Research Review
EDUCATIONAL SERIES

An Update on Sunscreens II

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Abbreviations used in this issue
SPF = sun protection factor
UV = ultraviolet radiation (wavelength 200-400nm)
UVA = ultraviolet radiation A (wavelength 320-400nm)
UVB = ultraviolet radiation B (wavelength 290-320nm)

This educational resource summarises recent developments in sunscreen research, knowledge, and use. It starts with a review of the Nambour Skin Cancer Prevention Trial, which contributes to the evidence for a protective effect of sunscreen against melanoma. This is followed by consideration of UVA protection, correct application of sunscreen, skin type in sun protection, and compliance with sun protection. This resource also addresses the issue of balancing vitamin D adequacy with sun protection and highlights the importance of educational campaigns for sun protection. The anti-ageing effects of sunscreens are also covered, accompanied by details of the recently adopted Sunscreen Standard 2604:2012 for cosmetic sunscreen products.

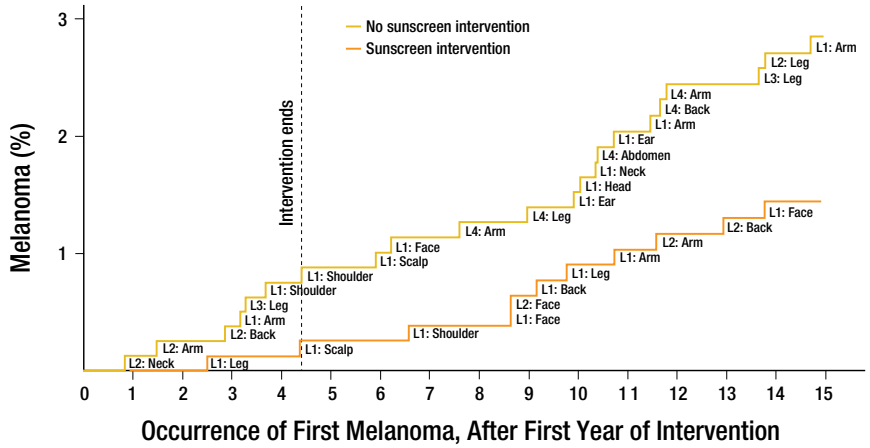
Introduction

People have sought to protect their skin from the sun since early times when the ancient Egyptians used the first sunscreens, which were developed from minerals.[1] Today, armed with the knowledge that excessive sun exposure leads to skin cancers and premature ageing of the skin, the promotion of sun protection is the primary preventative health strategy for skin care. The range of sun protection strategies includes sun avoidance, seeking shade, use of protective clothing, and sunscreen application. However, outdoor living, occupations, and recreational and sporting activities often render staying indoors, shade seeking, and wearing protective clothing impractical. In this context, regular use of today's sophisticated organic and inorganic sunscreens offers a practical and effective compromise.

Clinical Research

Focus on the Nambour Skin Cancer Prevention Trial

There is an established aetiological role for sun exposure in the development of melanoma, the most deadly form of skin cancer. The Nambour Skin Cancer Prevention Trial (NSCPT) provides strong evidence that long-term regular sunscreen use can prevent melanoma. The Australian community-based study, which was conducted from 1992 to 1996, randomly assigned randomly selected residents (aged 25-75 years) from the township of Nambour in Queensland to daily (n=812) or discretionary (n=809) sunscreen (SPF16) application for a period of 4.5 years. Ten years after the end of the trial, the number of people who developed melanomas in the group that applied sunscreen every day (n=11) was half that of the group that did not apply sunscreen daily (n=22) (**Figure 1**).[2]



Persons at risk															
No sunscreen intervention	809	806	804	803	798	792	789	784	780	773	764	752	745	740	738
Sunscreen intervention	812	808	804	800	795	788	782	780	773	769	763	754	747	744	741

Figure 1. Occurrence of first primary melanoma in people who applied sunscreen every day (sunscreen intervention group) and people who applied sunscreen at their discretion (no sunscreen intervention group) according to the NSCPT long-term follow-up analysis.[2]

The researchers pointed out that, in addition to the trial results having direct relevance to populations living in sunny climates, they also have relevance to people living in temperate climates who often holiday in sunny destinations.[2]

It is also worth considering that the melanoma protective effect of regular sunscreen use may be even greater than was evident in the NSCPT given that today's sunscreens offer greater sun protection than the SPF16 sunscreen product that was used in the trial.

