ASSC Australian Skin and Skin Cancer Research Centre

POSITION STATEMENT

BALANCING THE HARMS AND BENEFITS OF SUN EXPOSURE

ENDORSED BY THE FOLLOWING ORGANISATIONS

Cancer Council Australia

Skin Cancer College Australasia

Australasian College of Dermatologists

Healthy Bones Australia

The Australian and New Zealand Bone and Mineral Society

Melanoma Patients Australia

MS Australia

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Conflicts of interest

Rachel Neale has received research funding and honoraria from Viatris. David Whiteman has received speaker fees from Pierre Fabre. Peter Ebeling has received research funding from Sanofi, Amgen and Alexion, and honoraria from Amgen and Pfizer. Rebecca Mason has received speaker fees from Sanofi. Craig Sinclair works for an organisation that profits from sales of sunscreen. All other contributors declare no conflicts of interest.

SUMMARY AND BACKGROUND

DEVELOPMENT OF THE POSITION STATEMENT

This position statement was developed following a Sun Exposure Summit that was held by the Australian Skin and Skin Cancer Research Centre in March 2021 (http://www.assc.org.au/assc-sun-exposure-summit-march-2021/). The Summit included a symposium during which invited experts presented up-to-date information about the risks and benefits of sun exposure, and the understanding of the general public and clinicians. At a subsequent Round Table invited representatives considered advice that should be included in a position statement that aimed to balance the risks and benefits of sun exposure in Australia. An over-arching theme was that the statement needed to explicitly recognise the diversity of Australia's population, and to provide advice that can be used to clearly guide behaviour. The statement has been developed through several rounds of email communication among Roundtable attendees, and then circulated to relevant organisations for their endorsement.

PURPOSE OF THE POSITION STATEMENT

This position statement is intended to provide evidence-based recommendations, intended primarily for clinicians, public health practitioners, and policy makers. These recommendations will provide the basis for developing materials for both mass- and individual-level communication. For example, this document may underpin advice given in clinical practice, assist in the development/enhancement of 'apps', or inform mass communication campaigns. Balancing the risks and benefits of sun exposure is complex, and it is important to engage consumers to consider appropriate communication methods, particularly outside clinical settings.

BACKGROUND

The sun has risks and benefits for health. Over-exposing the skin to the sun causes damage to the skin (causing skin cancer, premalignant lesions, and photoaging) and eyes (causing cataract, pterygium, and cancers of the ocular surface). Australia has the highest incidence of skin cancer in the world and, in addition to the impact on affected individuals, the cost to the respective health systems is estimated to be approximately $1.7 billion and $180 M, respectively. At least two thirds of melanomas and almost all keratinocyte cancers in Australia are attributable to exposure to UV radiation. There is evidence that the rates of skin cancer are declining in younger cohorts and this is, at least partially, likely to be due to public health campaigns that began in the 1980s. 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, some of which are mediated by UV radiation (i.e., the same wavelengths that cause skin cancer, cataract, and pterygium). Vitamin D production is the benefit of exposure to UV radiation that is supported by most evidence. Vitamin D plays a critical role in calcium homeostasis, and deficiency causes osteomalacia (inadequate bone mineralisation). There is emerging evidence that vitamin D deficiency also increases the risk of other health outcomes. Arguably the strongest evidence is for effects on the immune system, with consequent effects on autoimmune diseases, such as multiple sclerosis, and infectious diseases such as acute respiratory tract infection. In the 2010/11 Australian Health Survey 23% of adults were vitamin D deficient according to current guidelines. In southern states in winter the prevalence of vitamin D deficiency approached 50%.

Dietary sources of vitamin D can contribute to an individual's intake of vitamin D although most people will not be able to meet their vitamin D requirements through dietary sources alone. Dietary sources of vitamin D include oily fish (such as tuna, salmon, mackerel, sardines and herrings), meat, eggs, and

mushrooms. In Australia some foods are fortified with vitamin D. These include some milks, soy milk, edible oil spreads/margarine, breads and breakfast cereals.

Avoiding the sun and using dietary sources and/or vitamin D supplements to meet vitamin D requirements may seem an attractive solution. However, exposure to UV radiation may have benefits independently of vitamin D, particularly for the immune system, with adequate vitamin D status being an indicator of having received sufficient sun exposure to obtain other benefits. Further, exposing the eyes to longer wavelengths in sunlight reduces the risk of myopia, influences circadian rhythm, and improves sleep and mood. Aside from the direct benefits of sunlight, spending time outdoors facilitates physical activity, which plays a vital role in maintaining health and well-being. Thus completely avoiding sun exposure is not optimal for health.

There is evidence from surveys that the public and clinical workforce are unclear about how to balance the risks and benefits of sun exposure. Confusion about the time needed to make vitamin D can lead to both over- and under-exposure to the sun, increasing risks of both skin cancer and vitamin D deficiency at a population level.

RECOMMENDATIONS

The following recommendations apply to the **general adult population**. Advice for children can be found at: https://www.cancercouncil.com.au/cancer-prevention/sun-protection/preventing-skin-cancer/sun-protection-for-babies-and-children/

The balance of the risks and benefits of sun exposure varies between individuals according to skin type and underlying risk of skin cancer. The **recommendations** are targeted to three groups.

People at high risk of skin cancer: People who are at high risk of skin cancer (i.e., very pale skin and/or olive/pale brown skin but with other risk factors) are advised to adopt an extremely cautious approach to sun exposure. Where possible, time outdoors when the UV index is ≥3 should be avoided, and when outdoors at these times a full suite of sun protection measures should be used. This may increase the risk of vitamin D deficiency. Vitamin D requirements can be met through dietary sources and/or vitamin D supplements, and the benefits of other solar wavelengths can be obtained through early morning exposure when the UV index is <3.

People at low risk of skin cancer: People with constitutively dark skin are at low risk of skin cancer and the dose of UV-B needed to generate vitamin D is greater, leading to higher risk of vitamin D deficiency. These people are advised to spend sufficient time outdoors with ample skin exposed when the UV index is ≥3 to obtain a vitamin D-effective dose of UV radiation. Sun protection is not needed unless spending extended time outdoors when the UV index is ≥3.

People at intermediate risk of skin cancer: There is a group of people who are at intermediate risk of skin cancer (i.e., with olive or pale brown skin and no other risk factors), for whom the risk versus benefit equation is less straightforward. For this group, sun protection is important. However, current evidence suggests it is prudent to invoke the precautionary principle and advise spending sufficient time outdoors with ample skin exposed to avoid vitamin D deficiency; that is, to obtain a *vitamin D-effective dose*. If spending any more than the time estimated to obtain a vitamin D-effective dose, a full suite of sun-protection behaviours is advised. Sunscreen should be applied as part of the usual daily routine on all days when the UV index is forecast to reach ≥3; there is little evidence to suggest that this increases risk of vitamin D deficiency.

Recommendations regarding time outdoors to maintain sufficient vitamin D status: The length of time outdoors to obtain a vitamin D-effective dose of UV radiation varies according to skin type, amount of skin exposed, and factors that influence the intensity of UV radiation (i.e., geographic location, season, time of day). Appendix 1 gives estimates of the minimum time required at selected locations by month and time of day, for two different skin surface areas exposed. However, the time will vary from day to day depending on cloud cover, and there is considerable inter-individual variation, even after accounting for skin type. Thus the tables in Appendix 1 are intended to be indicative rather than prescriptive. They highlight several important issues:

- It is important to expose ample skin to minimise the time outdoors required (and therefore the dose delivered to individual skin cells);
- The time outdoors needed to gain a vitamin D-effective dose is less than the time that will deliver a minimal erythemal dose for all skin types;
- There is little vitamin D production in the early morning and late afternoon/evening;
- A very small amount of time outdoors can deliver a vitamin D-effective dose across the whole of Australia during summer, provided exposure occurs between 8am and 5pm and there is sufficient skin exposed. For many people this will be achieved through incidental sun exposure.
- In most of southern Australia during winter it is possible to maintain existing vitamin D status, by spending time outdoors with sufficient skin exposed during the middle of the day.

When a vitamin D-effective dose cannot be obtained: There are people who are unable to obtain a vitamin D-effective dose of UV radiation for cultural, health, lifestyle, occupational, or residential reasons. People with deeply pigmented skin need to spend more time outdoors to obtain a vitamin D effective dose of UV radiation, and this may be difficult to achieve.

In addition, in southern states in winter, climate conditions may make exposing skin outdoors impracticable. The vitamin D molecule measured to determine vitamin D status [25 hydroxy vitamin D (25(OH)D] has a long half-life, so a higher concentration prior to winter may avoid end of winter vitamin D deficiency. However, the pre-winter 25(OH)D concentration required is unclear, as is the dose of UV radiation needed to both meet daily requirements and increase the 25(OH)D from the winter nadir to the required pre-winter level. In light of current knowledge, it is prudent to aim for vitamin D maintenance throughout the year, potentially by using supplements, rather than increasing exposure times to 'stockpile' vitamin D prior to winter.

