



Systematic review

Recommendations for Sun Protection in Children and Young People: A Systematic Review of Guidelines and Consensus Statements

Heather-Lynn Theano Kessar^{1,2}, Dasmesh Singh Sron¹, Asha Bowen^{2,3,4} and Bernadette Ricciardo^{1,2,4,5}

¹ Department of Dermatology, Fiona Stanley Hospital, Murdoch, Australia;

² Healthy Skin and ARF Prevention Team, Wesfarmers Centre of Vaccines and Infectious Diseases, The Kids Research Institute Australia, Nedlands, Australia;

³ Department of Infectious Diseases, Perth Children's Hospital, Nedlands, Australia;

⁴ School of Medicine, University of Western Australia, Crawley, Australia;

⁵ Department of Dermatology, Perth Children's Hospital, Nedlands, Australia

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CORRESPONDING AUTHOR

Dr. Dasmesh Singh Sron,
Department of Dermatology,
Fiona Stanley Hospital,
Murdoch, WA, 6150,
Australia
tel: (08) 6152 2222
e-mail: Dasmeshsron@gmail.com

ABSTRACT

Ultraviolet radiation (UVR) is the leading preventable cause of skin cancer, and early-life exposure increases long-term risk. Despite this, guidelines on sun protection for children and young people (CYP) are inconsistent. While those with skin of colour (SOC) are often considered lower risk for skin cancer, they experience delays in diagnosis and poorer prognosis highlighting the importance of tailored guidelines. This systematic review examined recommendations on sun protection for CYP from January 2000 to October 2024. Of 7228 manuscripts, 15 were included: three were paediatric-specific, ten included paediatric recommendations, one was SOC-specific, and two included SOC-specific recommendations. Common themes included UVR avoidance, sunscreen use, and physical protection (hats, clothing, sunglasses). However, specific details varied, with few tailored recommendations for SOC. Expert consensus on sun protection recommendations for CYP is needed, with specific consideration of the needs of CYP with SOC.

1. Introduction and background

Ultraviolet radiation (UVR) refers to UVA and UVB radiation emitted from the sun, both of which impact skin health. UVA is the most abundant type that reaches earth (1, 2) penetrating the skin to the level of the dermis, with UVB penetrating to the epidermis (1-3). UVR is the major cause of skin cancer (4, 5) with other negative impacts on the skin, including sunburn, photoaging, exacerbation of pigmentary disorders, and photodermatoses (9, 10). Benefits of UVR also exist, including synthesis of vitamin D (needed for healthy bodily functions such as bone health), positive impacts on mood, and a sense of well-being (2, 7).

In 2020, the global incidence of melanoma was 324,635 and accounted for 57,043 deaths (8). The number of new cases of all non-melanoma skin cancers (NMSC) without the inclusion of basal cell carcinoma (BCC) was 1, 198, 073, however the deaths globally of NMSC accounted for 63, 731 (inclusive of BCC) (8). Australia and New Zealand have the highest rates of both melanoma and NMSCs, followed by North America for NMSCs and Western European countries for melanoma (8).

Skin of colour (SOC) refers to skin with increased melanin and darker pigmentation, compared to traditionally viewed White (lightly pigmented) skin. SOC is a spectrum, examples include African, Asian, Latinx, Middle Eastern, and Indigenous Oceanic ancestry (11, 12). Skin cancer incidence in SOC is comparatively lower than that seen in White skin; however, has higher associated mortality, attributed to a delay in detection and treatment (13, 14). People with SOC are more likely to have melanomas in sun-protected sites (especially acral sites) and there are limited studies on their UVR exposure and melanoma risk (15). People with SOC have poorer survival rates for melanoma compared to White skin, with a 2022 study in the US showing the largest disparity in survival rates between Black and White patients with an absolute difference

of 25% with no elaboration on which sites were most affected (14). Contributing factors include misconceptions regarding SOC being fully protective against melanoma, socioeconomic barriers to health care, atypical presentations of skin cancer in SOC, a lack of skin cancer preventative behaviours, and a lack of physician awareness of skin cancer risk and recommendations for screening (13, 15, 16).

