Institution: University of Manchester

Unit of Assessment: 7 (Earth Systems and Environmental Sciences)

Title of case study: Affecting change of UK public health policy on vitamin D, sun exposure, skin cancer and vitamin D supplementation

Period when the underpinning research was undertaken: 2007 - 2019

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Ann Webb	Professor	2000 – to date
Lesley Rhodes	Professor	2000 – to date

Period when the claimed impact occurred: October 2013 – April 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

Research which established and mapped safe levels of sun exposure while meeting vitamin D requirements for different skin types has led to new public health advice and guidance from a range of UK public health, medical professional and charitable bodies. This includes a recommendation from Public Health England that everyone take a vitamin D supplement in autumn/winter or all year round in particular cases (given sun exposure and skin pigmentation). Making use of the team's UK ultraviolet radiation (UVR) and vitamin D availability map, Boots Plc undertook a UK-wide press campaign promoting vitamin D supplementation and other bone health products with a [text removed for publication] increase in like-for-like sales of vitamin D, showing a shift in public behaviour *re* vitamin D supplementation.

2. Underpinning research

From 2007 onwards, interdisciplinary environmental research at The University of Manchester (UoM) has combined expertise in atmospheric science, dermatology and photobiology. The novelty of this research is in combining large-scale climate monitoring and modelling, with complex intervention studies with human participants. The research had the aim of determining whether it is possible in the UK to gain sufficient vitamin D through safe sun exposure (no risk of sunburn) [1, 2] and to deliver this information in a format suitable for a public health message.

Supporting this aim, the research had the following objectives:

- to establish the seasonal cycle in vitamin D status across the UK [3];
- to determine how much UVR and sunlight is required to raise vitamin D status to sufficient levels [4 - 6] and
- to determine whether this is easily attainable in the UK climate.

The work was completed for two population sub-groups, lighter skin (skin types I-IV) and darker skin (skin type V) [2, 5] since melanin (pigmentation) protects against sunburn but also reduces vitamin D synthesis.

The most significant research findings are:

i. The research confirmed, for the first time in *in vivo* studies, the seasonal cycle in vitamin D status and associated 'vitamin D winter' i.e. the period when there is not enough sunlight to make any appreciable vitamin D in skin (October to early March) in the UK [3]; a hypothesis first established in *ex vivo* (or modelling) research by Webb and colleagues in the late 1980s.

ii. The research has established, for the first time, levels of sunlight exposure – for lighter and darker skin types – that balances the benefits of adequate vitamin D production with the risks of sunburn and skin cancer. This research [1, 3, 4] showed that summer

sun exposure could safely provide for yearly vitamin D needs in UK (maintaining the circulating metabolite at > 25 nmol/L year round).

iii. More specifically, the research shows that, 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 [4 - 6]. For most, this will be a relatively safe level of exposure, minimising the risks of skin cancer seen with higher exposure levels. 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. The research also shows that, for people with darker skin (skin type V) in the UK, 25-40 minutes of exposure under the same conditions will avoid summertime deficiency, while vitamin D supplements should be considered during the winter months [2, 5]. This research showed that these complexities could be presented as relatively simple messages for lighter and darker skin types [2]. Nonetheless, it was clear that for many, this exposure was not achieved in an increasingly diverse population [3 - 5], where existing public health policy was to protect against sun exposure.

iv. For the first time, the research has established a highly rigorous annual UK UVR – and, therefore, vitamin D – availability map, showing a broad diminution in availability of UVR from sunlight from south west to north east in the UK [6]. While this work is UK specific it is directly applicable to locations at similar latitudes and can be modified to other latitudes based on the local UVR climatology.

3. References to the research

The underpinning research is published in over ten papers in peer-reviewed journals. Citations from Web of Science (November 2020).

[1] Felton SJ, Cooke MS, Kift R, Berry JL, **Webb AR,** Lam PM, de Gruijl FR, Vail A, and **Rhodes LE** (2016) Concurrent beneficial (vitamin D production) and hazardous (cutaneous DNA damage) impact of repeated low-level summer sunlight exposures. *British Journal of Dermatology,* **175**: 1321-28, DOI: 10.1111/bjd.14863 (34 citations)

[2] **Webb AR**, Kazantzidis A, Kift RC, Farrar MD, Wilkinson J, and **Rhodes LE** (2018) Meeting Vitamin D Requirements in White Caucasians at UK Latitudes: Providing a Choice. *Nutrients,* **10**(4), 497; DOI: 10.3390/nu10040497 (14 citations)

[3] **Webb, AR**, Kift RC, Durkin M, O'Brien S, Vail A, Berry JL, and **Rhodes LE** (2010). The role of sunlight exposure in determining the vitamin D status of the UK white Caucasian adult population. *British Journal of Dermatology,* **163**, 1050-1055; DOI:10.1111/j.1365-2133.2010.09975.x. (104 citations)

