Consensus Vitamin D position statement

This consensus statement represents the unified views of the British Association of Dermatologists, Cancer Research UK, Diabetes UK, the Multiple Sclerosis Society, the National Heart Forum, the National Osteoporosis Society and the Primary Care Dermatology Society.

Vitamin D is essential for good bone health and for most people sunlight is the most important source of vitamin D. The time required to make sufficient vitamin D varies according to a number of environmental, physical and personal factors, but is typically short and less than the amount of time needed for skin to redden and burn. Enjoying the sun safely, while taking care not to burn, can help to provide the benefits of vitamin D without unduly raising the risk of skin cancer. Vitamin D supplements and specific foods can help to maintain sufficient levels of vitamin D, particularly in people at risk of deficiency. However, there is still a lot of uncertainty around what levels qualify as "optimal" or "sufficient", how much sunlight different people need to achieve a given level of vitamin D, whether vitamin D protects against chronic diseases such as cancer, heart disease and diabetes, and the benefits and risks of widespread supplementation.

Summary

- Everyone needs vitamin D, which is essential for good bone health. Low levels are linked to bone conditions such as rickets in children, and osteomalacia and osteoporosis in adults.
- There is currently no standard definition of an 'optimal' level of vitamin D. The consensus is that levels of 25(OH)D below 25nmol/L indicate 'deficiency'. Some have argued that this level is conservative. Raising the definition of "deficiency" or "sufficiency" to higher levels is inappropriate until results from randomised trials can show that maintaining such levels has clear health benefits and no health risks.
- The evidence suggesting that vitamin D might protect against cancer, heart disease, diabetes, multiple sclerosis and other chronic diseases is still inconclusive. Some studies have suggested that high levels of vitamin D are associated with a reduced risk of bowel cancer although the mechanism has yet to be elucidated. For other cancers, the evidence is inconsistent or limited. Even for bowel cancer, it is too early to say if vitamin D directly protects against this cancer or if it reflects another aspect of our health.
- Sun exposure is the main source of vitamin D, but excessive sun exposure is the main cause of skin cancer, including melanoma, the fastest rising type of cancer in the UK. Enjoying the sun safely, while taking care not to burn, can help to provide the benefits of vitamin D without unduly raising the risk of skin cancer.
- It is impractical to offer a one-size-fits-all recommendation for the amount of sun exposure that people need to make sufficient vitamin D, because this varies according to a number of environmental, physical and personal factors.
- The time required to make sufficient vitamin D is typically short and less than the amount of time needed for skin to redden and burn. Regularly going outside for a matter of minutes around the middle of the day without sunscreen should be enough. When it comes to sun exposure, little and often is best, and the more skin that is exposed, the greater the chance of making sufficient vitamin D before burning. However, people should get to know their own skin to understand how long they can spend outside before risking sunburn under different conditions.
- Vitamin D supplements, fortified fat spreads and dietary sources such as oily fish (including salmon, trout and sardines) can be useful for helping to maintain sufficient levels of vitamin D. These sources are particularly important during the winter and among people at higher risk of vitamin D deficiency, including pregnant and breastfeeding women, young children, older people, darker-skinned people, those who wear whole-body coverings, those living in institutions, skin cancer patients and those who avoid the sun. People at risk of low sun exposure should take a 10 microgram supplement of vitamin D a day (7 micrograms a day for children aged 6 months to 5 years), which is the Government-recommended dose.
- There is not enough evidence to support a recommendation for food fortification or widespread vitamin D supplementation for the general population. Unlike vitamin D produced in the skin, there is the potential that vitamin D from supplements and fortificants could build up to toxic levels and there is not enough evidence about the possible risks of raised vitamin D blood levels in the general population over a long period of time.

