Balancing the risks and benefits of sun exposure: A revised position statement for Australian adults

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Abstract

Objective: To describe the development of a new position statement regarding balancing the risks and benefits of sun exposure for Australian adults.

Methods: We conducted a Sun Exposure Summit in March 2021, with presentations from invited experts and a workshop including representation from academic, clinical, policy, and patient stakeholder organisations. The group considered advice about balancing the risks and benefits of sun exposure for Australian adults and developed a revised consensus position statement.

Results: The balance of risks and benefits of sun exposure is not the same for everybody. For people at very high risk of skin cancer, the risks of exposure likely outweigh the benefits; sun protection is essential. Conversely, people with deeply pigmented skin are at low risk of skin cancer but at high risk of vitamin D deficiency; routine sun protection is not recommended. For those at intermediate risk of skin cancer, sun protection remains a priority, but individuals may obtain sufficient sun exposure to maintain adequate vitamin D status.

Conclusions: The new position statement provides sun exposure advice that explicitly recognises the differing needs of Australia's diverse population.

Implications for public health: Mass communication campaigns should retain the focus on skin cancer prevention. The new position statement will support the delivery of personalised advice.

Key words: skin cancer, vitamin D, sun exposure, policy

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Introduction

Sunlight exposure has risks and benefits for human health. Too much exposure to the sun causes damage to the skin (skin cancer, premalignant lesions, and photoageing) and eyes (cataracts, pterygia, and cancers of the ocular surface). Australia has the highest incidence of skin cancer in the world, costing the health system an estimated $1.7 billion per year.[1] At least two-thirds of melanomas and almost all keratinocyte cancers in Australia are attributable to Australia's high ambient UV radiation.[2] Declining rates of skin cancer in younger cohorts are likely to be due, in part, to public health campaigns promoting the use of sun protective measures that began in the 1980s.[3,4] Given the established harms of sun exposure, skin cancer prevention must remain a high public health priority.

Exposing the skin and eyes to the sun also has benefits, many of which are mediated by the same wavelengths of UV radiation that cause the most harm. Skin synthesis of vitamin D is the most well-known benefit. Vitamin D plays a critical role in calcium homeostasis, and sufficient vitamin D is necessary for adequate musculoskeletal health. Despite Australia's abundant sunshine, vitamin D deficiency is common. In the 2011-2013 Australian Health Survey, 23% of adults were vitamin D deficient (25-hydroxy vitamin D [25(OH)D] < 50 nmol/L). The prevalence of deficiency varied markedly by state and season; in the winter months in the southern states/territories of Victoria, the Australian Capital Territory, and Tasmania, the prevalence of vitamin D deficiency was over 40%, compared with 15% and 17% in Queensland and the Northern Territory, respectively.[5]

The overlap in the UV radiation wavelengths that cause both risks and benefits makes finding the balance challenging. Importantly, there is increasing recognition that the balance of risks and benefits may not be the same for all people. In the United Kingdom, National Institute for Health and Care Excellence (NICE) information recognises variation in susceptibility to the harms of UV radiation.[6] In Australia, there has been inconsistent messaging about this balance,[7] and the lack of clear advice may contribute to suboptimal sun-protection knowledge and behaviours. For example, the 2016 National Sun Survey found that 28% of Australian adults were concerned about their vitamin D; those concerned were more likely to exhibit pro-tanning beliefs and to be sceptical about sunscreen safety, and less likely to use sun protection, although the direction of the association cannot be reliably ascertained (i.e. it is plausible that people with pro-tanning beliefs used concern about vitamin D to justify their sun exposure behaviour).[8] A 2020 survey of approximately 5,000 Australian adults demonstrated poor knowledge about the time needed to maintain adequate vitamin D status.[9]

Concern about vitamin D deficiency is also apparent among Australian general practitioners, with a ~100-fold increase in vitamin D testing since 2000.[10] A 2009 survey of general practitioners found that: (i) 83% were concerned that their patients were not getting enough vitamin D; (ii) 68% agreed that skin cancer prevention messages contributed to vitamin D deficiency; and (iii) only 32% agreed that it is more important to stay out of the sun than it is to get enough vitamin D.[11]

In 2016, a position statement regarding balancing the risks and benefits of sun exposure was released.[12] In view of the rapidly evolving research on the benefits of sun exposure, new advice to apply sunscreen daily,[13] the knowledge gap in the community, new modelling of the time required to maintain adequate vitamin D status,[14] and increasing recognition of the need to consider population diversity, in 2021 we brought together key stakeholders to review the evidence and determine whether existing guidance should be updated.