In Australia, data regarding NMSC in First Nations people are limited, as NMSC are not reportable to cancer registries unlike melanoma (17). Available data from a case series of presentations in Sydney demonstrated First Nations people had late-presentation of skin cancers (including melanoma and NMSC) with high morbidity and mortality, especially in those patients with Fitzpatrick Skin Types (FST) II and III. (18) It is important to note that there is significant phenotypic variation among First Nations people in Australia, and so Indigenous status does not always correlate with higher FST (18). Moreover, it is recognised that population group and ethnicity do not always correlate with a specific FST or skin colour and so should not be used as surrogates (19).

UVR exposure and sunburn in childhood increases the risk of melanoma later in life (10, 20, 21). Younger melanocytes are more susceptible to UVR and exposure during peak melanocytic activity early in life increases the risk of melanoma initiation (10). Children with multiple episodes of sunburn and lighter skin are more at risk (10). Sun exposure also increases the risk of development of naevi, with increased risk of melanoma seen when there is increased number and clinical atypia or histological dysplasia (22, 23).

In view of the significant role that UVR plays early in life, sun protection is fundamental in preventing skin cancers later in life. This systematic review aims to summarise sun protection recommendations for children and young people (CYP).

2. Methods

The protocol has been registered with PROSPERO at the National Institute for Health Research and Centre for Reviews and Dissemination (CRD) and has been

reported according to the PRISMA 2020 statement and checklist ([Appendix A](#)) (24).

Eligibility criteria

Study design

Review articles, evidence-based guidelines, consensus-based guidelines, expert statements, and position statements published in English with recommendations for sun protection in CYP were eligible for inclusion.

Study population

Studies with recommendations for sun protection in CYP aged up to and including 25 years were eligible

for inclusion. Where no age-group was specified, the article was included. There were no restrictions on setting, ethnicity or FST.

Outcomes

The primary outcome was sun protection recommendations to prevent skin cancer and other UVR-related skin disease.

Information sources and search strategy

Literature searches were conducted in MEDLINE (Ovid), EMBASE (Ovid), EMCARE (Ovid) and Web of Science, for English language studies published between 1 January 2000 and 23 October 2024, using the pre-defined search strategies ([Appendix A](#)). The reference lists of all included full-text articles and relevant review articles were scanned for additional manuscripts for inclusion. Citation searching of all included full-text articles was performed. A grey literature search of government websites, public health organisations, large clinical organisations (including professional so-

cieties or large hospitals) and cancer advocacy organisations was performed using Google Advanced, and the deep web searched using BASE and MedNar. Key words used in the search strategies pertained to ‘recommendations’ and ‘sun protection,’ with results limited to the English language and published since 01 January 2000. In total, three separate search strategies were employed: Medline/Embase/Emcare, Web of Science and the grey literature search, the full details of each have been provided in [Appendix B](#).

Selection process

Covidence Systematic Review Software (Veritas Health innovation, Melbourne Australia) was used to aid the selection process, including removal of duplicate records prior to article screening. Two reviewers (HK and DS) independently screened

and reviewed the database articles to assess specified inclusion criteria. Discrepancies were resolved through consensus with a third investigator (BR).

Data collection process

One reviewer (HK) extracted the data and a second reviewer (DS) checked all data for accuracy and completeness.

Data items

Summary tables were created to synthesise the recommendations of each included article.

Risk of bias assessment

Two reviewers (HK and DS) critically appraised all included articles using the AGREE-II tool ([Appendix C](#)) (25). Disagreements about critical appraisal were

resolved by consensus without requiring consultation with a third reviewer (BR).

3. Results

Of 7228 studies identified, 6064 titles and abstracts were screened, accounting for duplicates. 26 full text studies were identified for eligibility, and 3 additional papers through other sources (Fig. 1). 15 articles were

eligible and included (Table I). Nine countries are represented, notably all at least middle-upper income countries (26).