Vitamin D requirements

The level of 25-hydroxyvitamin D (25(OH)D) in the blood is the best indicator of vitamin D status. There is consensus that levels below 25nmol/L (10ng/ml) qualify as 'deficient',[1, 2] but beyond this there is currently no standard definition of 'optimal' 25(OH)D levels.[3, 4] There is also lack of standardization of methods used to measure 25(OH)D status, with different tests producing very different results.[5]

Some scientists suggest that levels above 50nmol/L (20ng/ml) are 'sufficient', while 70–80nmol/L (28-32ng/ml) is 'optimal'.[1, 6, 7] However, raising the definition of "deficiency" or "sufficiency" is currently inappropriate since no results from randomised trials suggest that maintaining such levels of 25(OH)D prevents chronic diseases. It is also unclear whether these levels are practical for all individuals, given that various studies have found that that 25(OH)D levels plateau at around 70-80nmol/L, with wide variation across individuals.[8, 9] For example, a Hawaiian study found that half of healthy, young surfers had levels below 75nmol/L despite extensive unprotected outdoor exposure and tanned complexions.[9]

The Department of Health currently recommends a daily 10 microgram vitamin D supplement for those at risk of vitamin D deficiency, including all pregnant and breastfeeding women, older people and those at risk of inadequate sun exposure (for example those who cover their skin for cultural reasons or those confined indoors). A daily vitamin D supplement of 7 micrograms is also recommended for all children aged 6 months to 5 years. [2] The National Institute for Health and Clinical Excellence (NICE) also emphasises the importance of maintaining adequate vitamin D during pregnancy and breastfeeding, and suggests that women may choose to take up to 10 µg of vitamin D a day during these periods.[10]

Factors affecting vitamin D levels and groups at high risk of vitamin D deficiency

The amount of UVB in sunlight changes substantially with season, latitude and time of day.[11] These factors greatly affect vitamin D production, which is greatest around two hours either side of solar noon, and during summer months. Physical characteristics can also affect vitamin D production, with darker skin requiring longer UV exposures to produce the same amount of vitamin D.[12, 13] Older people have a reduced ability to make vitamin D through their skin.[14] Obese people have lower 25(OH)D levels, which may be due to less sun exposure or greater uptake of vitamin D in fat tissue, which may be more inaccessible.[15]

Certain groups of people have a higher risk of vitamin D deficiency including those with darker skin,[12, 13] those who wear whole-body coverings,[16, 17] older people,[14] pregnant women,[18] infants born to vitamin D-deficient mothers,[19] skin cancer patients, those who are housebound or in institutions, and those who avoid the sun.[20]

Some studies have found that sunscreen use reduces vitamin D production.[21] However, sunscreens do not provide complete protection against UVB and there is great variation in the way people use these products. Based on studies and trials that reflect actual sun exposure habits, it is unlikely that these products contribute significantly to vitamin D deficiency.[22, 23]

Sun exposure

Exposure to ultraviolet B (UVB) radiation in sunlight is the most efficient way to boost vitamin D supply but it is still unclear how much sunlight is required to produce a given level of 25(OH)D. Environmental and personal factors greatly affect vitamin D production in the skin, making it difficult to recommend a one-size-fits-all level of exposure for the general population.

However, the best estimates suggest that for most people, everyday casual exposure to sunlight is enough to produce vitamin D in the summer months, provided optimal environmental conditions.[24, 25] The area of skin exposed will also influence the amount of vitamin D made after sun exposure. In a recent study, Caucasian British people were given a simulated dose of a summer exposure to sunlight, while dressed in casual summer clothes that revealed a third of their skin. These controlled conditions (the equivalent of 13 minutes of midday exposure to the summer sun given three times a week for six weeks during winter) raised 25(OH)D levels to greater than 50nmol/L in 90% of people and greater than 70nmol/L in 26% of people [8]. The true amount of time may be greater and will vary depending on other factors including posture, time of day, outdoor activities, and the presence of shading structures.