Consensus process

A virtual Sun Exposure Summit was held over two days (15-16 March 2021). The Summit was convened by the Australian Skin and Skin Cancer Research Centre (ASSC; assc.org.au) as one of a series of annual policy workshops. The Summit brought together representatives from government departments, cancer control agencies, specialist medical colleges, research institutions, and consumer organisations. Organisations included clinical bodies focused on skin cancer and endocrinology, research collaborations and organisations with special interest in either skin cancer or vitamin D, and cancer control agencies that deliver sun protection messaging. The organising committee used expert knowledge to identify relevant organisations and individuals; no organisations declined the invitation to be involved. The first day of the Summit comprised a series of presentations from invited experts regarding the harms and benefits of sun exposure. On the second day, we held a facilitated closed workshop attended by key stakeholders from clinical organisations and peak bodies that deliver advice about sun exposure, along with consumer organisations (the organisations represented are shown in Box 1: hereafter designated the Policy Group).

The Policy Group was asked to consider whether alterations to the 2016 position statement were required for the general public and/or clinicians. The workshop began with the following points of shared understanding: (1) skin cancer, premalignant lesions, photoageing, and UV-induced eye diseases are a major health and economic burden in Australia, and any new position statement must ensure that sun protection messages are not undermined; (2) sun exposure has health benefits, one of which is vitamin D production, but there are other known and emerging benefits; and (3) the balance of risks and benefits varies between people.

The workshop was conducted over four hours and consisted of several breakout sessions (Table 1), followed by whole group discussions. Following the workshop, a draft position statement was circulated. Eight subsequent rounds of revision occurred; these

BOX 1. Organisations represented / affiliations of members of the Policy Working Group

*Australasian College of Dermatologists.
*Australia and New Zealand Bone and Mineral Society.
Australian National University.
*Australian Skin and Skin Cancer Research Centre.
*Cancer Council Australia.
*Healthy Bones Australia.
*Melanoma Patients Australia.
*Multiple Sclerosis Australia.
QIMR Berghofer Medical Research Institute.
*Royal Australian College of General Practitioners.
Royal Children's Hospital, Melbourne.
*Skin Cancer College of Australasia.
University of Queensland.
**Statement officially endorsed by this organisation.*

Table 1: Breakout group topics and details.

Over-arching topic	Existing advice in the 2016 position statement	Discussion points considered by the workshop
Advice when the forecast maximum UV index is ≥ 3	When the maximum UV index is forecast to be ≥3 a few minutes of *mid-morning or mid-afternoon* sun exposure to hands and arms, or an equivalent exposed area, is sufficient for vitamin D production.	• Is mid-morning or mid-afternoon the most appropriate time to spend outdoors? • Is this advice appropriate for those locations/times when the UV index only reaches 3 for a short time? In such circumstances, would middle of the day exposure be more appropriate? • Body surface area exposed is important. Should advice about this be incorporated more explicitly?
Advice when the forecast maximum UV index is < 3	In late autumn and winter, in those parts of Australia where the UV index is below 3, sun protection is not recommended. During these times, to support vitamin D production, it is recommended that people be outdoors in the middle of the day with some skin uncovered on most days of the week. Being physically active while outdoors will further assist with vitamin D levels.	Obtaining an adequate vitamin D dose on days when the maximum UV index is <3 is difficult without considerable surface area exposed. a. Should the advice be more explicit about exposed skin and the time outdoors required to maintain vitamin D? b. If sufficient time outdoors in the middle of the day, with sufficient skin exposed, is not possible, what options are there? i. Recommend supplementation. ii. Recommend higher sun exposure in the months prior to winter (supported by modelling to identify: the 25(OH)D required prior to winter to avoid 25(OH)D dropping below 50 nmol/L and the UV dose needed to increase from end winter to beginning winter). iii. no specific advice; for many people, there is a natural correction after winter. iv. Other
Diversity	It is recommended that people who may be at risk of vitamin D deficiency discuss their vitamin D requirements with their medical practitioner to determine if dietary supplementation rather than sun exposure is appropriate.	• Is this advice sufficiently inclusive? • Is the advice for populations at increased risk of vitamin D deficiency correct? • Should explicit advice for people with darker skin types be provided? • Should people at high risk of skin cancer be advised to meet vitamin D requirements through supplementation? i.e. for these people, should we advise that the risk outweighs the benefit of being outdoors for the purpose of vitamin D production?
Non-vitamin D benefits		• Should the statement give advice about sun exposure for the non-vitamin D benefits? If so, what should this be?

focused on ensuring the clarity of the text and did not result in any alteration of any core concepts. After the consensus statement was finalised, it was circulated to key stakeholder organisations for endorsement. One organisation (Cancer Council Australia) requested some alterations of wording prior to endorsing the document but supported the core advice. Ethical review was not required for this project.

