Reapplying knowledge on sunscreen and photoprotection: A narrative review

Vanessa Tran, Vanessa Morgan, Celestine Wong

Background
Research indicates that education on sun protection and proper sunscreen application is insufficient, leading to widespread under-application of sunscreen. This lack of adherence to recommended practices increases the risk of skin cancers, photoageing and exacerbates conditions like melasma and lupus.

Objective
This review aims to provide clinicians with a practical framework to educate patients on effective sun protection, including sunscreen use, and to address common barriers to adherence.

Discussion
Sunscreen is crucial for preventing melanoma, non-melanoma skin cancers, photoageing and exacerbating conditions like melasma and lupus. Despite its importance, it is often underapplied. Effective patient education is essential, and clinicians are well positioned to guide effective sunscreen use and encourage holistic sun protection behaviours. In addition to sunscreen, this includes wearing protective clothing, broad-brimmed hats, sunglasses and seeking shade.

THE RESURGENCE of tanning trends on TikTok and other social media platforms raises significant concerns about the skin health of the Australian population, especially the youth. Australia's 'Slip, Slop, Slap, Seek, Slide' campaign has long been at the forefront of sun safety education.[1] However, recent viral challenges on social media such as the 'tan line' trend, where users deliberately create tan lines through sunbathing, promote unprotected sun exposure and downplay its well-documented risks. Given the widespread reach of social media, there is a pressing need for renewed public health messaging about evidence-based sun protection.

Effective sun protection involves key strategies used in combination: applying broad-spectrum, water-resistant sunscreen (SPF50+); wearing a broad-brimmed hat, sunglasses and sun protective clothing; and seeking shade when possible.[2] Despite the importance of sunscreen, studies have shown that it is commonly insufficiently applied, contributing to inadequate sun protection.[3–9] Clinicians are well positioned to educate patients on proper sunscreen use and holistic sun safety. A cross-sectional study, however, suggested that consumers do not receive guidance from dermatologists about sunscreen use and do not have adequate knowledge of current sunscreen guidelines.[10] A large study in the United States revealed that sunscreen was mentioned in only 1.6% of all dermatology visits and 0.9% of all patient visits associated with skin disease.[11] This highlights the need for improved patient education in all clinical settings.

Aim

This review aims to equip clinicians with a practical framework for patient education on comprehensive sun protection, with focus on the complexities of sunscreen use.

Benefits: Why do we recommend sunscreen use?

Sun exposure has well-documented dermatological consequences, including melanoma and non-melanoma skin cancers (NMSCs). Sun protection through regular sunscreen use has been shown to prevent these malignancies.[12–14] Sun exposure also exacerbates pigmentary disorders, such as melasma, cutaneous porphyrias, cutaneous lupus erythematosus and polymorphic light eruption (PMLE).[15–19] Lastly, sunscreen has been shown to prevent the photoageing effects of the sun, which can be a general concern for patients.[20]

Active ingredients: What makes sunscreen protective against the sun?

Sunscreens are largely divided into two groups, chemical/organic or mineral/inorganic, based on the type of UV filters that are used. In Australia, there are currently 27 chemical filters and two mineral filters that are approved by the Therapeutic Goods Administration (TGA) for use in sunscreens.[21]

Chemical sunscreens

Chemical sunscreens contain organic filters such as octocrylene, octinoxate, oxybenzone and avobenzone. These sunscreens protect the skin from UV radiation through the absorption of UV rays, which are then converted into heat and released from the skin.[22] Chemical filters penetrate the stratum corneum and absorb specific wavelengths of UVA and UVB radiation, preventing them from causing cellular damage. As they need to be absorbed into the stratum corneum, these sunscreens should be applied 20 minutes prior to sun exposure (Table 1).

