

# calcium

## FACT SHEET



## Importance for health

### Bone health

Osteoporosis is a chronic, progressive, bone disease that can affect the entire skeleton. It reduces bone mass and disrupts bone microarchitecture resulting in reduced bone strength and increased fracture risk. It is often characterized as a "silent" disease because it may go unnoticed as long as no symptoms appear. The disease is preventable, but because there are only few warning signs until fractures occur relatively few people are aware of its presence during early phase. It is an extremely prevalent disease in Europe. Around 1 in 8 European citizens over the age of 50 have spinal fractures. One in 3 women and 1 in 9 men over the age of 80 will have a hip fracture.<sup>1</sup>

Calcium, together with adequate intake of vitamin D, is essential in the process of bone formation. The variation in bone mass can be ascribed to a wide range of factors, including genetics, smoking, excessive alcohol intake, physical activity, dietary habits and other life style factors account for 20% of that variation.<sup>2</sup> The importance of dietary factors should not be understated. It has been estimated that a 5% difference in peak-bone-mass will result in a 40% decrease in simple fractures.<sup>2</sup> Optimisation of peak bone mass through adequate calcium intake has been recognized as the most effective way to reduce risk of osteoporotic fractures later in life.<sup>3</sup> Trials have shown that supplementation with calcium may increase bone mineral accretion in children and adolescent girls.<sup>4,5,6</sup> The extent to which an intake above the level that allows the normal mineralisation of the bones can provide further benefits for the bones has been the subject of considerable discussion and the critical amount of calcium needed is not agreed upon. The most convincing results have been found when calcium supplementation has been given together with vitamin D<sub>7</sub> probably due to the key role of vitamin D in calcium absorption.

### Mineralisation of teeth

The substance of the teeth is mainly composed of bone-like material composed of a cellular, protein-containing matrix (hydroxyl-apatit) in which calcium salts are deposited.

### Regulation of nerve excitability

The excitability of nerve and muscle cells is caused by changes in sodium and potassium conductance producing an action potential. A decrease in extracellular calcium increases the excitability by decreasing the amount of depolarisation necessary for the action potential, while an increase in extracellular calcium "stabilizes" the membrane by decreasing excitability. Change in calcium availability is regulated via voltage-gated calcium channels.

### Control of muscle contraction

Calcium is involved in the initiation of contraction of smooth muscle, as it is in skeletal muscle.

### Blood coagulation

Activation of the blood coagulation system is dependent on the presence of calcium ions. Blood coagulation is initiated by intimal injury and causes expression of the so-called tissue thromboplastin factor. The key blood coagulation factor VII will, if complexed with tissue thromboplastin factor and in the presence of calcium further activate the coagulation cascade.

### Premenstrual syndrome

Studies have suggested that disturbances in calcium regulation may underlie the pathophysiologic characteristics of premenstrual syndrome and that calcium supplementation may be a simple, safe and effective therapeutic approach.

### Calcium and vitamin D

Primary calcium deficiency due to low calcium intake is a rather rare occurrence in most Western countries. Most often, hypocalcaemia is part of a hypovitaminosis D complex due to low exposure to sunshine and/or inadequate intake of vitamin D. Thus hypocalcaemia typically occurs together with hypovitaminosis D and is characterised by a serum calcidiol level below 10 ng/ml. Calcium and vitamin D supplementation decreases serum PTH and consequently bone resorption, particularly in individuals with a low dietary calcium intake and/or vitamin D insufficiency.

1 European Commission Employment and Social Affairs, Building Strong Bones and Preventing Fractures: Summary Report on Osteoporosis in the European Community - Action for Prevention, (1998), 4-6.  
2 Lemann J, Pleuss JA, Gray RW. Potassium causes calcium retention in healthy adults. J Nutr 1993;123:1623-1626.

3 Matkovic V, Ilic JZ. Calcium requirements for growth: Are current recommendations adequate? Nutr Rev 1993; 57: 171- 180.  
4 Lee WTK, Leung SSF, Wang SH et al. Double-blind controlled calcium supplementation and bone mineral accretion in children accustomed to a low-calcium diet. Am J Clin Nutr 1994; 60: 744-750.

5 Bonjour JP, Carne AL, Ferrari S et al. Calcium-enriched foods and bone mass growth in prepubertal girls: A randomized double blind placebo controlled trial. J Clin Invest 1997; 99: 1287- 1294.  
6 Lloyd T, Andon MB, Rollings N et al. Calcium supplementation and bone mineral density in adolescent girls. JAMA 1993; 270: 841-844.

7 Chapuy MC, Arlot ME, Duboeuf F, et al. Vitamin D3 and calcium to prevent hip fractures in elderly women. N Engl J Med 1992;327:1637- 1642.

