# Photoprotection for skin of all color: Consensus and clinical guidance from an expert panel

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The negative effects of sun exposure have become better accepted among health care professionals and the lay public over recent decades. Most attention has been focused on the effects of UV light, particularly UVB wavelengths (290-320 nm). Accordingly, products to protect skin from sunlight-associated harm (sunscreens) have been developed to minimize UVB exposure. The effects of longer wavelengths, including UVA (320-400 nm) and visible light (VL, 400-700 nm), are increasingly appreciated. VL accounts for approximately half of the solar radiation that reaches the earth's surface and understanding of its effects on the skin is improving. Studies have shown that VL can induce hyperpigmentation in individuals with dark skin types (Fitzpatrick skin types IV-VI). In addition, VL can contribute to the exacerbation of pigmentary disorders, including melasma. Because these findings are relatively new, there are gaps in understanding the needs for photoprotection and guidance for clinicians. A panel of dermatologists and photobiologists was convened to develop consensus recommendations and clinical guidance about sunscreen use relevant to the current understanding of risks associated with sun exposure using a modified Delphi method. (J Am Acad Dermatol 2022;86:S1-8.)

***Key words:*** photoprotection; skin of color; sunscreens; ultraviolet light; visible light.

## INTRODUCTION

There is general agreement that photoprotection is needed to minimize the risks of sun exposure, which can range from sunburn to early skin aging and skin cancers. According to the most recent 2019 recommendations from the United States Food and Drug Administration (FDA), photoprotection encompasses the following[1]: (1) seek shade when outdoors; (2) be cautious about sun exposure, particularly during midday (10 AM to 2 PM) when light is most intense; (3) cover up with clothing, wide brimmed hat, and sunglasses; and (4) apply broad-spectrum sunscreens with sun protection factor (SPF) 30 or above, and repeat applications frequently (1 or more times every 2 hours) when outdoors.[1] The American Academy of Dermatology recommends sunscreens that have an SPF of 30 or higher and are water resistant and broad spectrum, along with sun protective clothing, hat, glasses, and sun avoidance. In this article, the term "photoprotection" refers to all of the above strategies.

Sunlight includes wavelengths in the UVB and UVA ranges (UVB, 290-320 nm; UVA2, 320-340 nm; and UVA1, 340-400 nm) and visible light (VL: 400-700 nm).[2,3] Because the damaging effects of UVB were recognized first (sunburn), sunscreens were developed primarily to prevent UVB from penetrating skin.[4] The SPF of a sunscreen, defined as "the level of sunburn protection" assesses damage caused primarily by UVB and, to a lesser degree, UVA2 but does not provide information about protective ability

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against other wavelengths of light.[1,4] SPF was adopted by the FDA in 1978.

Cutaneous structural damage due to UVA exposure was first reported by Kligman[5] in 1969, who coined the term "photoaging" in response to his findings. In 2011, the FDA changed the definition of "broad-spectrum sunscreen" to incorporate UVA protection due to increasing evidence supporting the damaging effects of UVA and because of concerns about the "potential for inadequate UVA protection in marketed sunscreen products."[1] To date, the FDA has not incorporated a measure of the protective capacity of sunscreens against VL, and there is no internationally agreed upon rating system for either UVA or VL. A wide variety of UVB filters are currently approved by the FDA but only 2 of those approved offer longwave UVA protection: zinc oxide and avobenzone.[4]

**CAPSULE SUMMARY**

- UV filters have traditionally focused on the ultraviolet spectrum.
- Visible light can induce hyperpigmentation in individuals with dark skin types and contribute to the exacerbation of pigmentary disorders.