Key considerations

Details of all factors considered are included in the revised position statement, along with the level of evidence assigned by the Policy Group.[15] Issues that were considered to be particularly important are detailed below.

For people with susceptible skin types there is no known safe dose of sun exposure

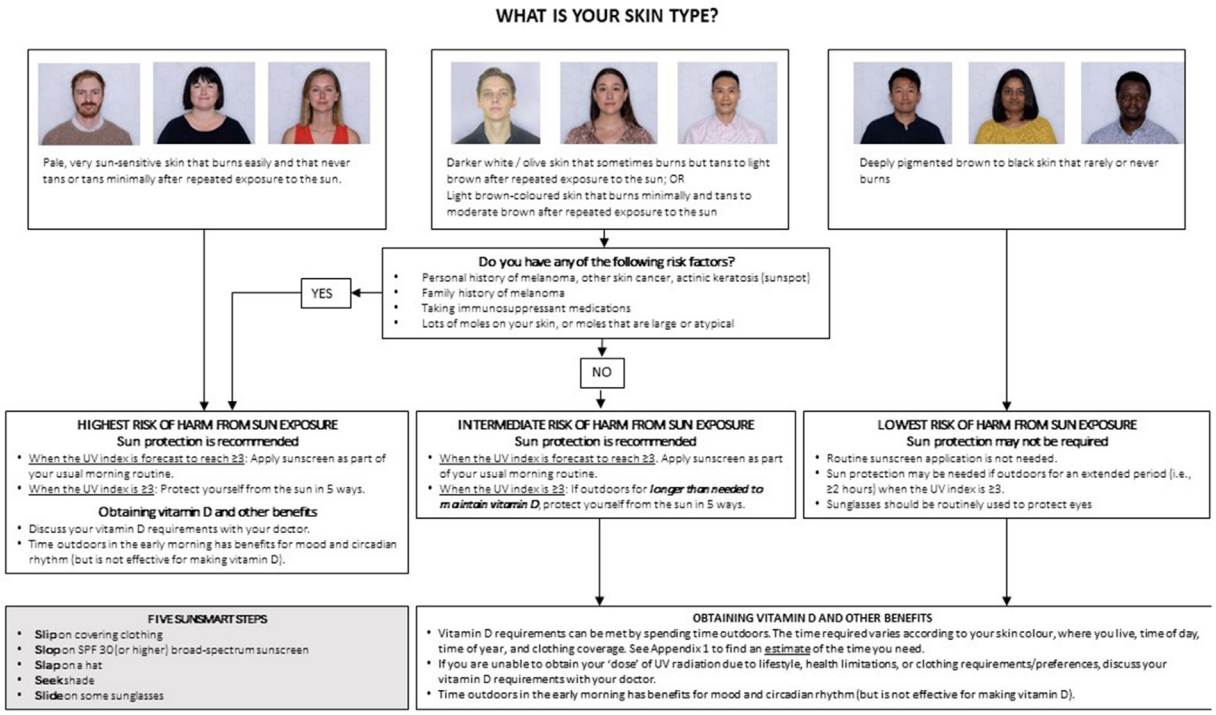
Skin cancers are primarily caused by direct or indirect damage to DNA. There is strong evidence that exposing the skin to sufficient UV radiation to cause erythema increases the risk of skin cancer.[16–19] The epidemiological evidence for the harms of lower-dose exposures is less clear, although laboratory studies show that sub-erythemal exposures can lead to typical UV-induced DNA mutations.[20] The skin has effective DNA repair mechanisms, but some mutations can persist,[21] ultimately leading to skin cancer. For people susceptible to skin cancer due to genotypic or phenotypic factors, it is likely that there is no 'safe' dose of UV radiation, but exposure to frequent low doses with sufficient time between them to enable DNA repair is thought to be safer than exposure to less frequent higher doses. Further, there is evidence that sunscreen can prevent photodamage.[20,22]

