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Calcium recommendations: why, what, who and how?

INTRODUCTION

Over the last decade, studies have raised debate about the effectiveness of calcium in our diet and the recommended levels for calcium intake.[1-6]

Dietary calcium intake of both adults and children in South Africa is far below the recommended level.[7–9] A better understanding of the absorption and bioavailability of calcium and how to enhance dietary intake from food sources could assist health professionals in effectively advising their clients on meeting the recommended intakes for dietary calcium. This review will revisit the physiologically important role of calcium, review calcium requirements as the basis for dietary recommendations and offer guidance on how these recommendations can be met specifically from food sources.

why do we need calcium?

Calcium is the most abundant mineral in the body and an essential micronutrient, which should be provided by the diet. A mature body contains about 1000 g of calcium, 99% of which is found in the bones where it forms part of the rigid skeletal structure and serves as a mineral reservoir for the blood. The residual 1% is found in extracellular fluids, intracellular structures and cell membranes, where vitamin D and the action of hormones (parathyroid and calcitonin) facilitate its role in muscle contraction, blood clotting, neural transmission and regulating blood pressure.[10-12] Apart from its physiological functions and the role in maintaining bone health, calcium has also been shown to have a role in the prevention and treatment of cardiovascular disease, certain cancers and weight management.

The body's need for calcium varies owing to relative skeletal growth and remodelling in different life stages. Calcium is critically important for bone accretion during skeletal growth and maintenance of bone mass after growth is completed. Net calcium is lost from the body when bone formation no longer keeps up with bone resorption during late adulthood.[12]

Obligatory losses of calcium occur through urine, faeces and the skin, ranging from 150–300 mg/day. These requisite losses, together with the physiological requirements for growth, can be balanced only by sufficient dietary calcium intake. If dietary calcium is inadequate, calcium is taken from the bone through the interaction of the main calcium-regulating hormones.[10,11,13] The serum calcium concentration, which is tightly regulated at 2.25–2.60 mmol/L by means of homeostatic control, is therefore maintained at the expense of bone.

how much calcium do we need?

Food-based dietary guidelines and/or nutrient reference intakes are used across the world to ensure sufficient intakes of nutrients for general good health. In South Africa, the food-based approach is used and the guideline 'Have milk, maas or yoghurt every day' has been included specifically to address the low calcium and potassium intakes of South Africans and the high prevalence of hypertension and non-communicable diseases.[14]

As part of the non-pharmacological management of patients with osteoporosis, the National Osteoporosis Foundation of South African (NOFSA) recommends daily intakes of 1000–1200 mg calcium and 800–1000 IU vitamin D. They further recommend obtaining calcium through dietary intake of low-fat dairy and suggest supplementation only when sufficient dietary intake is not possible. The calcium recommendations by NOFSA are based on dietary reference intakes (DRIs).[15]

One serving of dairy is calculated to provide 300 mg of calcium and therefore three servings of dairy per day should allow most age groups to meet their daily calcium requirements.

dairy™ 3-A-DAY EVERY DAY

Campaigns such as **3-A-Day™** dairy, which advocate the consumption of three servings of dairy as part of a daily diet, therefore encourage sufficient calcium intake among consumers.