# Calcium

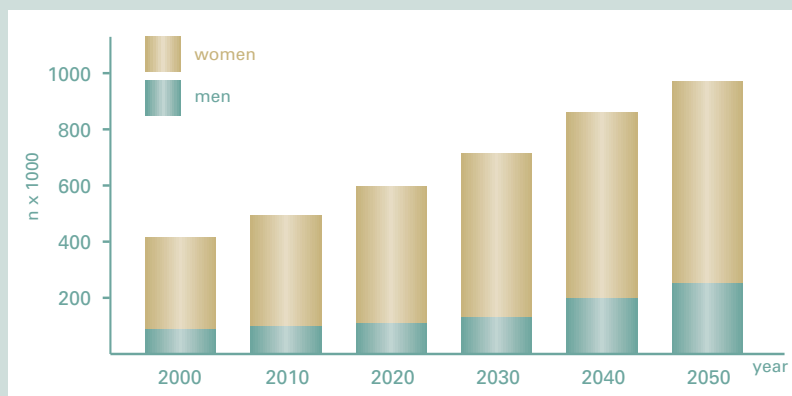


## The social impact of osteoporosis

The European Commission has predicted dramatic increases in the future of the number of people likely to suffer hip fractures due to osteoporosis (see Figure 1 – incidence of hip fracture).

As a result, it estimates that the percentage of hospital beds required for patients with spine or hip fractures will rise from 0.88% to 1.97% which would prove to be an enormous burden on hospital services throughout the European Community.<sup>1</sup>

Fig 1. 50 year forecast for hip fracture in the European Union<sup>8</sup>



## Dietary sources

The most important dietary sources of calcium are milk and milk products, dried fruits and pulses (see Table 1). Vegetables, bread, cereals, meat and fish may contribute significantly to the intake of calcium for people not consuming milk and dairy products, although additional calcium from supplements may be required.

Table 1: Food sources of calcium<sup>8</sup>

Food	Serving	Calcium (mg)
Milk	100 ml	130
Yoghurt	100 g	130
Cheddar Cheese	50 g	360
Red beans	100 g, cooked	45
Chinese cabbage	100 g, cooked	590
Broccoli	100 g, cooked	70
Spinach	100 g, cooked	150
Rhubarb	100 g, cooked	200
White fish	100 g, cooked	10
Oily fish	100 g, cooked	20-60
Bread	100 g	10-70
Meat	100 g, cooked	10-15
Dried fruit	100 g	300



## Recommended intakes

In general recommended intakes for calcium range between 600 and 1000 mg/day for adults (Table 2) and between 400 and 800 mg/day in young children. Sufficient dietary intake of calcium during childhood is associated with increased bone mass in adulthood and a reduced risk of fracture later in life. Calcium supplementation augments the rate of increase in bone mineral density and may also further reduce fracture risk.<sup>9</sup> Postmenopausal women and elderly men are at an increased risk of osteoporosis. Due to the low energy intake in the elderly, supplements of calcium and vitamin D are recommended.<sup>10</sup> Higher intake may also be beneficial for smokers as smoking is associated with bone loss and osteoporotic fracture. This may be due to decreased calcium absorption efficiency.<sup>11</sup>

**Table 2: Recommended Dietary Allowances (RDA) of calcium (mg) for adults in Europe<sup>12</sup>**

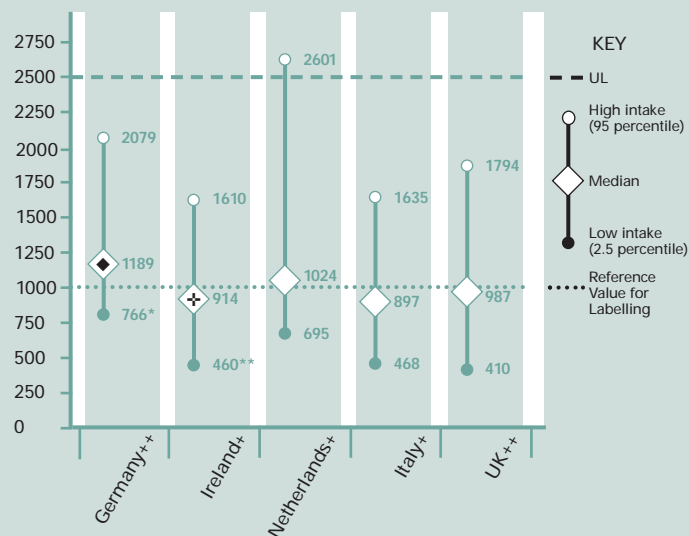
Country	Adults (mg/day)
Belgium, 2000	900
DACH*, 2000	1000
France, 2001	900
Netherlands, 2000	1000
Nordic countries, 1996	800
Portugal, 1982	800
Spain, 1994-1998	600-850
UK, 1991	700
EU Reference Labelling Value, 2003	1000

\* Recommendations for Germany, Austria and Switzerland

## Current intakes

Austrian data demonstrates inadequate average intakes in all age groups among women and in all men except those aged 26-35 years.<sup>13</sup> A similar situation can be seen in the UK, where 77% of women and 52% of men do not achieve recent recommendations of intake at 1000 mg/day<sup>14</sup> and in Italy where 75% of Italian women and over 50% of men also fail to achieve this level of intake. In the Netherlands, by contrast the majority of the population do meet daily recommendations (see Table 2).<sup>15</sup>

**Fig 2: Average daily intake of calcium for adult men (mg) – (intake from all sources including food supplements\* or excluding food supplements+).**<sup>14,15,16,17,18</sup>



◆ 10 and 90 percentile given, + 5 and 95 percentile given

9 Johnston CC, Miller JZ, Slememda CW, et al. Calcium supplementation and increases in bone mineral density in children. *N Engl J Med* 1992; 327: 82-87.

