

magnesium

FACT SHEET



Importance for health

Magnesium is involved in about 300 enzymes and plays an important role in the body's metabolism, including muscle tension, the regulation of blood pressure and bone cell function.

Muscle cramps

Calcium and magnesium are essential for the contraction or relaxation of the muscle. If magnesium is not available in adequate amounts, it is probable that the muscle contracts constantly or earlier and relaxation does not occur. Research suggests that magnesium supplementation can lead to a lower frequency or even prevent muscle cramps.^{1,2}

In addition, magnesium is thought to affect the tone of blood vessels and is able to change the tension that normally exists.^{2,3,4} A deficiency in magnesium may be a risk factor for preeclampsia, because magnesium can support vasodilation. For example Kisters et al. found, in a small-scale study, significantly lower plasma and intracellular magnesium concentrations in pregnant and preeclamptic women.³

Headaches

According to Altura and Altura, tense muscles in the neck or head might be a cause of headaches together with widened or cramped vessels or changed pressure in the head. About 70% of persons with migraine or tension type headaches have cramped or weak muscles, and it was estimated that magnesium is influential in about half of these headache attacks.^{1,5} Moreover, low magnesium concentrations in blood have been reported in migraine patients between attacks.^{1,5} Peikert et al. have shown with 68 patients that 600 mg magnesium for a 12-week period could reduce the frequency of migraines in the last 4 weeks by 41,6% (placebo 15,8%). A significant decrease in drug consumption was also detected. The duration and intensity of the attacks decreased, but not significantly.⁶

Blood pressure

Epidemiological studies have shown that magnesium may be an important factor in maintaining normal blood pressure. When dietary magnesium intakes are low, a higher risk for hypertension has been detected.^{2,4,7} Observational studies have often found an inverse relation between magnesium and hypertension, but intervention studies have not provided conclusive outcomes, suggesting that further investigation is needed. Van Leer et al. found a significant inverse association between dietary potassium, magnesium and blood pressure in 20921 Dutch men and women, with the strongest association for magnesium.^{7,8}

Bone health

About 50% of the body's magnesium can be found in bone, so magnesium is pivotal in the mineral and bone homeostasis, bone cell function, growth and hydroxyapatite (a calcium phosphate mineral) crystal formation,⁷ where it is understood to form a fixed and dynamic pool. This dynamic pool can be seen as a quick exchangeable magnesium store that is able to restore serum magnesium during deficiency. This pool declines during advancing age from 50% in early adolescence to 33% in adults to about 10% in the elderly of the magnesium concentrated in bone.^{9,10}

According to Rude, in postmenopausal osteoporosis the serum magnesium content seems to be decreased. It is also supposed that women, especially those with diagnosed osteoporosis, can benefit from supplementation, although the evidence is not yet conclusive.^{2,7}

1 Altura BM, Altura BT: Tension headaches and muscle tension: is there a role for magnesium? *Medical Hypotheses*, 57, 6 (2001) 705-713.

2 Rude RK. Magnesium deficiency: A cause of heterogeneous disease in humans. *Journal of bone and mineral research* 13, 4 (1998) 749-758.
3 Kisters K et al.: Membrane, intracellular and plasma magnesium and calcium concentrations in preeclampsia. *AJH*, 13 (2000) 765-769.

4 Paolisso G, Barbagallo M: Hypertension, diabetes mellitus, and insulin resistance, the role of intracellular magnesium. *AJH*, 10 (1997) 346-355.

5 Mazotta et al.: Electromyographical ischemic test, clinical symptoms related to neuromuscular hyperexcitability, and intra- and extracellular Mg⁺⁺ levels in headache patients. *J Headache Pain*, 4 (2003) 24-30.

6 Peikert A et al.: Prophylaxis of migraine with oral magnesium: results from a prospective, multi-center, placebo-controlled and double-blind randomized study. *Cephalalgia*, 16 (1996) 257-263.
7 Institute of Medicine. *Dietary Reference Intakes for calcium, phosphorus, magnesium, vitamin D and fluoride*. National Academy Press, Washington, (2001) 190-249.

8 Van Leer et al.: Dietary calcium, potassium, magnesium and blood pressure in the Netherlands. *International Journal of Epidemiology*, 24, 6, (1995) 1117-1123.
9 Biesalski HK et al.: *Vitamine, Spurenelemente und Mineralstoffe*. Thieme Verlag, Stuttgart, 6 (2002) 132-237, 274, 333-334, 426, 485-486, 561.