It has been consistently shown that vitamin D can be efficiently and sufficiently produced at doses of UV below those which cause sunburn (i.e. reddening of the skin).[21, 26-31] After prolonged UV exposure, vitamin D is converted into inert substances in the skin.[11, 32] Thus, additional UV exposure provides no additional vitamin D but linearly increases levels of DNA damage and risk of skin cancer. Some unprotected exposure in the hours close to solar noon may be necessary, but people should not be advised to deliberately sunbathe or expose themselves to the sun for long periods of time in order to produce more vitamin D. When it comes to sun exposure, little and often is best.[31, 33]

During winter months in the UK, there is not enough UVB for vitamin D synthesis and people rely on tissues stores, supplements and dietary sources.[11] If people achieve a sufficient supply of vitamin D in the summer most should keep levels greater than 25nmol/l in winter even without supplements; in others supplementation with vitamin D can help to maintain these levels in the winter. [34-36]

Dietary sources

Vitamin D is found in only a few foods, with oily fish and fish oils, liver, meat and eggs being the main natural sources. In the UK, processed and some powdered milks, margarine, fat spreads and breakfast cereals are often voluntarily fortified with vitamin D. On average, UK men and women get 3.7 µg and 2.8 µg of vitamin D per day through diet.

The potential contribution of diet to vitamin D supply is a topic of debate. Widely quoted estimates suggest that more than 90% of vitamin D requirements come from exposure to sunlight.[37] The International Agency for Research on Cancer (IARC) concluded that results do not support this, noting that many studies from around the world have found that use of vitamin D supplements and oily fish consumption predicted vitamin D levels as well as outdoor activities, holidays in sunny areas and sunbed use.[38] Even people with genetic disorders that necessitate sun avoidance can maintain sufficient vitamin D levels through diet.[39]

The Food Standards Agency has funded three studies investigating the contribution of diet and sunlight to vitamin D status in the adult and elderly population. One of these, the Vitamin D, Food Intake, Nutrition and Exposure to Sunlight in Southern England study (D-FINES; currently unpublished), concluded that dietary vitamin D intake currently makes little contribution to the 25(OH)D status of British Caucasians and Asians living in the South of England, and that too few foods provide a valuable source**.** Foods can certainly contribute to vitamin D status, but on their own, it is unclear if they can sufficiently raise levels of 25(OH)D in people who experience deficiency.

Supplements

Vitamin D is present in a range of unlicensed dietary supplements (including fish oil products) and licensed medicines, which can help to boost vitamin D levels.[34] A study commissioned by the FSA concluded that it takes 9 µg/day of supplements for the vast majority of the population to achieve 25(OH)D levels greater than 25nmol/L in the winter. To achieve levels greater than 50nmol/L and 80 nmol/L, predictive modelling suggests it would take on average 28 µg/day (1120 IU) and 41 µg/day (1640 IU) of supplements respectively.[40]

Supplements may be warranted for groups with high-risk of vitamin D deficiency and the Department of Health already recommends vitamin D supplements (10 micrograms/day or less) for all pregnant and breastfeeding women, young children, older people and those at risk of low sunlight exposure. Supplements containing vitamin D3 (cholecalciferol) are preferable to those containing vitamin D2 (ergocalciferol). And supplements that contain only vitamin D are preferable over multivitamins, since other trials have shown that most vitamin supplements are ineffective for cancer prevention, and some can increase the risk of cancer.[41] Supplements that contain vitamin A, including cod liver oil, are unsuitable for older people and pregnant women.

The human body avoids building up toxic levels of vitamin D by limiting the amount that is produced in the skin in response to UV light. Vitamin D taken through supplements is not subject to the same controls that prevent the build-up of toxic levels of vitamin D in response to UV light. As such, it is premature to recommend vitamin D supplements for the general population. Trials have suggested that vitamin D supplementation of 10-20 µg/day (400-800 IU) could reduce all-cause mortality in elderly people with low vitamin D status,[42] but there is still a lack of evidence about the possible risks of chronically raising levels of vitamin D in healthy people through supplementation.[38] Studies like National Health and Nutrition

Examination Survey (NHANES III) and the Cohort Consortium Vitamin D Pooling Project of Rarer Cancers (VDPP) suggest that high levels of vitamin D beyond the threshold of 75nmol/L could be associated with negative effects,[43, 44] and past experience has shown that high-dose supplements of other micronutrients have led to increased risk of cancer, despite promising early studies.