Furthermore, a follow-up analysis of the NSCPT suggests that the daily application of regular sunscreen also reduces skin ageing,[3] which could act as an additional motivating factor for long-term regular sunscreen use (see Anti-ageing Effects of Sunscreen). The original NSCPT publication is available free to download: Full Article

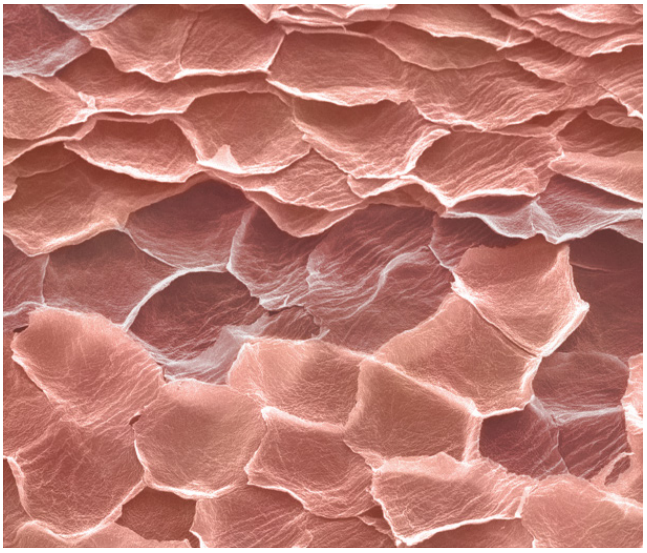
Commentary by Gavin Greenoak, Photobiologist

- Due to the earth's axial tilt, Australia and New Zealand are closer to the sun than North Hemisphere countries, which, combined with relatively low levels of pollution, results in greater risk from overexposure to sunlight.
- Rather than being interpreted in relation to 'burn times', SPF numbers should be considered as relative values and used for comparative purposes only.
- Cosmetic products claiming SPF, such as moisturizers, are considered as secondary sunscreens given that sun protection is not their primary purpose.
- With the packaging of some 'high end' moisturizers advising to 'use sparingly' the labelled SPF may not be achieved.
- Sunscreens should be applied 15-30 min prior to sun exposure to permit emulsion systems, which break on application to the (microscopically) rough skin surface, to resettle for optimum performance.
- Given the importance of their emulsion systems, sunscreens work best when evenly applied to the skin as a layer or film rather than being rubbed into the skin.
- In view of the recommendation for pre-application of sunscreen, the further recommendation of a second application at the time of exposure will counter the compliance problem of under-usage, and elevate protective capability closer to that predicted by the labelled SPF.
- It is important to remember that sunscreens are filters not 'blocks'. The higher the SPF the longer it takes to accumulate over time a sunburning dose of UV. Sunburn is a delayed skin response, and once the sunburning dose has been received then no further application of sunscreen will prevent it.

Improvements in Sunscreen UVA Protection

The terrestrial sunlight spectrum to which human skin is naturally adapted is continuous, but is conventionally divided into the UVB and UVA regions. It has only been in the last two decades that a greater understanding of the harm caused by UVA exposure has been gained.

UVA is less energetic than UVB but is more abundant and penetrates deeper into the skin where it interacts with endogenous and exogenous photosensitisers to generate reactive oxygen species that damage cellular DNA, lipid membranes, and proteins. UVA also suppresses immune function. As a result, UVA exposure contributes to photocarcinogenesis and photo-ageing.[4-7]



Sunburnt skin. Coloured electron micrograph (SEM) of epidermal skin cells after sunburn. These stratified epithelial cells have been destroyed by ultraviolet (UV) light in the sun's ray and are sloughing off. UV radiation also damages the tiny blood vessels beneath the epidermis.

The historical under-appreciation of the skin damaging effects of UVA is reflected in a 2010 study that reported suboptimal performance of UVA protection among sunscreen products marketed in Australia and New Zealand.[8] The poor UVA protection performance was partially attributed to inadequate photostablity of UV-filtering chemicals in the UVA spectrum.

Newer UV filters used in sunscreens have greater photostability, while others can be rendered photostable by other UV filters. For example, avobenzone, which is one of the best chemicals for filtering UVA radiation but has poor photostability, has been photostabilised with oxybenzone, which also adds additional UVA filtering. Furthermore, the availability of zinc oxide, which provides protection from long-wavelength UVA (340-400nm) and is photostable and does not react with organic sunscreen chemicals,[9] has also contributed to the improvement in UVA protection performance of sunscreen products.

