DBN Review Nº 5
A resource about dairy-based nutrition
A product of the Consumer Education Project of Milk SA
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This review briefly explains what dietary reference intakes mean, with specific focus on how the recommendations for calcium were derived and how they apply in practice.

A publication for health professionals

Calcium *recommendations*

Calcium needs

Food-based dietary guidelines or nutrient reference intakes are used across the world to ensure sufficient intake 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.[1]

As part of the non-pharmacological management of patients with osteoporosis, the National Osteoporosis Foundation of South Africa (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).[2]

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

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. The 1997 report established only an adequate intake (AI) value for all life stage groups, but no estimated average requirements (EARs) or RDAs.[3] In 2011, the report was updated to include EARs and RDAs for all life stages, except infants. Current DRIs therefore include AI, EAR, RDA and tolerable upper intake level (UL) values. The DRIs for calcium are given in Table 1.[4] A notable similarity exists in the global and country-specific recommendations for daily calcium intake (800–1300 mg).

Table 1

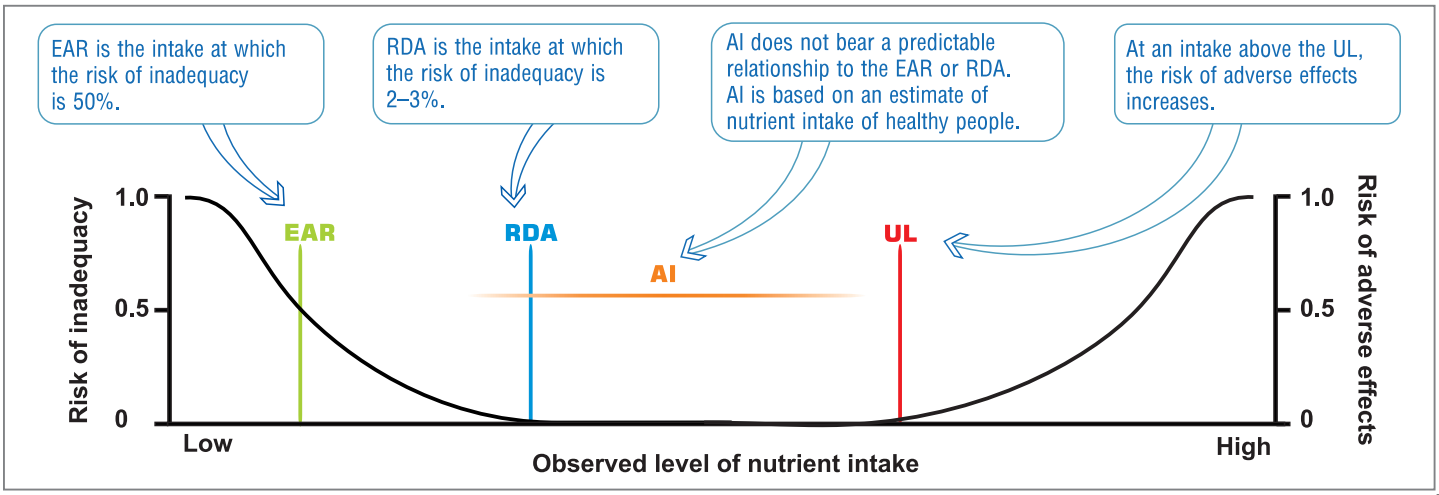
Dietary reference intakes for calcium by life stage (mg/day)[4]

	1997	2011			
Life stage group	**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

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

Components of the dietary reference intakes

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 *Lippincott's Illustrated Reviews: Biochemistry*[5]

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

Figure 1

Comparison of the components of the dietary reference intakes

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.[4]

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 from being calculated, an AI value rather than an RDA is set as a goal for the nutrient intake of individuals.[4]

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 ULs are especially valuable because of the increasing interest in and availability of fortified foods and the increased use of dietary supplements.[4]

Dietary reference intakes for calcium

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.[4] 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.[4,6,7]

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,[3] whereas the latest DRIs (2011) are based on current scientific evidence about the role of calcium in both skeletal and non-skeletal health outcomes. Because the evidence for non-skeletal outcomes was inconsistent and inconclusive, a causal role of calcium (and vitamin D) in skeletal health provided the basis for the recommendations. The EARs and RDAs established for calcium rely primarily on calcium balance studies for people between 1 and 50 years of age.[4]

Ethnicity and calcium recommendations

Ethnic differences in the metabolism of calcium and phosphate do exist. Redmond et al.[8] found that urinary calcium and phosphate excretions are lower in African Americans compared with their European peers, and in Gambians compared with their British counterparts of European descent. 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.[9]

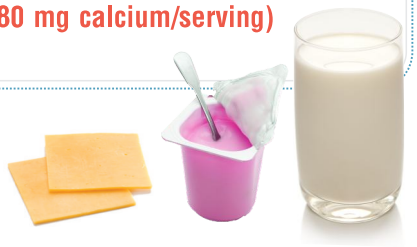
Although there may be some biological differences in different ethnic groups' response to calcium, data are limited and the extent to which such observations may affect requirements for the nutrients is unknown at this stage. The current DRIs are based on the current understanding of the biological needs for calcium across the North American population.[4] NOFSA highlights that the established recommendations are based on a white population with a Western lifestyle. However, evidence does exist to show that African Americans and black South Africans are more efficient at conserving calcium than people of European origin, and therefore probably would not need more calcium in their diets than the recommended amounts.[2]

Nutrient content claims for calcium

'source of', 'containing' or 'with added' calcium
>15% NRV (⩾195 mg calcium/serving)

'high in' calcium
>30% NRV (⩾390 mg calcium/serving)

'very high' or an 'excellent source' of calcium
>60% NRV (⩾780 mg calcium/serving)



Choosing food products to meet calcium requirements

The nutritional information on a product's packaging can help consumers to choose food products for meeting their 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. The NRV for calcium is set at 1300 mg.[10]

Apart from the calcium content being listed in the nutritional information table, certain nutrition claims with regard to calcium, including nutrient content, function and health claims, specifically in relation to the reduction of disease risk (Table 2), are allowed. Function claims (e.g. 'Calcium is necessary to maintain healthy bones and teeth') are permitted only if the product contains at least 30% of the NRV per single serving[10] (390 mg in the case of calcium).

Table 2

Claims regarding calcium for reducing disease risk[10]

Calcium	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 • At least 30 mg per 100 g food • Phosphorus content may not exceed calcium content	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.
Enhanced bone mineral density	• At least 200 mg calcium naturally present in the food per serving • At least 15 mg magnesium per 100 g food • Phosphorus content may not exceed calcium content	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.

References

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