Mineral sunscreens

Mineral sunscreens, or physical sunscreens, contain the inorganic filters zinc oxide (ZnO) or titanium dioxide (TiO_2). These filters act as a physical barrier against UV rays and provide protection by reflecting and scattering UV rays away from the skin. Mineral sunscreens have the benefit of causing less skin irritation, making them a preferred choice for individuals with sensitive skin or other skin conditions, such as rosacea and eczema.[23] Traditional formulations contained larger particles of ZnO or TiO_2, which leave a noticeable white appearance on skin. The development of micronised (100–2500 nm) and nanosized (1–100 nm) particles of these ZnO or TiO_2 has allowed for more cosmetically acceptable mineral sunscreens.[22] Safety concerns for nanoparticles is discussed later in this piece.

With a wide variety of sunscreen filters available, consumers are encouraged to choose a product that they find comfortable and are willing to use consistently. Table 1 outlines the key advantages and disadvantages of different sunscreen types to help guide selection.

Iron oxides

The addition of iron oxides to sunscreen can provide protection against visible light, which is implicated in pigmentary disorders and photodermatoses such as porphyria and cutaneous lupus erythematosus. Studies have demonstrated that iron oxide-containing sunscreens are superior in preventing visible light-induced pigmentation, particularly in individuals with skin of colour (SOC).[24,25] Iron oxides provide tint to sunscreens and other cosmetic products. Patients with pigmentary disorders and photodermatoses, therefore, might benefit from the use of a tinted sunscreen in favour of a non-tinted sunscreen.

Sunscreen efficacy: How is the effectiveness of sunscreen determined?

The effectiveness of sunscreens is defined by several parameters. In Australia, the TGA issues a set of guidelines for the approval of sunscreens, which involves a set of rigorous testing to ensure its efficacy in sun protection.[21] Products that receive TGA approval will receive a 'AUST L' identification number, which is displayed on the product packaging. However, Australian consumers now have easier access to international sunscreen products that might not have undergone TGA approval.

UVB protection

The sun protection factor (SPF) measures how much sunscreen increases the minimal erythema dose (MED) compared to unprotected skin. The MED is defined as the UVB dose required to produce minimal skin erythema.[26] SPF is based on in vivo testing on human participants, with the sunscreen applied at a dose of 2 mg/cm^2. Achieving the labelled SPF of a sunscreen, therefore, relies on application to this dose.

UVA protection

Broad-spectrum sunscreen provides protection against UVA radiation, which in Australia is indicated by a pass/fail test rather than a numerical grade.[27] UVA protection of sunscreen is determined through in vitro testing of the critical wavelength of the sunscreen, which indicates the UV radiation that the product effectively blocks. A sunscreen product is labelled as 'broad-spectrum' by the TGA when it has both UVB protection, conveyed through its SPF rating, and passes

Table 1. Summary of some advantages and disadvantages of chemical/organic and mineral/inorganic sunscreens

Type	Pros	Cons
Chemical/organic sunscreen	• Lightweight and easier to apply • Cosmetically elegant with no white cast • Formulas can be water-resistant	• Requires 20 minutes to absorb before sun exposure • Can cause skin irritation or allergic reactions in sensitive individuals • Some ingredients (eg oxybenzone, octinoxate) linked to environmental concerns, particularly coral reef damage • Can degrade faster when exposed to sunlight, requiring frequent reapplication
Mineral/inorganic sunscreen	• Provides immediate protection after application • Less likely to cause irritation, making it ideal for sensitive skin and children • More photostable, offering longer-lasting protection • Generally considered reef-safe and environmentally friendly	• Can leave a white appearance on skin, particularly on darker skin tones • Thicker texture, which might feel heavy or greasy • Might require more frequent reapplication because of potential rubbing or sweating off

the UVA test.[21] In Europe, compliant sunscreens display a 'UVA' symbol enclosed within a circle on the packaging, which might also appear on some Australian products.