A cross-sectional study of sunscreen products commercially available in the US from 1997 to 2009 showed a large discrepancy between UVA protection claims and actual presence of UVA filters (**Table 1**). Following the approval of both avobenzone and zinc oxide as UV filters by the FDA in late 1997, the number of products containing a known UVA filter increased markedly in many sunscreen products.[7]

	Percentage of total number of products surveyed		
	1997 (n=59)	2003 (n=188)	2009 (n=330)
UVA protection claim	81%	82%	80%
Contains UVA filters*	5%	56%	70%

*Zinc oxide and avobenzone

Table 1. Percentage of sunscreen products claiming UVA protection versus those containing UVA (340-400nm) filters in a survey analysis conducted over the period 1997 to 2009.[7]

		1997 Survey			2003 Survey			2009 Survey		
		Daily	Recreational	Total	Daily	Recreational	Total	Daily	Recreational	Total
Products	Number Percent	11 19%	48 81%	59 100%	70 37%	118 63%	188 100%	189 57%	141 43%	330 100%
UVA active use (frequency)	Zinc oxide Avobenzone	18% 0%	0% 2%	3% 2%	14% 31%	11% 27%	12% 29%	16% 43%	16% 67%	16% 54%
UV active combinations (frequency)	Avobenzone and octocrylene Avobenzone and octinoxate	0% 0%	0% 2%	0% 2%	7% 24%	12% 17%	10% 20%	23% 23%	54% 13%	36% 19%

Table 2. Detailed analysis of the UVA (340-400nm) filters contained in sunscreen products surveyed over the period 1997 to 2009.[7]

From 1997 to 2009, the percentage of products containing zinc oxide increased from 3% to 16% and those containing avobenzone increased from 2% to 54%. The percentage of products containing both avobenzone and octocrylene, a combination that enhances the UVA photostability, increased from 0% to 36% over the 12-year survey period. However, almost 20% of the products analysed in 2003 and 2009 contained avobenzone and octinoxate (octylmethoxycinnamate), a combination that accelerates the photodegradation of both UV filters (**Table 2**).[7]

Sun Protection Compliance

A small questionnaire-based survey of young adult males (aged 18-21 years) in the US who participated in outdoor activities with high UV exposure demonstrated positive attitudes, preferences, and behaviour regarding sun exposure. However, lack of frequent breaks allowing adequate time to apply sunscreen during their open-field activities was a barrier to sunscreen re-application. These findings emphasise the need for research and development into delivery systems that facilitate rapid and even application of sunscreen, which may help to prevent UV exposure in young adult males.[10]

Recent Australian research has demonstrated that individuals who undertake physical activity during the weekend are more likely to report sunburn than those who are physically inactive, prompting the recommendation of sun-safe habits during outdoor physical activity to reduce the risk of skin cancer.[11,12]

An Australian study in which weekly cross-sectional telephone interviews of adolescents (aged 12-17 years) and adults (aged 18-69 years) were conducted over three summers suggests consistent improvements in attitudes to sun protection over time but that behavioural changes are more variable and far from ideal, although sunscreen use was increased among adults. The investigators concluded that compliance with sun protection increased over time but is still far from ideal.[13]

With regard to occupational sun protection, only one in three outdoor workers reported use of sunscreen on all exposed skin in a recent New Zealand survey,[14] suggesting the need for comprehensive programmes to improve outdoor workers' sun-protective practices. However, voluntary workplace sun protection my not be sufficient, with an Australian study having demonstrated greater sun protection success with a mandatory workplace policy.[15]

A less well researched aspect of compliance is that of sun-protection measures while driving. In a retrospective survey of people attending a Mohs micrographic surgery clinic in the US, significantly ($p<0.05$) fewer respondents reported wearing sunscreen while in a motor vehicle compared with general daily sunscreen use and most respondents did not think they needed to use sunscreen while driving. The study authors concluded that skin cancer prevention initiatives should be modified to include messaging about the importance of sun protection while in a motor vehicle.[16]

Sun Protection and Vitamin D Adequacy

Vitamin D is required by the human body to regulate calcium levels and is beneficial for maintaining musculoskeletal health and reducing the risk of bone fracture. For these reasons, it is important to maintain adequate vitamin D levels all year round. Sun exposure is considered the main source of vitamin D in summer by GPs.[17]

Concerns that sun protection may result in vitamin D inadequacy may be unfounded based on data from the Nambour NSCPT,[18] which indicate that regular use of an SPF 16 sunscreen to reduce the risk of skin cancer can be maintained without affecting vitamin D levels. Similarly, the results of a large cross-sectional national survey conducted in the US suggest that frequent sunscreen use does not result in vitamin D inadequacy.[19] However, both studies showed that consistently seeking shade when outdoors does appear to be associated with vitamin D inadequacy.[18,19]

The health risks and benefits of UV exposure in terms of vitamin D levels continue to be debated, potentially creating confusion in the community at a time when reducing skin cancer mortality and incidence remains a public health concern. Indeed, a recent survey of Australian GPs reveals confusion regarding vitamin D, sun exposure, sun protection, and skin cancer in general practice.[19]