While existing guidance from the American Academy of Dermatology and FDA focuses primarily on UV risks, there is emerging evidence about the importance of VL. Approximately 50% of sunlight is in the visible spectrum (wavelengths 400-700 nm), and it is increasingly appreciated that these longer wavelengths have biologic effects on the skin.[6-8] The cutaneous effects of VL include pigment darkening (Fitzpatrick skin type [FST] IV-VI) and erythema (FST I-III), with the former being more long-lasting and intense than that induced by UVA1.[7,9] The clinical relevance of VL was noted when studies of women with melasma showed that sunscreens had variable efficacy in protecting from relapse due to differences in their coverage of VL wavelengths.[10] Further, investigation with LED lights showed that the lower range of VL (blue-violet light or approximately 415 nm) was primarily responsible for inducing pigmentation in dark skin types.[10,11]

Thus, while all skin types should be protected from UV radiation, VL is a concern, especially for individuals with dark skin types. There also appears to be a synergy between UV and VL, where VL seems to accentuate the effects of long wavelength UVA.[12] To date, photoprotection against VL relies primarily on sun avoidance and use of protective clothing, hats, and glasses. UV filters approved for use in sunscreen formulations in the United States do not protect against VL; however, tinted sunscreen does. In addition, new ingredients, such as antioxidants and radical quenchers, are also being investigated for VL protection.[4]

The purpose of this supplement is to highlight emerging data and current knowledge gaps surrounding the use of sunscreen, particularly for patients with dark skin types. To synthesize existing information and supplement areas where the evidence base is sparse, the group reviewed the literature and performed a modified Delphi method to reach agreement on aspects of sunscreen use that could update the knowledge base and provide consensus guidance. Consensus statements are provided here, along with a bulleted listing of key supportive points, as well as guidance for individualizing recommendations about sunscreens for patients.

Three detailed reviews are also included with this supplement. These provide an in-depth examination of the current literature on specific topics of relevance. Rigel et al present *Photoprotection for All: Current Gaps and Opportunities*, Lim et al discuss the *Impact of Visible Light on Skin Health: The Role of Antioxidants and Free Radical Quenchers in Skin Protection*, and Taylor et al review *Misconceptions of Photoprotection in Skin of Color*.

## METHODS TO ACHIEVE CONSENSUS

The Delphi method, a structured decision-making method, was used to arrive at consensus statements regarding aspects of photoprotection that have not been addressed specifically in existing guidance. Based on the literature, a list of key statements was formulated by the group. These were shared via an online survey process and panelists rated their level of agreement with each statement based on a 5-point Likert scale from "strongly agree" to "strongly disagree" in an anonymous fashion. Panelists were also asked to expand upon their response with a brief written statement. Results were tallied after the first round and shared with the group, along with compiled comments. At this stage, the panel members had the opportunity to revise their answers while considering compiled comments. Based on feedback, the statements were modified and a second round of rating was performed, also online. For the final round, panelists met in person via videoconferencing to review and discuss each statement, thereby arriving at the final consensus statements. At each round, consensus was defined as a supermajority (7 or 8 of the 8 panelists rating the statement as "agree" or higher). Evince Communications, LLC was the facilitator of the Delphi process.

*Abbreviations used:*

FDA: Food and Drug Administration
FST: Fitzpatrick skin type
SPF: Sun protection factor
UV: Ultraviolet
UVA: Ultraviolet A
UVB: Ultraviolet B
VL: Visible light

## NEW PERSPECTIVES ON SUNSCREEN USE

### Consensus: UVA/UVB protection alone is not sufficient for overall skin health, especially in dark skin types

- The proliferation of sunscreen products demonstrates the increase in global awareness and demand for sun protection among consumers.[4]
- It is important for clinicians to understand the safety and effectiveness of existing sunscreen filters, specifically regarding non-UVB wavelengths.[4]
- This may be especially true when recommending photoprotection for the purposes of protection against disorders of hyperpigmentation, including melasma or post-inflammatory hyperpigmentation.[7,10,11,13]

### Consensus: Emerging types of photoprotection should be considered

UV and VL generate reactive species (ie, reactive oxygen and nitrogen species) that contribute to skin damage and skin dyspigmentation (eg, hyperpigmentation, melasma, uneven skin tones, photoaging, and post-inflammatory hyperpigmentation). Therefore, emerging types of photoprotection, including those containing stable and physiologically active oral and/or topical antioxidants, should be considered.