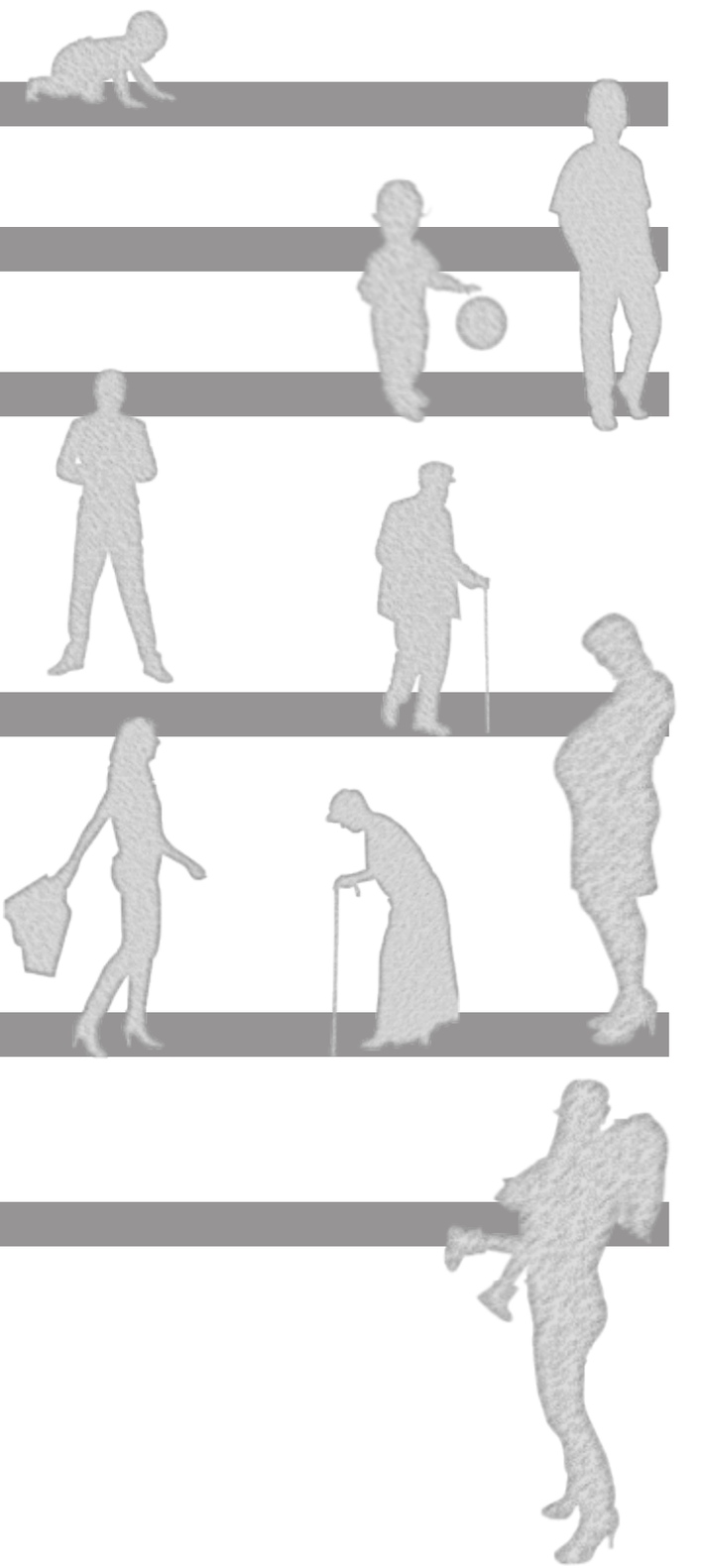
who developed the dietary reference intakes?

In 1997, the Food and Nutrition Board (FNB) of the Institute of Medicine developed a broad set of reference values for dietary nutrient intakes, including calcium, to support general good health of citizens of the United States and Canada. These DRI values replaced the previously recommended dietary allowances (RDAs), which have been published by the National Academy of Sciences since 1941.[16]

The 1997 report established only an adequate intake (AI) value for all life stage groups, but no estimated average requirements (EARs) or RDAs.[16] In 2011, the report was updated to include EARs and RDAs for all life stages, except infants.[12]
Current DRIs therefore include **AI**, **EAR**, **RDA** and tolerable upper intake level (**UL**) values.
The DRIs for calcium are given in Table 1.

Table 1: Dietary reference intakes for calcium by life stage (mg/day)[12]

LIFE STAGE GROUP	1997	2011			
	AI	AI	EAR	RDA	UL
Infants					
0–6 months	210	200			1000
7–12 months	270	260			1500
Children					
1–3 years	500		500	700	2500
4–8 years	800		800	1000	2500
Adult men					
9–13 years	1300		1100	1300	3000
14–18 years	1300		1100	1300	3000
19–30 years	1000		800	1000	2500
31–50 years	1000		800	1000	2500
51–70 years	1200		800	1000	2000
Elderly	1200		1000	1200	2000
Adult women					
9–13 years	1300		1100	1300	3000
14–18 years	1300		1100	1300	3000
19–30 years	1000		800	1000	2500
31–50 years	1000		800	1000	2500
51–70 years	1200		1000	1200	2000
Elderly	1200		1000	1200	2000
Pregnant women					
14–18 years	1300		1100	1300	3000
19–30 years	1000		1100	1000	2500
31–50 years	1000		800	1000	2500
Lactating women					
14–18 years	1300		1100	1300	3000
19–30 years	1000		1100	1000	2500
31–50 years	1000		800	1000	2500