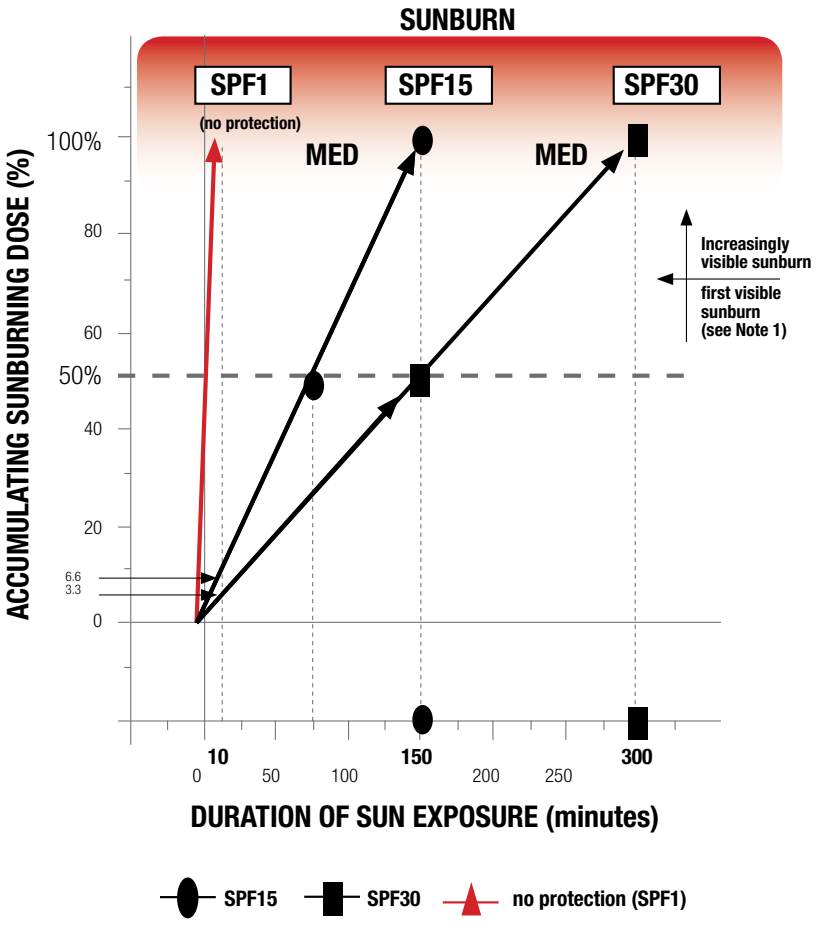
According to the Cancer Council Australia more work is needed to ensure that people are getting enough sun exposure to maintain adequate vitamin D levels, without increasing their risk of skin cancer. The council recommends that people at risk of vitamin D inadequacy should seek medical advice (e.g. supplementation may be an option) and that solariums should never be used to boost vitamin D levels.[21]

Relationship between SPF and UV Protection,
by Gavin Greenoak, Photobiologist

Despite claims circulated in the public domain that the difference in sun protection conferred by a higher versus lower SPF sunscreen is insignificant, the relationship between SPF numbers and UV protection is in fact linear. Properly applied, an SPF60 sunscreen provides double the protection of an SPF30 sunscreen, which provides double the protection of an SPF15 sunscreen. The figure below illustrates this point with SPF15 and SPF30 products.

If unprotected skin receives a sun-burning dose after 10 min of exposure (100% of a burning dose), the same skin, protected by an SPF30 sunscreen will, in the same 10 min, transmit 3.3% of a burning dose, and an SPF15 sunscreen 6.6%. After 30 min of exposure, the SPF30 sunscreen will have transmitted 10% of a sun-burning dose and an SPF15 sunscreen 20%. After 150 min of exposure, an SPF30 sunscreen will have transmitted 50% of a sun-burning dose, and an SPF15 100%.

In addition, it is important to note that once the sunburn threshold dose has been exceeded further application of sunscreen will not prevent its manifestation.



Comparison of the UV protection provided by sunscreens of increasing SPF (accumulating percentage sunburn doses as a function of the duration of sun exposure with no protection, SPF15, and SPF30 sunscreen) based on a skin that will receive a sun-burning dose (minimal erythema dose, MED) after 10 min exposure to sunlight at summer noon.

(Australian Photobiology Testing Facility (APTF), University of Sydney, December 2997).

Note: SPF1 (no protection) = 100% MED; SPF15 = 6.6% MED; SPF30 = 3.3% MED.

Application Aspects of Sunscreen

The effectiveness of protection afforded by a sunscreen depends on applying the sunscreen to an appropriate thickness. In addition, the purpose of reapplying sunscreen is not merely to replace sunscreen that has worn off with movement and sweating – reapplication is important to achieve and maintain a protective initial thickness of sunscreen.

