Dietary calcium – strategies to optimize intake

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ABSTRACT

Calcium is an essential nutrient required for numerous biological functions. Studies have demonstrated an association between low calcium intake and chronic diseases, such as osteoporosis, colon cancer, hypertension, and obesity. However, most Brazilians do not meet the adequate intake for calcium. This review focuses on the endogenous (age, hormonal state) and exogenous (phytate, oxalate, sodium, bioactive compounds and vitamin D) factors that can influence calcium absorption. The main methods used for evaluating calcium absorption and bioavailability. The potential factors for the low calcium intake: 1) Food habits – substitution of milk for soft drinks, eating away from home and skipping meals specially breakfast; 2) High cost of dairy food. Besides, this article discuss strategies to optimize calcium intake: 1) Increase knowledge of the relationship between calcium and health and the main food sources; 2) Increase availability of calcium-fortified foods; 3) Supplement use for target groups – when and how administrate calcium salts.

Keywords: *calcium, absorption, bioavailability, intake, calcium salts.*

INTRODUCTION

The need for an adequate calcium intake has been the focus of a number of studies.[1-3] Calcium is an essential nutrient needed in biological functions such as muscular contraction, mitosis, blood coagulation, nervous or synaptic impulse transmission, and structural support of the skeleton.[4] Many studies have demonstrated that calcium intake prevents diseases like osteoporosis, hypertension, obesity, and colon cancer.[1,3]

Some studies try to explain the relation between the intake of calcium and chronic diseases. Zemel (2001) argues that the increase of calcium intake attenuates the sensitivity to salt and reduces the blood pressure, mainly in hypertensive individuals.[5] The relation between calcium and obesity is explained by $1,25(OH)_2D_3$, which stimulates the inflow of calcium inside the adipocyte resulting in the increase of lipogenesis and inhibition of lipolysis. It is believed that the production of $1,25(OH)_2D_3$ varies inversely with the calcium intake, therefore the increase in calcium intake would lead to a reduction in fat mass.[5] When it comes to cancer, evidences indicate that non-absorbed fatty acids and bile irritate the mucosa enabling the proliferation of cancerous cells. In this context, calcium can form complexes with fatty acids as well as with the bile, causing them to be harmless.[6]

The recommendations for calcium intake from several countries is shown in Table 1. Calcium requirements vary throughout an individual's life, with greater needs during the periods of rapid growth in childhood and adolescence (1,300 mg/day). In these periods, bone growth and increase of mineral deposit occur, until the peak of the bone mass is reached around the third decade of life. On adult age, the daily need of calcium is around 1,000 mg. In periods when intestinal absorption finds itself decreased or the bone reabsorption rate is increased, such as the menopause, the need of calcium raises once again (1,200 to 1,300 mg/day).[7]

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Table 1. Recommendation for calcium intake in several countries (mg/day)

Country/ organization	Babies	Children	Adolescents		Adults		Elderly
			M	F	M	F	
Australia	300 550	700 800	1,000 1,200	800 1,000	800	800	800
European Community	400	450 550	1,000	800	700	700	700
FAO/WHO	300 400	600 700	1,300	1,300	1,000	1,000	1,300
Mexico	450 600	800	1,200	1,200	800	800	800
Venezuela	210 270	500 800	1,300	1,300	1,000	1,000	1,200
United Kingdon	525	350 550	1,000	1,000	700	700	700
Food Nutrition Board	210 270	500 800	1,300	1,300	1,000 1,200	1,000 1,200	1,200
Nordic Countries	360 540	600 700	900	900	800	800	800

M=male; F= female; FAO/WHO= Food and Agriculture Organization of the United Nations/ World Health Organization; Adapted from reference 7

According to food consumption data obtained by the BRAZOS (Brazilian Osteoporosis Study) research of 2007, 90% of the interviewed reached 1/3 (400 mg) of the calcium intake preconized by the *Dietary Reference Intakes* (DRI). The use of a calcium supplement was referred by only 6% of the individuals.[8]

Considering that large proportion of the Brazilian population fail to achieve the recommended calcium intake, a better understanding of the absorption, bioavailability and the factors which can influence them, as well as how to optimize the intake of this nutrient through food sources and supplements, it is important to develop strategies to increase calcium intake.