The risk of skin cancer varies according to skin type

The incidence of UV radiation-induced skin cancer in people with constitutively dark skin (i.e. Fitzpatrick type 5/6) is extremely low. There is limited information for Australia, but in the United States, the incidence of melanoma is 30 times lower in Black men and 26 times lower in Black women compared to non-Hispanic White men and women.[23] Those melanomas that do occur in Black people are much more likely to be of the acral lentiginous subtype (occurring on the palms or soles and less likely related to sun exposure), accounting for approximately a quarter of melanomas in this group compared with around 1% of melanomas in non-Hispanic White cohorts in the United States.[24] Keratinocyte cancer also occurs much less frequently in people with deeply pigmented skin,[25,26] and a considerable percentage arises on sun-protected body sites.[27] These differences in epidemiology are supported by laboratory findings showing that melanin affords approximately 60-fold protection against DNA damage in the basal layer of Fitzpatrick type VI skin compared with type I and II skin.[28]

At the other extreme, those with very pale skin (Fitzpatrick skin type I/II) are at markedly increased risk of skin cancer. For example, in an Australian cohort study (the QSkin Study), in which analysis was restricted to those with white European ancestry, those who reported having fair compared with olive or dark skin were at a 2.9-fold increased risk of melanoma.[29] The risk of keratinocyte cancer is also markedly increased in people with fair skin.[30]

Figure 1: Risk-stratified advice regarding balancing the risks and benefits of sun exposure.



Other factors that increase risk of melanoma or keratinocyte cancer

Apart from skin type, other factors that increase the risk of skin cancer are the presence of naevi and a family history of melanoma. The strongest phenotypic risk factor for melanoma is having many naevi. In the QSkin Study, participants who reported having many naevi on their skin at age 21 had a five-fold higher risk of developing melanoma compared with those who reported no naevi.[29] Having one first-degree family member affected by melanoma increases the risk of developing melanoma by up to 75%.[31] Separately from family history, there are multiple genetic variants associated with the risk of melanoma[32] and keratinocyte cancer.[33] However, these are not yet used to stratify the population for targeted skin cancer prevention or screening.

People who are immunosuppressed following organ transplantation are at particularly high risk of skin cancer. While this is most marked for squamous cell carcinoma, with risks up to 200-fold higher than in the general population,[34] there is also a five- to seven-fold increased risk of basal cell carcinoma and melanoma.[35] The use of immune-modulating drugs for treatment of inflammatory diseases is also associated with a modestly (less than two-fold) increased risk of nonmelanoma skin cancer.[36,37]

Vitamin D is important for musculoskeletal health and may have other benefits

Approximately 8% of hospitalisations for each of hip fractures and falls in Australia may be attributable to vitamin D deficiency.[38] Beyond musculoskeletal health, vitamin D has important effects on the immune system, both upregulating innate immunity and downregulating inflammatory pathways, with consequent benefits for infection and autoimmune disease. Observational studies consistently show inverse associations between 25(OH)D concentration and acute respiratory tract infection,[38] and meta-analyses of randomised controlled trials suggest a benefit of vitamin D supplementation.[39,40] Living in areas with high ambient UV radiation is associated with a reduced risk of multiple sclerosis, and Mendelian randomisation studies indicate that this may be at least partly attributable to vitamin D.[41,42] Observational studies consistently demonstrate an inverse association between 25(OH)D concentration and all-cause mortality, and Mendelian studies and randomised controlled trials suggest that this association may be causal.[43]

Adequate vitamin D status can be maintained through short regular exposures to sunlight

The Policy Group concluded that the Royal College of Pathologists of Australasia recommendations to maintain 25(OH)D concentrations above 50 nmol/L should be maintained. Previous guidelines have suggested that Australians should aim for a concentration of 60-70 nmol/L in summer, in order to avoid vitamin D deficiency through winter.[12] However, the additional dose of UV radiation required in non-winter months to both meet the daily requirements and accumulate a vitamin D reserve is unknown. Further, advice to increase 25(OH)D during summer could lead to an increased risk of skin cancer. Considering this uncertainty, the Policy Group concluded that aiming to maintain a steady 25(OH)D concentration across the year, using supplements where required, is a more appropriate strategy than recommending that people create a vitamin D store during non-winter months.