10 Gennari C. Calcium and vitamin D nutrition and bone disease of the elderly. *Public Health Nutrition* 2001; 4: 547-559.

11 Krall EA, Dawson-Hughes B. Smoking increases bone loss and decreases intestinal calcium absorption. *Journal of bone and mineral research* 1999; 14: 215-220.

12 EC Scientific Committee on Food: Opinion of the Scientific Committee on Food on the revision of reference values for nutrition labelling (2003).

13 Institut für Ernährungswissenschaften, Österreichischer Ernährungsbericht (1998).

14 UK Office for National Statistics, The National Diet & Nutrition Survey (NDNS) (2003).

15 Gezondheidsraad, Enkele belangrijke ontwikkelingen in de voedselconsumptie (2002).

16 Robert Koch Institut. Was essen wir heute? Beiträge zur Gesundheits berichterstattung Cles Bundes (2002).

17 Irish Universities Nutrition Alliance (IUNA), The North-South Ireland Food Consumption Survey (2001).

18 Turrini A, Saba A, Perrone D, Ciaffa E, & D'Amico A. Food Consumption Patterns in Italy: the INN-CA Study 1994-96. *European Journal of Clinical Nutrition*, 55, 7(2001) 571-588.

## Food supplements

Food supplements containing calcium are often pure calcium products oriented at maintaining bone health. Multivitamin and mineral products will also generally contain calcium. A survey of UK dietary patterns found that calcium supplements provide on average between 1% and 12% of total calcium intake. The greatest recorded daily intake of calcium from supplements was 324 mg/day in women in the UK aged 50-64 with the highest level of intake (97.5 percentile).

Country	Calcium content (mg/day)
Austria	200 – 1000
Belgium	120 – 1600
Denmark	200 – 800
Finland	200 – 800
Germany	200 – 800
Netherlands	200 – 1500
Norway	200 – 1500
Sweden	150 – 800
UK	400 – 1200

**Table 3: Range of calcium content in food supplements on free sale (via health stores and supermarkets) in the EU<sup>19</sup>**

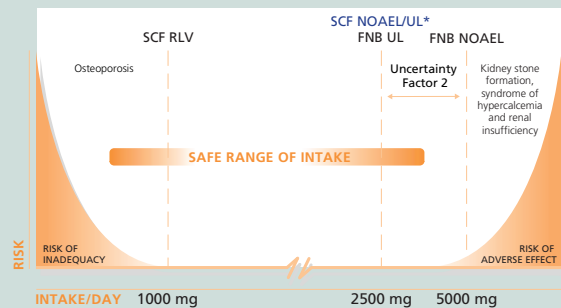
## Food fortification

Food such as bread, baked products and breakfast cereals are fortified with calcium in Europe. In the UK, the legal requirement to add calcium to white and brown flour contributes around 10% to the calcium intakes of many adults. In a number of Member States fruit juice based drinks are frequently fortified, for example, in Germany and Austria where approximately 25% and 19% respectively of fruit juices on the market are fortified.<sup>20</sup> These beverages are a popular breakfast drink in these countries and make an important contribution to the daily nutrient intake of many adults and teenagers. For a number of consumers who do not eat or drink dairy products the enrichment of "non milk based" beverages with calcium is important to ensure adequate intakes. In accordance with EU legislation calcium is also added as defined to specific foodstuffs for particular nutritional uses, for example, formulae milks, meal replacers and dietetic supplement drinks.

## Safety

Excessive intakes of calcium may lead to hypercalcaemia and renal insufficiency (Milk-Alkali Syndrome or MAS). The EC Scientific Committee established a No Observed Adverse Effect Level (NOAEL) of 2500 mg/day on the basis of a large number of long-term studies based on this level of intake. It considered that given the extent of the available database, no uncertainty factor needed to be applied and therefore established a Tolerable Upper Intake Level (UL) of 2500 mg/day for calcium from all sources of intake. The same level of 2500 mg/day has been established as a UL by the Food and Nutrition Board of the Institute of Medicine.<sup>21</sup> Guidance set by the UK Expert Group on

Vitamins and Minerals recommends that there is no risk associated with daily supplemental dosages of 1500 mg/day.<sup>22</sup>



\* No uncertainty factor applied due to extensive database

<sup>19</sup> Market survey undertaken by the European Responsible Nutrition Alliance in 2001-2003.

<sup>20</sup> Deloitte & Touche, Study to evaluate the functioning of the principle of mutual recognition in selected sectors: Canned food, alcohol free beverages and beer, and fortified or vitamin products (July, 2002).

<sup>21</sup> Institute of Medicine, Food and Nutrition Board. Calcium. In: Dietary Reference Intakes for Calcium, Phosphorous, Magnesium, Vitamin D, and Fluoride (1999).

<sup>22</sup> Report of the UK Expert Group on Vitamins and Minerals (2003).