CALCIUM BIOAVAILABILITY AND ABSORPTION

Calcium is absorbed by the gastrointestinal tract via active transport, which occurs predominantly in the duodenum and the proximal jejunum, and passive diffusion, located mainly in the distal jejunum and the ileum.[1,9]

The active component is saturatable, stimulated by $1,25(OH)D_3$ (calcitriol), regulated by dietary intake and by organ system needs. Calcitriol influences the active transport, increasing the permeability of the membrane, regulating the calcium migration through the intestinal cells, and increasing the level of calbindin (calcium transporting protein – CaBP).[1,9] The fraction of absorbed calcium increases as its intake decreases. It is a partial adaptation to calcium restriction, resulting in the increase of the active transport mediated by calcitriol. Therefore, the active transport is characterized as the main mechanism of calcium absorption when the intake of this nutrient is low.[10]

As calcium intake increases (> 500 mg/day), passive diffusion presents a greater absorption of calcium.[10] As a result, the passive process can become the predominant mechanism of absorption of great dosages of calcium, once the active transport is already saturated.[1,9] Dietary nutrients such as milk proteins and lactose, which increase the solubility and osmolarity of calcium in the ileum, tend to stimulate the passive diffusion. On the other hand, other factors (phosphates, oxalates e phytates) turn insoluble calcium into neutral pH, causing passive absorption in the ileum to be more difficult.[1]

According to Bronner (1993), bioavailability is characterized by a sequence of metabolic events that include digestibility, solubility, absorption, retention, and use by the organ system, enzymatic transformation, secretion, and excretion.[9]

Calcium bioavailability, besides being influenced by exogenous components which interfere in its absorption and excretion, is also controlled by endogenous factors like age, physiological conditions and hormonal regulation.

Exogenous Factors that Interfere in Calcium Absorption and Bioavailability

Some food constituents, such as phytates (found in cereals and seeds), oxalates (spinach and nuts), and tannins (tea), can form insoluble complexes reducing calcium absorption. However, these components seem to affect the absorption only when the diet is unbalanced.[1]

Another factor that can influence calcium bioavailability is sodium, once the elevated intake of this nutrient results in an increase of renal excretion of calcium.[11] According to predictive equations, it is believed that, to each 2 grams of sodium intake, the excretion of urinary calcium increases an average of 30 to 40 milligrams.[1] However, if the sodium intake is below 2,400 mg/day, there won't be a negative impact over bone health.[11]

Nowadays, many studies demonstrate the benefic effects of bioactive compounds in different biological processes, including the increase of calcium absorption. The nondigestible oligosaccharides (inulin, fructans etc.) are resistant to hydrolysis of the food enzymes. Once they are not hydrolyzed and absorbed in the stomach and small intestine, these components suffer partial or total fermentation when they arrive to the large

intestine.[12-14] Fermentation leads to the production of short chain fatty acids, which results in the acidification of the intestine and consequent stimulation of calcium absorption.[12,14]

Vitamin D deficiency directly affects the absorption of calcium. Vitamin D_3 (colecalciferol) is produced through cutaneous synthesis, and solar exposition is responsible for 80% to 90% of the stocks of vitamin D.[15] Vitamin D can also be acquired by by food intake sources sources of this nutrient, in the forms of vitamin D_2 (ergocolecalciferol) and vitamin D_3. Next, vitamin D, from both diet and solar exposition, has to pass through two hydroxylations to become functional in its primary biological part in the homeostasis of calcium and phosphorus. The first hydroxylation occurs in the liver, where it is metabolized into 25(OH)D_3, which can be stored or released into circulation. When the physiological demand of calcium increases, circulating 25(OH)D_3 is hydroxylized in the renal tubules to its active form 1,25 $(OH)_2D_3$.[16,17] Therefore, the low intake of food sources of vitamin D and insufficient sun exposition can interfere in the absorption of calcium.