- While the FDA regulates sunscreens as over-the-counter drugs, the European Commission regulates sunscreens as cosmetics.[4] In comparison to the 16 FDA-approved sunscreen filters, the European Commission currently has 27 approved filters, primarily due to more approved UVA filters. Thus, consumers in the United States have less access to sunscreens with broad-spectrum filters compared to Europe.
- In 2015, Diffey et al[14] compared UV protection afforded by 4 sunscreens in the United States and 4 in Europe, each with SPF of 50 or more. The ability of sunscreens in the United States, which included modern UVA filters, to prevent UVA from reaching skin was approximately 3-fold lower than that of the European sunscreens.[14] This prompted the FDA to change the UVA protection standard, removing the worst-performing sunscreens from the market.[4]
- Inclusion of antioxidants and other ingredients in sunscreen to provide protection against UVA and VL wavelengths is an emerging area of research and development. The rationale for including antioxidants in sunscreens stems from their ability to scavenge free radicals, which can mediate oxidative skin damage.[15-17] The article *"Impact of Visible Light on Skin: The Role of Antioxidants and Free Radical Inhibitors in Photoprotection,"* in this supplement details currently existing evidence in the literature.
- Discussion of products with antioxidants and, potentially, use of oral antioxidants should be considered when counseling patients with dark skin types about their needs for photoprotection. However, it should be noted that currently there are no standard assessments to evaluate their biologic activity once applied to the skin. It is also important to be aware that some antioxidants are included in sunscreen formulations to prevent lipids from being oxidized but are not biologically relevant in photoprotection.

### Consensus: There are misconceptions surrounding the need for the use of photoprotection for dark skin types

- Differences in the use of sunscreens and photoprotective practices between individuals with light skin (FSTs I-III and those with dark skin (FSTs IV-VI) have been documented, showing individuals with dark skin, or skin of color (SOC, [FSTs III-IV]), to be less likely to use sunscreens and practice other photoprotective behaviors despite having experienced sunburns.[18]
- Further, many individuals with SOC are unaware of the need for photoprotection, due to the belief that their naturally dark skin tone is more capable of providing protection against photodamage.[19,20] While progress has been made in educating patients with SOC about the need for photoprotection, more efforts are needed. The article *"Misconceptions of Photoprotection in Skin of Color"* in this supplement addresses this topic.

### Consensus: There are major gaps in photoprotection products for both UV and VL

- Because the original focus was on UV damage, sunscreens were developed to protect against the effects of UV radiation, primarily UVB.[4]

- There is a need for a standardized method to assess UVA and VL protection.
- Existing systems to evaluate UVA protection include the European Commission-recommended UVA-PF, the FDA-recommended critical wavelength method, and the Boots star rating system used in the United Kingdom.[21]
- Among filters approved by the FDA, zinc oxide and avobenzone absorb in the longwave UVA spectrum; unfortunately, avobenzone is not photostable.
- While other photostable broad-spectrum UV filters are available in many parts of the world, these are not currently approved in the United States.[22]

## RECOMMENDATIONS FOR CLINICAL MANAGEMENT

### Consensus: Photoprotection education and evaluation should be included as part of overall patient skin assessments

- Dermatologists are well aware of the need for photoprotection; however, there are gaps in educating patients with SOC about the risks of sun exposure. As recently as 2021, it was found that dermatologists were less likely to counsel patients with SOC about photoprotection, and 42.9% of the dermatologist respondents indicated never/rarely/only individualizing sunscreen recommendations according to patient skin phototype.[23] This highlights a growth opportunity within dermatology to gain familiarity with sunscreen types and formulations oriented toward use by patients with SOC.[23] The literature about educational efforts and evaluation of photoprotection in SOC are discussed in detail in the article, Photoprotection for All: Current Gaps and Opportunities, elsewhere in this supplement.

