

In plant-based diets

Calcium and Vitamin D

What is calcium?

Calcium is a mineral that is required for all life. Found naturally in our environment, plants absorb calcium through their roots before integrating it into their plant cell structure. Calcium also supports the structure of animals as an integral component of shells, bone tissue and teeth. Calcium is the most abundant mineral in the human body with 99% stored within bone in the form of hydroxyapatite, with the remaining 1% supporting the function of the nervous system, blood clotting and muscle control¹. Without sufficient dietary sources of calcium, we are at increased risk of weakened bones, osteoporosis and bone fracture.

99%
bone tissue

1%

other roles e.g.,
nervous system,
blood clotting,
muscle control¹

What is vitamin D?

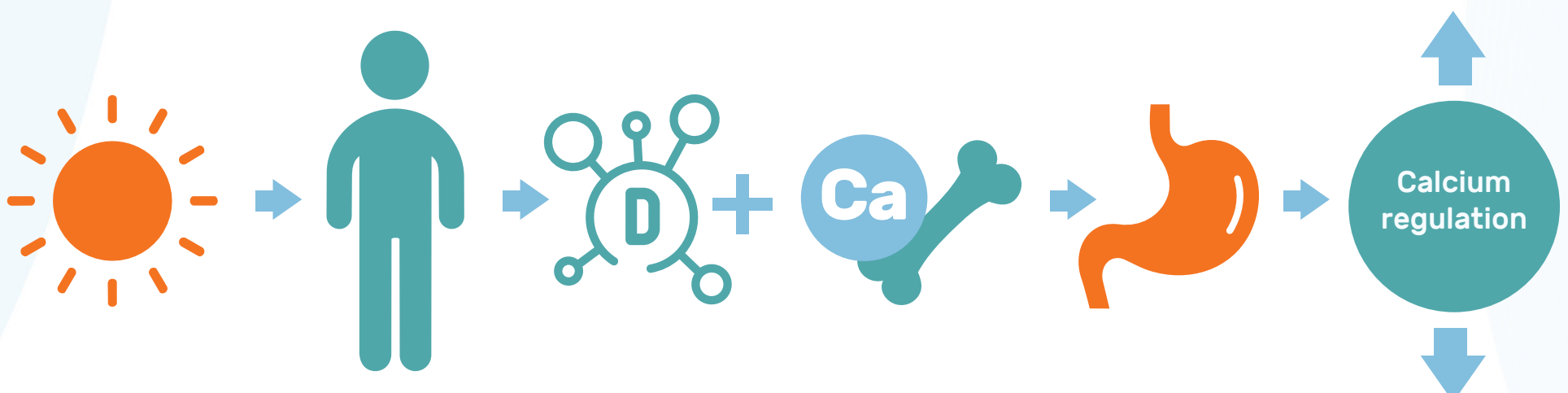


Vitamin D is a fat-soluble vitamin, that is also vital for bone health due to its role in regulating calcium and phosphate levels in the body. Vitamin D circulates in our blood in the form of ergocalciferol (vitamin D2) and cholecalciferol (vitamin D3). Vitamin D deficiency can also lead to osteoporosis as well as muscle weakness².



How do calcium and vitamin D interact?

Calcium and vitamin D work together. Calcium is actively absorbed through the lining of the small intestine when vitamin D is present³. Optimal levels are necessary to increase absorption from 10-15% of dietary calcium to 30-40%³. Unabsorbed calcium is lost through urine, faeces, skin and sweat⁴.