Recommendations: Ensuring adequate application and reapplication of sunscreen

The Cancer Council recommends using the five sun protection strategies when the UV index, which measures the UV radiation levels, is three or above.[28] This following section elaborates on several key sunscreen recommendations to ensure adequate protection (Table 2).

It is recommended that Australians choose a broad-spectrum sunscreen with an SPF rating of 50 or 50+. An SPF rating of at least 50 means that at least 98% of the UVB radiation is being filtered by the sunscreen, whereas broad-spectrum indicates adequate UVA protection.

The efficacy of sunscreen relies on adequate application and reapplication. Real-world studies have demonstrated that consumers apply only one-fifth to half of the required amount of sunscreen.[3–9] To improve application, practical tools such as the 'teaspoon' guide and 'finger unit' guide have been developed to ensure sunscreen application to achieve the recommended dose of 2 mg/cm^2 (Table 3).[29–31] Both guides have been developed based on the 'rule of nines' for body surface area. The 'teaspoon' guide refers to the application of one teaspoon worth of sunscreen to each specified body area.[30,31] The 'finger unit' guide can offer a more practical solution as it does not require measuring instruments – rather, two 'finger units' refers to the amount of sunscreen squeezed along the length of the index and middle fingers, from the palmar crease to the fingertips.[29]

Timing of application is also important to ensure sunscreen efficacy. Chemical sunscreens should be applied at least 20 minutes before sun exposure to allow adequate absorption into the stratum corneum, where the filters absorb UV radiation. To maintain photoprotective efficacy, sunscreen should also be reapplied every two hours during sun exposure, and immediately after swimming, sweating or towel drying. For chemical sunscreens, reapplication is necessary because of degradation over time upon sun exposure. In contrast, mineral sunscreens, which form a protective barrier on the skin surface and reflect UV radiation, require reapplication as they can be physically removed through routine activities.

Common sunscreen issues: Concerns and how to address them

Texture, feeling and appearance

The sensory and aesthetic experience of applying sunscreen plays a crucial role in its uptake and compliance. Studies have found that the texture, feel and appearance of sunscreens can be a barrier to its use.[32–34] A common complaint is the appearance of a white cast or greasy feeling on the skin after sunscreen application.[34] This is often attributed to the large particle size of traditional mineral sunscreens, which sit on the skin surface and reflect light. Micronised or nanosized particles of ZnO or TiO_2 are now increasingly used, offering a sheer and more cosmetically acceptable mineral sunscreen.[22] In general, chemical filters also typically offer better cosmetic appearance and texture. Sunscreens are also available in many forms to suit consumer preference, including lotion, creams, gels, sprays, serums or integrated into makeup products, such as primers and powders. Overall, dermatologists agree that the best sunscreen is one that patients will comply with.[35]

Acne, rosacea and periorificial dermatitis

As mentioned, mineral sunscreens are generally better tolerated by patients with

Table 2. Summary of sunscreen application recommendations and rationale

Recommendation	Reasoning
• Use a comprehensive sun protection strategy, which includes sunscreen, when the UV Index is 3 or above	• The UV Index indicates the level of UV radiation at ground level on a given day, with 1 being the lowest and 11 being extreme.[28] A UV Index of 3 indicates moderate UV radiation exposure, which can cause damage to the skin
• Select a broad-spectrum sunscreen with an SPF rating 50 or 50+	• Higher SPF ratings provide better protection against UVB rays, which cause sunburn. Broad-spectrum sunscreens ensure UVA protection, which is responsible for skin cell damage
• Apply sunscreen 20 minutes prior to sun exposure	• This applies to chemical sunscreens, as the UV filters need to be absorbed into the stratum corneum, where they absorb UV rays
• Ensure adequate amounts of sunscreen are applied. Follow the 'teaspoon' rule for each body region as a guide (Table 3)	• The testing of sunscreen efficacy is based on application of sunscreen at a dose of 2 mg/cm^2. Application of less sunscreen volume will result in inadequate sun protection[30,31]
• Reapply sunscreen every 2 hours or more frequently if swimming or sweating	• As mineral sunscreens sit on top of the skin and reflect UV rays, they can rub off over time because of physical activity or sweating
• Considering using a waterproof sunscreen if undertaking these activities	• Chemical sunscreens can degrade when exposed to sunlight, thus requiring reapplication. For example, the chemical filter, avobenzone, is photolabile and might lose 50% of its efficacy after 1 hour of UV exposure[22,27]