### Consensus: A personalized photoprotection regimen should be recommended for all FSTs

- Photoprotection recommendations should be discussed with the patient and then implemented based on joint decision-making about potential risks of exposure and preferences. Factors to consider include FST, geography (extent of sun exposure, humidity, etc), and lifestyle. Some suggestions for tailoring sunscreen recommendations are provided in Table I, while Table II shows ingredients that may offer potential benefit for individual skin diseases/characteristics.[24-28]
- Additional considerations that may affect counseling discussions with patients are presented in Table III.[29]

## RECOMMENDATIONS FOR EDUCATIONAL INITIATIVES

### Consensus: Additional training/education for dermatologists and other clinicians in photoprotection and impact of VL is needed

- This is an evolving area of research, but it is important for clinicians to know about the biologic effects of VL to be better equipped to counsel patients.
- Clinicians with a good understanding of photoprotection can potentially improve adherence via measures to minimize risks associated with light exposure. For example, personalized intervention mapping has been shown to improve photoprotective behaviors in adults with xeroderma pigmentosum, a population at high risk for skin cancer.[30]

### Consensus: Additional research in photoprotection and the biologic effects of sunlight is needed

- There is a need for broader understanding of the effects of light on skin. While the understanding of the effects of UVB is fairly advanced, knowledge of the effects of UVA and especially VL exposure remains limited and mechanisms of cutaneous damage are incompletely understood.[31]
- While prior studies on how tissues interact with light have provided insights into skin aging, cutaneous cancers, and other dermatologic diseases, more research is still urgently needed.
- Advancing our understanding in this area can then lead to advances in sunscreen ingredients, which, in turn, could translate to improved photoprotection and perhaps influence patient acceptance and utilization.

### Consensus: Patients should be educated about the potential role of VL's impact on overall skin health

Patient education about the potential impact of VL on skin health includes induction and/or exacerbation of multiple skin conditions: hyperpigmentation, melasma, post-inflammatory hyperpigmentation, uneven skin tone, and photoaging, especially in FST IV-VI.

- As indicated in this publication and the remainder of the supplement, there are nuances in photoprotection that can be individualized based on patients' preferences, lifestyle, and characteristics.
- The current array of sunscreen products available allow selection of a formulation that can enhance adherence while protecting overall skin health.

**Table I.** Individualizing sunscreen recommendations

| Patient characteristic | Suggestions |
|---|---|
| Atopic dermatitis/ sensitive skin[24] | • Although controlled sun exposure has benefits for some patients with atopic dermatitis, exposure in others may result in impaired skin barrier function<br>  ○ Patients with atopic dermatitis may experience photoaggravation (long-lasting erythema)/ photosensitivity<br>• Optimize skin care regimen with gentle cleanser and moisturizer, particularly moisturizers with SPF<br>• Consider mineral sunscreens because they have low absorption (examples: titanium dioxide, zinc oxide)<br>• Avobenzone and octocrylene are rare sensitizers and considered safe<br>• Ingredients to avoid due to potential for contact dermatitis:<br>  ○ Benzophenone-3 (oxybenzone)<br>  ○ Patient-specific triggers |
| Concern about photodamage/ premature aging[26] | • Daily use of broad-spectrum photostable sunscreen on all sun-exposed areas and protective clothing and hats as often as practical<br>• After-sun products to help repair skin damage and support skin regeneration<br>• Consider retinol-containing product at nighttime to increase cell turnover |
| Oily and/or acne-prone skin[25] | • When possible, cleanse skin prior to applying sunscreen<br>• Choose non-comedogenic, lightweight, non-greasy formulations that absorb quickly (examples: gel or liquid formulations)<br>• Choose products with matte finish to avoid adding a shiny appearance; powder sunscreen also may be useful<br>• Avoid fragrances and oils (example: coconut oil)<br>• Consider oil-absorbing moisturizers with SPF<br>• Consider mineral sunscreens, because they have low absorption (examples: titanium dioxide, zinc oxide) |
| Hyperpigmentation[28] | • Most common in FST IV-VI<br>• Sunscreen should be broad-spectrum and protect against VL and may benefit from the addition of anti-inflammatory agents such as licochalcone A and glycyrrhetinate, although the efficacy of these agents is still under evaluation<br>• Limit sun exposure when possible<br>• For PIH, opaque dressings for 15 days may be beneficial |
| Photosensitivity[28] | • Consider mineral sunscreens because they have low absorption (examples: titanium dioxide, zinc oxide)<br>• Apply products containing retinol/retinoids at night<br>• Review topical and systemic medication use |
| Rosacea[28] | • Daily use of broad-spectrum sunscreens to minimize effect of UV radiation and heat on erythema and telangiectasia<br>• Select sunscreens containing dimethicone or cyclomethicone to reduce irritation |

*FST*, Fitzpatrick skin type; *PIH*, postinflammatory hyperpigmentation; *SPF*, sun protection factor; *UV*, ultraviolet; *VL*, visible light.

