

Sunlight exposure and vitamin D

Getting the balance right: sunlight exposure advice that ensures adequate vitamin D while minimising the risk of sunburn and cancer

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In Summary

- Sunlight is the body's principal natural source of vitamin D, which protects bone and muscle health. Levels of vitamin D deficiency in the UK are high.
- University of Manchester research shows that, although public awareness of vitamin D is good, behaviour is largely driven by concerns about sunburn and skin cancer.
- The University's research shows that a 'little and often' approach to sunlight exposure in the UK can provide sufficient vitamin D and avoid vitamin D deficiency.
- Public health messages should be designed to enhance awareness of the benefits of sunlight exposure and of the 'little and often' message. This will better balance the benefits of sunlight exposure for vitamin D production while minimising risks of sunburn and skin cancer.



In Detail

1. Background

Vitamin D is important throughout the life course. This is because it helps regulate the amount of calcium and phosphate in the body, which in turn keep bones, teeth and muscles healthy. **A lack of vitamin D can lead to a range of musculoskeletal problems.** In children, inadequate levels of vitamin D can cause bone deformities such as rickets. In adults, vitamin D deficiency can lead to bone pain and weakness (osteomalacia and osteoporosis), and poor muscle strength, resulting in fractures and falls. Links between vitamin D deficiency and a number of other conditions – perhaps most notably, a range of cancers – have been proposed. However, in its [2016 review of vitamin D and health](#), the Scientific Advisory Committee on Nutrition (SACN) considers data in this area to be inconclusiveⁱ. Vitamin D is present in some foods, such as oily fish, red meat, liver, egg yolks and fortified foods; however, importantly, unlike many other vitamins, adequate vitamin D cannot be easily obtained from dietary sources. This means that the body's principal source of vitamin D is the ultraviolet radiation (UVR) in sunlight and oral vitamin D supplementsⁱⁱ.

The UK National Diet and Nutrition Surveyⁱⁱⁱ (NDNS) has tracked levels of vitamin D deficiency in the UK population for nine years, from 2008/2009 – 2016/2017^{iv}. The 2019 survey suggests that – even in July-September, when sunlight availability is at its highest – more than 1.5 million UK adults (one in 25 of those aged 19-64) have inadequate levels of vitamin D. This figure rises to a staggering 11 million (almost one in three) during January-March, following the winter months when sunlight availability is at its lowest. There is also evidence that vitamin D deficiency is increasing in the UK. For instance, the NDNS suggests that, among adults aged 19-64 and several other age groups, the incidence of vitamin D deficiency has increased by an average of one percentage point each year over the nine years of the survey. Similarly, NHS admissions data shows that the proportion of admitted patients in whom vitamin D deficiency was detected increased almost fourfold over the five years from 2012-2013 and 2017-2018^v. Importantly, it is not clear whether these figures reflect: increased prevalence of vitamin D deficiency; increased testing for vitamin D (which has revealed levels of vitamin D deficiency which are higher than previously thought); or a combination of the two. Whichever explanation is correct, these figures point to a significant UK challenge in this regard.

Particular groups are at higher risk of vitamin D deficiency than the general population. An important one is people with darker skin, such as people from African, African-Caribbean

and south Asian backgrounds; this is because the production of vitamin D is inhibited by higher levels of protective melanin in darker skin types. People who expose their skin to sunlight very infrequently are also at greater risk; this might include elderly or unwell people or people who keep their skin covered for religious, cultural or health reasons, such as photosensitive skin. Infants and pregnant women are also understood to be more prone to vitamin D deficiency. Finally, since sunlight availability varies geographically, so too does the risk of vitamin D deficiency. Broadly speaking, sunlight availability across the UK decreases from south to north; people in Scotland are at higher risk than people on the south coast.

2. The University of Manchester research

The [Vitamin D and Sunlight team](#) at The University of Manchester is a collaboration between atmospheric scientist, Professor Ann Webb, and clinical and experimental dermatologist, Professor Lesley Rhodes. In addition to these disciplines, the research has drawn on the expertise of osteologists, endocrinologists, paediatricians, statisticians and social scientists. For more than ten years, the team has conducted ground-breaking research into vitamin D and sunlight, in particular investigating – for a variety of skin types – the challenge of providing public health advice that balances the ongoing need for vitamin D without increasing the risk of sunburn and skin cancer. This research has been funded by [Action Medical Research](#), [BUPA](#), [Cancer Research UK](#) and Department of Health Policy Research Programme.

