

Limitations of Modern Sunscreens: Implications for UVA Protection and Skin Cancer Prevention

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ABSTRACT

Sunscreens have evolved from primarily blocking UVB radiation to theoretically broad-spectrum formulas that protect against both UVA and UVB. Despite these advances, UVA-associated squamous cell carcinoma (SCC) and melanoma have risen disproportionately compared to UVB-associated basal cell carcinoma (BCC), suggesting inadequate UVA protection. Modern broad-spectrum products continue to quantify protection using sun protection factor (SPF), which reflects UVB coverage. This focus on UVB may help explain the observed shift in cancer ratios. High SPF sunscreens have been very successful in preventing UVB induced burns, but in turn, this may encourage patients to spend much more time outdoors thus leading to a significant increase in UVA exposure. Continued research, improved UVA coverage, and standardized methods for measuring UVA protection are essential for optimizing skin cancer prevention.

BACKGROUND

Early generation sunscreens predominantly offered UVB protection with minimal UVA coverage, whereas modern formulations use advanced chemical and physical filters to meet regulatory standards for both UVA and UVB. Despite these advances, recent studies highlight a disproportionate rise in UVA-driven cancers such as SCC and melanoma compared with UVB-related BCC, raising concerns about the adequacy of UVA protection in modern sunscreens.

METHODS

PubMed was searched and English articles were included, supplemented by citation tracking and the authors' expert clinical opinion.

RESULTS

Historical chemical sunscreen formulations primarily protected against UVB radiation (280–320 nm) to prevent sunburn, with minimal or inconsistent coverage of UVA, including UVA2 (320–340 nm) and UVA1 (340–400 nm). Figure 1 shows their depth of penetration. Some inorganic filters, such as titanium dioxide and zinc oxide, blocked UVB and limited UVA but had poor cosmesis and inadequate UVA coverage.