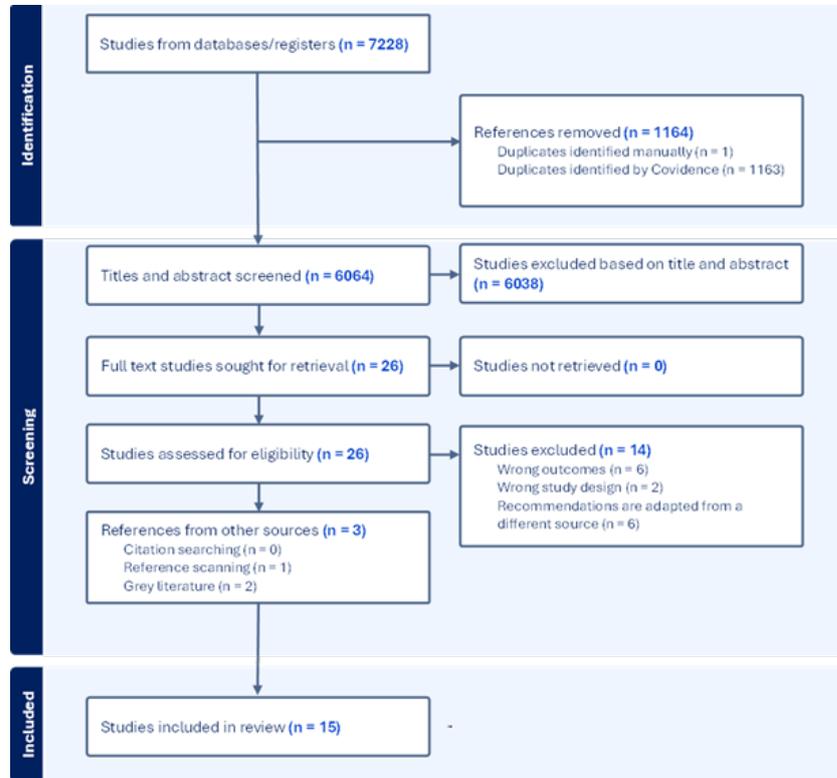


Fig. 1. Flowchart of systematic review according to the PRISMA 2020 statement.

Table I. Summary of included articles.

Article reference	Country of publication	Year of publication	Population described
Cancer council (27)	Australia	2022	General population
Schalka et al. (28)	Brazil	2014	Brazilian population
Marrett et al. (29)	Canada	2016	General population
Berneberg & Surber (30)	Germany	2009	Children
Elsner et al. (31)	Germany	2007	General population
Garbe et al. (32)	Germany	2024	Fair-skinned populations
Greinert et al. (33)	Germany	2015	General population
Narbutt et al. (34)	Poland	2018	General population
Tod et al. (19)	South Africa	2024	South African population
Lautenschlager et al. (35)	Switzerland	2007	General population
NICE (36)	UK	2016	General population
AAFP (37)	USA	2000	Not defined
Agbai et al. (38)	USA	2014	Skin of colour
Balk et al. (39)	USA	2011	Children and adolescents
Julian et al. (40)	USA	2015	Children

Five major themes were identified: avoiding UVR, sunscreen use, protective clothing, hat and sunglasses (Table II). The most frequent specific recommendations for each of these five themes are summarised, along with paediatric- and SOC-specific recommendations

(Table III). A full breakdown of the recommendations are available in Table V (Appendix D). A synthesis of recommendations for CYP, including CYP with SOC has been compiled (Table IV).

Table II. Broad sun protection recommendations in the included articles.

Recommendations	Article reference															
	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(19)	(35)	(36)	(37)	(38)	(39)	(40)	
Avoidance of UVR	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
Artificial UV-source avoidance	Red	Green	Green	Green	Green	Green	Green	Red	Green	Red	Red	Green	Green	Green	Green	
Sunscreen	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
Protective clothing	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
Hat	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	
Sunglasses	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Green	Green	Green	Green	Green	

Green = Yes
Red = No

Table III. Most frequent specific sun protection recommendations in the included articles (See appendix for full breakdown of recommendations).

