ARTIGO ORIGINAL

Why we need to eat milk products?

Porque precisamos ingerir produtos lácteos?

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ABSTRACT

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Introduction: The World Health Organization (WHO) defines osteoporosis as a systemic metabolic bone disease, characterized by the reduction of bone mass and deterioration of the micro architecture of the bone tissue. The mineral bone density in adults, an important component of bone resistance, depends on the peak of bone mass acquired and accumulated by 11 to 14-year-old girls and by 13 and 17-year-old boys. **Sources:** MEDLINE, LILACS, Scielo and PUBmed were searched for relevant Portuguese, English and spanish- language article. **Objectives:** This article revises the properties of calcium, the risk factors for osteoporosis as well as the various physiological and nutritional factors that may intervene in the bioavailability of calcium. **Results:** As a result, patients should be oriented about food rich in calcium and their daily needs. A good bone formation is considered one of the most efficient ways to prevent osteoporosis in old age.

Keywords: calcium neded, adequate calcium intake, osteoporosis, vitamin D.

INTRODUCTION

The demographic changes observed in the most developed regions in the world have been calling public attention due to deaths and diseases related to degenerative and chronic illnesses, among which one can find osteoporosis[1].

It is estimated that the percentage of chronic and degenerative non-transmissible diseases could be raised to 57% until the year 2020, including osteoporosis, also in developing countries due to the increase in the population´s life expectancy. A good bone formation is considered one of the most effective ways to prevent osteoporosis in advanced ages[3].

Women are more susceptible to osteoporosis than men (4:1), and this related to the progressive reduction in estrogen during the period of menopause, which takes to an unbalance between the formation and the bony reabsorption[1].

Independently of the demographic region or social and economic class of Brazilian men and women, a low intake of calcium and vitamin D can be verified in all population. Because of this, health workers dealing with this population must be aware of the situation and look for ways to minimize or neutralize the negative effects of the bone nutritional inadequacy[13].

It is estimated that the incidence of fractures will be four times bigger in the next 50 years, consequence of the increase in life expectancy. The clinical and public health importance of osteoporosis lies on the fact that it can be prevented, reducing, in this way, the incidence of fractures, morbidity, disability and mortality.

The importance of the bone mineral density

Osteoporosis is classified, by the World Health Organization (WHO), as a systemic metabolic bone disease, characterized by the reduction in body mass and

consequent deterioration of the micro architecture of the bone tissue; osteopenia, on its side, is defined by the reduction of bone mass, but without the compromising of the micro architecture. Both situations have, as a consequence, the increase of bone fragility and, therefore, susceptibility to fractures (table 1)[2].

The bone mineral density of adults (BMD), an important component of bone resistance, depends on the peak of bone mass acquired until the end of the second decade in life. The bone growth presents a process of maturation that goes from the first weeks of embryo life until adult (21/25 years of age). There is also report about the positive correlation between birth and childhood weight and the content and the BMD of an adult. As age advances there is a progressive reduction in bone mass, what predisposes the person to osteoporosis and its consequences. Although there is no consensus as to the age in which the peak of bone mass occurs, several authors believe that approximately 40% of the peak of bone mass is accumulated between 11-14 years in girls and between 13-17 years in boys[1,6].

The involvement of adolescence with nutrition constitutes a very important aspect for, in this phase of life, the last moment of growth acceleration takes place, and the person acquires approximately 15 % of his/her definite structure, 40% of his/her maximum skeleton mass and 50% of his/her ideal adult weight.

In Pediatrics, one considers low BMD when z-score presents itself as inferior to -2 standard deviation (SD). A study conducted by Golding et al. verified that the risk of fracture duplicates with the reduction of 1 SD in BMD[5].

Risk factors for osteoporosis

Risk factors for the development of osteoporosis and fracture follow: family history; low intake of energetic nutrients, protein, vitamins and minerals (calcium, phosphor, magnesium); previous history of fracture; low weight; female gender; white race; genetic factors; environmental factors (smoking, abusive intake of alcoholic drinks and caffeine, physical inactivity); reproduction cycle (precocious menopause, late menarche, amenorrhea); use of drugs (corticosteroid, antiepileptic, thyroid hormones, cyclosporine, antacids with aluminum); endocrinological diseases (primary hyperparathyroidism, thyrotoxicosis, *Cushing* syndrome, hypogonadism, diabetes mellitus); hematological diseases (multiple myeloma); rheumatologic diseases (rheumatoid arthritis); gastroenterological diseases (malabsorption syndrome, inflammatory bowel disease, celiac disease) and neurological diseases (dementia)[4]. Five factors were selected by the *National Osteoporosis Foundation* as being useful for the clinical diagnosis because they are easily accessible and relatively common. They are: 1) low BMD, 2) previous history of fracture after 40 years of age, 3) family history of rib, wrist or vertebrae fractures, 4) low weight below percentile 25 and 5) smoking[11].

Calcium and its properties

Among the inorganic elements, calcium is one of the most important ones for the organism. It represents 1,5 to 2% of the total corporal weight, being 90% of this amount found in the bones, 0,5% in the teeth and 0,5% in the soft tissue. It can be found in ionized form (90% of the total amount – physiologically active fraction) and non-ionized (40% connected to serum protein, mainly albumin), and 5 to 15% connected to ions, (mainly citrate and phosphate)[4].