Endogenous Factors that Interfere in Calcium Absorption and Bioavailability

The efficiency of calcium absorption is influenced by age, genetics and hormonal state among other factors.[18]

Growth hormone (GH) can promote calcium absorption indirectly activating the renal 1α hydroxylase and elevating the serum concentration of 1,25$(OH)_2D_3$.[19] It is an important mechanism during the periods of rapid growth, in which the gain of bone mass is really fast (pubertal growth spurt).[19,20]

During gestation and lactation, the physiological demand increases in 200 to 300 mg of calcium per day.[21] As a result, an increase of serum concentration of 1,25$(OH)_2D_3$ occurs and, consequently, of calcium absorption, as a compensatory mechanism to the increase of the pregnant bone remodeling.[22] During lactation, the absorption of calcium is not altered; however, there is a reduction in the excretion.[19,22]

Calcium absorption can be harmed during menopause due to the reduction of estrogen.[19] There are evidences that this hormone presents a direct effect in calcium absorption.[23] According to Gennari (1990), estrogen preserves the intestinal response to 1,25$(OH)_2D_3$.[24] Some studies suggest that its deficiency can reduce the number of vitamin D receptors (VDR).[25,26] On the other hand, reduced levels of estrogen decrease the renal excretion of calcium.[19]

Additionally, calcium absorption declines with age and especially after 75 years old.[27] Apparently this reduction is related to the sufficiency state of vitamin D which can be compromised due to the reduction of intestinal absorption of vitamin D, as well as the cutaneous synthesis and hepatic and renal hydroxylation of vitamin D.[18,27,28]

METHODS USED TO EVALUATE CALCIUM BIOAVAILABILITY

Calcium absorption, deriving from diet, fortified food or dietetic supplement, has been studied by various methods. Considering that calcium bioavailability is altered by diverse factors, the understanding of the available methods is a crucial factor. According to Heaney (1991), stating that a product is superior based on one of those methods requires the understanding of what is being measured and which are its requirements and its limitations.[29] It is important to notice that there is not an ideal method to evaluate calcium bioavailability – the choosing of the method will depend on the goal of the study, time and available resources.

Metabolic Balance

It estimates the difference between calcium oral intake and fecal excretion.[29] Therefore, it refers to the intestinal balance and not to the whole body balance.[31] The metabolic balance is an imprecise, expensive, laborious and slow method.[1,29,30] The validity of the obtained results depends on the accuracy of the parameters used to evaluate intake and excretion. Furthermore, this method supplies more satisfactory results in animal models than in humans.[31] The main disadvantage is due to the fact that this method comprehends the calcium which was not absorbed in the gastrointestinal tract and the calcium which has already been absorbed and is resecreted with the gastric juice, also known as endogenous calcium fecal loss.[29,32]

Stable and Radioactive Isotopes

A stable calcium isotope is added to the food or supplement which will be tested. We start from the premise that the isotope is completely swapped with the intrinsic calcium of the food or supplement and it is absorbed and metabolized in the same proportions.[30,33]

The most accurate methods are: direct measurement of the radioisotope calcium retention of the whole body, which presents high precision and requires little effort from the participants; administration of two isotopes, an oral one and a parenteral one, in which calcium absorption is estimated from urine and blood. This method showed to be highly precise and reproducible.[29,30,33]