Application thickness directly correlates with the degree of sun protection afforded by sunscreen. The SPF of sunscreen is tested at a thickness of 2.00 mg/cm^2, but many studies have shown that most users apply much less than this, typically ≤1.0 mg/cm^2.[22-25] This reduced level of sun protection resulting from inadequate application of sunscreen product in real life may be mitigated by use of higher SPF products.

Support for this premise is provided by Ou-Yang et al.[25] They tested six sunscreen products with SPFs ranging from SPF30 to SPF100 and found that lower application amount was associated with lower mean SPF value. However, reduced application amount produced proportionately higher mean SPF values for sunscreen products with higher labelled SPFs (**Figure 2**).

Based on these findings, the investigators concluded that compared with SPF30-50 sunscreens, which may not provide sufficient sun protection at actual consumer use levels, sunscreens with ≥SPF70 may deliver an actual SPF that compensates for the thinner layers achieved in typical consumer use situations.[25] Encouraging a double application of sunscreen has been suggested by Japanese researchers as another means of compensating for the insufficient amounts of sunscreen used by most people.[26]

Another factor to consider in the application of sunscreen is that different types of sunscreen formulation work best on different areas of the body in terms of achieving an appropriate thickness. A cream might work best on dry skin, especially the face, and a gel or spray might work better for areas covered with hair, such as the scalp or a man's chest. Parents often prefer sprays because they are easy to apply on children. With spray sunscreen in particular, the application should be generous to ensure a sufficiently thick and even coating.[6] For children who are old enough to apply their own sunscreen, the use of a pump dispenser will facilitate thicker application than squeeze bottle or roll-on products according to a recent Australian study.[24]