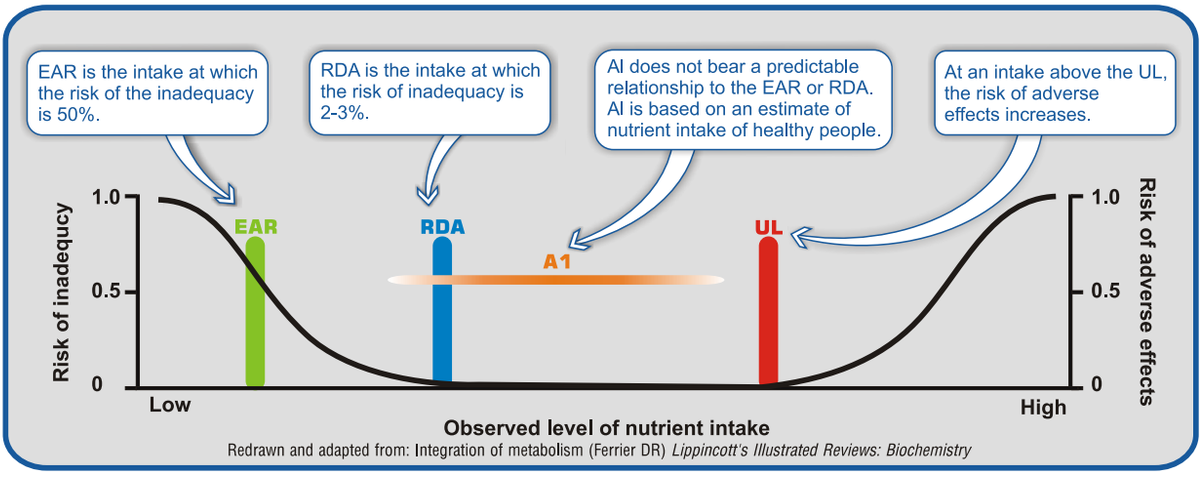
A notable similarity exists in the global and country-specific recommendations for daily calcium intake (800–1300 mg), as shown in Table 2. Recommendations relevant to South Africa are highlighted.

Table 2: Country-specific recommendation for calcium intake (mg/day)

Country/ Organisation	Infants	Children	Adolescents	Adults		Elderly >70 years	
	0–12 months	1–8 years	9–18 years	Men	Women	Men	Women
National Osteoporosis Foundation of South Africa (NOFSA)[15]	500	500 (1–5 years) 800 (6–10 years)	1200	1000	1000	1000	1200
Food Nutrition Board[12]	200 260	700 (1–3 years) 1000 (4–8 years)	1300	1000	1000 1200	1200	1200
Food and Agriculture Organization/World Health Organization (FAO/WHO)[17]	300 400	500 (1–3 years) 600 (4–6 years) 700 (7–9 years)	1300	1000	1000	1300	1300
European Community[11]	280 (7-11 months)	450 (1–3 years) 800 (4–10 years)	1150 (11–17 years)	1000 950 (>25 years)	1000 950 (>25 years)	950	950
United Kingdom[18]	525	350 (1–3 years) 450 (4–6 years) 550 (7–10 years)	1000 (boys) 800 (girls)	700	700	700	700
Australia/New Zealand[19]	210 270	500 (1–3 years) 700 (4–8 years)	1000 1300	1000	1000 1300	1300	1300

what do the components of the dietary reference intakes mean?

As shown in Figure 1, the values that make up the DRI give a relative indication of the risk of inadequacy or adverse effect at specific intakes.