[4] **Rhodes LE, Webb AR**, Fraser H, Kift R, Durkin M, Vail A, O'Brien S, Allan D, and Berry JL (2010) Recommended summer sunlight exposure levels can produce sufficient (>20 ng ml^{-1}) but not the proposed optimal (>32 ng ml^{-1}) 25(OH)D levels at UK latitudes *Journal of Investigative Dermatology*, **130**, 1411-1418; DOI:10.1038/jid.2009.417 (98 citations)

[5] Farrar MD, Kift R, Felton SJ, Berry JL, Durkin MT, Allan D, Vail A , **Webb AR** and **Rhodes LE** (2011) Recommended summer sunlight exposure amounts fail to produce sufficient vitamin D status in UK adults of South Asian origin, *The American Journal of Clinical Nutrition.* **94** (5): 1219-1224; DOI: 10.3945/ajcn.111.019976. (70 citations)

[6] Kazantzidis A, Smedley ARD, Kift RC, Rimmer JS, Berry JL, **Rhodes LE** and **Webb AR** (2015) Modelling approach to determine how much UV radiation is available across the UK and Ireland for health risk and benefit studies. *Photochemical and Photobiological Sciences* **14**:1073-81; DOI: 10.1039/c5pp00008d (17 citations)

The research has been supported by GBP1,300,000 in funding from: European Union, Department of Health Policy Research Programme, Action Medical Research, BUPA Foundation, Dunhill Medical Trust and Cancer Research UK (three grants), and British Skin

Foundation. The research is also underpinned by UV monitoring, funded by DEFRA (GBP1,600,000, 2007-2018).
Rhodes was awarded the Edna Roe Lecturer Award 2019, for contributions to photobiology science (International Union of Photobiology). Webb and Rhodes have delivered invited plenary lectures at major international conferences, including: World Congress of Photobiology (2019), American Society for Photobiology Congress (2018), European Society for Photobiology Congress (2010-17), British Association of Dermatologists Conference (2015). As detailed below, Webb and Rhodes have undertaken advisory roles for numerous important government and charity scientific advisory groups, including Scientific Advisory Committee on Nutrition, Public Health England, and the National Institute for Health and Care Excellence.

4. Details of the impact

Vitamin D is an essential vitamin, helping to regulate the amount of calcium and phosphate in the body, and therefore important to healthy bones and muscles. A lack of vitamin D can lead to bone deformities and pain, and recent research suggests vitamin D reduces infection and modulates the severe complications of Covid-19. For most people, exposure to sunlight is the primary source of vitamin D. Yet the dominant message in health advice has focussed solely on the risk of sun exposure, such as sunburn and skin cancer, rather than these important benefits. In 2019, a YouGov poll for the University of Manchester showed that while many people know about the benefits of sun exposure their behaviour is still very often driven by risk aversion.

This research [1-6] has produced impact in two key areas relating to vitamin D acquisition: UK public health policy and communications relating to sunlight exposure, and sales of vitamin D supplementation.

i) Changing guidance and informing UK public health policy

Impact through changing guidance and informing public health policy has been achieved as a result of the research being used in policy development by relevant public bodies and charities. By virtue of their research [1-6], Webb and Rhodes have acted as scientific experts to these bodies. Much of this policy change has resulted through the **Scientific Advisory Committee on Nutrition (SACN)**. SACN's recommendations directly inform those of **Public Health England (PHE)** and the **National Institute for Health and Care Excellence (NICE)**.

In 2013, SACN undertook a review of their sun exposure assumptions in providing for the nation's vitamin D needs. Webb was a special advisor on the photobiology of vitamin D to the SACN 'Vitamin D and Health' committee and report ([A], p.*v*), delivering a position paper in October 2013 and following up with further evidence in November and December 2013. This drew upon the research into safe summer sun exposure providing adequate vitamin D [1, 3, 4] as well as how this is simply conveyed for lighter and darker skin tones [2].

Subsequently, SACN published recommendations based on the University of Manchester research [1-4] that – for the first time – recommended a Reference Nutrient Intake for vitamin D of 10 µg (400 IU) per day for everyone over age 4 years [B]. Prior to the 2016 report and based on the assumption that needs were met through sunlight exposure, there was no recommended dietary intake of vitamin D for most of the UK population. Whilst SACN Recommendation S.37 ([A], p.*xv*) acknowledges that sunlight is a major source of vitamin D, it notes that numerous complex factors associated with exposure preclude offering specific advice on sun exposure. [Text removed from publication].