Table 3. A recommendation on the amount of sunscreen applied to each body region for adequate coverage based on the 'teaspoon' and 'finger units' guides

Body region	Number of teaspoons (5 mL)	Finger units[A]
Face/head/neck	1	2
Right upper limb	1	2
Left upper limb	1	2
Anterior trunk	1	4
Posterior trunk	1	4
Right lower limb	2	4
Left lower limb	2	4

[A]Two finger units refers to the amount of sunscreen squeezed along the length of the index and middle fingers, from the palmar crease to the fingertips.

rosacea and eczema. However, conversely, the occlusive properties of traditional mineral sunscreens containing large particles of ZnO or TiO_2 might trigger or flare skin conditions such as acne and periorificial dermatitis. In these patients, it might be beneficial to recommend newer micronized mineral filters or a switch to chemical filters. Patients with oily skin, acne or rosacea might also prefer lighter gel-based, serum or powder formulations.[36]

Contact allergy

Contact dermatitis results from a delayed hypersensitivity reaction to sunscreen ingredients. The most reported UV filters associated with contact allergy include oxybenzone (benzophenone-3), octocrylene and avobenzone.[37] In addition to UV filters, sunscreen products often contain other potential allergens, such as fragrances, emulsifiers and preservatives, which can also trigger contact allergy. For patients with suspected contact allergy to sunscreen, a dermatology referral for patch testing can be recommended.

Environmental safety

Increasing awareness of the environmental impact of sunscreens, particularly concerning coral reef health, has led to growing consumer concern. Certain chemical filters, such as oxybenzone and octinoxate, have been implicated in coral bleaching and marine toxicity.[38] However, real-world evidence for their direct impact on coral bleaching is limited and further research is required.

Safety of nanoparticles

Concerns regarding nanoparticle sunscreens have gained attention because of their potential for skin penetration and systemic absorption.[39] Research to date indicates that nanoparticles of ZnO or TiO_2 do not penetrate deeply enough into skin to reach viable epidermal layers.[40] Although further research is required to ensure consumer safety, the current evidence supports the safety of nanoparticle sunscreens.

Conclusion

Sunscreen is an important component of photoprotection behaviours. Beyond its crucial role in prevention of skin cancers, it serves an important role in the management of other dermatological conditions, such as pigmentary disorders. Studies have shown that sunscreen remains underutilised or incorrectly applied by many individuals, resulting in inadequate sun protection.[3–9] Education from healthcare professionals is lacking.[11] This issue is compounded by social media trends promoting sun tanning, particularly among adolescents and young adults. This highlights the need for improved education through public health initiatives and from healthcare professionals, such as general practitioners, who are well-positioned to provide guidance on sun protection.

In addition to proper sunscreen usage, it is essential that other sun protection measures are also encouraged, such as wearing wide-brimmed hats, sunglasses, long-sleeve clothing and seeking shade.[1]

This review summarises key information to support clinicians in counselling patients on correct and effective sunscreen use. Given the complexities of sunscreen use, this review focuses on the properties, applications and common barriers to adherence. However, sunscreen is just one aspect of comprehensive sun protection. A holistic approach to sun safety remains essential and should be emphasised in patient education.