Redrawn and adapted from: Integration of metabolism (Ferrier DR) *Lippincott's Illustrated Reviews: Biochemistry*

Figure 1: Comparison of the components of the dietary reference intakes[20]

EAR: estimated average requirement;
RDA: recommended dietary allowance;
AI: adequate intake;
UL: tolerable upper intake level

The **EAR** includes an adjustment for an assumed bioavailability of the nutrient and is used in establishing the **RDA.** The EAR may be used as one factor for assessing and planning the adequacy of intake by consumer groups.[12]

As the **RDA** is associated with the lowest risk for inadequacy, it should be used as a goal for dietary intake by healthy individuals and not to plan diets for groups or to assess the composition quality of diets. When insufficient scientific evidence prevents an EAR being calculated, an **AI** value rather than an **RDA** is set as a goal for the nutrient intake of individuals.[12]

The **UL** is the highest daily level at which a nutrient can be safely consumed, as applicable to the general population. It is established according to the total intake of a nutrient from food, water and supplements. The **UL**s are especially valuable because of the increasing interest in and availability of fortified foods and the increased use of dietary supplements.[12]

how are the dietary reference intakes for calcium determined?

Balance studies are commonly used to establish the requirements for individual nutrients, with the underlying assumption that the requirements for other nutrients are being met.[12] An individual's calcium balance (positive, neutral or negative) expresses the body's retention of calcium as the difference between total intake and excretion. It is based on the assumption that the body preserves the required amount of calcium and so maintains equilibrium (a null balance) between calcium intake and calcium losses. Measurement of calcium balance (or "calcium retention") can therefore reflect conditions of bone accretion, bone maintenance, or bone loss.[11–13]

Calcium balance measurements offer important guidance on calcium requirements relative to the typical intake of the population under study. However, it should be noted that the universal interpretive value of these measurements is limited owing to the cross-sectional nature and precision levels associated with the studies and the specific focus on the North American population.

The initial DRIs for calcium (1997) used bone health as indicator for setting reference values for adequacy,[16] whereas the latest DRIs (2011) are based on current scientific evidence about the role of calcium in both skeletal and nonskeletal health outcomes. Because the evidence for nonskeletal outcomes was inconsistent and inconclusive, a causal role of calcium (and vitamin D) in skeletal health provided the basis for the recommendations.[12]

The EARs and RDAs established for calcium rely primarily on calcium balance studies for people between 1 and 50 years of age.[12] The considerations underlying calcium recommendations set for the respective life stages are discussed briefly.

Infants

The AI is based on the calcium content of human milk.[12] Breastmilk contains an average of 259 mg calcium/L, translating to a calcium intake of 202 mg/day in exclusively breastfed infants (assuming an average consumption of 780 mL per day).[13] Calcium intake levels among infants were not associated with elevated calcium excretion in a feeding study, and therefore allowed for a UL to be derived for this population.[12]

Children and adolescents

Calcium recommendations for this population focus on the level of calcium intake consistent with bone accretion and a positive calcium balance.[12] For children between the age of two and eight years, the adequate intake was estimated at 800 mg/day according to balance studies, with the RDA set 200 mg higher (1000 mg) to ensure a level of skeletal retention of calcium for maximal peak bone mass. For children and adolescents between 9 and 18 years old with intakes of 1100 mg calcium per day, the daily needs for bone accretion are estimated at 92–210 mg, with maximal calcium retention around 240 mg/day in girls and 400 mg/day in boys. Calcium balance becomes negative at an intake below 700 mg/day.[13] The higher UL for children and adolescents between 9 and 18 years reflects the pubertal growth spurt.[12]

Adults

In this life stage, the recommended value for calcium intake is aimed at maintaining bone and achieving a neutral calcium balance. The different EARs and RDAs set for women aged 51–70 years are to account for the effect of menopause on bone. After the age of 70 years, the effects of aging on bone loss are similar for men and women, resulting in similar EARs and RDAs. An intake of 741 mg calcium/day has been established to maintain a neutral calcium balance in adults based on controlled calcium balance studies.