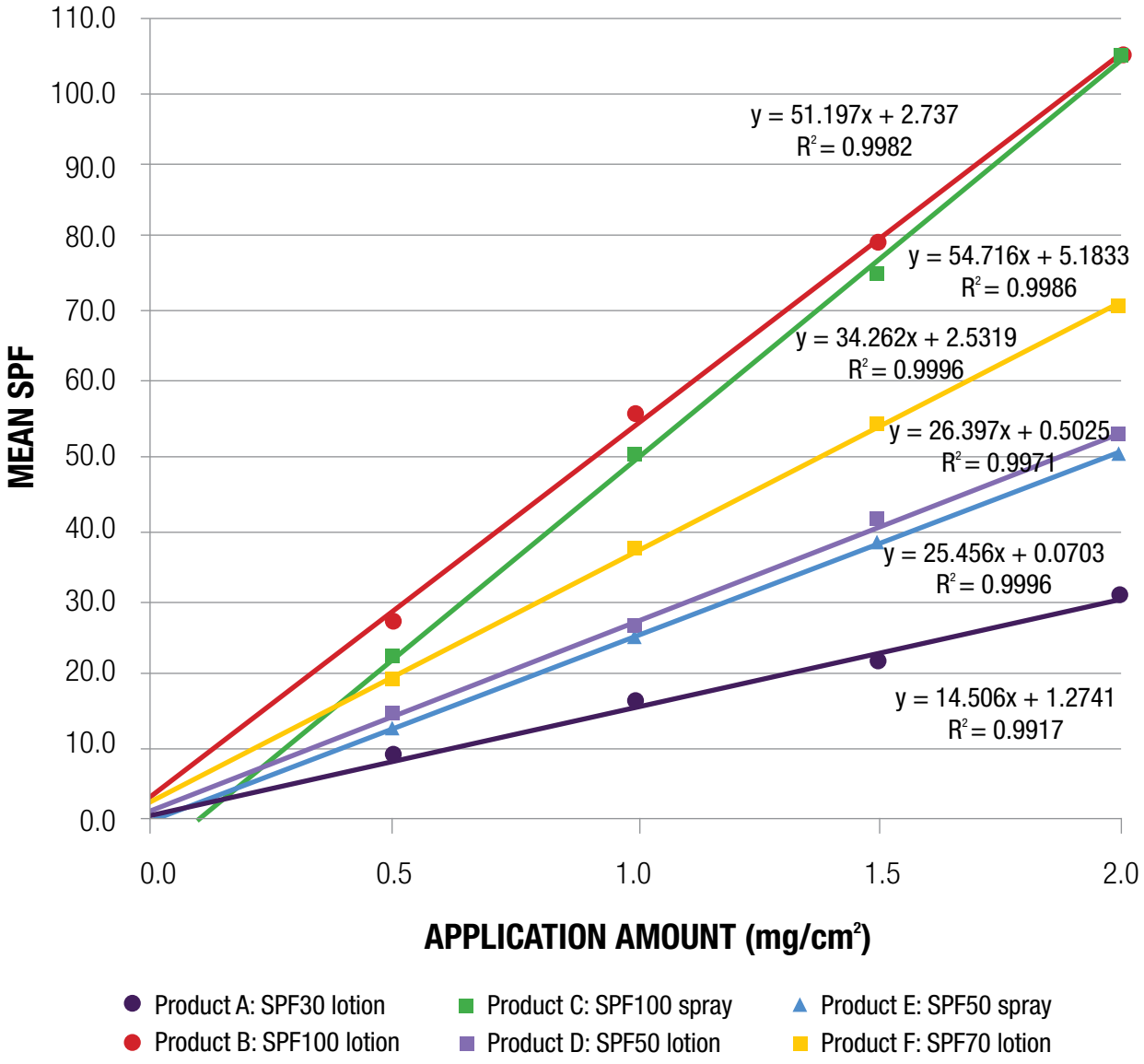


Figure 2. Correlation coefficients (R^2) for linear curve fits were >0.99 for six sunscreen products tested suggesting a linear relationship between application amount and SPF.[25]

Sun Protection in the Workplace

Outdoor workers in Australia and New Zealand experience high levels of sun exposure and skin cancer, and both individual and workplace factors influence outdoor workers' sun protection.[15,27]

Recent research suggests that targeting workers' knowledge, attitudes, and risk perceptions (other than skin type) is unlikely to be the most effective approach to improving sun protective practices in the workplace. Rather, ensuring provision of protective equipment and promotion of a culture of sun protection is likely to be most productive approach to improving workplace sun-protection practices.[14]

The clustered survey of over 1000 workers across nine different outdoor occupations in New Zealand revealed that higher scores for workplace sun-safety culture and provision of protective equipment (including sunscreen) were significantly ($p<0.001$) associated with a higher personal sun-protection score.[14]

Support for employer-based initiatives being the most effective approach to occupational sun protection is provided by an Australian workplace survey in which skin sun damage was significantly ($p=0.008$) less among employees working under a mandatory sun protection policy versus those working under a voluntary policy.[15]

In terms of the characteristics of the 'ideal' sunscreen for workplace use, a German randomised clinical study that assessed the acceptance and usability of sunscreens during outdoor work concluded that they must contain very high SPF broad-spectrum filters for both UVB and UVA, and that they must be easy to apply, be sweat resistant, and should not irritate the eyes.[28]

Just as has been recommended for people engaging in open-field activities during extreme UV exposures,[10] taking breaks every two hours that allow sufficient time for sunscreen application is advisable for people who have outdoor occupations.

Skin Type Considerations in Sun Protection

Skin cancer is less common in people with darker complexions compared with fair-skinned individuals. However, when skin cancer does occur in darker skinned people it is associated with higher morbidity and mortality than in Caucasians.[29,30] Differences in survival have been attributed to delayed detection and treatment, as well as a false perception that darker skin confers complete protection against skin cancer.[29,31] For example, a survey conducted in a US dermatology clinic revealed reduced ability of persons of colour to recognise skin cancer lesions and to practice sun protection, prompting a recommendation to increase awareness of skin cancer risk in persons of colour.[31]

People with darker skin tend to tan easily and not burn; hence, they may not feel the need to use sunscreen. However, a tan, like sunburn, indicates DNA damage caused by UV radiation.[32]

A focus group study has assessed the sun protection knowledge, attitudes, and behaviours of first generation Australian-born individuals with olive and darker skin types.[33] Many of the 39 participants (of Asian, Mediterranean, Middle Eastern and Indian background), who had reasonable knowledge of the dangers of skin cancer, perceived darker skin type as providing protection against sunburn and skin cancer. The researchers concluded that beliefs that sun protection is not necessary on the basis of skin type highlight the need for further studies to explore differences in the sun protection attitudes and practices of those with olive and darker skin compared with the general population.[33]

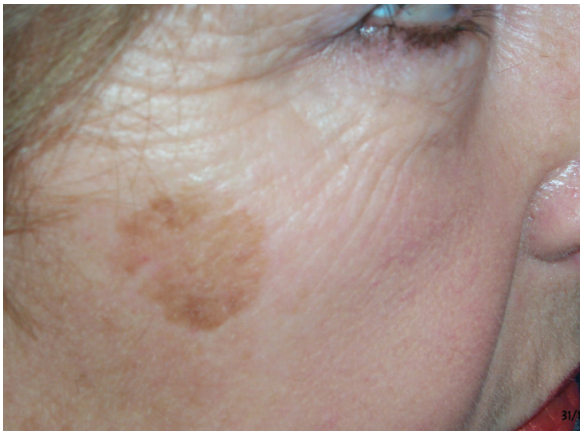
For appearance reasons, darker-skinned people may also be reluctant to use the inorganic titanium- and zinc-based sunscreens because they look white on the skin. Newer inorganic formulations, however, tend to be micronised so that the particles are small enough to blend into the skin.[32]