In 2003, the Food Standards Agency's Expert Group on Vitamins and Minerals cautioned that excess vitamin D intake may lead to hypercalcaemia and hypercalciuria and that moderate levels (0.025-0.05 mg/day) of intake may enhance renal stone formation in predisposed individuals.[45] The Group also set an upper guidance level for supplemental intake of 25 µg/day, which would not be expected to cause adverse effects in the general population.

Vitamin D and the risk of diseases

Bone health
Prolonged deficiency leads to rickets in infants and children and osteomalacia in adults. It is also associated with osteoporosis, hip fractures and falls in older people. Low levels of 25(OH)D are associated with secondary hyperparathyroidism and low bone mineral density and, thus, a higher risk of fractures. Some studies have suggested that low vitamin D levels are associated with an increased risk of certain cancers and other chronic diseases but evidence for a causal association is weak and inconclusive.

Cancer
Levels of 25(OH)D in the blood are the only reliable indicators of vitamin D status.[46] IARC recently concluded that low vitamin D levels are associated with a higher risk of bowel cancer, but the evidence is limited for breast cancer, non-existent for prostate cancer and too sparse for all other cancer types to draw firm conclusions.[38] These results are consistent with other meta-analyses and systematic reviews.[47, 48] A pooled analysis of 10 cohort studies found that levels of 25(OH)D greater than 75 nmol/L do not reduce the risk of womb, oesophageal, stomach, kidney or ovarian cancers, nor non-Hodgkin lymphoma.[49] The analysis also found that levels of 25(OH)D greater than 100 nmol/L was associated with a doubling of pancreatic cancer risk.[50] Even where bowel cancer is concerned, it is unclear if a lack of vitamin D causes an increased risk of cancer, or is simply a consequence of poor health or bowel malfunction. Two clinical trials have assessed the effects of vitamin D supplementation. Both showed that such supplements are ineffective at reducing the risk of cancer,[51, 52] but both have been criticised for methodological weaknesses.[38] Further trials are needed.

Much of the support for a protective role of vitamin D against cancer comes from laboratory, animal and ecological studies.[53] Ecological studies report that several cancers are more common at higher latitude, which is taken as a proxy for lower UV exposure and lower vitamin D levels.[54, 55] However, this approach is prone to confounding by other factors such as socioeconomic status and skin type and it does not account for variations in individual behaviour, which are stronger predictors of UV exposure than latitude.[38, 56]

Other chronic diseases
Vitamin D deficiency has also been linked to a variety of other chronic diseases, including multiple sclerosis, heart disease and diabetes. As with cancer, all of these links are still inconclusive and causal relationships cannot be drawn from existing evidence.

Sunbeds

Sunbeds do not grant protection against vitamin D deficiency.[57] Sunbed use is accompanied by a high frequency of sunburns, which are linked to a higher risk of melanoma.[58] While any exposure to UVB radiation can increase vitamin D levels, such increases through sunbed exposures plateau rapidly and are outweighed by the risks. Sunbeds also emit high levels of UVA, which can cause melanoma but do not contribute to vitamin D production.[59]

Further research

There are many questions around vitamin D that still need to be answered.

- What is the optimal level of 25(OH)D for various health outcomes?
- Can higher levels of 25(OH)D directly reduce the risk of cancer or other chronic diseases, and can supplementation achieve the same effects?
- How much sun exposure is needed to ensure optimal levels of vitamin D in people of different skin types and under different environmental conditions?
- What roles do dietary sources and supplements have in achieving optimal vitamin D levels, particularly in the winter?
- Are there any adverse consequences of chronically high levels of 25(OH)D, raised through supplementation or food fortification?
- Does body fat act as a sink or source of vitamin D in winter?

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