Specific recommendations	Article reference
Specific time of day to avoid UVR	
Seek shade	(38)*, (39)^, (30)^, (32), (33), (35), (29), (34), (28), (19), (36), (27)
When the UVI is ≥ 3	(32), (29), (27)
Between 10am and 4pm	(39)^, (19), (37)
Type of sunscreen	
Broad-spectrum	(38)*, (39)^, (30)^, (31), (32), (33), (40)^, (35), (29), (4), (28), (19), (36), (27)
Water-resistant if outside for a prolonged time, or where sweating or water-contact likely	(31), (34), (28), (36)
Frequency of sunscreen use	
Daily	(38)*, (30)^, (31), (33), (34), (19), (37)
When the UV index is ≥ 3	(32), (29), (28), (27)
SPF	
SPF ≥ 15	(39)^, (31), (35), (37)
SPF ≥ 30	(38)*, (33), (40)^, (29), (36)
Timing of sunscreen application	
15-30 mins before sun exposure	(38)*, (39)^, (33), (35), (19)
Reapplication 2-hourly	(38)*, (39)^, (33), (40)^, (34), (28), (19), (27)
Reapplication when outdoors, after swimming, towel drying, sweating or if rubbed off.	(38)*, (39)^, (30)^, (33), (40)^, (34), (28), (19), (36), (37)
Method of sunscreen application	
Apply liberally	(38)*, (39)^, (35), (29), (28), (19), (36), (37), (27)
Cover all sun-exposed areas	(38)*, (39)^, (30)^, (31), (32), (40)^, (35), (29), (34), (28), (19), (36), (37)
Apply 2 mg/cm2 of sunscreen on the body surface to protect the skin	(39)^, (30)^, (33), (29), (34), (28), (19), (27)
Type of clothing	
Tightly-woven fabric	(39)^, (33), (40)^, (29), (34), (28), (19), (36), (37), (27)
Long clothing	(39)^, (30)^, (32), (33), (40)^, (35), (29), (34), (28), (19), (36), (37), (27)
Type of hat	
Wide-brimmed	(38)*, (39)^, (30)^, (31), (32), (33), (40)^, (29), (34), (28), (19), (36), (37), (27)
Hat or cap	(34), (28)
Type of sunglasses	
UV-absorbing/protective lenses	(38)*, (39)^, (30)^, (31), (33), (29), (28), (19), (37), (27)
Skin of colour	
No recommendations	(39)^, (30)^, (31), (32), (33), (40)^, (35), (29), (34), (36), (37), (27)
Organic sunscreens are more cosmetically acceptable for skin of colour	(38)*, (19)
Photoprotective measures recommended for individuals of any skin colour	(38)*, (28), (19)
Tinted sunscreens are beneficial for patients with pigmentary disorders	(19)
Paediatric	
Infants younger than 6 months should be kept out of direct sunlight	(39)^, (32), (34), (28), (19), (36)
Sun exposure up to 2-4 years of age should be limited	(27), (40)^
Avoidance of sunscreen on infants <6 months	(40)^, (27)
Avoidance of organic sunscreens in young infants/children/2 years of age	(35), (19), (40)^, (34), (28)

Table IV. Synthesis of recommendations for CYP, including CYP with skin of colour.

Broad category	Recommendation
UVR avoidance Type of sunscreen	Avoid sun exposure when the UVI is ≥ 3 , seek shade always when outdoors Broad-spectrum, water-resistant sunscreen. For CYP (over the age of 2) with SOC, organic sunscreens may be more cosmetically acceptable
SPF	SPF $\geq 50+$
Frequency of sunscreen use	Daily year-round
Timing of sunscreen application Method of sunscreen application	15-30 mins before sun exposure in two layers, then 2-hourly re-application thereafter, or after swimming, sweating or if it is rubbed off 2 mg/cm ² , which can be simplified to use the equivalent amount required to fill the child's cupped hand
Type of clothing	Long and tightly woven clothing that covers the arms and legs, including footwear that covers the entire foot
Type of hat	Wide-brimmed or legionnaire-style hats
Type of sunglasses	UV-absorbing/protective lenses (spectrum of absorption to up to 400nm) that cover the eye and periorbital skin area as much as possible
Infants	Infants under 6 months of age should be kept out of the sun and avoid the use of sunscreens in this age group
Young children	Use inorganic sunscreens from the age of 6 months to 2 years and limit sun exposure as much as possible

UVR avoidance

All papers recommended UVR avoidance, 12 advised seeking shade and 11 advised avoiding artificial UVR sources. Specific times to avoid UVR varied: four based on UV index (UVI >3 or "when at the highest"), (27-30), with nine giving specific times for UV avoidance within the range of 10am to 4pm (19, 30-32, 34-37). Three papers advised avoidance of UVR exposure, ranging from 1-2 hours before and after the solar apex. (27, 38-39).