In July 2016, based on the SACN report and UoM research, **PHE** updated their advice on vitamin D. PHE now recommend that everyone take a vitamin D supplement in autumn/winter or all year round in particular cases e.g. those with little sun exposure, or pigmented skin [C]. PHE (to be replaced with the National Institute for Health Protection in 2021) has responsibility for advising the UK governments and agencies on standards of protection for exposure to non-ionising radiation. To support this, they set up the **PHE**

Advisory Group on Non-ionising Radiation (AGNIR) in 1990, which is specifically a scientific review body advising Government. AGNIR last published a review of the health effects of ultraviolet radiation (UVR) in 2002. In 2013, AGNIR appointed Rhodes as a Board member, and to co-author the 2017 'UVR and Vitamin D Report' [D]. PHE commissioned the report in response to the difficulties faced by SACN in handling sun exposure recommendations and specifically the nuanced messaging required to address the entire population [4, 5]. The report contributed to PHE's recognition of the importance of sunlight in vitamin D supply. This underpinned a change in PHE advice on supplementation during Covid-19 lockdown (April 2020) [C]: the limits on outdoor activity for the whole population during this time, led to advice for the whole population to supplement through summer.

NICE Public Health Advisory Committee on sunlight and vitamin D have also changed guidance and recommendations following the UoM research [E]. Rhodes was invited onto the Committee as an Expert Member (2014-2016) and NICE confirm that the UoM work [3-5] "*directly contributed to the new NICE guidance (NG34)*" on Sunlight and Vitamin D [F]. NG34 now acknowledges that, despite the recommendations in the 2016 SACN report, some people will choose to get their vitamin D from sunlight. The guidelines directly reflect the findings of the UoM research of population sub-groups [4, 5], and recommend developing tailored messages for sun exposure for different skin types. **NICE guidelines for Vitamin D (PH56)** [G] were updated in 2017, in accordance with the updated SACN recommendations from the UoM research to define specific at-risk groups, and to update reference nutrient intake details [F].

Further public health messages have since been revised, based on the UoM research. Rhodes' advice [3-5] on sunlight exposure was reflected in adjustments to **NHS Choices** public advice website post-2010 to include the vitamin D benefit of sunlight exposure [H]. Webb's advice was further reflected in new guidance regarding supplementation [H: 2016], while PHE advice to NHS on Vitamin D during the 2020 Covid-19 pandemic was informed by the work of Webb and Rhodes [C]. **Cancer Research UK (CRUK)** have also used the research, specifically using the findings of [2] to update their policy and online advice to include specific advice in terms of recommended minutes of safe sunlight exposure for different skin types [I]. In 2018, Rhodes and CRUK collaborated on a CRUK blog including this advice, which has been accessed more than 20,000 times [I]. In 2018, this research also led the **British Association of Dermatologists (BAD)** to develop two new areas of the BAD public-facing information website: 'Sun advice for skin of colour' and 'Vitamin D Information' [Text removed for publication].

ii) Changing behaviour of the UK population

The UoM research can be seen to be changing public behaviour in relation to Vitamin D in-take and sun exposure. In late 2018 Boots plc (a major pharmaceutical retailer in the UK), through advertisers Ogilvy, approached Professor Webb to develop a UK UVR and vitamin D availability map [6]. Between February and April 2019, Boots Plc used this research [6] to undertake a UK-wide press campaign promoting vitamin D supplementation and other bone health products [K]. The UoM research specifically identified Stirling as the UK city with greatest risk of vitamin D deficiency [6], and targeted marketing activity by Boots in the city led to a [text removed for publication] increase in sales there. Nationally, Boots experienced an increase in like-for-like sales of vitamin D products of [text removed for publication], compared to 2018 [K]. This increase demonstrates that this public health advice has now reached a significant proportion of the UK population, and altered their vitamin D intake behaviour.

5. Sources to corroborate the impact

[A] SACN (2016) Vitamin D and Health Report, July 2016, Available at: https://www.gov.uk/government/groups/scientific-advisory-committee-on-nutrition
[B] Letter of support from Chair of the Committee, Scientific Advisory Committee of Nutrition (SACN), May 2020
[C] Letter of support (and appended blogs) from Head of Centre for Radiation, Chemical and Environmental Hazards, Public Health England (PHE), June 2020
[D] PHE (2017) *Ultraviolet Radiation, Vitamin D and Health: Report of the independent Advisory Group on Non-ionising Radiation*, March 2017
[E] Letter of support from Associate Director Science Policy and Research, NICE, June 2020
[F] NICE (2016) *NICE guidance. Sunlight exposure: risks and benefits* (NG34). Available at https://www.nice.org.uk/guidance/ng34
[G] NICE (2014) NICE guidance. Vitamin D: supplement use in specific population groups (PH56). Updated August 2017. Available at https://www.nice.org.uk/guidance/ph56
[H] NHS Choices website (July 2016) "The new guidelines on vitamin D – what you need to know" [online][Archived NHS website, saved as pdf]
[I] Letter of support (and blog links) from Senior Health Information Manager, Cancer Research UK
[J] Letter of support from Nina Goad, Head of Communications, British Association of Dermatologists, October 2019
[K] Boots Plc. (2019) Boots Healthcare Vitamin D Campaign Summary Results Report. Confidential Report.