## LIMITATIONS AND PANEL SELECTION

The final 9 consensus statements developed via the modified Delphi method could be organized into 3 categories: (1) new perspectives on sunscreen use; (2) recommendations for clinical management; and (3) recommendations for educational initiatives. Clinicians may consider implementation of the panel's recommendations on photoprotection, in particular expanding patient awareness for the need for photoprotection against both UV and VL in all skin tones. Nevertheless, there are limitation to consider, which provide direction for expanded discussions and recommendations.

The panel that was developed was selected based on several criteria and knowledge of the subject area with the objective aiming to bring together a multidisciplinary group of leaders in the fields of dermatologic impacts in SOC, photoprotection, and photobiology, representing both academic and private practice. Additionally, inclusion of representatives from multiple regions of the United States were included, as well as years of practice to maximize views of the subject areas discussed; however, the small size of the panel (N = 8) should be noted. The major gaps discussed and presented, though focusing on gaps in photoprotection in SOC, aimed

**Table II.** Ingredients that may offer potential benefits in specific settings

| Ingredient with potential benefit | Acne/oily skin | Atopic dermatitis/ sensitive skin | Hyperpigmentation | Photoaging | Photosensitivity | Rosacea |
|---|---|---|---|---|---|---|
| Alpha glucosylrutin | | | | | Yes | |
| Bisabolol | | Yes | | | | |
| Ceramide | | Yes | Yes | | | Yes |
| Cyclomethicone/dimethicone | | | | | | Yes |
| Dexpanthenol (anti-irritant/ itch) | | Yes | | | | |
| Ectoin | | Yes | | Yes | | |
| Glycyrrhetinate | Yes | | Yes | | | |
| Green tea | Yes | | | Yes | | |
| Hyaluronic acid | Yes | Yes | Yes | Yes | | |
| Lactic acid | Yes | | | | | |
| Licochalcone A | | Yes | Yes | Yes | | |
| Lipid absorbing pigments (tints) | Yes | Yes | Yes | Yes | Yes | Yes |
| Occlusive agents (dimethicone) | | Yes | | | | |
| Niacinamide | Yes | | | | | |
| Thiamidol | | | Yes | | | |
| Vitamin C | Yes | | | Yes | | |
| Vitamin E/alpha-tocopherol | Yes | Yes | | | | |

**Table III.** Counseling men about skin and sunscreen[29]

- Educate male patients that their skin is different from women's skin, and should have specific care. Things to discuss include:
  - In general, male skin is approximately 20% thicker than female skin and contains more collagen. As a result, it ages differently and signs of aging may appear later in men but may also occur more rapidly after onset compared with women.
  - Sebaceous glands may be more active and larger, resulting in oilier skin.
  - Shaving makes facial skin stressed and irritated and can be a factor in poor tolerance of sunscreens.
- Surveys indicate that men are less likely to use sunscreen and protective clothing or hats than women. It is important to discuss the need for photoprotection along with a skin care regimen to protect skin.

to discuss overall gaps in photoprotection for all skin tones, especially from UVA and VL, which is increased due to FDA guidance on sunscreens in the United States, thus the inclusion of only dermatologists from the United States on in the panel. However, the selection of only a panel of experts from the United States was not meant to assess photoprotection issues and gaps worldwide, nor areas with high concentration of SOC residents, but rather to increase awareness about the importance for photoprotection for skin of all color.