However, the main limitation is the marking of the isotope, which should be preferentially intrinsic. In addition, all atoms

and molecules from the tested food should have the same probability of containing the isotope.[30] The marking can also be performed extrinsically, but food such as vegetables, which contain phytates and oxalates, can't make the swap with the isotopes.[1] Another limitation is the ionizing radiation, which should not be used in children, pregnants and lactants; in these cases, the stable isotope is the most indicated.[33] The method with isotopes reveals the absolute quantity absorbed, the gross absorption, i.e., the unidirectional flow out of the lumen and into the circulation.[30]

Serum Calcium

The serum concentration of calcium is measured after the intake of a high dosage of such nutrient. So, the results reflect the instantaneous absorption. However, the observed increment tends to be small, once the homeostasis of calcium prevents from great changes. Therefore, this method presents a low sensitivity.[30]

Urinary Excretion of Calcium

The urinary excretion of calcium is measured from 3 to 4 hours after the intake of a specific quantity of calcium (around 500 mg), reflecting the effectiveness of calcium absorption.[1,30] Nevertheless, the results reflect the momentarily absorption and depend on diverse dietetic factors that can affect the excretion of calcium such as intake of phosphorus, sodium, and protein.[1,29] It is a simple, cheap and fast method, but imprecise since it presents interpersonal variability caused by the own renal depuration.[1,30]

Kinetic Studies

They constitute a combination of the isotopes with the metabolic balance studies and provide the index of transformation among the body compartments. They are used to evaluate changes in the relation between calcium absorption, excretion and bone remodeling. Kinetic studies have showed, for instance, how absorption and bone remodeling are altered with calcium intake.[31]

In Vitro Tests

This method is used mainly to identify pharmaceutical formulations of supplements. Its biggest attractive is the low cost.[30] The first step for absorbing calcium supplement is its disintegration and dissolution in the stomach and later release of the active substance. The test is performed according to the parameters described by the United States Pharmacopeia (USP), which uses a kinetic test of dissolution in hydrochloric acid or acetic acid.[1,34] The biggest limitation of this method is the fact that it does not represent the conditions found in the gastrointestinal tract, once it does not consider nutritional and physiological facts which can influence the absorption.[1,30]

DIETARY CALCIUM

The main reasons for the low calcium intake in the Brazilian population is probably due to elevated cost, cultural and alimentary habits.

Levy-Costa *et al*. (2005) analyzed the evolution of the acquisitions of food and drink for family consumption in the metropolitan areas of the country between 1974 and 2003 through the Family Budget Survey.[35] In this study, the intake of food like milk and dairy, fruits, greenness and vegetables showed a positive association with the income of the families, showing that the food rich in calcium can cause the budget of lower income families to be onerous. In metropolitan areas, the participation of milk and dairy increased 36%, while soda had a 400% increment. Nevertheless, it is noticed that the increase of milk and dairy occurred mainly between 1974 and 1988, after that there was almost no change. On the other hand, the participation of soda has been progressively growing.[35,36]

Calcium has received special attention and nowadays is considered a political matter of public health, as it is of fundamental importance to bone and global health. Even in populations of developed countries, such as the United States, an intake of dietary calcium below the recommended is observed.[3] One of the main factors which influence calcium intake is precisely the replacement of milk by soda.[4] National Institute of Health (2000) attributed the low calcium intake to the limited intake of milk and dairy, low intake of fruits and vegetables, and an elevated intake of soft drinks with a low calcium content like soda.[37] A similar situation to the one found in Brazil by FBS 2002-2003 and an indication that in Brazil there is also a replacement of dairy beverages by soda, once its consumption increased considerably in the last years.