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Dietary sources

Magnesium can be found in varying concentrations in both animal and plant food sources. Green leafy vegetables (due to chlorophyll), unpolished grains and nuts are particularly rich in magnesium, contributing around 45% of dietary intake. Significant magnesium content can also be found in meat, milk, starches and eggs (see Table 1). Lower concentrations can be found in refined or processed foods, as 80% of magnesium is lost during production.^{7,11}

Food	Portiion Size	Magnesium content (mg)
Egg	1 egg	5
Milk	100 ml	13
Fats	20 g butter	0.3
	15 ml veg. or olive oil	0
Cereals	100 g bran flakes	178
	1 cup of cornflakes	11
Breads, biscuits, crackers	1 slice of bread wholewheat, soft	24
	1 slice of bread, white, soft	6
Meat, fish	100 g cooked halibut	108
	100 g cooked flatfish	59
	100 g cooked lamb	23
Sweets	1 tbsp. honey	0.4
Juices	30 ml apple/tom. juice	3-15
Vegetables,	1 baked potato with skin	54
	1 boiled potato, peeled before cooked	27
Fruits	1 raw unpeeled apple	6
	1 raw banana	34
Mineral water	1 litre	4-101

Table 1: Magnesium content in food ^{9,11}

Dietary intake

Recent surveys in Austria¹², Ireland¹³ and the UK¹⁴ provide an indication of current intake of magnesium (see Figure 1). Cereals and cereal products (including bread) provide 22-27% of magnesium intake and meat a further 13-16% of total magnesium intake. Alcoholic beverages, in particular beer, are another considerable source of magnesium contributing 10-12% to the diet. In Ireland, potato intake provides 15% of magnesium intake compared to 10% in the UK.

In the UK, 50% of men and 72% of women did not meet the UK dietary recommendations for magnesium (300 and 270 mg/day respectively).¹⁴ Intake in Ireland was shown to be marginally higher, although no population group on average met the figure of 375 mg/day recently set by the EU Scientific Committee for Food.¹³ The highest intake was seen in the eldest age group (51-64 years) with a mean intake of 345 mg for men and 255 mg for women. Austrian data demonstrated that only women aged between 27 and 35 years and adult men less than 35 years were meeting national dietary recommendations.¹² Average daily intake appears to have decreased between 1987 and 2001 in the UK by 12 mg.¹⁴

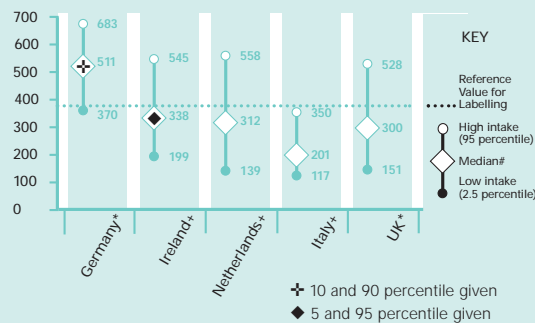


Figure 1: Average daily intake of magnesium (mg) for adult men – (intake from all sources including food supplements* or excluding food supplements+), ^{13, 14, 15, 16, 17}

10 WHO/FAO, Human Vitamin and Mineral Requirements, Report of a Joint FAO/WHO Expert Consultation, FAO/WHO, Rome (2002).
11 Shils M et al., Modern nutrition in health and disease, Williams & Wilkins, Baltimore, 9th edition (1998) 169-192.

12 Institut für Ernährungswissenschaften, Österreichischer Ernährungsbericht (1998)
13 Irish Universities Nutrition Alliance (IUNA), The North-South Ireland Food Consumption Survey (2001).

14 UK Office for National Statistics, The National Diet & Nutrition Survey (NDNS): adults aged 19 to 63 years (2003).
15 Robert Koch Institut, Was essen wir heute?: Beiträge zur Gesundheitsberichterstattung des Bundes. (2002).

16 Gezondheidsraad, Enkele belangrijke ontwikkelingen in de voedselconsumptie (2002).
17 Turrini A, Saba A, Perrone D, Cialfa E, & D'Amico A (2001): Food Consumption Patterns in Italy: the INN-CA Study 1994-96, European Journal of Clinical Nutrition, Vol. 55, 7, pp. 571-588.



esium

Specific reasons for taking magnesium

Certain population groups may be at a particular risk of not meeting recommended intakes for magnesium (see Table 2).

The elderly may be vulnerable due, for example, to lower appetite and problems with eating. Ageing is also associated with an increase in the urinary excretion and a decrease in absorption of magnesium. Diuretics, often used by the elderly, may also lead to higher excretion rates.^{2,7}

Pregnant women may be at risk of deficiency due to reduced serum magnesium levels. An increase in lean tissue during pregnancy, minimised urinary magnesium excretion and elevated bone resorption during lactation, may lead to increased requirements during and after pregnancy.⁷ Magnesium depletion sometimes develops during periods of high physical activity leading to muscle cramps. Recovery capacity may be reduced due to insufficient magnesium intake.⁹

Magnesium depletion is also very common in cases of chronic alcoholism. Lower intake, as alcohol replaces "normal" eating habits and gastrointestinal disorders like diarrhoea, vomiting and gastritis deplete magnesium levels. Urinary losses are raised through the direct action of alcohol.^{2,11}

Table 2: Recommended Dietary Allowances (RDA) of magnesium (mg) for adults in Europe¹⁸

Country/organisation	Male	Female
Belgium, 2000	420	330
DACH*, 2000	350	300
France, 2001	420	360
Netherlands, 2000	300-350	250-300
Nordic countries, 1996	350	280
Portugal, 1982	350	300
Spain, 1994-1998	350-400	330
UK, 1991	300	270
EU Reference Labelling Value, 2003	375	375