The ULs for calcium in the adult population are derived from data related to the incidence of kidney stones, mainly from studies on postmenopausal women who use calcium supplements.[12]

Pregnant and lactating women

The calcium requirements of this group are similar to that of non-pregnant and non-lactating women.[12] The development of the foetal skeleton occurs mainly in the third trimester of pregnancy and requires 200–250 mg calcium per day, which is met by the mother's increased calcium absorption rate.[13]

how does ethnicity influence calcium recommendations?

Ethnic differences in the metabolism of calcium and phosphate do exist. Redmond *et al.*[21] found that urinary calcium and phosphate excretions are lower in African Americans compared with their Caucasian peers, and in Gambians compared with their British counterparts of Caucasian descent.[21] In a study among South African women, white postmenopausal women presented with higher ionised serum calcium, lower serum parathyroid hormone and higher urinary calcium excretion levels than black women. There were, however, no ethnic differences in biochemical markers of bone formation (serum alkaline phosphatase and osteocalcin) or bone resorption (urine hydroxyproline and pyridinoline) in either the pre- or postmenopausal groups.[22]

Although there may be some biological differences in different ethnic groups' response to calcium, data are limited and the extent to which such observations may affect requirements for the nutrients is unknown at this stage. The current DRIs are based on the current understanding of the biological needs for calcium across the North American population.[12] NOFSA highlights that the established recommendations are based on a Caucasian population with a Western lifestyle. However, evidence does exists to show that African Americans and black South Africans are more efficient at conserving calcium than people of Caucasian origin, and therefore probably would not need more calcium in their diets than the recommended amounts.[15]

who are at risk for inadequate calcium intake?

Dietary calcium intakes below the recommended levels may have negative health consequences in the long term. The following groups are among those most likely to need extra calcium owing either to increased needs or to specific lifestyle choices:[10]

- **postmenopausal women**
- **amenorrheic women and the female athlete triad**
- **individuals with lactose intolerance or cow's milk allergy**
- **vegetarians**
- **patients with osteoporosis.**

how can dietary calcium recommendations be achieved?

Bioavailability of calcium depends on its absorbability and the incorporation of absorbed calcium into bone. In contrast, absorbability depends on the components of the given food item.[23] One of the strategies to optimise calcium intake is to increase the availability of calcium from foods.

Calcium absorption and bioavailability are influenced by both endogenous and exogenous factors, such as phytates, oxalates, vitamin D, sodium and bioactive compounds specifically.[24]

For example:

- Food constituents such as phytates (found in wheat bran, beans, seeds, nuts, soy isolates and fibre-containing wholegrain products), oxalates (found in spinach, nuts, cabbage, sweet potatoes, rhubarb and beans) and tannins (tea) can reduce calcium absorption by forming insoluble complexes.[24]

- Insufficient vitamin D levels due to inadequate dietary intake and sun exposure also interfere with calcium absorption.[24]

- The renal excretion of calcium increases by an average of 30–40 mg for every 2 g of sodium intake; however, a sodium intake below 2400 mg/day will not negatively impact bone health.[23,24]

- The increases in urinary calcium excretion associated with high-protein diets do not seem to be linked to an impaired calcium balance, and so have no detrimental effect on bone health. In fact, data from a systematic review by Calvez *et al.*[25] indicate that high protein intakes induce an increase of intestinal calcium absorption, promote bone growth and retard bone loss. The presence of phosphorus also decreases urinary calcium between 40-65% depending on the level of protein intake, counteracting the hypercalciuretic effect of protein intake.[25]

- Nondigestible oligosaccharides (inulin, fructans, etc.) are partially or totally fermented in the large intestine, leading to the production of short-chain fatty acids. This stimulates calcium absorption owing to the acidification of the intestine.[24]

- Calcium from dairy products is well absorbed (22–27%).[23] Lactose and certain casein phosphor peptides formed during the digestion of caseins from milk also enhance calcium absorption. The amount of absorbable calcium in various food sources is compared with that of milk in Table 3.