Another factor which influences the intake of food rich in calcium is the growing number of meals away from home. There is data indicating that the amount of calcium intake at home is larger than in restaurants and fast foods.[4] The poor availability of milk and greater availability of other beverages, like juices and soda, in these establishments contributes to meals with a lower content of calcium.[4,38]

Furthermore, skipping meals like breakfast can also compromise calcium intake, in case there is no attention in consuming a sufficient quantity of this nutrient throughout

the day.[4] Ortega *et al*. (1999) demonstrated that children who didn't eat breakfast consumed less calcium and compromised the quality of the diet.[39]

Individuals with lactose intolerance can present low intake of calcium, but also of other nutrients like vitamin A and D, riboflavin and phosphorus.[40,41] Studies highlight that these individuals can consume milk without presenting symptoms, especially if they are intake in spaces of time during the day and in combination with other foods that don't contain lactose. Aged and hard cheese, like the Swiss and the Parmesan, are usually better tolerated, as well as yogurt, particularly those with active culture, for they help to break the lactose molecules.[4] It is important to verify the individual tolerance, starting with small portions and gradually increasing them. Apparently, the incremented or continuous exposition to increasing quantities of fermentable sugar can lead to tolerance, not as a consequence of the increased production of the lactase enzyme, but maybe because of the increased colonic flora.[4,40,41]

Optimizing Calcium Intake

Calcium intake can be optimized by three ways: changes in alimentary behaviors, including the increase of food naturally rich in calcium intake; consumption of food fortified with calcium; or with the using of supplements.[42]

The priority should be given to adequate the calcium ingestion with food.[4] Nevertheless, it is a challenge to make real changes in alimentary behavior in large populations. Some strategies can be taken, like increasing the information about the importance of calcium intake for the health as well as about the main calcium food sources (Table 2).[4,42]

To most people the main calcium food source is milk and dairy. In the United States it represents 72% of the total calcium ingested.[43] The ingestion of four glasses (240 mL) of milk is enough to reach the recommendations for individuals above 50 years old. Yogurt and cheese are also good sources of calcium. Reduced-fat foods are usually recommended, and it is important to notice that there is little difference in the amount of calcium when compared to whole ones, the skimmed presenting a bit larger quantity.[44] Dark green vegetables such as broccoli and cabbage are alternative calcium sources; however, the quantity and bioavailability of calcium in these foods are smaller when compared to milk and dairy.[31]

Parents present an important influence in children concerning choices and intake of food rich in calcium, and for this reason they should give the example of healthy alimentary habits.[4] A study from Fisher *et al*. (2001) indicated that the intake of milk by mothers was a predictor of milk ingestion in their daughters.[45]

Table 2
Selected food sources of calcium – by consumed quantity[46]

Food	Portion	Weight (g)	Calcium (mg)
Milk enriched with calcium*	1 cup	240	384
Fresh cheese	2 slices	56	324
Skimmed milk	1 cup	240	322
Whole milk	1 cup	240	295
Baked sardines	2 units	50	219
Boiled spinach	1 cup	190	213
Mozzarella cheese*	1 slice	30	140
Yogurt with fruits	1 small pot	130	130
Boiled Brazilian pink beans	1 ½ serving spoon	160	109
Cream cheese	1 tablespoon	30	78
Sweet lime orange	1 unit	180	56
Tofu	2 slices	56	45
Cheese bread	2 average units	40	41
Soy-based beverage	1 cup	240	40

Adapted: Brazilian Table of Food Composition – TACO Version II, 2nd edition, 2006
* Information obtained by the manufacturers.

Considering the increasing tendency of eating away from home, it is important to develop strategies which help the consumers to make healthier choices, especially in calcium rich food.[4]

The messages on nutrition education aimed towards children and their parents should encourage the limitation of soda intake. Policies of restricting this beverage in schools should also be implemented, having the directives for the Promotion of Healthy Alimentation in schools and the directives of the National Program of Scholastic Alimentation as presupposition.[47,48]

Food fortified with calcium supplies a healthy choice to reach the recommendations. Nevertheless, a special attention should be given to the selection of the products which will be fortified, so that specific groups which present a greater difficulty in reaching the recommendations of calcium can be also reached.[42] Countries such as the United States and Canada have food fortification policies. Orange and apple juices can be fortified with calcium and they proved to be as bioavailable as the calcium in milk.[44,49] Breakfast cereals are also frequently fortified with diverse minerals including calcium.[44]