* Recommendations for Germany, Austria and Switzerland

Fortified foods

In Europe, approximately 3% - 9% of the mean total food energy may be derived from fortified foods. In relation to magnesium, there are technological and economical reasons, which limit the scope of magnesium fortification.¹⁹ In Germany, where a wide range of fortified foods are sold only a limited number of products have added magnesium at moderate levels, for example, 15% RDA per 100g of product. Fruit juices and sport mineral

drinks are the most popular products to be enriched with magnesium.²⁰ In France and the UK some breakfast cereals and cereal-based products have added magnesium and in Spain and Italy magnesium fortified dairy products are available.²¹ In accordance with EU legislation magnesium is added as defined to specific foodstuffs for particular nutritional uses, for example, formulae milks, meal replacers and dietetic supplement drinks.

¹⁸ EC Scientific Committee on Food (SCF): Opinion of the Scientific Committee on Food on the revision of reference values for nutrition labelling. European Commission (2003).

¹⁹ Flynn A et al.: Vitamins and minerals: A model for safe addition to foods. Eur J Nutr, 42 (2003) 118-130.

²⁰ Winkler G et al.: Supplements as a source of micronutrient intake in middle-aged men in southern Germany: Results of the MONICA dietary survey 1994/1995. Z. Ernährungswiss 37 (1998) 315-318.

²¹ Young J: Guide to functional food ingredients. Leatherhead Food Research Association, Leatherhead, Surrey, May 2001.

Food supplements

Of the 23% of regular supplement users, approximately 8% take supplements containing minerals. In a study of 6 European countries, mineral supplements proved to be most popular in Italy and Poland.²² Magnesium intake from food supplements provides no more than 2.5% of total magnesium intake.¹³ Magnesium intake from food supplements is highest in women aged over 35 years and men between 35 and 49 years.¹⁴

Table 3 provides a review of the range of magnesium content in products currently sold freely in the EU, i.e. those that consumers can find on the shelves of supermarkets and health stores (including products that in some countries may be registered as medicines). Food supplements sold in pharmacies and subject to specific controls are not included.

Country	Content (mg/day)
Germany	75-490
Denmark	75-600
Finland	75-350
Ireland	75-400
Netherlands	75-700
Portugal	75-400
Sweden	75-400

Table 3: Range of magnesium content in food supplements on free sale (via health stores and supermarkets) in the major EU markets

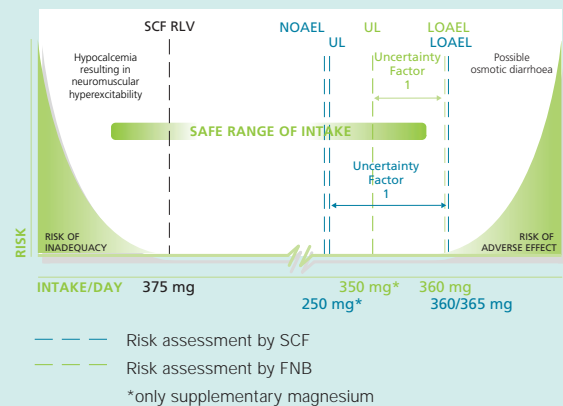
Bioavailability of magnesium

The bioavailability of magnesium is firstly related to the amount ingested: as intakes increase a lower proportion of the magnesium is absorbed. Secondly, the composition of the food can complicate the absorption of magnesium.^{7,11} In a normal diet, about 30-50% of dietary magnesium is absorbed.^{2,7}

Safety

While no adverse effects are associated with dietary sources of magnesium, mild adverse effects such as diarrhoea can be associated with high amounts of supplementation.⁷ The Scientific Committee on Food (SCF) and the Food and Nutrition Board (FNB) have estimated Tolerable Upper Intake Levels (UL) for supplementation with magnesium. The SCF LOAEL (Lowest Observed Adverse Effect Levels) of 360/365 mg/day, where a small number of adult subjects showed first signs of diarrhoea. At 250 mg weak laxative effects were not detected in adult men, women, lactating or pregnant women, so this was identified as NOAEL (No Observed Adverse Effect Level) by the SCF, (without taking into account amounts from foods and beverages). Subsequently the NOAEL was divided by an uncertainty factor of one, due to the mild and reversible nature of diarrhoea, to establish a UL for supplementation of 250 mg/day.²⁴

The FNB estimated nearly the same LOAEL of 360 mg/day from non-food sources, according to the results of Bashir et al., although even one study showed no effects at amounts up to 1200 mg/day. Like the SCF, this body estimated an uncertainty factor of about one resulting in a UL of 360 mg/day supplemental magnesium.⁷



22 Gallup European Consumers Awareness and Behaviour Survey on Vitamin and Mineral Supplements and Fortified Foods (Roche Vitamins Europe, 1999).

23 Market survey undertaken by the European Responsible Nutrition Alliance in 2001-2003.

24 Scientific Committee on Food: Opinion of the Scientific Committee on Food on the Tolerable Upper Intake Level of Magnesium. European Commission, Brussels, 11.10.2001