Other skin-type considerations include people with sensitive skin (including babies and children) and people with allergy-prone skin or conditions such as acne or rosacea who may react to chemical sunscreen agents, especially oxybenzone and para-aminobenzoic acid (PABA), or preservatives or fragrances. People with these skin types tend to better tolerate inorganic sunscreens.[32]

A simple and easy-to-use tool for skin typing is the Fitzpatrick Scale, which was developed by US epidemiologist Thomas Fitzpatrick in 1975 as a way to numerically classify the tendency of different types of skin to tan and/or burn when exposed to UV.[34] The Fitzpatrick Scale categorises people into one of six groups **(Table 3)** based on three factors:

1. Genetic disposition (e.g. eye, hair, and skin colour)
2. Skin's response to sun exposure (e.g. always burns; never tans)
3. Tanning habits (e.g. use of artificial sunlamps).

A person's Fitzpatrick Skin Type score can be calculated by self-assessment using the Fitzpatrick Skin-Type Chart.[34]



Skin Damage Image: Photo Ageing and Solar Lentigo

Anti-ageing Effects of Sunscreen

Evidence that sunscreen use reduces photo-ageing, including wrinkles, pigment irregularity, and spider veins, comes mainly from short-term *in vivo* studies.[35-37]

Recent data from the NSCPT, however, provide supporting evidence that regular sunscreen use does reduce skin aging.[3]

In the randomised, controlled, community-based study of 903 healthy adults (aged <55 years), those who used a broad-spectrum sunscreen every day showed 24% less skin ageing after 4.5 years than those who used sunscreen at their discretion.

Photo-aging was measured by analysis of skin texture and fine wrinkling using cutaneous microtopography as well as an analysis of a silicone cast of the skin at the beginning and end of the study period. The study investigators suggested that their study provides evidence that protecting oneself from skin cancer by using sunscreen regularly has the added bonus of maintaining younger looks.[3] Indeed, although skin ageing has multiple causes its link with sun exposure is of particular relevance given that the skin-ageing effects of the sun may be a strong motivator to sun protection.

An analysis of the determinants of skin ageing in people who participated in a large UK melanoma case-control study that demonstrated a protective role for sunscreen against skin ageing is supportive of the Nambour data set analysis.[38]

Skin Type	Example	Sun History
I (scores 0-7)	Pale white skin; red-headed, freckled, Irish/Scots/Welsh	Always burns, never tans; extremely sun-sensitive
II (scores 8-16)	White to beige skin; fair-skinned, fair-haired, blue or green-eyed, Caucasian	Burns easily, tans minimally; very sun-sensitive
III (scores 17-24)	Beige skin; average skin	Burns moderately, tans gradually to light brown; minimally sun-sensitive
IV (scores 25-30)	Light brown skin; Mediterranean-type Caucasians	Burns minimally, tans well to moderate brown; minimally sun-sensitive
V (scores >30)	Moderate brown skin; Middle Eastern, some Hispanics, some African-Americans	Rarely burns, tans profusely to dark
VI (scores >30)	Dark brown or black skin; African-American	Never burns, tans profusely

Table 3. The Fitzpatrick Skin Type Scale categorizes skin types into six groups based on inherent skin colour and response to UV exposure.[34]

Education Programmes for Sun Protection

Australia's community-based SunSmart education programme was launched in 1988 to reduce excessive sun exposure.[41,42] First and foremost, when engaging in outdoor activities, whether recreational or occupational, wearing sun-protective clothing should be preferred to sunscreen use because the most to least effective photoprotective strategies are: sun avoidance > seeking shade > use of protective clothing > application of sunscreen.[43]

A telephone-based survey of weekend sun protection and sunburn over 11 summers since the commencement of the SunSmart programme (1987/88 to 2006/07) indicates an overall improvement in behaviours, including reduced unprotected body exposure and sunburn and increased sunscreen use. The researchers concluded that sun-related behaviours are amenable to change and recommended that additional programmes may be needed to maintain the gains already realised and to achieve universal use of sun protection.[41]

An increase in use of personal sun protection (including greater sunscreen use) among Australian children (aged 12 to 35 months) following the launch of the SunSmart programme has also been shown in a recent cohort-based study.[42]