Calcium has several essential physiological functions that include phases of blood clotting, cell communication, membrane permeability, exocytosis, endocytosis, mitosis, muscular contraction, myocardial function, neuromuscular transmission and structural support of the skeleton[1].

Several physiological and nutritional factors interfere in the bioavailability of calcium. Among the physiological factors, we have the presence of vitamin D, which raises its absorption, age, race, pregnancy (bigger absorption) and sex. Among the dietary factors, we have the presence of lactose (bigger absorption), proteins and sodium (bigger renal disposal of calcium), phytic acid (smaller calcium absorption) and balance phosphorus/calcium[1,3]. However, it is necessary to observe that high ingestions of calcium can lead to a reduction in the absorption of iron, phosphorus and zinc[15].

The availability of calcium in food can be influenced by the addition of certain substances while it is prepared for consumption.

Calcium in milk and in its derivatives is best used efficiently in comparison to calcium in vegetables. The bioavailability of calcium in non-dairy food can vary from 5% (spinach) and 50% (cabbage and broccoli); however, the high fraction of absorption of some food does not compensate the low content of this mineral. Breast milk practically double favors the absorption of calcium in relation to other kinds of milk. Children that are being breast fed or in use of infantile diary formulas, when intake at least 500 ml/Day, get an adequate ingestion of calcium[1,14].

Diet calcium is the main determinant factor in bone formation. Its deposit in the bone will depend mainly on the total amount present in food, on its intestinal absorption (time of the transit and permeability of the intestinal mucosa) and on its daily disposal. Calcium has a more efficient active absorption in the duodenum and in the proximal jejunum, where the pH is more acid; however, its absorption is bigger in the ileum, where its time permanency is bigger.

On the other hand, its disposal occurs through urine, feces and sweat[1].

The necessity of calcium varies according to age,

and it is bigger in periods of rapid growth such as adolescence (1300mg/day)[15].

The necessity of a nutrient is defined as the lowest level of continued ingestion *(*Dietary

Reference Intakes - DRI*),* which maintains the status of nutrition in a certain level, evaluated according to a certain criterion of nutritional adequacy. The DRIs can be used for planning and evaluating diets for healthy people, defining labeling and planning programs of nutritional orientation[10].

The DRI calcium was established for the first time in 1997 and took into consideration the necessary levels to prevent future osteoporosis. On the other hand, the level of adequate ingestion (*Adequate Intake*) of calcium was established with basis on the maximum retention of calcium for the different groups (table 2)[12].

The genetic contribution influences on 60 to 80% of the increase in BMD. A study conducted in Mexico demonstrated that bone mineralization received an important genetic influence on grandparents, mothers and daughters, i. e., three subsequent generations.

Physical exercises, particularly those that involve a bigger impact, demonstrate positive effects to the bone tissue, independently of the phase in life. A study conducted by Universidade Federal de São Paulo in 1997 got to the conclusion that the sufficient consumption of calcium and the adequate practice of exercises during someone´s whole life assume a protector factor against the loss of bone mass related to the process of aging [7].

The factor of growth type insulin 1 (IGF-1), a regulator of growth during puberty, is an important predictor of calcium retention along with the diet intake by teen boys[13].

The homeostasis of systemic calcium is reached by the regulation of vitamin D and by the parathormone (PHT) in the target organs (kidneys, bonés and intestine)[1].

When the concentration of plasma calcium diminishes, the PTH is liberated, as a consequence, there is an increase in the renal debugging of phosphate, raise in the renal tubular reabsorption of calcium, activation of the osteoclastic activity, bone reabsorption and activation of vitamin D[1].

Nutrological Handling of calcium and vitamin D defficiency

People must be oriented as to which food is rich in calcium and if daily needs are not achieved, they should get medicated supplementation.

Among the rich food in calcium, one that is fundamental is milk and its derivatives (ricotta, cheese, yogurt, cream cheese, butter, cream, margarine). Still with less bioavailability: oatmeal, beans, dark Green vegetables (broccoli, spinach, cabbage, watercress, ruccola), fish, among others[17].

The supplements of calcium are derived from natural products, for example, oyster shells and bones. Some of them are commercialized primarily as antacids. Carbonate and calcium phosphate have the biggest concentration of elementary calcium, around 40%. Calcium citrate contains 21%, calcium lactate 13%, calcium carbonate 40%, and calcium gluconate 9% of elementary calcium, respectively. The absorption of calcium citrate seems to be 27% bigger than calcium carbonate when taken on an empty stomach and 22% bigger when taken at meals[16].

The most common adverse events of calcium supplements are intestinal constipation and abdominal distention for excess of gases, being more frequent in the presence of calcium carbonate[16].

Magnesium has been added as nutritional supplement because some researches reveal hypomagnesaemia in women presenting osteoporosis. This is possible because magnesium, as well as other minerals, are part of the bone matrix[16].