Key points

- Ultraviolet radiation is a key environmental risk factor for skin cancer, photoageing and pigmentary disorders.
- Comprehensive sun protection includes sunscreen, protective clothing, hats, sunglasses and shade-seeking behaviour.
- Sunscreen efficacy depends on proper application technique, amount and regular reapplication.
- Guidelines such as the 'teaspoon rule' or 'finger-tip unit' help standardise adequate sunscreen use.
- Clinicians play a vital role in addressing sunscreen misconceptions and promoting adherence through patient education.

Authors

Vanessa Tran BBMed, MD, Research Fellow, Department of Dermatology, Royal Melbourne Hospital, Melbourne, Vic

Vanessa Morgan MBBS, FACD, Head of Unit, Department of Dermatology, Royal Melbourne Hospital, Melbourne, Vic; Associate Professor, Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne, Melbourne, Vic

Celestine Wong MBBS, BMedSci, FACD, Consultant, Department of Dermatology, Royal Melbourne Hospital, Melbourne, Vic; Honorary Fellow, Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne, Melbourne, Vic; Consultant, Department of Dermatology, Monash Health, Melbourne, Vic

Competing interests: None.

Funding: None.

Provenance and peer review: Not commissioned, externally peer reviewed.

AI declaration: The authors advise that there was use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and accept full responsibility for all content. Details on how AI was used have been declared to the Editors.

Correspondence to:
vanessatranv@gmail.com

References

1. Cancer Council. Slip, Slop, Slap, Seek, Slide. Cancer Council, [date unknown]. Available at www.cancer.org.au//cancer-information/causes-and-prevention/sun-safety/campaigns-