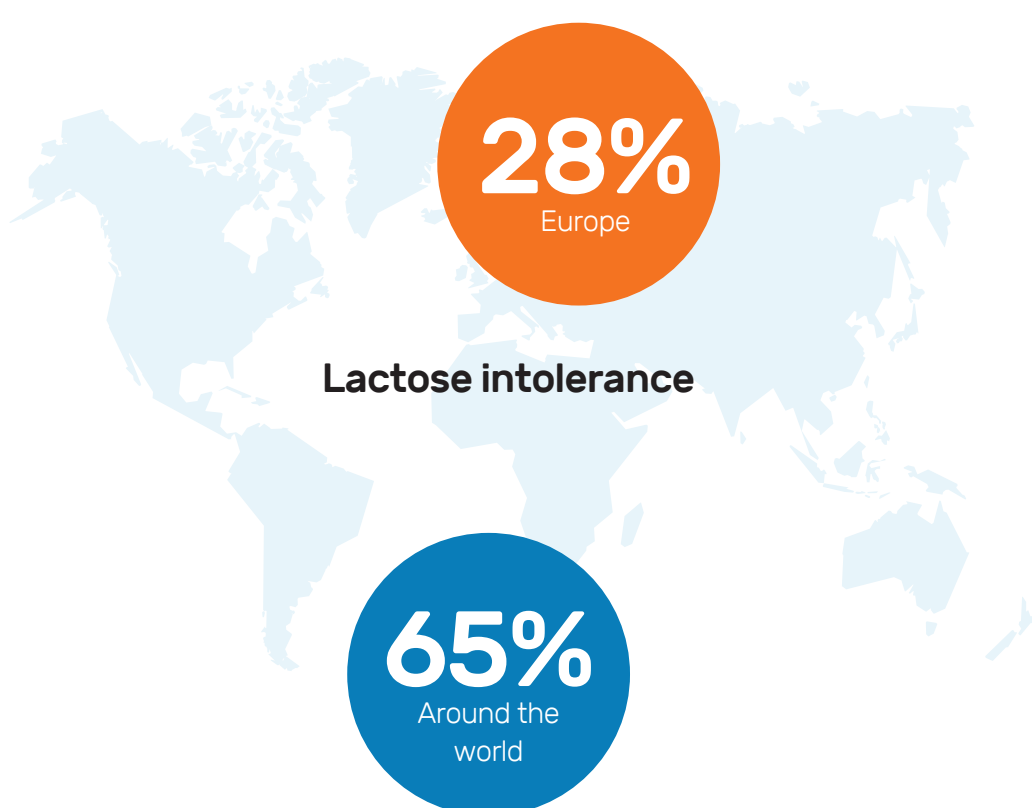
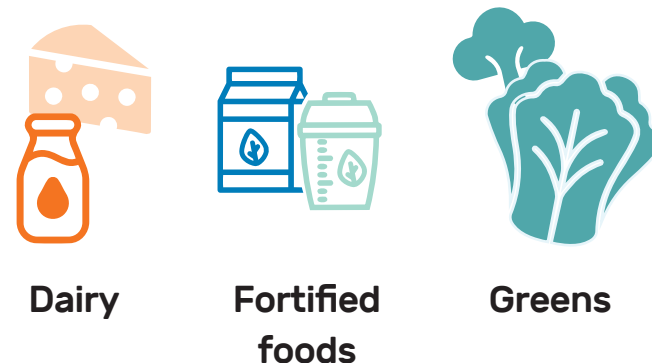


Where do we get calcium and vitamin D from?

Our diet and lifestyle plays a major role in achieving sufficient levels of both calcium and vitamin D.

Calcium is obtained through dietary intake with dairy and dairy products being the most recognised sources. The contribution of dairy products such as milk, yogurt and cheese to total calcium intakes across Europe varies from 43% in the UK⁵ to 59% in Italy⁴.