Vitamin D production may reach a steady state within the skin; i.e. once a plateau is reached, further exposure to UV radiation does

not lead to additional vitamin D.[25] While the UV dose at which this plateau occurs is not well established, the efficiency of vitamin D production declines with an increasing UV radiation dose in a single episode. Thus, exposing the skin for a shorter time on multiple days per week, rather than for a longer time on fewer days, is potentially superior for vitamin D production and safer in terms of skin cancer risk, as this allows for DNA repair between exposures. Similarly, while the relationship between the amount of skin surface area exposed and vitamin D production may not be linear,[44] it is thought better to expose ample skin for a short time rather than less skin for a longer time.

Laboratory studies in which people are exposed to artificially generated UV radiation, with or without sunscreen applied to the skin, suggest that sunscreen reduces but does not completely abolish vitamin D production.[45] Observational studies are largely uninformative about the effect of sunscreen use on vitamin D due to confounding by time outdoors and skin type. Importantly, two large randomised controlled trials of daily sunscreen application (SPF ~16) versus discretionary use or placebo did not find lower 25(OH)D concentrations in the active arms of the trials.[45]

The risk of vitamin D deficiency varies according to skin type

People with dark skin are at increased risk of vitamin D deficiency compared to lighter-skinned people living in the same region. The Australian National Health Survey found that the prevalence of vitamin D deficiency was 50% in people born in countries where English is not the main language compared to 19% of those born in Australia, although this study did not report results by skin colour.[46] The dose of UV radiation needed to deliver an increase in 25(OH)D concentration in people with dark skin is uncertain, with studies suggesting that people with Fitzpatrick skin type VI require 1.3- to 8-fold higher doses of UV radiation compared with those with skin types I to III to produce the same amount of vitamin D.[44]

Spending time outdoors has benefits for health beyond vitamin D production

Advising complete sun avoidance and meeting vitamin D requirements through food or supplements may be a suitable strategy for some people who are at particularly high risk of skin cancer. However, exposure to the UV wavelengths in sunlight may have benefits independent of vitamin D through mechanisms such as immune system modulation[47] and the release of nitric oxide.[48] It is plausible, although not yet well established, that having sufficient 25(OH)D concentration is a proxy for having received adequate UV radiation to obtain these benefits.[49] The Policy Group considered that the evidence for these benefits is limited but, following the precautionary principle, recommended that people at intermediate or low risk of skin cancer obtain sufficient controlled exposure to UV radiation to maintain adequate vitamin D status.

Exposure to the non-UV wavelengths in sunlight improves circadian rhythm and mood, and time outdoors is associated with a reduced risk of myopia.[49] These benefits can be obtained at times of the day when the UV index, and thus the risk of initiating skin cancer, is comparatively low.

Changes to recommendations regarding sun exposure and sun protection

Given the diversity of Australia's population and the marked variation in risks of skin cancer and vitamin D deficiency by skin type, the Policy Group considered that advice about sun exposure and sun protection for people living in Australia should be stratified according to the relative risks of skin cancer and vitamin D deficiency. Three strata were defined: (1) people at highest risk of skin cancer, defined as all those with Fitzpatrick type I or II skin, and also people with Fitzpatrick III or IV skin who have any of: a personal history of skin cancer, a family history of melanoma, multiple naevi, or are immunosuppressed; (2) people at intermediate risk of skin cancer, defined as those with Fitzpatrick type III or IV skin, with no other risk factors; and (3) people at lowest risk of skin cancer, defined as people with Fitzpatrick type V or VI skin (Figure 1). The advice within the three groups is summarised below, and more details are provided in the position statement.[15]

People at highest risk of skin cancer

People at high risk of skin cancer due to phenotype, family history of melanoma, or immunosuppression are advised to take great care to protect their skin from the sun. Sunscreen should be applied routinely on all days when the UV index is forecast to reach 3 or greater. In addition, time outdoors at times when the UV index is 3 or greater should be avoided, and if this is not possible, the skin and eyes should be protected by shade, clothing, hats, sunglasses, and reapplication of sunscreen. People in this group should not spend time outdoors deliberately to maintain adequate vitamin D status. If this advice is followed, vitamin D deficiency may occur. Vitamin D requirements can be met through supplements. Time outdoors in the early morning can deliver the benefits of exposure to the non-UV wavelengths in sunlight, but this will not lead to adequate vitamin D production.

People at intermediate risk of skin cancer

People at intermediate risk of skin cancer should apply sunscreen on all days when the UV index is forecast to reach 3 or greater. People in this risk group should aim to spend sufficient controlled time outdoors to obtain a vitamin D-effective dose of UV radiation on most days of the week but should take precautions if spending (or planning to spend) more time outdoors than needed to maintain vitamin D when the UV index is 3 or greater. Across the whole of Australia in summer, and in northern parts in winter, many people will avoid vitamin D deficiency by going about their usual day-to-day activities.