Research in this area is challenging due to the number of variables that are implicated in the relationship between sun exposure and vitamin D levels. These include: skin type, the amount of skin that is exposed, the time of day, the season, the latitude, the weather, the openness of the terrain and behaviour. Addressing these challenges, The University of Manchester has employed and combined a range of methodological approaches, including: research with different skin types; monitoring individuals' sun exposure, diet, and vitamin D status; the provision of UVR in controlled conditions; and UVR/sunlight availability modelling. The research has led to more than ten articles in scientific journals.

In addition, the team has carried out qualitative focus group research and – very recently – the first large-scale quantitative survey research into public awareness, knowledge and behaviour with respect to sunlight exposure and vitamin D (see below).

3. Key scientific findings: getting the balance right

The key finding from this research programme is that it is possible to identify a level of UK sunlight exposure that bestows adequate year-round vitamin D levels while minimising the risk of sunburn and cancer. **The research shows that ‘little and often’ is the best approach to vitamin D production through sunlight exposure.** For people with lighter skin, daily (or almost daily) sunlight exposure of unprotected skin for just 10-15 minutes during the spring and summer months should provide adequate vitamin D to avoid vitamin D deficiency all year round. For most, this will be a relatively safe level of exposure, balancing the benefits of vitamin D production and the risks of skin cancer. It is important to note that this should be undertaken in the middle of the day, with exposure of lower arms and lower legs to maximise benefit^{vi}. The research also shows that, for people with darker skin in the UK, 25-40 minutes of exposure under the same conditions will avoid summertime deficiency, and vitamin D supplements should be considered during the winter months. Importantly, levels of sunlight exposure that make an individual’s skin look pink or sunburnt – either during or some hours after exposure – are too high and should always be avoided. People with very light or sensitive skin and others who may not be able to follow this advice should seek further guidance from their doctor about alternative sources of vitamin D.

For the time being, the 2016 SACN review of vitamin D and health has concluded that, it is not possible to quantify the sunlight exposure that would be required in the summer to achieve adequate vitamin D levels all year round because of the number of factors that affect vitamin D synthesis. This suggests that more research is needed in this important area.

4. Public awareness, knowledge and behaviour

In June 2019, the University of Manchester Sunlight and Vitamin D team undertook a survey of the sunlight and vitamin D awareness, knowledge and behaviour of a representative sample of UK adults (n = 2024)^{vii}. The results of the survey suggest that general awareness and knowledge of vitamin D issues is strong. For instance, 74% correctly agreed with the statement ‘Vitamin D is needed for strong bones and muscles’, 85% rightly disagreed with the statement, ‘Vitamin D is important for children but not for adults’, and 78% correctly agreed with the statement, ‘Your skin can make vitamin D if it is exposed to sunlight’. More mixed results were also observed: 42% wrongly agreed with the statement, ‘A balanced diet

will give most people enough vitamin D' (with 39% correctly disagreeing); further, 40% wrongly agreed that, 'Vitamin D prevents scurvy' (with 34% rightly agreeing).

Knowledge of the 'little and often' message for adequate vitamin D production is less strong. For instance, 68% of respondents correctly identified the 'often' element, indicating that sunlight exposure is important either daily (53%) or every other day (15%). Less encouragingly, only 20% of respondents absolutely correctly identified the 'little' element, indicating that daily exposure of 10-15 minutes is appropriate; that said, 10% opted for up to 10 minutes and 25% for 15-30 minutes. Significantly, 20% answered 'Don't know' to both of these questions. Results relating to behaviour indicated that performance of positive 'little and often' behaviour for vitamin D production is also relatively low. In response to the question, 'How often do you...ensure regular exposure to the sun for short periods of time (e.g. 15-20 minutes)', 8% answered 'Always', 25% answered 'Often' and 44% answered 'Sometimes'. Asked about changes in their behaviour over the past ten years, only 19% said they were doing this more often (6% 'much more often', 13% 'a little more often').