The use of supplements can also be effective in the optimization of calcium intake in individuals who didn't reach

the recommendation, however its effectiveness is limited in population studies.[42]

In Brazil, among the public policies contributing to the optimization of calcium intake are: the national program of milk distribution, scholastic lunch and inclusion of calcium carbonate in the RENAME (*Relação Nacional de Medicamentos Essenciais*/National List of Essential Drugs) list of 2008, which directs the offer and prescription of drugs in the public health system (*Sistema Único de Saúde* - SUS). Nevertheless, studies to evaluate the effectiveness of these programs in increasing the calcium intake are necessary.

CALCIUM SALTS

Although individuals should be encouraged to take calcium through diet, supplementation of this nutrient could be necessary in individuals who restrict or eliminate milk and dairy from their diet; in individuals with diseases which involve the bone metabolism; in food allergy; among others.[4] There is a debate on the ways of supplementing calcium and its different effects, mainly in groups with a high risk for fractures.[50-52] Then, the two more common calcium salts in Brazil, calcium carbonate and calcium citrate, will be discussed, as well as the best way to perform the supplementation.

Composition and Solubility

One of the differences found in the diverse types of supplements is the proportion of calcium element present in each salt. Table 3 shows the percentage of calcium element present in some calcium salts. Calcium carbonate is the salt with the higher percentage of bioavailable calcium (40%), followed by tricalcium phosphate (38%) and calcium citrate (21%).[31,34] Higher percentage of calcium implicates a lower number of pills to reach the daily needs.

Many calcium salts were commercialized as superior sources based on their solubility. So it was believed that the better the solubility was the better calcium would be absorbed.[31,51] According to Heaney (1990), solubility has a minimal influence in its absorbability.[53] Calcium carbonate is a relatively insoluble salt, while calcium citrate is substantially more soluble. Although when evaluated concerning grade of absorption, calcium carbonate and calcium citrate present similar results.[51]

Table 3
Percentage of calcium present in different salts

Calcium Salts	%
Calcium carbonate	40
Tricalcium phosphate	38
Calcium citrate	21
Calcium citrate malate	13
Calcium lactate	13

Adapted from Weaver and Heaney, 2006

Calcium Administration

It is important to consider how to administer the supplement, once this can influence its bioavailability. The effectiveness of calcium absorption decreases with the increase of ingestion. Nevertheless, the total of calcium absorbed is still greater according to an increase of the dosage.[31]

Additionally, studies have demonstrated that, depending on the supplement, the greater the fractioning of the supplementation during the day the better will be the calcium absorption. It is observed that dosages over 500 mg per day can diminish the efficiency of the absorption.[29,31,54] The state of the individual calcium, determined by the habitual ingestion of calcium, influences the effectiveness of calcium absorption.[31] Abraham (2004) demonstrated that girls with a low calcium intake presented greater efficiency in its absorption. However, the ability to adapt to the chronic low ingestion of calcium was not enough to protect the bones in most individuals.[55]

Another important factor to be considered is the moment the supplement should be ingested. Relatively insoluble preparations like calcium carbonate are not adequately absorbed when calcium is administered in fast. On the other hand, in more soluble salts like calcium citrate the absorption is not harmed and, as a result, it is the most indicated supplement to individuals with achlorhydria.[1,56] The calcium taken together with food is better absorbed. The meal provokes a greater secretion of gastric acid and slow gastric emptying allowing a better dispersion, dissolution and absorption of less soluble preparations.[8,54,56] Supplementation combined with the meal has proved to be important not only for calcium carbonate, but also to calcium salts with a greater solubility such as calcium citrate.[56]

Although the possibility of negative effects of the concomitant administration of supplement and the meal (formation of phytic acid and oxalic acid), a light meal raises in 20% to 25% the absorption of calcium salts.[29,56] When ingested with the meal, calcium carbonate and calcium citrate present a similar absorption.[51,56]