and-events/slip-slop-slap-seek-slide [Accessed 14 November 2024].
2. Cancer Council. Be SunSmart. Cancer Council, [date unknown]. Available at www.cancer.org.au/cancer-information/causes-and-prevention/sun-safety/be-sunsmart [Accessed 26 February 2025].
3. Stenberg C, Larkö O. Sunscreen application and its importance for the sun protection factor. Arch Dermatol 1985;121(11):1400–02. doi: 10.1001/archderm.1985.01660110048013.
4. Bech-Thomsen N, Wulf HC. Sunbathers' application of sunscreen is probably inadequate to obtain the sun protection factor assigned to the preparation. Photodermatol Photoimmunol Photomed 1992–1993;9(6):242–44.
5. Autier P, Boniol M, Severi G, Doré JF; European Organization for Research and Treatment of Cancer Melanoma Co-operative Group. Quantity of sunscreen used by European students. Br J Dermatol 2001;144(2):288–91. doi: 10.1046/j.1365-2133.2001.04016.x.
6. Neale R, Williams G, Green A. Application patterns among participants randomized to daily sunscreen use in a skin cancer prevention trial. Arch Dermatol 2002;138(10):1319–25. doi: 10.1001/archderm.138.10.1319.
7. Szepietowski JC, Nowicka D, Reich A, Melon M. Application of sunscreen preparations among young Polish people. J Cosmet Dermatol 2004;3(2):69–72. doi: 10.1111/j.1473-2130.2004.00119.x.
8. Diaz A, Neale RE, Kimlin MG, Jones L, Janda M. The children and sunscreen study: A crossover trial investigating children's sunscreen application thickness and the influence of age and dispenser type. Arch Dermatol 2012;148(5):606–12. doi: 10.1001/archdermatol.2011.2586.
9. Petersen B, Datta P, Philipsen PA, Wulf HC. Sunscreen use and failures — On site observations on a sun-holiday. Photochem Photobiol Sci 2013;12(1):190–96. doi: 10.1039/c2pp25127b.
10. Vasicek BE, Szpunar SM, Manz-Dulac LA. Patient knowledge of sunscreen guidelines and frequency of physician counseling: A cross-sectional study. J Clin Aesthet Dermatol 2018;11(1):35–40.
11. Akamine KL, Gustafson CJ, Davis SA, Levender MM, Feldman SR. Trends in sunscreen recommendation among US physicians. JAMA Dermatol 2014;150(1):51–55. doi: 10.1001/jamadermatol.2013.4741.
12. van der Pols JC, Williams GM, Pandeya N, Logan V, Green AC. Prolonged prevention of squamous cell carcinoma of the skin by regular sunscreen use. Cancer Epidemiol Biomarkers Prev 2006;15(12):2546–48. doi: 10.1158/1055-9965.EPI-06-0352.
13. Ulrich C, Jürgensen JS, Degen A, et al. Prevention of non-melanoma skin cancer in organ transplant patients by regular use of a sunscreen: A 24 months, prospective, case-control study. Br J Dermatol 2009;161 Suppl 3:78–84. doi: 10.1111/j.1365-2133.2009.09453.x.
14. Green AC, Williams GM, Logan V, Strutton GM. Reduced melanoma after regular sunscreen use: Randomized trial follow-up. J Clin Oncol 2011;29(3):257–63. doi: 10.1200/JCO.2010.28.7078.
15. Kuhn A, Gensch K, Haust M, et al. Photoprotective effects of a broad-spectrum sunscreen in ultraviolet-induced cutaneous lupus erythematosus: A randomized, vehicle-controlled, double-blind study. J Am Acad Dermatol 2011;64(1):37–48. doi: 10.1016/j.jaad.2009.12.053.
16. Schleyer V, Weber O, Yazdi A, et al. Prevention of polymorphic light eruption with a sunscreen of very high protection level against UVB and UVA radiation under standardized photodiagnostic conditions. Acta Derm Venereol 2008;88(6):555–60. doi: 10.2340/00015555-0509.
17. Mahmoud BH, Hexsel CL, Hamzavi IH, Lim HW. Effects of visible light on the skin. Photochem Photobiol 2008;84(2):450–62. doi: 10.1111/j.1751-1097.2007.00286.x.
18. Mahmoud BH, Ruvolo E, Hexsel CL, et al. Impact of long-wavelength UVA and visible light on melanocompetent skin. J Invest Dermatol 2010;130(8):2092–97. doi: 10.1038/jid.2010.95.
19. Dawe R. An overview of the cutaneous porphyrias. F1000 Res 2017;6:1906. doi: 10.12688/f1000research.10101.1.
20. Seité S, Colige A, Piquemal-Vivenot P, et al. A full-UV spectrum absorbing daily use cream protects human skin against biological changes occurring in photoaging. Photodermatol Photoimmunol Photomed 2000;16(4):147–55. doi: 10.1034/j.1600-0781.2000.160401.x.