People at lowest risk of skin cancer

People with Fitzpatrick type V or VI skin do not need to apply sunscreen routinely. Sun protection may be required during extended periods outdoors when the UV index is high. Where possible, people with deeply pigmented skin should regularly spend sufficient time outdoors to achieve and maintain adequate vitamin D status.

Time outdoors for maintaining adequate vitamin D status

New modelling has estimated the amount of time outdoors required to maintain existing 25(OH)D concentration (i.e. to meet the daily spend requirements) under different clothing conditions that expose 10% and 35% of the body surface area according to the month of the year and

the time of the day for capital cities and selected locations in Australia.[14] Full details are given in the appendices of the position statement.[15] Briefly, throughout Australia in summer, for those with Fitzpatrick skin type I to IV, less than 10 minutes outdoors on four or more days per week between 9 am and 5 pm is required, provided approximately 35% of the body surface area is exposed (e.g. wearing shorts and a short-sleeved t-shirt). If only 10% of the body surface area is exposed (e.g. wearing full-length trousers and a shirt with sleeves to the elbow), the time required increases, although with time outdoors between 9 am and 3 pm less than 20 minutes is needed in most regions.

In winter, people with Fitzpatrick skin type I to IV living in northern parts of Australia (latitude approximately 12.5°S to 27.5°S) to can continue to maintain adequate vitamin D with fewer than 10 minutes outdoors through the middle of the day, but longer is required outside these times. In most southern states in winter (below approximately 30°S), people can maintain sufficient vitamin D status with approximately 30 minutes outdoors in the middle of the day with 35% of the body surface area exposed, but outside these times or wearing covering clothing, which is usually needed for the cold, the time required increases markedly.[15]

For people with Fitzpatrick skin types V and VI, under the assumption that 2.5 times more UV radiation is needed to produce the same increment in vitamin D as those with lighter skin types (evidence for skin type V[50]), about 20 minutes between 10 am and 4 pm is sufficient to maintain adequate vitamin D status in summer. In winter, around 20 to 30 minutes in the middle of the day is sufficient in northern Australia, but in southern Australia, up to an hour is needed, with 35% of the body surface area exposed in many areas, and in Tasmania, more than an hour is required. With only 10% of the body exposed, there are some parts of southern Australia where it is not possible for people to make sufficient vitamin D to maintain their existing 25(OH)D concentration.

For some people, obtaining a vitamin D-effective dose of UV radiation might not be advisable or achievable. For example, if those people at highest risk of skin cancer follow the recommended advice, they may not meet their vitamin D requirements. For others, health, occupational, lifestyle, or clothing choices may prevent sufficient skin exposure to UV radiation. In winter in southern states, weather conditions may make it very difficult to expose sufficient skin for long enough, particularly for those with dark skin. If a vitamin D-effective dose is not obtained, supplementation can be used to maintain adequate vitamin D status. Australians in this situation are advised to discuss their vitamin D requirements with their doctor.

Summary

The risks and benefits of sun exposure are not the same for all Australians. The new position statement provides advice that explicitly recognises this diversity. However, preventing skin cancer must remain a priority; it is critical that this new advice does not undermine skin cancer prevention messages. Mass communication campaigns should retain the focus on skin cancer prevention. This position statement will enable personalised advice to be provided by clinicians and directly to consumers through public-facing materials.

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Ethics

No approval from a Human Research Ethics Committee was required.

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Conflicts of interest

David Whiteman reports a relationship with Pierre Fabre Australia that includes speaking and lecture fees. Peter Ebeling reports a relationship with Healthy Bones Australia that includes board membership. Peter Ebeling reports a relationship with the American Society for Bone and Mineral Research that includes board membership. Peter Ebeling reports a relationship with International Osteoporosis Foundation that includes: board membership. Peter Ebeling reports a relationship with the Asian Pacific Consortium on Osteoporosis that includes board membership. Craig Sinclair reports a relationship with Cancer Council Victoria that includes employment. Christian Girgis reports a relationship with the Australian and New Zealand Bone and Mineral Society that includes board membership. Christian Girgis reports a relationship with the University of Sydney that includes employment. Stephen Shumack reports a relationship with the Australasian College of Dermatologists that includes non-financial support.

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