



Implications of **vitamin D** deficiency

Executive summary

The reputation of vitamin D has changed dramatically in recent years as more and more evidence has emerged confirming its role in maintaining health and wellbeing. Today, vitamin D is firmly on the agenda and governments and authorities are revising recommended intake levels. Achieving an optimal status of vitamin D has a number of positive health outcomes. On the other hand, insufficient vitamin D is associated with the increased risk of non-communicable diseases, such as osteoporosis, some cancers and cardiovascular disease.

Low vitamin D status remains a major public health concern. Yet, there is evidence to suggest that a large number of people still do not get enough vitamin D via sun exposure and do not incorporate sufficient levels of vitamin D into their diet. Research by the International Osteoporosis Foundation has found that more than one third of the entire global population is showing insufficient levels of vitamin D.¹ Significant healthcare cost savings could be achieved if vitamin D deficiency and insufficiency was eliminated.

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Implications of vitamin D deficiency

Introduction

Vitamin D comprises a group of fat-soluble compounds that are essential for maintaining the mineral balance in the body. The form of vitamin D that is most beneficial to humans is cholecalciferol or vitamin D₃, which has been found to be substantially more bioavailable and efficacious as a vitamin D source for human health than vitamin D₂, and is also more cost effective. It can be synthesized in the skin by the action of ultraviolet light (UVB), and the human body is capable of producing the daily requirement of vitamin D in 15-30 minutes

(depending on skin type) when bare skin is exposed to the sun's rays under certain conditions.

However, several factors such as sunscreen (above factor 8), a lack of exposure to sunlight, age and darker skin pigmentation reduce the production of vitamin D in the skin. In countries such as the UK, the sun does not have sufficient UVB radiation during winter and at times of the day other than 11am to 3pm.



Insufficient sunlight exposure

- Geographical location (poor UVB at higher latitudes > 37°)
- Seasonal variations
- Wearing clothing
- Sunscreen use
- Air pollution
- Limited outdoor activity
- Living in an institutional setting, or being house-bound



Age

- Infants and babies of vitamin D deficient mothers
- Natural production of vitamin D through sunlight decreases with age



Skin pigmentation

- Dark-skinned individuals are less able to synthesise vitamin D from sunlight



Other factors

- Dietary habits
- Cultural considerations
- National policies on vitamin D fortification

Figure 1: factors that interfere with the body's ability to produce vitamin D from sunlight



Implications of vitamin D deficiency

A new study into vitamin D intake amongst adolescent women living in the United Arab Emirates highlights that social and cultural considerations also need to be taken into account. The results show a high prevalence of vitamin D deficiency amongst subjects, despite living in a very sunny climate. A cohort of 350 female Emirati nationals aged 11-18 years were evaluated in face-to-face interviews and 78.8% of participants were found to be severely deficient in vitamin D (<27.5 nmol/L), which is a level that puts health at risk.²

Unlike other types of vitamins, which are primarily acquired through dietary sources, the major source of vitamin D is exposure to sunlight, and it is only found in small amounts in a limited range of foods such as oily fish, eggs and milk. Consequently, it is very difficult to achieve

sufficient vitamin D intake through dietary sources alone, and there is a widespread problem for people with low sunlight exposure, who have to rely solely or more heavily on dietary intake.

The populations most vulnerable to low vitamin D intake are breast fed infants due to the low level of vitamin D in breast milk, elderly, institutionalized or obese individuals and African Americans of all ages.

Did you know?

When your shadow is longer than your height, your body is no longer producing sufficient vitamin D.



Vitamin D builds a strong foundation

Low vitamin D status has a significant impact on human health. Vitamin D has traditionally been closely linked to bone health and it improves bone mineral density through calcium absorption and deposition. It is necessary to prevent rickets in children, whereas in adults, low values contribute to osteomalacia, osteoporosis and the risk of fracture. Osteoporosis is often referred to as the 'silent disease', since it usually presents without symptoms and remains undiagnosed until the first fracture.

In addition, vitamin D also plays an important role in reducing the risk of falling by improving muscle strength. In December 2014, the European Commission authorized a new Article 14 EFSA health claim, which was submitted by DSM. This stated that "vitamin D helps to lower the risk of

falling associated with postural instability and muscle weakness"³ Fall prevention has important psychological benefits to seniors and it helps to reduce osteoporotic fractures.

There is an increased risk of refracture and premature mortality after fracture. A recent study monitored participants aged 60 years and older with incident fractures for further fractures and deaths over a twenty year period. Within 5 years following initial fracture, 24% women and 20% men refractured; and 26% women and 37% men died without refracture. Of those who refractured, a further 50% of women and 75% of men died, so that total 5-year mortality was 39% in women and 51% in men.⁴

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Increasing scientific interest in vitamin D

In the last decade, the number of scientific publications on vitamin D has increased exponentially and there are now approximately 3,500 studies published a year. This sheds new light on the potential impact of low vitamin D status on human health:

- There is emerging science on the role of vitamin D in strengthening the immune system and reducing the risk of multiple sclerosis and type 1 diabetes.
- A new study shows that vitamin D and omega-3s regulate serotonin synthesis to improve the symptoms of conditions such as autism, attention deficient hyperactivity disorder and schizophrenia.⁵

- Suboptimal vitamin D levels in childhood result in hardening of arteries and are a possible risk factor for adult cardiovascular disease.⁶

Additionally, there is an ongoing DO-HEALTH trial (NCT01745263) looking at the effects of vitamin D₃, omega-3 and home exercise on healthy ageing and longevity. The results are expected in 2017.⁷

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Vitamin D status can be assessed by using vitamin D levels in the blood as a biomarker. Insufficient levels of vitamin D is taken to be mean serum levels of 25(OH)D which is below 50nmol/L and is a value that is considered adequate by health authorities worldwide. Postmenopausal women and the elderly in particular appear to be an at-risk group for low vitamin D status.