If vitamin D cannot be obtained through sun exposure, people should seek the advice of a health professional to discuss how they can meet their vitamin D requirements.

Dietary sources of vitamin D may provide some vitamin D. Dietary sources of vitamin D, including oily fish, lean red meat, milk and eggs are recommended in the Australian Guide to Health Eating as a way of meeting a range of nutritional needs. However, most people do not obtain sufficient vitamin D through food, and supplements may be needed.

Vitamin D supplements are safe and relatively inexpensive compared with the cost of testing. Thus assessing risk of deficiency, based on whether a vitamin D-effective dose of UV radiation is achieved on most days of the week, may enable a decision about supplementation without the need for a vitamin D test.

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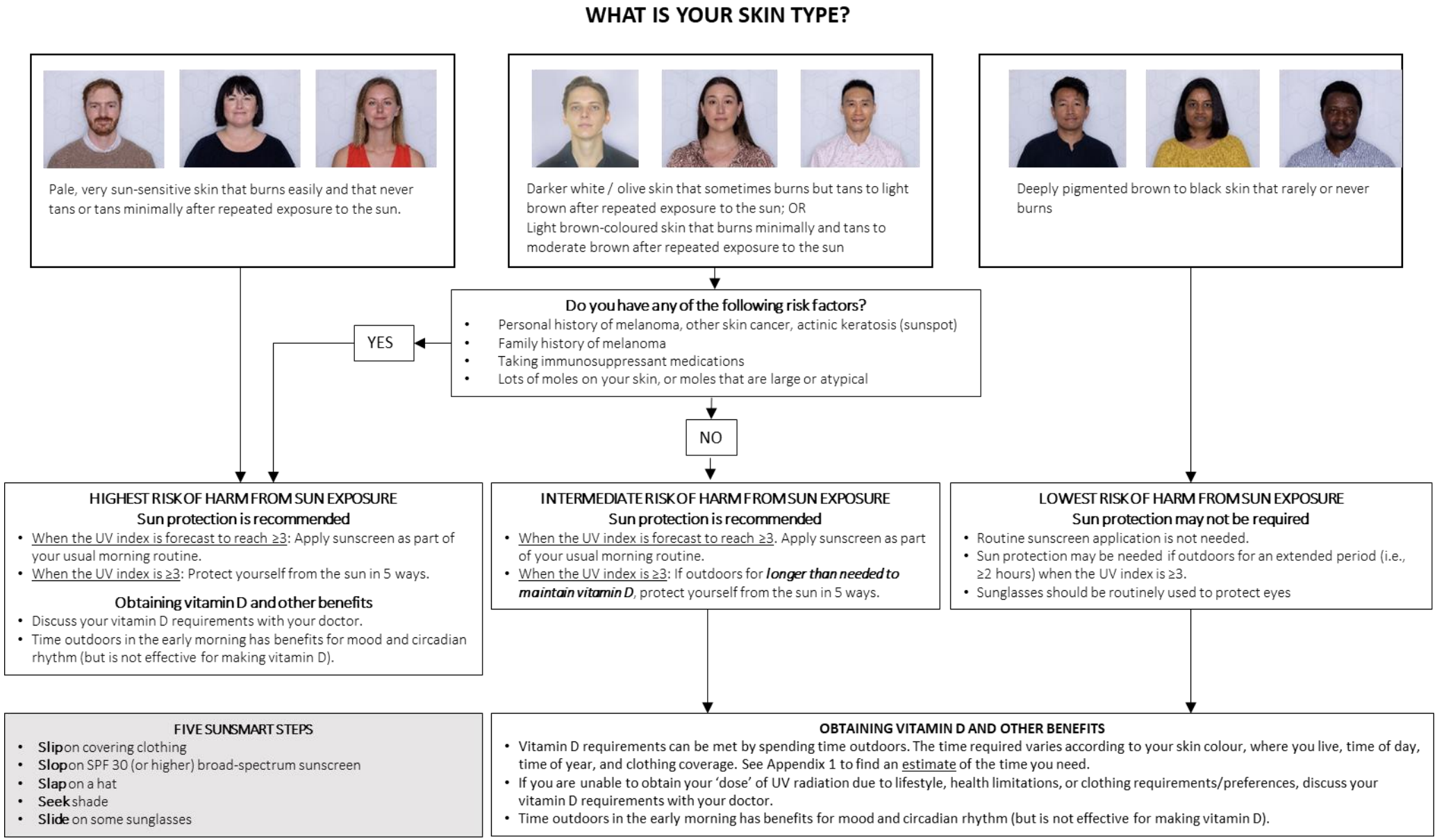
1 RECOMMENDATIONS ACCORDING TO RISK OF SKIN CANCER

The effects of exposure to sunlight, particularly the UV wavelengths, are complex and depend on environmental factors (e.g., the intensity of UV radiation; timing, pattern, and total time outdoors) and host factors (e.g., skin pigmentation, immune status). Two main health states are strongly determined by too much or too little exposure of the skin to UV radiation, respectively: skin cancer and vitamin D deficiency. Assessing the balance of harms and benefits of sun exposure requires consideration of all these factors.

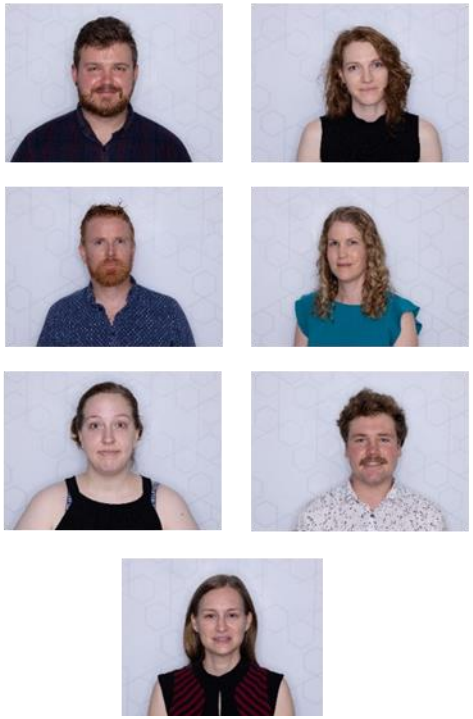
The recommendations that follow provide general advice for adults living in Australia, stratified by the risk of skin cancer (for graphical representation see Figure 1). However, within these risk categories, there is considerable inter-individual variability, and the relative importance of different health states varies between people. Thus, these recommendations are intended to be a guide only, and individuals should seek medical advice regarding their specific circumstances if required.

Figure 1: Recommendations according to risk of skin cancer

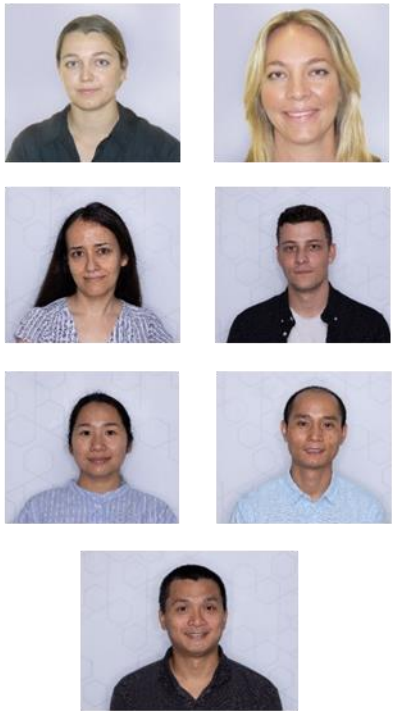


See next page for more skin type images

Light skin that burns easily and develops no or minimal tan



Darker white / olive skin that sometimes burns but tans to light brown after repeated exposure to the sun; OR Light brown-coloured skin that burns minimally and tans to moderate brown after repeated exposure to the sun



Deeply pigmented brown to black skin that rarely or never burns

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1.1 ADULTS AT HIGHEST RISK OF SKIN CANCER

People at highest risk of skin cancer are those who:

- Have Fitzpatrick type 1 or 2 skin (i.e., pale skin that burns easily and can only tan minimally); **OR**
- Have Fitzpatrick type 3 or 4 skin (i.e., skin that is light-to-moderate brown, burns infrequently, and can develop a moderate-to-deep tan) **AND** who have at least one of the following risk factors:
    - A personal history of melanoma or other skin cancer;
    - A family history of melanoma;
    - Immunosuppressive therapy (e.g., following organ transplantation or for other reasons);
    - Many naevi (moles) on the skin

For these people, who are at highest risk of skin cancer, the risks of exposure to solar UV radiation are likely to outweigh the benefits. These people are advised to adopt an extremely cautious approach to sun exposure. This may necessitate meeting vitamin D requirements through dietary sources and/or supplements.