According to Cancer Council Australia, comprehensive, community-wide programmes are more effective than smaller-scale interventions in promoting sun protection behaviours and reducing UV radiation exposure because they are delivered through multiple channels, creating repeated exposure to consistent sun protection messages. Though more expensive, community-wide interventions may prove the most efficient and cost-effective way to achieve behaviour change.[21]

A comprehensive cost-benefit analysis conducted in 2008 suggests that government investment in SunSmart would return AU$2.32 for every $AU1.00 invested over 20 years. It would also reduce the number of melanoma cases by 20,000 over that period and deliver AU$90 million in productivity gains each year.[21,44]

The effectiveness of public education programmes promoting sun protection are likely benefit from the support of healthcare professionals. Despite sunscreen use being an important component in sun protection, it may not be recommended by physicians as often as sun protection recommendations and policies dictate. This was the finding of a US survey of outpatient physician offices that received an estimated 18.3 billion patient visits annually from 1989 to 2010. The frequency of sunscreen recommendation by physicians was just 0.07% and in patient visits associated with a diagnosis of skin disease it was only 0.9%. Even dermatologists mentioned sunscreen at only 1.6% of all dermatology visits.[45] Notwithstanding the possibility that sunscreen use was mentioned as part of a larger discussion or in hand-outs on sun protection and hence not specifically recorded, the survey findings have been described as "a wake-up to physicians that we may be remiss in regard to sunscreen messaging".[46]

COSMETICS AMENDMENT (SUNSCREEN) STANDARD 2013

The revised Australian/New Zealand Sunscreen Standard (AS/NZS 2604:2012 Sunscreen products – Evaluation and classification, the 2012 Sunscreen Standard) has been adopted for cosmetic sunscreen products, effective from 1 August 2013. The change has been introduced with a five-year transition period.

The specific changes to the requirements for cosmetic sunscreen products are as follows:

- raising the maximum SPF that may be claimed on the label of a sunscreen product from 30+ to 50+ for face/nail products (skincare products are unchanged as they can have a maximum SPF of 15);
- limiting the permitted SPF claims to 4, 6, 8, 10, 15, 20, 25, 30, 40, 50 and 50+ (depending on the SPF test result) and removing the claim of SPF 30+;
- raising the minimum claimable SPF from 2 to 4;
- changing the criteria for categorization of protection as 'low', 'medium' (or 'moderate'), 'high' or 'very high' in accordance with the wider range of SPF claims allowed;
- making broad spectrum performance mandatory for all skin care cosmetic sunscreens, and for face and nail sunscreen products with SPF of 30 and above;
- adoption of the test procedure in the International Standard ISO 24443:2012 for determining broad spectrum performance; and
- enhanced broad spectrum performance requirements, whereby the degree of protection from UVA is to increase with increasing SPF.

Consistent with cosmetic sunscreen products being secondary sunscreens as defined by the Sunscreen Standard, the primary function of these products is to provide a cosmetic benefit to consumers, with the sunscreen providing a secondary health benefit. Consumers should therefore continue to use therapeutic sunscreen products to protect themselves from the harmful effects of the sun's UV rays.

These changes, which are detailed in the Explanatory Statement to the Cosmetics Amendment (Sunscreen) Standard 2013, follow the adoption of the 2012 Sunscreen Standard in November 2012 for therapeutic sunscreen products regulated by the Australian Therapeutic Goods Administration.[39,40]

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SUMMARY AND CONCLUDING REMARKS

- Daily application of sunscreen may help to reduce the risk of melanoma and photo-ageing.
- There is a linear relationship between SPF and sun protection, such that SPF60 provides double the protection of SPF30, which provides double the protection of SPF15.
- UVA protective efficacy of sunscreen products has shown improvement.
- Balancing sun exposure to maintain vitamin D adequacy with sun protection to reduce the risk of skin cancer requires clarification.
- Regular use of an SPF16 sunscreen does not appear to be associated with vitamin D inadequacy.
- Greater efforts are needed to improve sunscreen use during outdoor activities and in outdoor occupations.
- Greater promotion of the use of sun protection among people with darker skin colour is needed. For example, people with skin of colour can often be persuaded to use broad-spectrum high-SPF sunscreens to reduce facial pigmentation (e.g. melasma) and photo-ageing.
- Protection from skin cancer by using sunscreen regularly has the added bonus of having an anti-ageing effect.
- The recently adopted revised Australian/New Zealand 2012 Standard for cosmetic sunscreen products makes broad spectrum performance mandatory for all skin care cosmetic sunscreens and states that the primary function of these products is to provide a cosmetic benefit with the sunscreen providing a secondary health benefit.
- Comprehensive community-based education programmes are effective in improving sun protection behaviour and reducing sun exposure.

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