## CONCLUSIONS

It is increasingly recognized that sun care should be personalized based on FST, degree of sun exposure, and utility of individual sunscreen formulations and ingredients. The knowledge base surrounding the effects of UV and VL on skin is expanding, but gaps in understanding remain for both clinicians and, more prominently, patients. This is particularly true for individuals with dark skin types, who are at risk for pigmentation problems from VL. These individuals often believe that the higher degree of melanin in their skin protects them from the harmful effects of sun exposure; thus, there is a need not only to educate but also to dispel myths about sun care needs. New approaches, including novel ingredients and formulations, more balanced UVB, UVA, and VL protection, are under investigation to address gaps in care for specific skin types.

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### Conflicts of interest

Dr Taylor has served as an investigator for Concert Pharmaceuticals, Croma-Pharma GmbH, Eli Lilly and

Company, Immune Tolerance Network, and Pfizer; as a consultant/speaker/advisory board member for AbbVie, Arcutis Biotherapeutics, Beiersdorf Inc, Biorez, Inc, CannTec, Evolus, Galderma Laboratories, GloGetter Inc, L'Oreal USA, Inc, LuminDX, Medscape/WebMD, Johnson & Johnson Consumer Products, Scientis, and Vichy Laboratories; and has received book royalties from McGraw Hill. Dr Lim has served as investigator (grant to institution) for Incyte, L'Oreal, Pfizer, and Patient-Centered Outcomes Research Institute; as a consultant for Pierre Fabre, ISDIN, Ferndale, La Roche-Posay, and Beiersdorf; and as a speaker in a general education session for La Roche-Posay and Cantabria Labs. Dr Alexis has received grant/research support from Leo Pharma, Novartis, Almirall, Bristol Myers Squibb, Amgen, Menlo, Galderma, Valeant (Bausch Health), Cara, and Arcutis Biotherapeutics; and has served as a consultant/speaker for Leo Pharma, Galderma, Pfizer, Sanofi-Regeneron, Dermavant, Beiersdorf, Valeant, L'Oreal, Bristol Myers Squibb, Bausch Health, UCB Pharma, Vyne Therapeutics, Arcutis Biotherapeutics, Janssen, Allergan, Almirall, AbbVie, Sol-Gel, Amgen, Regeneron, Sanofi-Genzyme, Pfizer, and AstraZeneca. Dr Armstrong has served as research investigator and/or scientific advisor to AbbVie, ASLAN, Boehringer Ingelheim, Bristol Myers Squibb, EPI, Incyte, Leo Pharma, UCB Pharma, Janssen, Lilly, Novartis, Ortho Dermatologics, Sun, Dermavant, Dermira Inc, Sanofi, Regeneron, Pfizer, and Modmed. Dr Chiesa Fuxench has served as a consultant for the Asthma and Allergy Foundation of America and the National Eczema Association, Pfizer, Incyte and AbbVie for which she received honoraria for work related to atopic dermatitis; served as consultant for Beiersdorf, which supported this work, has received research grants from Regeneron, Sanofi, Tioga, Vanda, Menlo Therapeutics, Leo Pharma, and Eli Lilly for work related to atopic dermatitis; and has received honoraria for continuing medical education work in atopic dermatitis sponsored by educational grants from Regeneron and Sanofi. Dr Draelos has served as a consultant for Beiersdorf. Dr Hamzavi has served as an investigator (grant to institution) for Pfizer Inc, Bayer, Lenicura, and Incyte, Estee Lauder, L'Oreal, Unigen, Avita, Arcutis Biotherapeutics, and Ferndale Laboratories, Inc; as an Advisory Board member for AbbVie; and as a Consultant to Galderma Laboratories, LP, Incyte, Pfizer, UCB, Boehringer Ingelheim, Beiersdorf, and Clarify Medical. Dr Rigel has served as an advisor/consultant for Almirall, Beiersdorf, Castle Biosciences, Inc, DermTech, Ferndale, Johnson & Johnson, Myriad Genetics, Ortho Dermatologics, Pfizer, and Scibase. Evince Communications has served as scientific consultants for Beiersdorf, Inc, on educational initiatives and the dermMentors Resident of Distinction Award Program.

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