1.1.1 SUN PROTECTION

Awareness of the UV index and the sun protection times are needed to inform safe sun exposure behaviour. The sun protection times, and forecast and/or actual UV index can be found at:

- http://www.bom.gov.au/uv/about_uv_index.shtml
- https://www.cancer.org.au/cancer-information/causes-and-prevention/sun-safety/be-sunsmart/sunsmart-app

Sun protection on all days when the UV index is forecast to reach ≥ 3

On days when the UV index is forecast to reach 3 or greater, even if only for a short time, sunscreen of at least SPF 30 should be used in the mornings as part of the usual daily routine. It should be applied to the face, head, neck, hands, and all other parts of the body not covered by clothing.

The maximum UV index reaches 3 or greater for the entire year in much of Australia. In southern states there are some months when routine daily sunscreen application is not required Table 1).

Sun protection if outdoors at times when the UV index is ≥ 3

Where possible, outdoors activities should be planned for when the UV index is <3. If outdoors when the UV index is ≥ 3, irrespective of the length of time, the skin and eyes should be protected in 5 ways (Table 2).

Sun protection if outdoors when the UV index is < 3

While sun protection is not generally advised when spending time outdoors when the UV index is <3, extended exposure can be harmful, particularly in areas with reflective surfaces such as snow. People who plan to spend >2 hours (cumulatively across the day) outdoors when the UV index is between 1 and 3 should use sun protection. It is recommended that outdoor workers always use sun protection, irrespective of the UV index.

1.1.2 MAINTAINING SUFFICIENT VITAMIN D STATUS

Adhering closely to sun protection advice will help protect people from skin cancer, but may lead to vitamin D deficiency. This is particularly true of avoiding time outdoors when there is sufficient UV-B radiation to generate vitamin D and/or covering the skin with clothing at these times. Current evidence suggests that daily sunscreen application does not affect vitamin D status, although the effect of using sunscreen with very high SPF is not well understood.

In people who minimally expose their skin to the sun, vitamin D requirements can be met with dietary sources of vitamin D and vitamin D supplements. Recommended amounts of vitamin D intake are shown in Tables 3a and 3b.

1.1.3 GAINING THE BENEFITS OF SUN EXPOSURE NOT INDUCED BY UV-B

Early morning exposure is optimal for obtaining the benefits of sun exposure relating to mood and circadian rhythm. In all parts of Australia and at all times of the year, the UV index is low (<1) before 7 am and sun protection is not required.

1.2 ADULTS AT INTERMEDIATE RISK OF SKIN CANCER

For adults with skin type 3 or 4[a] and who do not have other risk factors[b], the balance between the risk and benefits of moderate amounts of sun exposure is less clear than for those at very high or very low risk. Skin cancer remains a clear risk of sun exposure for this group. However, obtaining sufficient UV-B radiation to avoid vitamin D deficiency will avoid the need for vitamin D supplements and may bring other benefits. With appropriate protections, the risks of skin cancer can be minimised.

[a] *Skin that is olive/light-to-moderate brown, burns minimally, and can develop a moderate-to-deep tan)*

[b]*Personal history of skin cancer or actinic keratoses, family history of melanoma, immunosuppression, multiple naevi*

1.2.1 SUN PROTECTION

Awareness of the UV index and the sun protection times is needed to inform sun exposure behaviour. The forecast and/or actual UV index and protection times can be found at:

- http://www.bom.gov.au/uv/about_uv_index.shtml
- https://www.cancer.org.au/cancer-information/causes-and-prevention/sun-safety/be-sunsmart/sunsmart-app

On all days when the UV index is forecast to reach ≥3

On days when the UV index is forecast to reach 3 or greater, even if only for a short time, sunscreen of at least SPF 30 should be used in the mornings as part of the usual daily routine. It should be applied to the face, head, neck, hands, and all other parts of the body not covered by clothing.

The maximum UV index reaches 3 or greater for the entire year in much of Australia. In southern states there are some months when routine daily sunscreen application is not required Table 1).

If outdoors at times when the UV index is ≥ 3

If outdoors when the UV index is ≥ 3, a small amount of time will maintain adequate vitamin D status (provided sufficient skin is exposed). If outdoors for longer than the time required to obtain a vitamin D-effective dose of UV-B radiation (Appendix 1), people should protect their skin and eyes in 5 ways (Table 2).

This advice is in addition to routinely applying sunscreen on all days when the UV index is forecast to reach ≥3.

If outdoors when the UV index is <3

While sun protection is not generally advised when spending time outdoors when the UV index is <3, extended exposure can be harmful. People who plan to spend >2 hours outdoors (cumulatively across the day) when the UV index is between 1 and 3 should be advised to use sun protection. It is recommended that outdoor workers always use sun protection, irrespective of the UV index.

1.2.2 MAINTAINING SUFFICIENT VITAMIN D STATUS

For adults in this intermediate risk category, it is appropriate to maintain sufficient vitamin D status through spending some time outdoors.

To maintain sufficient vitamin D status without supplementation, time outdoors on most days of the week with some skin uncovered by clothing is needed. The amount of time needed depends on the area of skin exposed, the time of year, time of day, and residential location (i.e., factors that influence the intensity of the UV radiation).

It is important to note that for almost all of Australia in summer months, less than 10 minutes outdoors with 35% of the body surface area exposed (i.e., wearing a short-sleeved shirt and shorts/skirt above the knee), provided the outdoors time occurs between 8 am and 5 (Appendix 1). *For many people this is achieved through incidental sun exposure.* Vitamin D production in the skin is not a continuous process, so spending extended time outdoors increases the risk of skin cancer without benefit for vitamin D.

Current evidence suggests that daily sunscreen application does not affect vitamin D status, although the effect of using sunscreen with very high SPF is not well understood.

Appendix 1 provides estimates of the approximate time required to maintain existing 25(OH)D concentration in different parts of Australia according to time of day and time of year.

For comparison purposes, approximate times to obtain a minimal erythemal dose for skin type 3 are given in Appendix 2.

Recommendations for adults unable to maintain vitamin D through sun exposure

For some adults it may not be possible to maintain adequate vitamin D status through sun exposure. For example, a person's time outdoors may be limited for health, residential, lifestyle, occupational, or climate reasons, or due to personal preference. Routinely wearing clothing when outdoors that covers most of the body prevents vitamin D production.

For adults who are unable to achieve a regular dose of UV radiation sufficient to maintain adequate vitamin D levels, vitamin D requirements can be met with dietary sources and/or vitamin D supplements. Recommended amounts of vitamin D intake are shown in Tables 3a and 3b.

1.2.3 GAINING THE BENEFITS OF SUN EXPOSURE NOT INDUCED BY UV-B

Early morning exposure is optimal for obtaining the benefits of sun exposure relating to mood and circadian rhythm. In all parts of Australia and at all times of the year, the UV index is low (<1) before 7 am and sun protection is not required.

1.3 ADULTS AT LOWEST RISK OF SKIN CANCER

Adults with Fitzpatrick skin type 5 or 6 (i.e., dark brown or black skin) are at low risk of skin cancer but are at greater risk of developing vitamin D deficiency, especially if living in southern Australia. For these people, benefits of sun exposure outweigh the harms.

1.3.1 SUN PROTECTION

Adults at low risk of skin cancer do not need to routinely protect the skin from the sun. However, sunburn can still occur if outdoors for extended periods when the UV index is ≥3, and exposure to the sun also causes photoaging and can cause increased pigmentation. Thus, people in the lowest risk group should consider wearing covering clothing or applying sunscreen if outdoors for an extended period when the UV index is ≥3. Sunglasses should be worn outdoors to protect the eyes.

1.3.2 MAINTAINING SUFFICIENT VITAMIN D STATUS

To maintain sufficient vitamin D without supplementation, it is recommended that adults with type 5 or 6 spends some time outdoors on most days of the week with some skin uncovered. The amount of time needed depends on the amount of skin not covered by clothing, the time of year, time of day, and residential location (i.e., factors that influence the intensity of the UV radiation).

Appendix 1 provides estimates of the approximate time required in different parts of Australia according to time of day and time of year for skin types 1 to 4. The additional time required for people with skin types 5 and 6 is unclear; on the basis of current evidence people with these skin types are advised to obtain 2-4 times more exposure than the times shown in the tables.

Recommendations for those unable to maintain vitamin D through sun exposure

For some adults it may not be possible to maintain vitamin D sufficiency through sun exposure. For example, a person's time outdoors may be limited for health, residential, lifestyle, or occupational reasons or due to personal preference. Routinely wearing clothing outdoors that covers most of the body prevents vitamin D production.

For adults who are unable to achieve a regular dose of UV radiation sufficient to maintain adequate vitamin D levels, vitamin D requirements can be met with dietary sources and/or vitamin D supplements. Recommended amounts of vitamin D intake are shown in Tables 3a and 3b.

1.3.3 GAINING THE BENEFITS OF SUN EXPOSURE NOT INDUCED BY UV-B

Early morning exposure is optimal for obtaining the benefits for mood and circadian rhythm. Sun protection is not needed during this exposure.