21. Australian Government, Department of Health and Aged Care, Therapeutic Goods Administration (TGA). Australian regulatory guidelines for sunscreens (ARGS). TGA, 2025. Available at www.tga.gov.au/resources/resource/reference-material/australian-regulatory-guidelines-sunscreens-args [Accessed 10 November 2024].
22. Jansen R, Osterwalder U, Wang SQ, Burnett M, Lim HW. Photoprotection: part II. Sunscreen: development, efficacy, and controversies. J Am Acad Dermatol 2013;69(6):867.e1–14; quiz 881-2. doi: 10.1016/j.jaad.2013.08.022.
23. Xu S, Kwa M, Agarwal A, Rademaker A, Kundu RV. Sunscreen product performance and other determinants of consumer preferences. JAMA Dermatol 2016;152(8):920–27. doi: 10.1001/jamadermatol.2016.2344.
24. Bissonnette R, Nigen S, Bolduc C, Méry S, Nocera T. Protection afforded by sunscreens containing inorganic sunscreening agents against blue light sensitivity induced by aminolevulinic acid. Dermatol Surg 2008;34(11):1469–76.
25. Castanedo-Cazares JP, Hernandez-Blanco D, Carlos-Ortega B, Fuentes-Ahumada C, Torres-Álvarez B. Near-visible light and UV photoprotection in the treatment of melasma: A double-blind randomized trial. Photodermatol Photoimmunol Photomed 2014;30(1):35–42. doi: 10.1111/phpp.12086.
26. Heckman CJ, Chandler R, Kloss JD, et al. Minimal Erythema Dose (MED) testing. J Vis Exp 2013;(75):e50175.
27. Wang SQ, Balagula Y, Osterwalder U. Photoprotection: A review of the current and future technologies. Dermatol Ther 2010;23(1):31–47. doi: 10.1111/j.1529-8019.2009.01289.x.
28. Cancer Council. UV Index: Know when to protect your skin. Cancer Council, [date unknown]. Available at www.cancer.org.au/cancer-information/causes-and-prevention/sun-safety/uv-index [Accessed 26 April 2025].
29. Taylor S, Diffey B. Simple dosage guide for suncreens will help users. BMJ 2002;324(7352):1526. doi: 10.1136/bmj.324.7352.1526/a.
30. Schneider J. The teaspoon rule of applying sunscreen. Arch Dermatol 2002;138(6):838–39. doi: 10.1001/archderm.138.6.838-b.
31. Isedeh P, Osterwalder U, Lim HW. Teaspoon rule revisited: Proper amount of sunscreen application. Photodermatol Photoimmunol Photomed 2013;29(1):55–56. doi: 10.1111/phpp.12017.
32. Solky BA, Phillips PK, Christenson LJ, Weaver AL, Roenigk RK, Otley CC. Patient preferences for facial sunscreens: A split-face, randomized, blinded trial. J Am Acad Dermatol 2007;57(1):67–72. doi: 10.1016/j.jaad.2007.04.003.
33. Weig EA, Tull R, Chung J, Brown-Joel ZO, Majee R, Ferguson NN. Assessing factors affecting sunscreen use and barriers to compliance: A cross-sectional survey-based study. J Dermatolog Treat 2020;31(4):403–05. doi: 10.1080/09546634.2019.1587147.
34. Diehl K, Schneider S, Seuffert S, Greinert R, Görig T. Who are the nonusers of sunscreen, and what are their reasons? Development of a new item set. J Cancer Educ 2021;36(5):1045–53. doi: 10.1007/s13187-020-01732-2.
35. Farberg AS, Rigel AC, Rigel DS. Online survey of US dermatologists' sunscreen opinions: Perceptions, recommendation factors, and self-usage. J Drugs Dermatol 2016;15(9):1121–23.
36. Latha MS, Martis J, Shobha V, et al. Sunscreening agents: A review. J Clin Aesthet Dermatol 2013;6(1):16–26.
37. Sabzevari N, Qiblawi S, Norton SA, Fivenson D. Sunscreens: UV filters to protect us: Part 1: Changing regulations and choices for optimal sun protection. Int J Womens Dermatol 2021;7(1):28–44. doi: 10.1016/j.ijwd.2020.05.017.
38. Downs CA, Kramarsky-Winter E, Segal R, et al. Toxicopathological effects of the sunscreen UV filter, oxybenzone (Benzophenone-3), on coral planulae and cultured primary cells and its environmental contamination in Hawaii and the U.S. Virgin Islands. Arch Environ Contam Toxicol 2016;70(2):265–88. doi: 10.1007/s00244-015-0227-7.
39. Therapeutic Goods Administration (TGA). Literature review on the safety of titanium dioxide and zinc oxide nanoparticles in sunscreens. TGA, 2022. Available at www.tga.gov.au/resources/publication/publications/literature-review-safety-titanium-dioxide-and-zinc-oxide-nanoparticles-sunscreens [Accessed 15 February 2025].
40. Mohammed YH, Holmes A, Haridass IN, et al. Support for the safe use of zinc oxide nanoparticle sunscreens: Lack of skin penetration or cellular toxicity after repeated application in volunteers. J Invest Dermatol 2019;139(2):308–15. doi: 10.1016/j.jid.2018.08.024.

correspondence **ajgp@racgp.org.au**