Table 3: Country-specific recommendation for calcium intake (mg/day)

Food	Typical serving size	Calcium content	Fractional absorption	Estimated absorbable calcium*	Servings needed to equal 240 ml milk
Unit	**gram (g)**	**milligram (mg)**	**%**	**milligram (mg)**	**Number of servings**
Milk	**240**	**300**	**32.1**	**96.3**	**1**
Beans (Red)	172	40.5	24.4	9.9	8.1
Beans (White)	110	113	21.8	24.7	9.7
Broccoli	71	35	61.3	21.5	4.5
Cheddar cheese	**42**	**303**	**32.1**	**97.2**	**1**
Spinach	85	115	5.1	5.9	16.3
Sweet potatoes	164	44	22.2	9.8	9.8
Tofu, with calcium	126	258	31	80	1.2
Yoghurt	**240**	**300**	**32.1**	**96.3**	**1**
Sardines, with bones	56	217	27	58.6	1.6
Salmon, with bones	56	135	27	36.5	2.6

*Calculated as the product of calcium content and fractional absorption

Calcium supplementation is recommended only if adequate amounts of calcium cannot be obtained from the diet. This may be the case for individuals who do not consume calcium-rich foods, because of either lifestyle choices or clinically diagnosed food intolerances or allergies. Calcium supplements are found as mineral compounds in various forms, including calcium carbonate, citrate, citrate malate, phosphate, gluconate and lactate, and also as calcium from dolomite (calcium magnesium carbonate) or bone meal. Calcium carbonate and calcium citrate are the most popular forms of supplemental calcium. The amount of elemental calcium provided by these different sources ranges from 9% (calcium gluconate) to 40% (calcium carbonate).[28]

Calcium carbonate is cost effective but should be taken with meals to ensure optimal absorption. This form of calcium supplement is, however, contraindicated in patients with achlorhydria or those taking gastric acid suppression medications such as H2 blockers or protein-pump inhibitors. Calcium citrate, which provides 21% elemental calcium, is recommended as an alternative in such cases. Calcium is best absorbed in multiple doses of not more than 500mg at a time (usually four times per day) to lower parathyroid hormone levels and decrease bone resorption.[28]

how should the calcium content on food labels be interpreted?

The nutritional information on a product can assist in choosing food products to meet calcium requirements. The calcium content of a food product is generally given per 100 g, per serving and as the percentage of nutrient reference value (NRV) per serving. According to SA labelling regulations the NRVs are defined as "a set of numerical values which are based on scientific data for the purpose of nutrition labelling and relevant claims for the general population from 37 months and older and are based on levels of nutrients associated with nutrient requirements, or with the reduction in the risk of diet-related non-communicable diseases". The NRV for calcium is set at 1300 mg. Vitamins and minerals present at less than 5% of the NRV per single serving do not need to be declared in the nutritional information table on a food product, whether occurring naturally or through addition.[29]

Apart from listing the calcium content in the nutritional information table, manufacturers are allowed to make certain nutrition claims with regard to calcium pending new legislation.*[footnote]*. These include nutrient content claims, function claims and health claims, specifically in relation to the reduction of disease risk.

A nutrient content claim is defined as one 'that describes the present level of certain micro-and macronutrients, carotenoids or energy contained in an end-product food'.[29] The following nutrient content claims for calcium are acceptable on food labels, provided that the stipulated NRV percentage is specified:

- A food can be labelled as a 'source of', 'containing' or 'with added' calcium if it contains more than 15% of the recommended NRV, that is, at least 195 mg calcium per serving.

- A food may be labelled as 'high in' calcium if it contains more than 30% of the recommended NRV, that is, at least 390 mg per serving.

- A food may be labelled as 'very high in' or an 'excellent source' of calcium if it contains more than 60% of the recommended NRV, that is, at least 780 mg per serving.

According to Regulation 429 which relates to labelling and advertising of food stuffs a function claim 'describes the physiological role and function of a nutrient or substance in growth, development and normal physiological functioning of the body'.

[The current regulation for food labelling, (Regulation 146 of Act 54 of 1972) will be replaced by Regulation 429 upon approval. At the time of writing (February 2018), the approval of the draft version of Regulation 429 was pending.]

Function claims are permitted only if the product contains at least 30% of the NRV (390 mg) per single serving.[29]

The following function claims are approved for calcium:

- Calcium is necessary to maintain healthy bones and teeth.
- Calcium is necessary for normal nerve and muscle function.