2 GENERAL RECOMMENDATIONS REGARDING SUN PROTECTION AND VITAMIN D INTAKE

Table 1: Average daily maximum UV index for Australian capital cities by month

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AUSTRALIA												
Darwin	12	13	13	11	9	8	9	10	12	13	12	12
Brisbane	12	11	10	7	5	4	4	5	7	9	11	11
Perth	12	11	9	6	4	3	3	4	6	8	10	11
Sydney	11	10	8	5	3	2	3	4	5	7	9	10
Canberra	11	8	7	5	3	2	2	3	5	7	9	11
Adelaide	11	10	8	5	3	2	2	3	5	7	9	11
Melbourne	10	9	7	4	2	2	2	3	4	6	8	10
Hobart	8	7	4	3	1	1	1	2	3	4	6	7

Blue shading shows months / locations when the average maximum UV index is <3.

Table 2: Five ways to protect the skin and eyes from the harmful effects of solar UV radiation

SLIP on covering **clothing**	Aim to wear clothing that covers as much skin as possible. Dark-coloured clothing with a tight weave offers the best protection.
SLOP on **sunscreen**	Use a broad-spectrum sunscreen with an SPF of 30 or higher.
SLAP on a **hat**	Use a broad-brimmed hat.
SEEK shade	Where possible, seek shade
SLIDE on **sunglasses**	Wrap-around sunglasses of category 2 or 3 that meet the Standard AS/NZS 1067 offer the most protection to the eyes and surrounding skin

For more information, see:

https://www.cancer.org.au/cancer-information/causes-and-prevention/sun-safety/preventing-skin-cancer

Table 3a: Recommended adequate vitamin D intake, assuming insufficient sun exposure to maintain vitamin D: Australian Nutrient Reference Values.

Age group (years)	Recommended adequate intake (IU/day)
19 to 50 years	200
51 to 70 years	400
> 70 years	600

Values obtained from https://www.nrv.gov.au/nutrients/vitamin-d (downloaded on 28/10/22).

It has been recommended that these Australian nutrient reference values be updated,[1] but as of the time of writing this had not occurred. The Summit Working Group considered that these intakes are likely too low in people with minimal sun exposure, and advise health practitioners to consider following the guidelines from the United States National Institutes of Health Office of Dietary Supplements as shown below.

Table 3b: Recommended dietary allowances for vitamin D, assuming insufficient sun exposure to maintain vitamin D: United States National Institutes of Health Office of Dietary Supplements

Age group (years)	Recommended dietary allowance (IU/day)
18 to 70 years	600
< 70 years	800

Values obtained from https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/ (downloaded on 28/10/2022):

3 KEY ASSUMPTIONS AND EVIDENCE

	Evidence base is strong
	Evidence base is fair
	Evidence base is weak

	1. Exposing the skin to UV radiation is the main cause of skin cancers and premalignant lesions. It has been estimated that two thirds of melanomas and virtually all KCs in Australia are attributable to Australia's high ambient UV radiation.[2]
	2. The incidence of skin cancer in people with constitutively dark skin (i.e., Fitzpatrick type 5/6) is much lower than in people with paler skins. In the United States the incidence of melanoma in Black men is 14 times lower than in White men; in women there is a 26-fold difference.[3] In countries with predominantly dark-skinned populations, the incidence is markedly lower than in countries with populations largely of European descent. For example, the age-standardised rate in Egypt is 0.22/100,000 compared with 16.0 in the United Kingdom and 36.6 in Australia. [4] Melanomas that occur in Black Americans are much more likely to be of acral lentiginous subtype (occurring on the palms or soles and less likely related to sun exposure), accounting for 26.6% of melanomas compared with 1.3% in Whites.[5]
	3. Sub-erythemal exposures to UV radiation are associated with increased risk of skin cancer Skin cancers are primarily caused by damage to DNA. However, the cumulative dose and pattern of exposure to UV radiation needed to induce skin cancer are unclear. There are consistent associations between sunburns and risk of skin cancer.[6-9] There is evidence from laboratory studies that sub-erythemal exposures can lead to typical UV-induced DNA mutations,[10] and while the skin has effective DNA repair mechanisms, some mutations can persist, ultimately leading to skin cancer. For people susceptible to skin cancer it is likely that there is no 'safe' dose of UV radiation, but low frequent doses with sufficient time between them to enable DNA repair is likely to be considerably safer than less frequent higher doses.
	4. People with fair skin that burns readily and tans poorly are at increased risk of melanoma and keratinocyte cancers. The QSkin cohort study in Queensland found that, compared with people with olive/dark skin, the risk of invasive melanoma in people with medium and fair skin was 3 and 5.5 times higher, respectively. Compared with people who

	developed a deep tan, the risk in those who only tanned lightly was 3-fold higher and those who did not tan at all had a 5.3-fold increased risk.[11] Having fair skin approximately doubles the risk of basal and squamous cell carcinomas compared with those classified as having olive/dark skin.[12,13] An important caveat to these risk estimates is that most were estimated within studies that included few people with Fitzpatrick skin types 5 and 6. A comparison of the skin types 1/2 and skin types 5/6 is likely to result in considerably higher relative risks.
	**5. A family history of melanoma and the presence of naevi on the skin are associated with increased risk of melanoma.** Having a family history of melanoma (usually defined as having at least one affected first-degree relative) almost doubles the risk of melanoma (summary RR 1.74; 95% CI 1.41-2.14).[14] In a meta-analysis the summary relative risk for having ≥1 atypical naevi was 3.63 (95% CI 2.85-4.62) and the relative risk increased by 1.017 (95% CI 1.014 to 1.020) for each additional common naevus,[15] but the heterogeneity for both estimates was high. In the QSkin cohort study based in Queensland, those who reported having 'many' naevi at age 21 years had an approximately 4-fold increased risk of melanoma compared with those who had no naevi.[16] The relative risk for a 'few' naevi vs none was 1.25 (95% CI 0.61 to 2.57). While it is accepted that there is a causal association between naevi and melanoma, the exact number of naevi that confers increased risk is unclear. Hence no specific number is given in the recommendations.
	**6. Preventing skin cancer is more cost effective than early detection.** A modelling study using data from Australia estimated that, compared with primary prevention through daily sunscreen use, early detection would result in an additional 22% of costs to society.[17]
	**7. Sunscreen use reduces DNA damage, and risk of SCC and premalignant lesions.** Applying sunscreen before exposing skin to UV radiation reduces DNA damage in laboratory studies.[18] Two randomised controlled trials of daily sunscreen application, one with a placebo control[19] and one where the control was discretionary sunscreen use,[20,21] have shown significantly reduced risks of SCC and actinic keratoses in the Australian setting.
	**8. Daily sunscreen use may reduce risk of melanoma.** People randomised to daily sunscreen application in the Nambour Skin Cancer Prevention Trial had lower incidence of melanoma than the control group when followed for 10 years beyond the end of the intervention period.[22] However, the number of melanomas was small (N=33), and as the analysis included melanomas occurring on sites other than where sunscreen was applied the mechanism underpinning the apparent protective effect is unclear.

	9. Exposing the skin to UV-B radiation induces vitamin D production. When the skin is exposed to UV_B radiation, 7-dehydrocholesterol in skin is converted to pre-vitamin D that then isomerises to vitamin D. This then undergoes thermal isomerisation to vitamin D. Pre-vitamin D reaches a steady state within the skin, such that after sufficient UV-B to produce the initial previtamin D has been obtained, additional exposure does not lead to further nett production, due to photochemical degradation of pre-vitamin D and vitamin D. [25] Vitamin D is transported to the liver where it undergoes the first of two hydroxylation steps needed to form the active compound. The molecule produced by this first step, 25 hydroxy vitamin D (25(OH)D) is measured to determine vitamin D status.
	10. Vitamin D plays a critical role in calcium homeostasis and bone mineralisation. The active molecule of vitamin D maintains calcium homeostasis by helping calcium absorption from the intestine, reducing excretion from the kidney and playing a role in resorbing calcium from the bones as required. Thus vitamin D deficiency may lead to rickets and osteomalacia.
	11. Vitamin D has wide-ranging other effects on health and disease. There are vitamin D response elements throughout the genome, and in laboratory studies vitamin D influences many processes such as cell cycling, immune function, release of brain chemicals, angiogenesis, the renin-angiotensin-aldosterone pathway etc. Observational studies show consistent links between low 25(OH)D concentration and increased risk of over 100 different health outcomes. Causality has not been confirmed for most of these by randomised controlled trials and/or Mendelian randomisation studies, but the design of these studies precludes an assessment of the effect of marked vitamin D deficiency on disease. Arguably the best evidence is for effects on the immune system, influencing both autoimmune diseases, such as multiple sclerosis,[23] and infectious diseases such as acute respiratory tract infection. [24,25] However, more evidence is needed about the broader health benefits of avoiding deficiency, or increasing mean 25(OH)D at a population level.
	12. 25(OH)D concentration should be maintained above 50 nmol/L. The recommended concentration of 25(OH)D is controversial. Healthy Bones Australia (previously Osteoporosis Australia) advises that people should maintain 25(OH)D concentration of 50 nmol/L throughout the year, in line with the United States National Institutes of Health.[26] This is reflected in the normal range recommended by the Royal College of Pathologists of Australasia.[27] While the United States Endocrine Society defines vitamin D insufficiency as 25(OH)D concentration <75 nmol/L,[28] and the United Kingdom Scientific Advisory Committee on Nutrition considered that the risks of adverse musculoskeletal outcomes occur at a 25(OH)D concentration < 25 nmol/L, the current Australian guidelines to maintain 25(OH)D ≥ 50 nmol/L likely avoid adverse consequences of vitamin D deficiency for most people.