The basal exams during treatment are creatinine and serum calcium, and calciuria. If there is hypercalcemia in evolution, the supplementation can be eliminated[16].
Under the treatment with vitamin D and calcium, even in the absence of significant increase of mineral bone density, the index of fractures diminishes dramatically.

The role of vitamin D

The plasma levels of calcium are maintained strictly in balance by the system of feedback parathyroid/vitamin D. Vitamin D is one of the nutrients that fundamentally regulate the metabolism of calcium and presents itself in two chemical ways, one synthetic (D2) and another is found in living beings (D3), or calciferol. The latter is a synthesized hormone in skin through a reaction of isomerization catalyzed by the radiation of ultraviolet solar light (UV) (290 to 315 nm), using a precursor coming from cholesterol, existing on animals´ epidermis.

With relation to the intestinal absorption of calcium, the active form of the metabolite of vitamin D $\{1,25(OH)_2D3\}$, produced in the kidneys, is the main controller of intestinal absorption. The latter has a considerable increase in its concentrations in the maximum phase of growth in adolescence. Vitamin D is produced by the skin synthesis, being the solar exposition responsible for 80-90% of the stocks of vitamin D. Although we are able to produce vitamin D, the solar light is sometimes not enough to produce the necessary daily quantity of the nutrient and this can vary according to factors such as the region of the planet, cultural and individual habits, and pre-existing diseases that make it impossible for people to be exposed to such a radiation. The need for a daily solar exposition varies from person to person, besides, nowadays patients are oriented to avoid excess of solar exposition as a

way to prevent skin cancer[15]. Some groups, particularly those older groups as well as institutionalized people, inhabitants of regions of low solar incidence or extended periods of winter, as well as those with darker skins will be more susceptible to hypovitaminosis[15].

In these cases, the diet is essential to supply the nutritional requirements of vitamin D.

Hypovitaminosis D causes disability in the mineralization of the bone matrix and insufficiency of endochondral calcification with epiphyseal non-calcified plaques. The vitaminic disability manifests itself as rachitis in children and osteomalacia in adults[4,9].

On the contrary, elevated levels of vitamin D, it is widely known, can cause tissue damages, mainly in the hepatic level.

Vitamin D is involved in the calcium, phosphorus metabolism and in the bone mineralization, and the averaage daily intake must be approximately 400 UI/day accompanied by a minimum solar exposition[4,15].

CONCLUSION

The combination of the non-transmissible chronic diseases, the mentioned aspects and the raising costs with health, make osteoporosis a relevant problem to those who are engaged in the world public health. Thus, the understanding of the process of bone mineralization leads us to search a primary prevention towards osteoporosis, the latter being considered a serious problem of public health, at high economic impacts. And although this disease manifests itself more commonly in adults and the elderly, the predisposition towards it as well as its prevention begins in childhood and adolescence[6,8].

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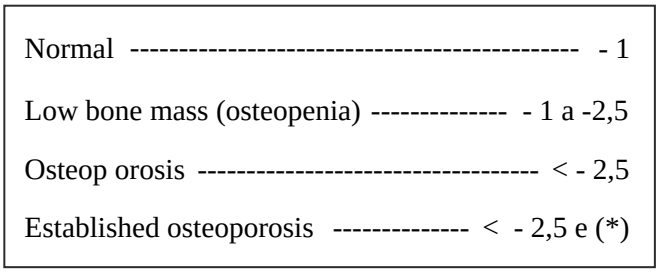
Figure 1 - Relation between fractures and bone status



(*) At least one fracture per bone fragility. Source: WHO 1994.

Table 1 - Recommendations for the intake of calcium in children and young adults according to the Dietary Reference Intakes (DRI), 2010:

AGE		INTAKE OF CALCIUM (mg/day)
Breast-fed	0-6 months	200
	7-12 months	260
Crianças	1-3 years	700
	4-8 years	1000
9-18 years		1300
19-30 years		1000
Pregnant women		1300

Table 2 - Quantity of calcium present in some food. Source: ANÇÃO MS, CUPPARI L, DRAIBE SA, SIGULEM D. Program of Support to Nutrition – NutWin.

FOOD	QUANTITY	CALCIUM
Whole, semi-skimmed or skimmed milk	1 glass (200 ml)	260mg 248mg 240mg
Iogurt	1 pot (120 ml)	203mg
Ricotta or Minas cheese	1 medium slice (30g)	206mg
Snack cheese or Mozzarella	1 slice (22,5 g)	225mg 116mg
Cream cheese	1 soup spoon (25g) 1 tip of a knife (5mg)	29mg 8mg
Cheese bread	1 medium unity (37,5g)	38mg
Oatmeal	4 level soup spoons (32,5g)	17mg
Beans	4 soup spoons (97,5g)	27mg
Dark green vegetables (watercress, ruccola, cabbage, spinach, broccoli ..)	1 full dessert dish (30g)	41mg
Cauliflower	1 full saucer (52,5g)	8mg
Fish	1 fillet and a half (165g)	22mg
Cake (any flavor)	1 medium slice (100g)	130mg
Ice cream or popsicle	2 balls (115g) 1 unity	147mg 66mg
Milk sweets (**pudding**...)	1 medium slice (100g)	111mg