OR

- Calcium is needed for muscular growth and contraction and prevents muscle cramps.
- Calcium is necessary for normal blood coagulation (clotting).

OR

- Calcium is essential in blood clotting.
- Calcium contributes to normal energy-yielding metabolism.
- Calcium contributes to normal neurotransmission.
- Calcium contributes to the normal functioning of digestive enzymes.
- Calcium has a role in the process of cell division and specialisation.
- Calcium is important for healthy, regular heartbeat.

Claims regarding the reduction of disease risk link the consumption of a food or a food constituent (such as calcium) to the reduced risk of developing a disease or a health-related condition, seen in context of the total diet. The approved claims of this type as apply to calcium are listed in Table 4.[29]

Table 4: Claims regarding the reduction of disease risk for calcium[29]

Claim	Food characteristics or criteria	Permitted wording of claim explaining the dietary context
Calcium and osteoporosis	At least 290 mg calcium naturally present in the food per serving	Regular exercise and a healthy diet high in calcium and an adequate vitamin D status may assist to maintain good bone health and may reduce the risk of osteoporosis or osteoporotic fractures later in life.
	At least 30 mg magnesium per 100 g food	
	Phosphorus content may not exceed calcium content	
Enhanced bone mineral density	At least 200 mg calcium naturally present in the food per serving	Regular exercise and a healthy diet high in calcium and an adequate status of vitamin D and other minerals essential for bone health may assist to maintain and enhance bone mineral density and good bone health.
	At least 15 mg magnesium per 100 g food	
	Phosphorus content may not exceed calcium content	

CONCLUSION

Current scientific literature indicates a key role for calcium in skeletal health and provides a sound basis for calcium recommendations, with an emphasis on meeting calcium requirements through dietary intake. Food sources with comparable calcium contents do not guarantee similar nutritional values, owing to the presence of calcium enhancers and inhibitors in food and meals consumed. Dairy products are the most readily available source of calcium. The consumption of calcium-fortified products may help consumers achieve the recommended targets for dietary intake of calcium. Calcium supplements should be used only if dietary calcium intake is inadequate. Total calcium intake should not exceed the set UL.

REFERENCES

1. Bolland MJ, Leung W, Tai V, Bastin S, Gamble GD, Grey A et al. Calcium intake and risk of fracture: systematic review. 2015. *BMJ* . 351:h4580.
2. Weaver CM, Alexander DD, Boushey CJ, et al. Calcium plus vitamin D supplementation and risk of fractures: an updated meta-analysis from the National Osteoporosis Foundation. *Osteoporos Int* . 2016 Jan;27(1):367-76. doi: 10.1007/s00198-015-3386-5. Epub 2015 Oct 28.
3. Bolland MJ, Grey A, Reid IR. Should we prescribe calcium or vitamin D supplements to treat or prevent osteoporosis? 2015.*Climacteric.* 18(Suppl 2):22–31.
4. American Society for Bone and Mineral Research. Latest research on osteoporosis, bone fractures in men, calcium and vitamin D supplements and new treatments for bone disease released at ASBMR 2013 Annual Meeting. American Society for Bone and Mineral Research. Available from: http://www.asbmr.org/About/PressReleases/Detail.aspx?cid=285ee54c-d6c1-4940-930a-4f9e87176a7c. [Accessed on 4 September 2018]
5. Michaëlsson K. Calcium supplements do not prevent fractures. 2015. *BMJ.*351:h4825.