13. The optimal sun exposure pattern to maintain sufficient vitamin D status is to obtain frequent small doses of UV-B radiation with ample skin exposed.

Since pre-vitamin D in the skin reaches a steady state (see point 8), frequent short exposures with adequate time between them for pre-vitamin D to convert to vitamin D and be absorbed into the blood stream is the most effective way to optimise vitamin D status. This approach also avoids erythema and allows time to build up skin adaptation and for DNA repair.

Vitamin D synthesised in all skin exposed to the sun contributes to the serum 25(OH)D concentration, so with more skin exposed vitamin D production occurs in a shorter exposure time. However the relation between skin surface area exposed and change in 25(OH)D concentration does not appear to be linear; exposing 85% of the body surface area to 4-5 exposures of 2 SEDs of UV-B radiation resulted in a 3.8-fold greater change in 25(OH)D than exposing 4% of the body surface area.[29] The relation over a smaller surface area range is unclear.

14. People with darker skin types need a higher dose of UV radiation to maintain adequate vitamin D status than those with lighter skin

Most experimental studies indicate that people with darker skin types need a higher dose of UV radiation to generate an equivalent amount of vitamin D as those with lighter skin types. However the extent to which having darker skin inhibits vitamin D production is unclear. Melanin is concentrated in the basal layer of the epidermis whereas 7-dehydrocholesterol is more evenly distributed, suggesting that melanin offers greater protection against DNA damage and erythema than its inhibition of vitamin D production. Two recent studies suggested that the vitamin D inhibition factor comparing Fitzpatrick skin type 6 with skin types 1 and 2 ranges from 1.3 to 8.[29] This wide range makes it difficult to generate public health advice for people with darker skins; this issue needs further investigation.

15. Regular sunscreen use poses minimal risk of vitamin D deficiency

Due to the overlap between the erythemal and vitamin D action spectra, sunscreens can also prevent vitamin D production. In experimental studies, which used artificial sources of UV radiation, applying sunscreen prior to exposure markedly reduced, but did not completely abrogate, vitamin D production.

There have been two randomised controlled trials of daily sunscreen application for the prevention of skin cancer or premalignant lesions;[19,20] in both, the intervention group applied sufficient sunscreen to reduce skin cancers or premalignant lesions, but there was no difference in 25(OH)D concentration between sunscreen and control (placebo or discretionary sunscreen use) groups (reviewed in [30]). While these results suggest that regular sunscreen application poses minimal risk of vitamin D deficiency, both trials used a low SPF sunscreen and were conducted in environments with high ambient UV radiation. The question of whether regular application with high SPF sunscreen and in areas with lower UV radiation remains unanswered.

	16. The amount of UV radiation needed to maintain vitamin D status is less than one standard erythemal dose per day if exposure to sufficient skin surface area occurs on most days of the week Using data from a study carried out in Manchester, United Kingdom, the average monthly spend of 25(OH)D was estimated to be 6.25 nmol/L.[31,32] This is thus the amount that needs to be generated each month to maintain stable 25(OH)D. This can be obtained by exposing the skin to less than one standard erythemal dose, provided sufficient skin is uncovered by clothing. More details are given in Appendix 1.
	17. Exposure to UV radiation may have benefits for the immune system independently of vitamin D production Exposure to UV radiation suppresses the immune system in skin and throughout the body, although the ability to respond to invading pathogens is not decreased. The suppression of immunity in the skin is partly what allows skin cancers to develop. However there are also some benefits of immune suppression. For example, there is a well-established latitude gradient in autoimmune diseases such as multiple sclerosis. This has been attributed to higher exposure to UV radiation at lower latitudes, with UV-B having a greater effect than UV-A. The mechanism underpinning systemic immune suppression is not clear; it may be at least partly to vitamin D induction, but there are also non-vitamin D effects on circulating immune cells, resulting in downregulation of inflammatory processes and upregulation of immunoregulatory pathways.[33] More research into mechanisms and the optimal pattern and dose of UV exposure to gain the immunoregulatory benefits is needed, but in the interim, adequate vitamin D status may be a good marker of sufficient UV radiation exposure.
	18. Exposure to UV radiation reduces blood pressure Blood pressure is inversely correlated with latitude and shows seasonal variation in temperate countries of the northern hemisphere, being higher in winter than in summer. It is difficult to disentangle the effects of temperature, UV radiation, and lifestyle but a recent study of over 340,000 haemodialysis patients found a persistent correlation between ambient UV-A / UV-B and blood pressure, independently of temperature. A possible mechanism is release of nitric oxide into the blood stream; this appears to be mostly mediated by UV-A.[34] More research is needed to determine whether there is a causal link with blood pressure and, if so, the wavelengths and dose that would be of benefit.
	19. Exposure to non-UV wavelengths in sunlight has benefits for circadian rhythm, mood, and vision There is convincing evidence that light influences circadian rhythm.[35] The effect is mediated by retinal ganglion cells that express the photopigment melanopsin. Melanopsin has a peak spectral sensitivity around 480 nm (i.e., in the visible light range). During the day, light intensities outside can reach illuminances of up to 25,000 lux. The light intensity in closed rooms is considerably lower, and decreases with increasing distance from windows; the intensity of standard office lighting is only around ~500 lux. The effects of light on the phase of the circadian clock depend on the timing of the light

	exposure. Morning light exposure advances the clock whereas night light delays the clock.[35] The influence on circadian rhythm has an important impact on sleep. Natural daylight advances the timing of sleep to earlier hours and improves sleep quality.[36] Light affects mood, both indirectly by altering circadian rhythm and sleep, and directly by modulating release of neurotransmitters such as serotonin. Bright light therapy is used as an effective treatment for seasonal affective disorder and non-seasonal disorder, but an hour of natural morning daylight is similarly effective.[37] Myopia is a common eye condition, the prevalence of which is increasing globally. There is convincing evidence that time outdoors reduces the onset, and possibly progression, of myopia in children and adolescents. There are a number of potential mechanisms that may underpin this association, but the most well-established theory is exposure to high illuminance (reviewed in [38])

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5 APPENDIX 1: TIME OUTDOORS TO MEET VITAMIN D REQUIREMENTS

The tables below give approximations of the number of minutes required (according to month of the year and time of day) to maintain adequate vitamin D status in people who are at high or intermediate risk of skin cancer (Fitzpatrick skin types 1 to 4). People with skin types 5 and 6 should aim to spend 2 to 4 times longer outdoors than the times given.

Notes:

- The times given are to maintain already sufficient vitamin D status, and not to treat vitamin D deficiency.
- The times assume exposure on at least 4 days per week. It is not appropriate to spend more time outdoors on fewer days, as this increases the risk of sunburn and skin cancer and may not increase vitamin D production due to photochemical isomerisation of pre-vitamin D and vitamin D to other compounds.
- Times are given for wearing: (i) trousers/skirt to mid-thigh and short-sleeved shirt; (ii) full-length trousers/skirt and sleeves to the elbow. With more body surface area exposed less time outdoors is required.
- These are average times. Some people will need more time and some less. People who are uncertain about their individual situation should discuss their vitamin D needs with their doctor.
- The times are calculated as follows:
  - A hybrid simulation model was used to calculate the minutes outside in full sun during each hour of the day needed to maintain existing 25(OH)D concentration, assuming a person only went out during that hour.
  - Historic values for 'standard erythemal dose' (SED)[*], solar zenith angle (SZA)[*] and climatological ozone[†] were used in a radiative transfer model to convert SED to 'standard vitamin D dose' (SDD) at 10-minute intervals.
  - A horizontal to vertical irradiance function based on the SZA was used to account for most sun exposure occurring while standing, walking or sitting.[39]
  - A linear relationship between body surface area exposed and change in 25(OH)D concentration was assumed. Trousers/skirt to mid-thigh and short-sleeved shirt was assumed to expose ~35% of the body surface area. Full-length trousers/skirt and sleeves to just below the elbow was assumed to expose ~10% of the body surface area.
  - The SDD accumulated throughout a month was used in a dose–response formula calculated based on whole-body exposure to repeated sub-erythemal doses of UV radiation.[40] The formula is:

$$\Delta 25(OH)D\ \left(\frac{nmol}{L}\right) = (9 \pm 0.5)\ \ln(SDD_{in\ a\ month}) - (7.1 \pm 0.5).$$

  - The simulation model varied time in sun within each hour to identify the model parameters resulting in a monthly change in 25(OH)D closest to zero.
  - All times are presented in local Australian standard time.

