useful thereafter to maintain the quantity of bone tissue. In fact milk contains a combination of nutrients particularly favourable to bone formation (proteins, calcium in the form of phosphate* above all, and also vitamin D, magnesium, potassium etc)

* Inorganic phosphate is an essential component of bone. Transport of phosphate is promoted by IGF-1 which has a positive effect upon bone. It also favours the retention of calcium.

11 What advice to give in practice?

Reducing the risk of osteoporosis by means of nutrition must begin in childhood and be maintained throughout one's lifetime by means of a balanced diet that provides a sufficient supply of dairy calcium.

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