Optimal vitamin D status throughout life supports a number of health benefits. Insufficient vitamin D is associated with increased risk of non-communicable diseases:

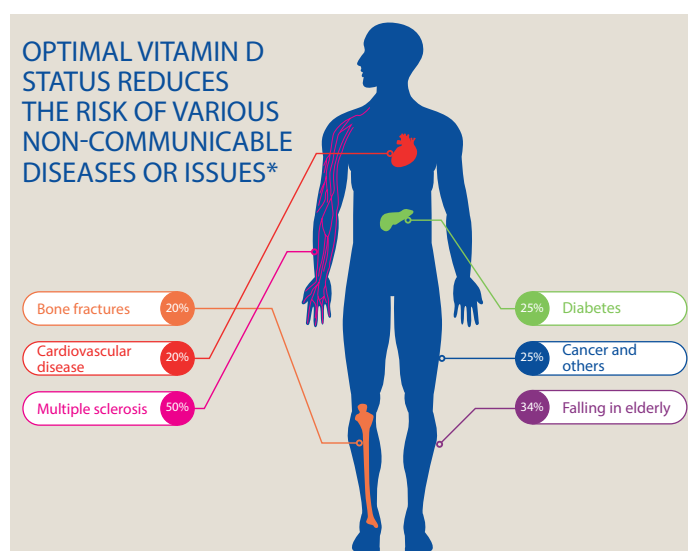


Figure 2: risk reduction by optimal vitamin status
* Grant et al, 2009

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What is the cost of vitamin D deficiency?

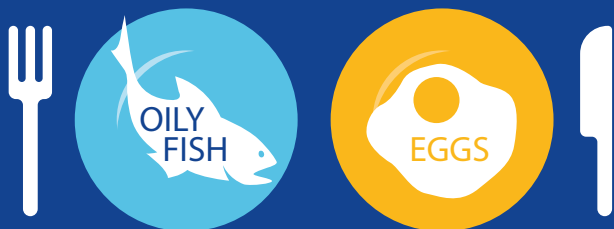
Vitamin D insufficiency is a major public health issue in both the developing and industrialized world.

Low vitamin D status has a significant impact on health care costs:

- The results of a 2009 review by Grant et al concluded that the total public health cost savings in the European Union (EU) if vitamin D deficiency was eliminated would be €187 billion annually.⁸
- In the United States (US), the healthcare cost related to osteoporosis-attributed bone fractures among all women over the age of 55 diagnosed with osteoporosis is expected to be nearly \$136 billion from 2013 to 2020. It is estimated that the cost could be reduced by \$15 billion if all women in the at-risk group were to supplement their diet with calcium and vitamin D at the recommended daily intake.⁹
- The cost of voluntary food fortification or supplementation of risk groups is €20-30 per person per year.¹⁰

Did you know?

To achieve 800 IU of vitamin D by diet alone would mean consuming two portions of oily fish or 40 eggs every day.



What is the recommended intake of vitamin D?

A simple blood test can determine whether an individual is getting enough vitamin D from sunlight or dietary sources. Vitamin D status in the blood is currently measured in either nmol/L or ng/ml₃. 'Desirable' levels of vitamin D are classified as blood concentrations of above 75nmol/L; 'inadequate' levels are classified between 50 and 75; 'insufficient' between 25 and 50, and 'deficiency' below 25nmol/L.¹¹


- The current intake recommendations per person and day for vitamin D vary: the D-A-CH countries (Germany, Austria and Switzerland) recommend 800 IU, other countries in the EU recommend between 200-600 IU, but increasingly key opinion leaders are recommending higher daily intakes, between 800-1000 IU to achieve the optimal level of 75 nmol/L or even 2000 IU for at-risk people.
- In the US, the Food and Drug Administration has established Reference Daily Intakes (RDIs) for vitamins and minerals which serve as the reference standards for the 'percent daily value (%DV)' that appears on a food/supplement product label. While the RDIs are often close to the Institute of Medicine (IOM) recommendations for Recommended Daily Allowance (RDA) and adequate intake (AI), they do not always match.
- To better reflect this newly-gained understanding of the role of vitamin D, IOM developed new Dietary Reference Intakes (DRIs) in 2010. These disregarded the inconsistent messaging and lack of comprehensive research that led to the original 1997 recommendations. The IOM reviewed more than 1,000 studies and concluded that the RDA should now be 600 IU per day for adults and children.¹²
- Many other countries like China and India, currently evaluate vitamin D recommendations.

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Conclusion

Modern lifestyles mean that it can be difficult to consume sufficient levels of vitamin D through diet or exposure to sunlight alone. Healthcare professionals frequently recommend vitamin D supplements or enriched foods as an important additional source of vitamin D for those who do not receive enough through diet or as a result of sun exposure. Dietary supplementation is an effective, low cost and safe way to fill nutritional gaps.

Quali-D DSM's Quali[®]-D (vitamin D₃) is available in oily and dry forms designed for fortified food and beverage products and dietary supplements. It is also suitable for vegetarians, as certified by the UK vegetarian society.

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