[*] From the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
[†] From the Earth System Research Laboratory and World Ozone and Ultraviolet Radiation Data Centre

In the tables, the cells are colour-coded as follows:

COLOUR	TIME NEEDED TO MAINTAIN VITAMIN D STATUS
	< 5 minutes
	5 to < 10 minutes
	10 to < 20 minutes
	20 to < 30 minutes
	30 to < 45 minutes
	45 to <60 minutes
	≥ 60 minutes
	NP[1]

[1] NP: not possible. This classification has been given where, even if a person continued to stay outdoors beyond the particular hour, there would not be sufficient UV radiation available in the remainder of the day to maintain existing 25(OH)D concentration.

MINUTES OUTDOORS, SKIN TYPES 1 TO 4, ASSUMING EXPOSURE ON ≥4 DAYS PER WEEK

A1 Table 1: **DARWIN** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	45 to <60	45 to <60	45 to <60	45 to <60	>60	>60	>60	>60	45 to <60	30 to <45	30 to <45	30 to <45
8-9 am	10 to <20	10 to <20	10 to <20	10 to <20	20 to <30	20 to <30	20 to <30	20 to <30	10 to <20	5 to <10	5 to <10	5 to <10
9-10 am	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
10-11 am	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2-3 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
3-4 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-5 pm	<5	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
5-6 pm	20 to <30	10 to <20	30 to <45	NP	NP	NP	NP	NP	45 to <60	45 to <60	45 to <60	30 to <45

A1 Table 2: **DARWIN** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	45 to <60	45 to <60	45 to <60	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	30 to <45	30 to <45
9-10 am	10 to <20	10 to <20	10 to <20	10 to <20	20 to <30	20 to <30	20 to <30	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20
10-11 am	5 to <10	10 to <20	10 to <20	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
2-3 pm	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
3-4 pm	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	10 to <20	5 to <10
4-5 pm	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	20 to <30	20 to <30	10 to <20	20 to <30	10 to <20
5-6 pm	>60	45 to <60	>60	NP	NP	NP	NP	NP	>60	>60	>60	>60

A1 Table 3: **ALICE SPRINGS** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	20 to <30	30 to <45	45 to <60	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
8-9 am	5 to <10	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	10 to <20	5 to <10	5 to <10	5 to <10
9-10 am	<5	<5	<5	5 to <10	5 to <10	10 to <20	10 to <20	5 to <10	5 to <10	<5	<5	<5
10-11 am	<5	<5	<5	<5	<5	5 to <10	5 to <10	<5	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2-3 pm	<5	<5	<5	<5	<5	5 to <10	<5	<5	<5	<5	<5	<5
3-4 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
4-5 pm	<5	<5	5 to <10	10 to <20	30 to <45	>60	30 to <45	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
5-6 pm	10 to <20	10 to <20	45 to <60	NP	NP	NP	NP	NP	NP	NP	45 to <60	20 to <30

A1 Table 4: **ALICE SPRINGS** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	45 to <60	20 to <30	20 to <30	20 to <30
9-10 am	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	30 to <45	30 to <45	10 to <20	10 to <20	10 to <20	10 to <20
10-11 am	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
2-3 pm	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
3-4 pm	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10
4-5 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	30 to <45	20 to <30	10 to <20
5-6 pm	45 to <60	45 to <60	>60	NP	NP	NP	NP	NP	NP	NP	>60	>60

A1 Table 5: **TOWNSVILLE** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	20 to <30	20 to <30	30 to <45	45 to <60	45 to <60	45 to <60	45 to <60	20 to <30	10 to <20	10 to <20	10 to <20
8-9 am	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	<5
9-10 am	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
10-11 am	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2-3 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
3-4 pm	<5	<5	<5	5 to <10	5 to <10	10 to <20	5 to <10	5 to <10	<5	<5	<5	<5
4-5 pm	5 to <10	5 to <10	10 to <20	10 to <20	NP	NP	45 to <60	20 to <30	10 to <20	10 to <20	10 to <20	5 to <10
5-6 pm	30 to <45	45 to <60	NP	NP	NP	NP	NP	NP	NP	NP	NP	45 to <60

A1 Table 6: **TOWNSVILLE** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	45 to <60
8-9 am	10 to <20	20 to <30	20 to <30	30 to <45	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	10 to <20
9-10 am	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	20 to <30	20 to <30	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10
10-11 am	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10	5 to <10
2-3 pm	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
3-4 pm	10 to <20	10 to <20	10 to <20	10 to <20	30 to <45	30 to <45	20 to <30	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20
4-5 pm	20 to <30	20 to <30	30 to <45	>60	NP	NP	>60	>60	45 to <60	45 to <60	30 to <45	20 to <30
5-6 pm	>60	>60	NP	NP	NP	NP	NP	NP	NP	NP	NP	>60

A1 Table 7: **BRISBANE** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	5 to <10	5 to <10
8-9 am	<5	5 to <10	5 to <10	5 to <10	10 to <20	20 to <30	20 to <30	10 to <20	5 to <10	5 to <10	<5	<5
9-10 am	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
10-11 am	<5	<5	<5	<5	<5	5 to <10	5 to <10	<5	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	<5	5 to <10	<5	<5	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5	<5
2-3 pm	<5	<5	<5	5 to <10	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	<5	<5	<5
3-4 pm	<5	5 to <10	5 to <10	10 to <20	45 to <60	NP	45 to <60	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
4-5 pm	5 to <10	10 to <20	30 to <45	NP	NP	NP	NP	NP	NP	NP	30 to <45	10 to <20
5-6 pm	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A1 Table 8: **BRISBANE** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	30 to <45	30 to <45	20 to <30
8-9 am	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	10 to <20
9-10 am	5 to <10	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	20 to <30	20 to <30	10 to <20	10 to <20	10 to <20	5 to <10
10-11 am	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10
2-3 pm	5 to <10	10 to <20	10 to <20	10 to <20	30 to <45	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20
3-4 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	NP	>60	>60	30 to <45	30 to <45	20 to <30	10 to <20
4-5 pm	30 to <45	45 to <60	>60	NP	NP	NP	NP	NP	NP	NP	>60	45 to <60
5-6 pm	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A1 Table 9: **SYDNEY** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	10 to <20	10 to <20	5 to <10
8-9 am	<5	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	30 to <45	20 to <30	10 to <20	5 to <10	<5	<5
9-10 am	<5	<5	5 to <10	5 to <10	10 to <20	20 to <30	10 to <20	10 to <20	5 to <10	<5	<5	<5
10-11 am	<5	<5	<5	<5	5 to <10	10 to <20	5 to <10	5 to <10	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	5 to <10	10 to <20	5 to <10	5 to <10	<5	<5	<5	<5
2-3 pm	<5	<5	<5	5 to <10	10 to <20	20 to <30	10 to <20	10 to <20	5 to <10	<5	<5	<5
3-4 pm	<5	<5	5 to <10	10 to <20	NP	NP	NP	30 to <45	10 to <20	5 to <10	5 to <10	<5
4-5 pm	5 to <10	10 to <20	30 to <45	NP	NP	NP	NP	NP	NP	45 to <60	20 to <30	10 to <20
5-6 pm	>60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A1 Table 10: **SYDNEY** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	30 to <45	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	30 to <45
8-9 am	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
9-10 am	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	>60	45 to <60	30 to <45	10 to <20	10 to <20	10 to <20	10 to <20
10-11 am	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
2-3 pm	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	>60	45 to <60	30 to <45	10 to <20	10 to <20	10 to <20	10 to <20
3-4 pm	10 to <20	10 to <20	20 to <30	45 to <60	NP	NP	NP	>60	30 to <45	20 to <30	20 to <30	10 to <20
4-5 pm	20 to <30	30 to <45	>60	NP	NP	NP	NP	NP	NP	>60	>60	45 to <60
5-6 pm	>60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A1 Table 11: **CANBERRA** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20
8-9 am	<5	5 to <10	10 to <20	10 to <20	30 to <45	>60	45 to <60	30 to <45	10 to <20	5 to <10	<5	<5
9-10 am	<5	<5	5 to <10	5 to <10	10 to <20	20 to <30	20 to <30	10 to <20	5 to <10	<5	<5	<5
10-11 am	<5	<5	<5	<5	5 to <10	10 to <20	10 to <20	5 to <10	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	5 to <10	10 to <20	5 to <10	5 to <10	<5	<5	<5	<5
2-3 pm	<5	<5	<5	5 to <10	10 to <20	20 to <30	10 to <20	10 to <20	5 to <10	<5	<5	<5
3-4 pm	<5	<5	5 to <10	10 to <20	NP	NP	NP	30 to <45	10 to <20	5 to <10	5 to <10	<5
4-5 pm	5 to <10	10 to <20	20 to <30	NP	NP	NP	NP	NP	NP	30 to <45	10 to <20	5 to <10
5-6 pm	30 to <45	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	45 to <60