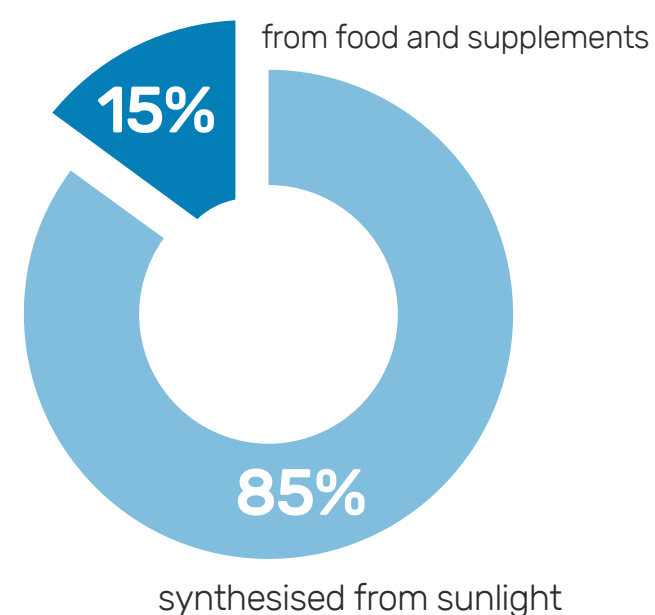
Despite the variation, they are generally the main dietary sources of calcium in all European countries studied⁴. National dietary guidelines, such as UK's Eat Well Guide⁶ highlight alternative sources of calcium in addition to dairy. Calcium-rich foods that also provide notable contributions to intake include calcium-fortified foods (such as cereals, plant-based alternatives to milk and tofu), grains, dark green vegetables, legumes, nuts, fish with bones, and even water in hard water areas⁷.



Not everyone consumes dairy as a source of calcium. Lactose intolerance affects a substantial proportion of the global population, with estimates of up to 65% worldwide⁸, and individuals with this condition often select lactose-free dairy products or plant-based alternatives to milk. Although the prevalence of lactose intolerance is lower among populations of European descent, estimated at around 28%, it can be considerably higher in other population groups, with reported values up to 70%⁹. Dairy avoidance may also occur for other reasons, including cow's milk allergy, as well as ethical or environmental considerations.

Vitamin D is unique in that 80-90% is synthesised in our skin from 7-dehydrocholesterol on exposure to UVB rays^{11,12}. Due to insufficient exposure to sunlight because of our modern lifestyles, seasonally low concentrations have led to the recommendation of vitamin D supplementation during the European winter (October to March). Vitamin D is available in 2 distinct forms, namely, ergocalciferol or vitamin D2 and cholecalciferol or vitamin D3. The naturally occurring plant-derived form, vitamin D2, was produced in the early 1920s through UV exposure of foods, such as yeast and mushrooms¹. Vitamin D3 is synthesized in the skin of humans from 7-dehydrocholesterol and is also present in animal-based foods, such as egg yolks and oily fish. Both vitamin D3 and vitamin D2 are synthesized commercially and found in dietary supplements or fortified foods².

Source of Vitamin D



Do we get enough calcium and vitamin D?

Current intakes

Average calcium intakes and vitamin D status vary across countries in Europe as shown in table 1. Recent research has found that most countries in Europe have an intake higher than 700mg per day¹³. Intake is also known to vary between subgroups, for example teenage girls in both the UK and the Netherlands have been found to have calcium intakes below recommendations^{14,15}.

Vitamin D deficiency [serum 25(OH)D <25nmol/l] has been reported in 2-30% of adults in Europe¹⁶, and some studies suggest that this could rise to 80% in the institutionalised elderly¹⁷. It has been noted that deficiency is entirely avoidable in western countries as access to vitamin D supplementation is both affordable and widely available.