Absorption and Bioavailability

The absorption of the different calcium salts and milk are similar.[1] Although small differences can be observed, the findings

are inconsistent are due to different methodologies used for the evaluation of calcium absorption.[4,29,51,54]

It is important to highlight that the intestinal absorption does not necessarily reflects the bioavailability of calcium to the organism, since calcium should be stored and used for bone formation and mineralization.[1] Mortensen and Charles (1996) demonstrated that the bioavailability of calcium carbonate was as good as the calcium from milk.[54] On the other hand, Martini and Wood (2002) evaluated the bioavailability of calcium from milk, orange juice fortified with calcium, and calcium carbonate supplement, and the three calcium sources presented equivalent bioavailability when used for a prolonged time.[49]

Kenny (2003) compared the effects of supplementation of calcium carbonate and calcium citrate over the bone metabolism in elderly women, and both supplements increased the urinary excretion of calcium and decreased the serum concentration of PTH. However, in this study, calcium citrate revealed to be more effective in decreasing the markers of bone reabsorption.[52]

More important than solubility, absorption and bioavailability of calcium salts are the qualities of the supplement's formulation. Bad formulated compounds do not disintegrate when in contact with gastric secretions, diminishing it´s absorption.[29] The bioavailability of a determined calcium salt can vary from preparation to preparation.[54] A study performed in Brazil by Reis *et al*. (2003) found that three of the four pills of calcium carbonate studied, available in the national pharmaceutical market, didn't follow the dissolution specification preconized by the United States Pharmacopeia (USP), a concerning data that should be considered when prescribing the supplement.[34]

Among the possible side effects of calcium supplementation there are nephrolithiasis and prostate cancer. The WHI (Women's Health Initiative) study of 2006 found a significant raise (IC 1,02-1,32) of 17% on the risk of nephrolithiasis in the group that received 1,000 mg of calcium and 400UI of vitamin D per day compared to the placebo group.[57] However, the initial ingestion of the participants who received the supplementation was already elevated and apparently resulted in a total ingestion of calcium of approximately 2,000 mg/day. Another study, the Health Professionals Follow-up Study, found a greater risk of prostate cancer in individuals with an ingestion superior to 2,000 mg/day.[58] So it is important to evaluate the basal calcium intake of the individual before recommending the supplementation. Also, the supplementation of calcium is not indicated to patients with hypercalcemia and nephrolithiasis.

FINAL CONSIDERATIONS

Considering the important role of calcium over bone health, as well as its relation with non-transmittable chronic diseases, it is necessary to take special care to reach the recommendations of calcium intake. This article described the factors that can influence calcium absorption, the methodologies used to evaluate calcium absorption and bioavailability and the best approach to optimize the intake of this nutrient.

It is important to emphasize that a better understanding of the different methodologies used to evaluate calcium absorption and bioavailability can explain the differences found in the many studies that compare also different sources of calcium. Furthermore, it is important to analyze the endogenous and exogenous factors that can interfere in calcium absorption and bioavailability so that the performed interventions are more effective.

One should highlight that the best way of achieving a good health is by diversifying food. In addition, the ingestion of food like milk and dairy supply not only calcium but also other nutrients important to the organ system. Many strategies can be used to maximize calcium intake, mainly with nutrition education which emphasize a better knowledge about the meaning of calcium intake, as well as the main food sources of such nutrient. Other important step is the creation of public policies which favor the fortification of food with calcium.

However, there are some situations in which food won't be a sufficient source of calcium; in that case, supplementation should be considered. It is verified that calcium salts, when not ingested in fast, present similar absorbability. Greater fractioning of the supplement's dosage improves calcium absorption; for this reason, it should be taken throughout the day in maximum dosages of 500 mg each. Furthermore, the supplement should be taken along with a light meal to optimize its absorption, especially in the case of calcium carbonate.

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