A1 Table 12: **CANBERRA** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	30 to <45
8-9 am	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20
9-10 am	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	5 to <10
10-11 am	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	30 to <45	20 to <30	10 to <20	5 to <10	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	5 to <10	10 to <20	20 to <30	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	10 to <20	20 to <30	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
2-3 pm	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20	5 to <10
3-4 pm	10 to <20	10 to <20	20 to <30	45 to <60	NP	NP	NP	>60	45 to <60	20 to <30	10 to <20	10 to <20
4-5 pm	20 to <30	30 to <45	>60	NP	NP	NP	NP	NP	NP	>60	45 to <60	30 to <45
5-6 pm	>60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	>60

A1 Table 13: **MELBOURNE** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	30 to <45	45 to <60	>60	>60	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20
8-9 am	5 to <10	10 to <20	10 to <20	20 to <30	>60	>60	>60	45 to <60	20 to <30	10 to <20	5 to <10	5 to <10
9-10 am	<5	<5	5 to <10	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	5 to <10	5 to <10	<5	<5
10-11 am	<5	<5	<5	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	<5	<5	<5
11-12 pm	<5	<5	<5	<5	5 to <10	10 to <20	10 to <20	5 to <10	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	5 to <10	10 to <20	10 to <20	5 to <10	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	10 to <20	10 to <20	10 to <20	5 to <10	<5	<5	<5	<5
2-3 pm	<5	<5	<5	5 to <10	10 to <20	20 to <30	20 to <30	10 to <20	5 to <10	<5	<5	<5
3-4 pm	<5	<5	5 to <10	10 to <20	>60	NP	NP	30 to <45	10 to <20	5 to <10	5 to <10	<5
4-5 pm	<5	5 to <10	10 to <20	NP	NP	NP	NP	NP	NP	20 to <30	10 to <20	5 to <10
5-6 pm	10 to <20	30 to <45	NP	NP	NP	NP	NP	NP	NP	NP	NP	20 to <30

A1 Table 14: **MELBOURNE** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	45 to <60
8-9 am	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20
9-10 am	10 to <20	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20
10-11 am	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20	5 to <10
11-12 pm	5 to <10	5 to <10	10 to <20	10 to <20	30 to <45	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	5 to <10
12-1 pm	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	10 to <20	10 to <20	30 to <45	45 to <60	45 to <60	30 to <45	10 to <20	10 to <20	10 to <20	5 to <10
2-3 pm	5 to <10	5 to <10	10 to <20	20 to <30	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	5 to <10
3-4 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	NP	NP	>60	45 to <60	20 to <30	10 to <20	10 to <20
4-5 pm	10 to <20	20 to <30	45 to <60	NP	NP	NP	NP	NP	NP	>60	45 to <60	20 to <30
5-6 pm	45 to <60	>60	NP	NP	NP	NP	NP	NP	NP	NP	NP	>60

A1 Table 15: **HOBART** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20
8-9 am	5 to <10	10 to <20	10 to <20	30 to <45	>60	>60	>60	>60	20 to <30	10 to <20	5 to <10	5 to <10
9-10 am	<5	5 to <10	5 to <10	10 to <20	30 to <45	>60	45 to <60	30 to <45	10 to <20	5 to <10	<5	<5
10-11 am	<5	<5	5 to <10	5 to <10	10 to <20	30 to <45	20 to <30	10 to <20	5 to <10	<5	<5	<5
11-12 pm	<5	<5	<5	5 to <10	10 to <20	20 to <30	10 to <20	10 to <20	5 to <10	<5	<5	<5
12-1 pm	<5	<5	<5	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	<5	<5	<5
1-2 pm	<5	<5	<5	5 to <10	10 to <20	20 to <30	10 to <20	10 to <20	5 to <10	<5	<5	<5
2-3 pm	<5	<5	5 to <10	10 to <20	30 to <45	>60	45 to <60	10 to <20	5 to <10	5 to <10	<5	<5
3-4 pm	<5	5 to <10	5 to <10	30 to <45	NP	NP	NP	NP	10 to <20	5 to <10	5 to <10	<5
4-5 pm	5 to <10	10 to <20	20 to <30	NP	NP	NP	NP	NP	NP	30 to <45	10 to <20	5 to <10
5-6 pm	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A1 Table 16: **HOBART** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45
8-9 am	20 to <30	30 to <45	>60	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20
9-10 am	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20
10-11 am	5 to <10	10 to <20	10 to <20	20 to <30	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	5 to <10
11-12 pm	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20	5 to <10
12-1 pm	5 to <10	5 to <10	10 to <20	10 to <20	45 to <60	>60	45 to <60	30 to <45	10 to <20	10 to <20	10 to <20	5 to <10
1-2 pm	5 to <10	10 to <20	10 to <20	20 to <30	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10
2-3 pm	5 to <10	10 to <20	10 to <20	30 to <45	>60	>60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20
3-4 pm	10 to <20	10 to <20	30 to <45	>60	NP	NP	NP	NP	>60	30 to <45	20 to <30	10 to <20
4-5 pm	20 to <30	30 to <45	>60	NP	NP	NP	NP	NP	NP	>60	45 to <60	20 to <30
5-6 pm	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A1 Table 17: **ADELAIDE** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
8-9 am	5 to <10	5 to <10	10 to <20	20 to <30	45 to <60	>60	45 to <60	30 to <45	10 to <20	5 to <10	5 to <10	5 to <10
9-10 am	<5	<5	5 to <10	5 to <10	10 to <20	20 to <30	20 to <30	10 to <20	5 to <10	<5	<5	<5
10-11 am	<5	<5	<5	5 to <10	5 to <10	10 to <20	10 to <20	5 to <10	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
2-3 pm	<5	<5	<5	5 to <10	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	<5	<5	<5
3-4 pm	<5	<5	5 to <10	10 to <20	30 to <45	NP	30 to <45	20 to <30	5 to <10	5 to <10	<5	<5
4-5 pm	5 to <10	5 to <10	10 to <20	NP	NP	NP	NP	NP	30 to <45	10 to <20	10 to <20	5 to <10
5-6 pm	10 to <20	30 to <45	NP	NP	NP	NP	NP	NP	NP	NP	>60	20 to <30

A1 Table 18: **ADELAIDE** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45
8-9 am	10 to <20	30 to <45	45 to <60	>60	>60	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20
9-10 am	5 to <10	10 to <20	10 to <20	20 to <30	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	10 to <20
10-11 am	5 to <10	5 to <10	10 to <20	10 to <20	30 to <45	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	5 to <10	10 to <20	20 to <30	30 to <45	20 to <30	20 to <30	10 to <20	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	10 to <20	20 to <30	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	5 to <10	10 to <20	20 to <30	30 to <45	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
2-3 pm	5 to <10	5 to <10	10 to <20	10 to <20	30 to <45	45 to <60	30 to <45	30 to <45	10 to <20	10 to <20	10 to <20	5 to <10
3-4 pm	5 to <10	10 to <20	10 to <20	30 to <45	>60	NP	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
4-5 pm	10 to <20	20 to <30	45 to <60	NP	NP	NP	NP	NP	>60	45 to <60	30 to <45	20 to <30
5-6 pm	45 to <60	>60	NP	NP	NP	NP	NP	NP	NP	NP	>60	>60

A1 Table 19: **PERTH** and surrounding areas: 35% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	30 to <45	10 to <20	10 to <20	10 to <20
8-9 am	5 to <10	5 to <10	10 to <20	10 to <20	30 to <45	45 to <60	45 to <60	30 to <45	10 to <20	5 to <10	5 to <10	<5
9-10 am	<5	<5	5 to <10	5 to <10	10 to <20	20 to <30	10 to <20	10 to <20	5 to <10	<5	<5	<5
10-11 am	<5	<5	<5	<5	5 to <10	10 to <20	5 to <10	5 to <10	<5	<5	<5	<5
11-12 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
12-1 pm	<5	<5	<5	<5	<5	5 to <10	5 to <10	<5	<5	<5	<5	<5
1-2 pm	<5	<5	<5	<5	5 to <10	5 to <10	5 to <10	5 to <10	<5	<5	<5	<5
2-3 pm	<5	<5	<5	<5	5 to <10	10 to <20	10 to <20	5 to <10	<5	<5	<5	<5
3-4 pm	<5	<5	<5	5 to <10	20 to <30	45 to <60	30 to <45	10 to <20	5 to <10	5 to <10	<5	<5
4-5 pm	<5	5 to <10	10 to <20	45 to <60	NP	NP	NP	NP	30 to <45	10 to <20	10 to <20	5 to <10
5-6 pm	10 to <20	30 to <45	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A1 Table 20: **PERTH** and surrounding areas: 10% body surface area exposed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45
8-9 am	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20
9-10 am	5 to <10	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10
10-11 am	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	10 to <20	5 to <10	5 to <10	5 to <10
11-12 pm	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	5 to <10	5 to <10	10 to <20	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10	5 to <10
2-3 pm	5 to <10	5 to <10	10 to <20	10 to <20	30 to <45	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
3-4 pm	5 to <10	10 to <20	10 to <20	30 to <45	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	5 to <10
4-5 pm	10 to <20	20 to <30	30 to <45	>60	NP	NP	NP	NP	>60	45 to <60	30 to <45	10 to <20
5-6 pm	45 to <60	>60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

6 APPENDIX 2: TIME OUTDOORS TO OBTAIN A MINIMAL ERYTHEMAL DOSE

The dose of erythemally weighted UV radiation that leads to a minimal erythemal dose (MED) varies between people. The strongest determinant is skin type, but even within people classified as having the same skin type there is considerable variability.