6. Seeman E. Evidence that calcium supplements reduce fracture risk is lacking. 2010. *Clin J Am Soc Nephrol*. 5(Suppl 1):S3–S11.
7. Labadarios D, Steyn NP, Maunder E, et al. The National FoodConsumption Survey (NFCS): children aged 1-9 years, South Africa, 1999. Pretoria: Department of Health; 2000.
8. LabadariosD, VanMiddelkoopA, editors. TheSouthAfrican Vitamin A Consultative Group (SAVACG). Children aged 6 to 71 months in South Africa, 1994: their anthropometric, vitamin A, iron and immunisation coverage status. lsando: SAVACG; 1995
9. Mchiza ZJ, Steyn NP, Hill J, et al. A review of dietary surveys in the adult South African population from 2000 to 2015. 2015. *Nutrients*. 7:8227–8250. doi:10.3390/nu7095389
10. Whitney E, Rolfes SR. *Understanding nutrition*. 14th ed. Stamford: Cengage Learning; 2016.
11. EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies). Scientific opinion on dietary reference values for calcium. 2015. *EFSA Journal*. 13(5):4101, 82 pp. doi:10.2903/j.efsa.2015.4101
12. Institute of Medicine. Dietary reference intakes for calcium and vitamin D. Washington, DC: National Academies Press, 2011.
13. Burckhardt P. Calcium revisited: Part I. 2013. *BoneKEy Rep*. 2: 433. doi:10.1038/bonekey.2013.167
14. Vorster HH, Wenhold FAM, Wright HH,Wentzel-Viljoen E, Venter CS, Vermaak M. "Have milk, maas or yoghurt every day": a food-based dietary guideline for South Africa. 2013. *S Afr J Clin Nutr*. 26(3)(Suppl):S57-S65.
15. Hough S, Ascott-Evans BH, Brown SL, Cassim B, de Villiers TJ, Lipschitz S *et al* .*National Osteoporosis Foundation* of South Africa. NOFSA guideline for the diagnosis and management of osteoporosis. 2010. *JEMDSA.* 15(3):1-188 (Supplement 1)
16. Institute of Medicine. Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride. Washington, DC: National Academies Press; 1997.
17. Food and Agriculture Organization/World Health Organization. Human vitamin and mineral requirements: Report of an FAO/WHO expert consultation. Rome: FAO; 2001.
18. British Nutrition Foundation. Nutrition requirements. 2016. Available from https://www.nutrition.org.uk/nutritionscience/nutrients-food-and-ingredients/nutrient-requirements.html.[accessed on 4 September 2017]
19. National Health and Medical Research Council, Australian Government Department of Health and Ageing, New Zealand Ministry of Health. Nutrient Reference Values for Australia and New Zealand. Canberra: National Health and Medical Research Council; 2006
20. Ferrier DR. Unit V: Integration of metabolism. Chapter 27. Nutrition. In: *Lippincott's Illustrated Reviews: Biochemistry.*6th edition. 2014. Available from: http://schoolbag.info/chemistry/biochemistr/27.html.
21. Redmond, Jarjou LMA, Zhou B, Prentice A, Schoenmakers I. Ethnic differences in calcium, phosphate and bone metabolism. 2014. *ProcNutrSoc.* 73(2):340–351.
22. Daniels ED, Pettifor JM, Schnitzler CM, Moodley GP, Zachen D. Differences in mineral homeostasis, volumetric bone mass and femoral neck axis length in black and white South African women. 1997. *Osteoporos Int.* 7(2):105–112.
23. Burckhardt P. Calcium revisited, part III: Effect of dietary calcium on BMD and fracture risk. 2015.*BoneKEy Rep.* 4: 708. doi:10.1038/bonekey.2015.77
24. Pereira GAP, Genaro PS, Pinheiro MM, Szejnfeld VL, Martini LA. Dietary calcium – strategies to optimize intake. 2009. *Rev Bras Reumatol.* 49(2):164–180.
25. Calvez J, Poupin N, Chesneau C, Lassale C, Tomé D. Protein intake, calcium balance and health consequences. 2012. *Eur J Clin Nutr.* 66:281–295.
26. Weaver CM, Proulx WR, Heaney R. Choices for achieving adequate dietary calcium with a vegetarian diet. 1999. *Am J Clin Nutr*. 70(suppl):543S–548S.
27. Titchenal CA, Dobbs J. A system to assess the quality of food sources of calcium. 2007. *J Food Compos Anal*. 20:717–724.
28. Straub DA. Calcium supplementation in clinical practice: a review of forms, doses, and indications. 2007. *Nutr Clin Pract*. 22:286–296.
29. South Africa. Department of Health. Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No 54 of 1972), Regulation R429: regulations relating to the labelling and advertising of foodstuffs: Amendment. *Government Gazette 37695.* Pretoria: Government Printer; 2014. Page 3, 6 June 2014.

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