Sunscreen Use

All studies recommended the use of sunscreen with 14 specifying broad spectrum. (19, 27-36, 38-40). Two advised water-resistant products (28, 29), particularly during prolonged outdoor activity/sweating or water contact (33-35, 38). Concerns about oxybenzone's weak oestrogenic effect were considered (36) and traditional clay based 'sunscreens' were suggested if sunscreen was unavailable (19).

Frequency of use

Sunscreen recommendation varied: daily use (19, 30, 33, 37-40), applications when UVI ≥ 3 (27-29, 34), when sunburn was possible (39) and in areas of high isolation (31).

SPF recommendations

Guidance differed: four recommended SPF ≥ 15 (31, 36-38), other SPF ≥ 30 (28, 30, 32, 35, 40) with variations for season (33), duration outdoors and risk group with lower risk expected in for Afro -descendent pa-

tients (34). The highest recommendation was SPF 50+, (29) with others using qualitative terms like "high protection" (39).

Timing and reapplication

11 papers recommended application timing ranging from 15 to 30 mins before sun exposure (19, 29-31, 33-34, 36-38, 40). Four papers recommended double application with varying protocols. Eight recommended reapplication every 2 hours (19, 29-30, 32-34, 36, 40) and 10 recommended reapplications after swimming, sweating, towel drying or being rubbed off (19, 30, 32-37, 39, 40). One paper suggested water-resistant products to reduce reapplication needs (32).

Application methods

Key themes included liberal application, (19, 28-29, 31, 34-37, 40) covering all uncovered skin, (19, 27-28, 31-40) and aiming for 2mg/cm² to the body (19, 28-30, 33-34, 36, 39). Simplified methods included the teaspoon method (28-29, 34-35) or using the child's cupped hand as a guide (32).

Clothing

Thirteen papers advised long clothes (19, 27-37, 39), 10 recommended tightly woven clothes (19, 28-30, 32-37), with a preference for dark colours (19, 29, 32, 34, 36), ultraviolet protection factor (UPF)-rated (19, 27-29, 36, 37) or chemically treated fabrics (27, 31, 33-34, 36). Some recommended materials including wool, synthetic materials, and denim (27, 31, 34, 36). Some recommended general "sun protective clothing", or full

coverage, including feet (38 -40).

Hats

Wide brimmed hats were strongly recommended by 14 papers (19, 27-30, 32-40), with some noting specific brim widths ($\geq 6-15\text{cm}$) or widths depending on hat style (19, 29, 38). Caps were mentioned but recognised as offering less protection (33-34).

Eye Protection

UV- protective/absorbing sunglasses were widely advised (19, 28-30, 34, 36-40) with specifics on fit (close, wrap around, wide frames) (19, 28-29, 33-35) and protection (95-100% UV block, up to 400nm, regional standards) (28-29, 33-36).

SOC

Three papers included SOC recommendations (19, 34, 40). All advised sun protection regardless of skin type, though noted cosmetic limitations of inorganic sunscreens containing zinc and titanium dioxide leaving white residue (19, 40). They also highlighted the role of sun protection in managing pigmentary disorders such as melasma and hyperpigmentation, which are more com-

mon in SOC (19, 34, 40).

Paediatric recommendations

Six papers advised infants under six months be kept out of direct sunlight (19, 27, 33-36), with two papers extending age cut-off for limiting exposure (2-4 years) (29, 32). Sun avoidance and clothing were preferred over sunscreen for infants (especially under six months) (33, 36), with sunscreen used only if other measures weren't feasible. Organic sunscreens were generally discouraged (19, 33-34). SPF recommendations varied by age and skin type, from ≥ 15 for infants over 6 months (33) to SPF 50+ for fair or atopic children (34).