Calcium intake and vitamin D status in 21 European countries from currently available data¹³

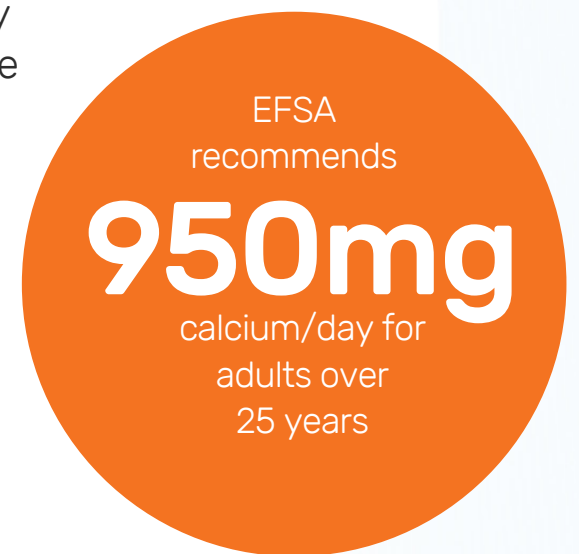
Table 1

Country	Age (years)	Calcium intake (mg/day)	Vitamin D status (nmol/L)
Norway	24-70	488	50-74
Belgium	19+	728	50-74
Italy	18+	765	25-49
Austria	55+	773	25-49
Czech Republic	45-69	782	50-74
Spain	19+	789	50-74
Poland	45-69	830	25-49
Latvia	19-64	865	Nd
France	19-79	877	50-74
Portugal	19+	923	Nd
Greece	33-72	942	25-49
Denmark	18-75	958	25-49
Croatia	18-55	965	Nd
Sweden	49-83	992	>75
UK	25-72	994	50-74
Switzerland	35-74	1067	50-74
Germany	19+	1068	25-49
Ireland	18-90	1080	Nd
Finland	25-64	1097	25-49
Netherlands	19-69	1102	50-74
Iceland	30-85	1233	25-49