A sense of the extent to which the public's sunlight exposure behaviour is driven instead by concerns about sunburn and skin cancer is offered by the responses to the question, 'How often do you...use sun cream when exposed to strong sun (ie no clouds in the sky)?'. In this case, 26% answered 'Always', 30% answered 'Often' and 29% answered 'Sometimes'. Asked about changes in behaviour in this regard over the past ten years, 30% said they were doing this 'more often' (13% 'much more often', 17% 'a little more often'). The survey also shows that the public is far more aware of public health communications relating to sunburn and skin cancer than relating to vitamin D. While 71% stated that they feel that the risks of sunlight exposure (sunburn and skin cancer) are well promoted (22% 'very well', 49% 'fairly well'), the corresponding figure for the benefits of sunlight exposure (vitamin D for strong bones and muscles) is just 23% (5% 'very well', 17% 'fairly well').

These findings suggest that there is an important public health communications task in terms of highlighting: the importance of vitamin D; the associated benefits of sunlight exposure; the 'little and often' message and the detail within this message. In addition, these findings suggest that behaviour change studies that examine the short- and long-term effectiveness of different forms of messaging and approach, and the reasons why behaviour change does and does not take place among a variety of groups, would be of value.

5. Key messages for policy and practice

- Vitamin D deficiency is high in the UK and there is evidence that it is increasing or more significant than previously thought.
- Research by the University of Manchester Sunlight and Vitamin D team provides the basis for balanced public health advice for sunlight exposure that ensures adequate vitamin D for most people while minimising the risks of sunburn and cancer.
- Although public knowledge and awareness of vitamin D issues – including the ‘little and often’ sunlight exposure message – is present, this is mixed. In addition, public behaviour appears to be more strongly driven by concerns about the risks of sunlight exposure.
- Part of the solution to significant levels of vitamin D deficiency lies in greater emphasis in public health communications – both general and targeted – on: the importance of vitamin D, the benefits of sunlight exposure and the ‘little and often’ message (including the detail described above), and the situations where supplementation should be advised.
- Further scientific research into the relationships between sunlight exposure, vitamin D production, and sunburn and skin cancer would be of value.
- In addition, social and behavioural research into the relationships between sun exposure messages, modes of communication, other behavioural interventions and behaviour change would also be of great value.

Authors

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ⁱ Scientific Advisory Group on Nutrition (2016) *Vitamin D and Health*, Public Health England, July 2016, <https://www.gov.uk/government/publications/sacn-vitamin-d-and-health-report>.

ⁱⁱ Ultraviolet radiation (UVR) in sunlight is absorbed through the skin and undergoes cutaneous synthesis. It then enters the bloodstream and classically undergoes hydroxylation in the liver to form 25-hydroxyvitamin D (25(OH)D). This is the major circulating form of vitamin D. 25(OH)D is further hydroxylated in the kidneys to produce 1,25-dihydroxyvitamin D (1,25(OH)2D). This is the active form of vitamin D in the body.

ⁱⁱⁱ <https://www.gov.uk/government/collections/national-diet-and-nutrition-survey>.

^{iv} Vitamin D status is measured by a blood test, typically using 25(OH)D as a proxy for vitamin D itself. In the UK, vitamin D deficiency is defined as 25(OH)D levels of less than 25 nanomoles per litre (<25 nmol/L).

^v In 2012-3, vitamin D deficiency was diagnosed as a primary or secondary diagnosis in 36,912 cases among a total of 15.1 million admissions (0.0024%). In 2017-8, vitamin D deficiency was diagnosed in 152,892 cases from 16.6 million (0.0096%). This represents an increase in proportion of 277% or almost fourfold.

^{vi} Webb AR, Kazantzidis A, Kift RC, Farrar MD, Wilkinson J, Rhodes LE (2018) Meeting Vitamin D Requirements in White Caucasians at UK Latitudes: Providing a Choice. *Nutrients* 10(4), 497;

<https://doi.org/10.3390/nu10040497>; Webb AR, Kazantzidis A, Kift RC, Farrar MD, Wilkinson J and Rhodes LE (2018) Colour Counts: Sunlight and Skin Type as Drivers of Vitamin D Deficiency at UK Latitudes. *Nutrients* 10(4), 457; <https://doi.org/10.3390/nu10040457>.

^{vii} The survey was designed by the University of Manchester research team, with support from researchers at Capita. The survey was implemented by You.gov as part of an online omnibus survey.