The following tables give an estimate of the number of minutes outdoors for a person with skin type 3 to obtain an MED, assuming that one MED is equivalent to 2.5 SEDs. Note that the relationship between skin type and MED is imperfect, so these tables provide a guide only for comparison with the time needed to maintain 25(OH)D concentration.

Historic values for 'standard erythemal dose' (SED) and solar zenith angle (SZA) were used in a horizontal to vertical irradiance function [39] to account for most sun exposure occurring while standing, walking or sitting.

Note: A dose of UV radiation that is less than that required to cause erythema is not necessarily safe. Suberythemal doses can lead to DNA damage, and therefore to skin cancer. The tables are given to enable comparisons with the time required to maintain sufficient vitamin D status, and to highlight the small amount of time needed to cause erythema through the middle of the day in summer at all locations.

THESE TABLES SHOULD NOT BE USED TO SUPPORT EXTENDED TIME OUTDOORS.

COLOUR	TIME FOR A MINIMAL ERYTHEMAL DOSE
	< 5 minutes
	5 to < 10 minutes
	10 to < 20 minutes
	20 to < 30 minutes
	30 to < 45 minutes
	45 to <60 minutes
	≥ 60 minutes
	NP[1]

[1] NP: not possible. This classification has been given where, even if a person continued to stay outdoors beyond the particular hour, there would not be sufficient UV radiation available in the remainder of the day to receive a minimal erythemal dose.

MINUTES OUTDOORS TO OBTAIN A MINIMAL ERYTHEMAL DOSE, SKIN TYPES 2 TO 3

A2 Table 1. **DARWIN**: Minutes to obtain an MED

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
9-10 am	45 to <60	45 to <60	45 to <60	45 to <60	>60	>60	>60	45 to <60	30 to <45	30 to <45	30 to <45	30 to <45
10-11 am	20 to <30	20 to <30	20 to <30	20 to <30	30 to <45	30 to <45	30 to <45	20 to <30	20 to <30	10 to <20	10 to <20	20 to <30
11-12 pm	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	20 to <30	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20
12-1 pm	10 to <20	5 to <10	5 to <10	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10	10 to <20
1-2 pm	10 to <20	5 to <10	10 to <20	10 to <20	10 to <20	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20
2-3 pm	10 to <20	10 to <20	10 to <20	10 to <20	20 to <30	20 to <30	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20	10 to <20
3-4 pm	20 to <30	20 to <30	20 to <30	30 to <45	45 to <60	45 to <60	30 to <45	30 to <45	30 to <45	30 to <45	30 to <45	20 to <30
4-5 pm	>60	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60

A2 Table 2. **ALICE SPRINGS**: Minutes to obtain an MED

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
9-10 am	30 to <45	30 to <45	30 to <45	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	20 to <30
10-11 am	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	>60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20
11-12 pm	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20
12-1 pm	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10	5 to <10
1-2 pm	5 to <10	5 to <10	10 to <20	10 to <20	30 to <45	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20
2-3 pm	10 to <20	10 to <20	10 to <20	20 to <30	45 to <60	45 to <60	45 to <60	30 to <45	20 to <30	20 to <30	10 to <20	10 to <20
3-4 pm	20 to <30	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	45 to <60	30 to <45	30 to <45	20 to <30
4-5 pm	45 to <60	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60

A2 Table 3. **TOWNSVILLE**: Minutes to obtain an MED

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	45 to <60	45 to <60
9-10 am	20 to <30	20 to <30	30 to <45	30 to <45	45 to <60	>60	>60	45 to <60	30 to <45	20 to <30	20 to <30	20 to <30
10-11 am	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20
11-12 pm	10 to <20	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10
12-1 pm	5 to <10	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	5 to <10	5 to <10
1-2 pm	10 to <20	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20	10 to <20
2-3 pm	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	45 to <60	45 to <60	30 to <45	20 to <30	20 to <30	20 to <30	10 to <20
3-4 pm	30 to <45	30 to <45	45 to <60	>60	>60	>60	>60	>60	45 to <60	45 to <60	30 to <45	30 to <45
4-5 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60

A2 Table 4. **BRISBANE**: Minutes to obtain an MED

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	30 to <45
9-10 am	20 to <30	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	20 to <30	20 to <30
10-11 am	10 to <20	10 to <20	20 to <30	30 to <45	30 to <45	>60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20
11-12 pm	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20	5 to <10
12-1 pm	5 to <10	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20	10 to <20
1-2 pm	10 to <20	10 to <20	20 to <30	30 to <45	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20
2-3 pm	20 to <30	20 to <30	30 to <45	>60	>60	>60	>60	>60	45 to <60	45 to <60	30 to <45	20 to <30
3-4 pm	45 to <60	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60
4-5 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	NP	NP	NP	>60	>60	>60	>60	>60

A2 Table 5. **SYDNEY**: Minutes to obtain an MED

Sydney	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	30 to <45	30 to <45
9-10 am	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	20 to <30
10-11 am	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
11-12 pm	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	10 to <20
12-1 pm	10 to <20	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20
1-2 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
2-3 pm	20 to <30	20 to <30	30 to <45	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30
3-4 pm	45 to <60	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60
4-5 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	NP	NP	NP	>60	>60	>60	>60	>60

A2 Table 6. **CANBERRA**: Minutes to obtain an MED

Canberra	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	45 to <60
9-10 am	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30	20 to <30
10-11 am	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
11-12 pm	10 to <20	10 to <20	20 to <30	30 to <45	>60	>60	>60	45 to <60	30 to <45	10 to <20	10 to <20	10 to <20
12-1 pm	10 to <20	10 to <20	20 to <30	30 to <45	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20
1-2 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
2-3 pm	20 to <30	20 to <30	30 to <45	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30
3-4 pm	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60
4-5 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	NP	NP	NP	>60	>60	>60	>60	>60

A2 Table 7. **MELBOURNE**: Minutes to obtain an MED

Melbourne	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60
9-10 am	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30
10-11 am	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20
11-12 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
12-1 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
1-2 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20
2-3 pm	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30
3-4 pm	30 to <45	30 to <45	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45
4-5 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	>60	NP	>60	>60	>60	>60	>60	>60

A2 Table 8. **HOBART**: Minutes to obtain an MED

Kingston	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60
9-10 am	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	30 to <45	30 to <45
10-11 am	20 to <30	20 to <30	45 to <60	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30	20 to <30
11-12 pm	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20
12-1 pm	10 to <20	10 to <20	30 to <45	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20
1-2 pm	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20
2-3 pm	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30
3-4 pm	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60
4-5 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	NP	NP	NP	>60	>60	>60	>60	>60

A2 Table 9. **ADELAIDE**: Minutes to obtain an MED

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	45 to <60
9-10 am	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30	20 to <30
10-11 am	10 to <20	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20
11-12 pm	10 to <20	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
12-1 pm	5 to <10	10 to <20	10 to <20	30 to <45	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20
1-2 pm	10 to <20	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
2-3 pm	10 to <20	10 to <20	30 to <45	>60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20
3-4 pm	30 to <45	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45
4-5 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	>60	NP	>60	>60	>60	>60	>60	>60

A2 Table 10. **PERTH**: Minutes to obtain an MED

Perth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-8 am	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
8-9 am	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45
9-10 am	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	30 to <45	20 to <30	20 to <30
10-11 am	10 to <20	10 to <20	20 to <30	30 to <45	>60	>60	>60	>60	30 to <45	20 to <30	10 to <20	10 to <20
11-12 pm	10 to <20	10 to <20	10 to <20	30 to <45	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	5 to <10
12-1 pm	5 to <10	10 to <20	10 to <20	30 to <45	45 to <60	>60	>60	45 to <60	20 to <30	10 to <20	10 to <20	5 to <10
1-2 pm	10 to <20	10 to <20	10 to <20	30 to <45	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20	10 to <20
2-3 pm	10 to <20	10 to <20	20 to <30	45 to <60	>60	>60	>60	>60	45 to <60	30 to <45	20 to <30	10 to <20
3-4 pm	20 to <30	30 to <45	45 to <60	>60	>60	>60	>60	>60	>60	>60	45 to <60	30 to <45
4-5 pm	45 to <60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
5-6 pm	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60