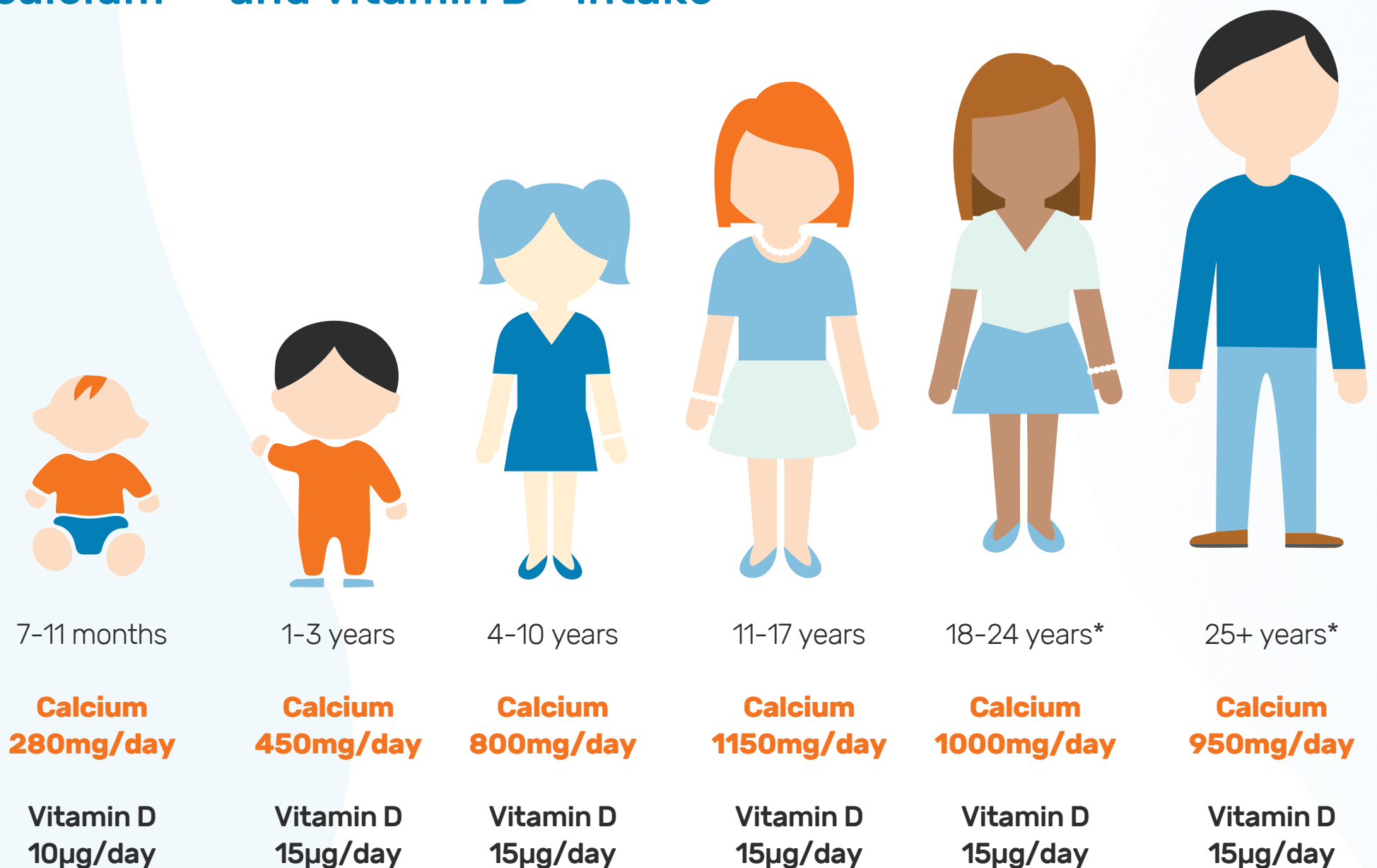
Recommendations

National and organisational recommendations for dietary calcium vary minimally around the world. The European Food Safety Authority (EFSA)⁴ recommend that all adults over 25 years obtain 950mg of calcium per day, and more for teenagers and young adults between 11 and 24 years due to rapid growth of the skeleton as shown below. This is approximately consistent with the Institute of Medicine (IOM) of the US National Academy of Sciences, but who also recommend increased levels at 1200mg/day for post-menopausal women and 1000mg/day in pregnancy and lactation¹⁸. In addition, specific medical conditions may require increased calcium intake for example up to 1500mg in coeliac disease¹⁹ and up to 1000mg in inflammatory bowel disease when on corticosteroids²⁰.

EFSA recommends a daily adequate intake (AI) of 15 µg of vitamin D for healthy individuals over one year of age²¹. Similarly, IOM sets the recommended dietary allowance (RDA) for vitamin D at 15 µg per day for healthy adults under the age of 70, increasing to 20 µg for those aged 70 and older.¹⁶



EFSA recommended daily calcium^{4,18} and vitamin D²² intake



*Including pregnant and lactating women

Summary



Calcium is the most abundant mineral in the human body.

Predominantly stored in bone tissue, calcium is essential for bone strength as well as function of the nervous system, blood clotting and muscle control.



Vitamin D is a fat-soluble vitamin that promotes calcium absorption

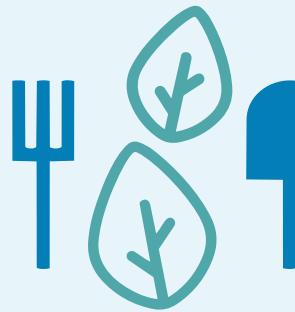
in the gut and helps to maintain adequate serum calcium and phosphate concentrations.



Calcium is obtained through dietary intake. The predominant source of calcium across Europe is dairy and dairy products however fortified products, including calcium fortified plant-based foods, also provide a notable contribution.



Vitamin D is primarily obtained through synthesis in the skin following exposure to sunlight, while smaller amounts come from dietary sources and fortified foods



Individuals following vegetarian or vegan dietary patterns can have a slightly higher risk of low vitamin D and calcium intakes if their diet is not well planned. However, low intakes and stores have been found across the population in all dietary patterns.



Monitoring calcium intake and vitamin D status is important across all population groups to support bone health.



Use of calcium and vitamin D fortified foods as well as supplementation is recommended to safeguard skeletal health.

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