The AGREE-II tool was used to assess the quality of the guidelines and risk of bias. The ratings of each component of every domain and overall assessment are in Appendix B. One article was deemed poor quality with a score of 1/7, and thus not recommended for use, failing in the areas of stakeholder involvement, rigour of development, and editorial independence. The remaining articles were recommended for use, either with or without recommendations and with overall quality scores ranging from 3/7 to 6/7.

4. Discussion

This is the first systematic review of sun protection recommendations for CYP. Across guidelines, core strategies were consistent including UVR avoidance, sunscreen, and protective clothing. For infants and young children, emphasis was placed on minimising sun exposure and using protective garments, with sunscreen use recommended only when these alternate interventions are not achievable. From around two years of age, recommendations aligned with those for the general population.

Variation in recommendations reflected regional context, audience, and publication date. SPF thresholds rose over time, from ≥ 15 in older guidelines to ≥ 50 in more recent ones, in line with product availability. Some papers advised double application to improve coverage, supported by the literature (42-44). Traditional alternatives, such as clay-based sunscreens, were noted but offered minimal protection (SPF 3.6-4) (46). Concerns about oxybenzone's oestrogenic effects were raised, though not supported by human evidence (47).

The variability in recommendations across guidelines reflects differences in regional priorities, target populations, and available evidence, yet highlights a critical public health gap: the absence of nuanced, popu-

lation-specific sun protection advice. Most guidelines fail to account for age, geographic UV burden, or FST, leaving CYP — especially those with SOC — without tailored recommendations. This is concerning, given that SOC populations often experience delays in the diagnosis of skin cancer and poorer outcomes (15), as well as being at greater risk for pigmentary disorders (such as post-inflammatory hyperpigmentation and melasma) where photoprotection is essential. Despite the variability we attempt to synthesise the recommendations found in this review in Table IV.

The results of this systematic review suggest that for individuals with SOC, general sun protection recommendations apply, with the exception of inorganic sunscreens being discouraged due to poor cosmesis. Research gaps remain regarding sunscreen efficacy in SOC and SPF performance on darker skin types, and no guidelines specifically address CYP with SOC (15).

Findings from this review, alongside the conclusions of a recent international expert panel, (48) reinforce the central role of early-life sun protection as a skin cancer prevention strategy. Universal measures — avoidance of direct UVR in infancy, use of protective clothing including tightly-woven fabrics, hats and sunglasses, and

water-resistant sunscreens on exposed areas — remain foundational. However, for SOC, recommendations must also consider cosmetic acceptability of formulations, cultural practices, burden of specific dermatoses,

Limitations

Exploring the benefits (i.e. vitamin D exposure) and balancing this with harms of sun exposure was beyond the scope of this article; however, this is a critical consideration for sun protection recommendations in CYP, especially CYP with SOC. Hence this review highlights the importance of ongoing efforts to establish tailored sun protection guidance for CYP, aiming to balance the risks and benefits of sun exposure, similar to adult guidelines recently published in Australia (49). Grouping similar recommendations into broad themes (Table III) may have introduced bias from misinterpretation. Grey literature searching found many resources

5. Conclusion

The findings of this systematic review highlight the need for harmonised, evidence-based sun protection guidelines that explicitly address the needs of CYP across diverse skin types and populations, including CYP with SOC. Developing such nuanced recommen-

and barriers to access to ensure adherence and equity.

from government and prominent health organisations, however they did not meet the inclusion criteria. The results were also limited by the author's location, search engine algorithm, coverage and results displayed. This may have limited the volume of information from various countries. Finally, whilst we did not limit our search by geography, our study inclusion was limited to the English language, likely excluding articles from many countries, including those with SOC populations. This can create bias due to the collated evidence and guidelines not comprehensively representing the available research globally.

dations represents not only a dermatological priority but also a public health imperative to ensure equitable prevention strategies to reduce disparities in skin cancer outcomes.

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