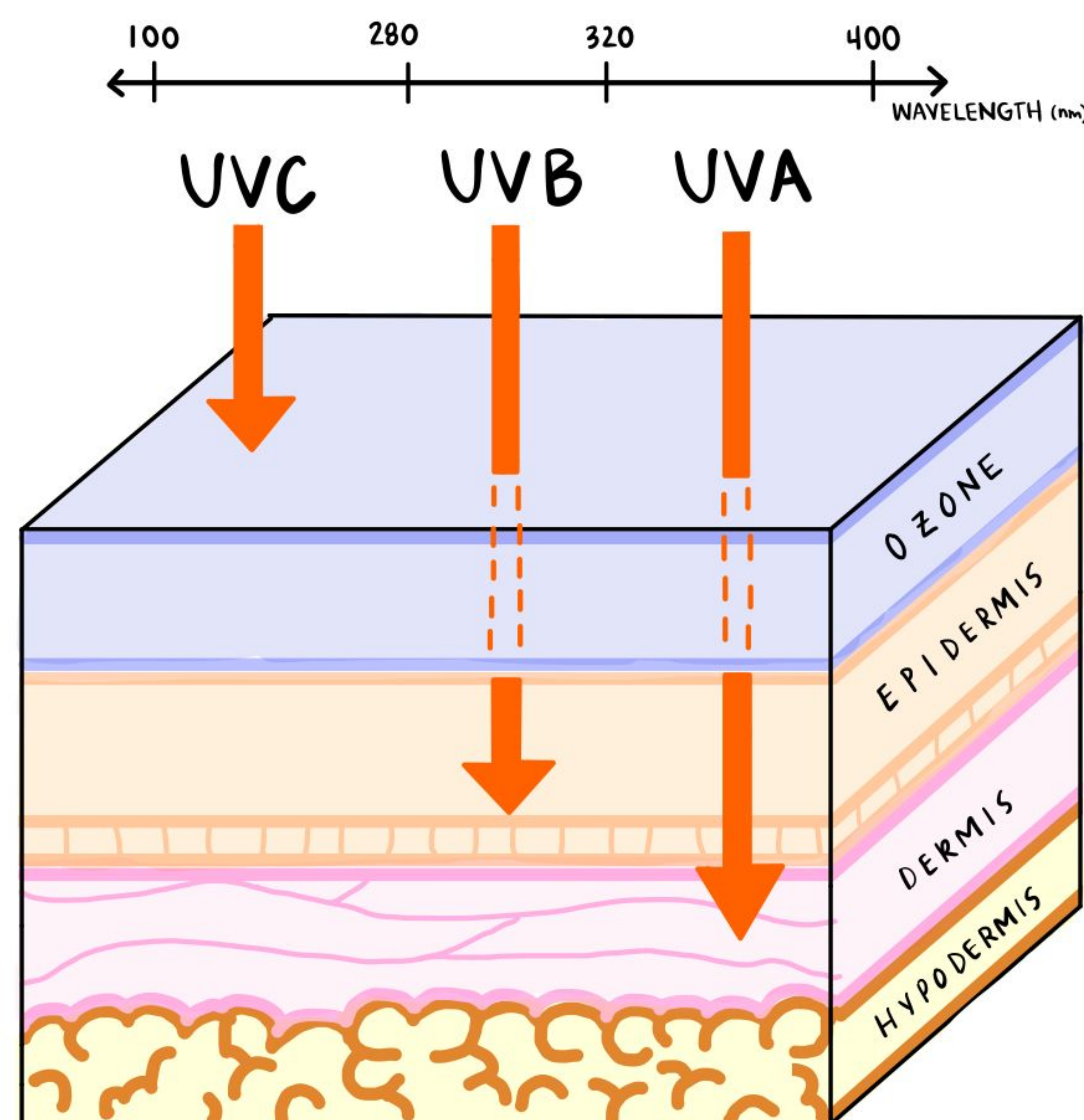


Figure 1: UV radiation varies by wavelength: UVB mainly affects the skin surface, while UVA penetrates deeper. UVC is blocked by the ozone layer.

Modern sunscreens now combine multiple chemical and micronized physical filters to meet FDA “broad spectrum” standards (critical wavelength ≥ 370 nm). SPF, the primary measure of sunscreen effectiveness, is calculated as the ratio of the minimum erythematous dose (MED) on protected skin to that on unprotected skin, with MED determined by UVB exposure.

Despite advances to broad-spectrum formulations, epidemiological data show rising SCC rates relative to BCC, with the U.S. ratio shifting from 1:4 in 1992 to 1:1 in 2012 and 3:1 in 2024. A 30-year prospective study showed that high UVA exposure in the form of psoralen plus ultraviolet-A (PUVA) therapy led to a 30-fold increase in SCC and only a 5-fold increase in BCC. The incidence of melanoma has also continued to steadily rise over the past few decades, with one epidemiologic study finding incidence rates increased more than 11-fold from the 1970s to the 2010s.

DISCUSSION

Despite advances in sunscreen, this poses a concern that current broad-spectrum formulations inadequately protect against UVA radiation and its associated skin cancers. This is likely due to insufficient UVA protection combined with adequate UVB coverage, which prevents sunburn and encourages longer time spent outdoors. Recent studies have shown an increase in the incidence of lesions on the actinic-SCC spectrum including isSCC and actinic keratoses, especially compared to BCC with daily sunscreen use compared to discretionary use, and a steadily rising incidence of melanoma.

PUVA therapy serves as a controlled model of UVA exposure and has been shown to increase the risk of SCC without a significant increase in BCC risk. The historical use of UVB-specific sunscreen, and modern broad-spectrum sunscreens likely having much lower UVA protection than stated, may be causing an increased susceptibility to UVA exposure even in the absence of UVB-implicated burns. This is likely increasing long-term SCC and melanoma risk and may help explain the observed ratio shift.

CONCLUSION

The transition to broad-spectrum standards has improved photoprotection, but the rising incidence of SCC and melanoma underscore the need for ongoing research and improved UVA coverage.

REFERENCES & DISCLOSURES

- Ziglar J, Mohammad TF, Gilaberte Y, Lim HW. Sunscreens: Updates on Sunscreen Filters and Formulations. *Photodermatol Photoimmunol Photomed*. 2025;41(3):e70026. doi:10.1111/phpp.70026
- Marrero-Perez A, Vanaria RJ, Chaudry A, Berman B, Nestor MS. Ratio of nonmelanoma skin cancer histologic subtypes in a South Florida dermatology practice: High incidence of squamous cell carcinoma subtypes. *J of Skin*. 2025;9(2):s571. doi:10.25251/skin.10.suppl.571
- Raymond-Lezman JR, Riskin SI. Sunscreen Safety and Efficacy for the Prevention of Cutaneous Neoplasms. *Cureus*. 2024;16(3):e56369. Published 2024 Mar 18. doi:10.7759/cureus.56369
- Zhou L, Zhong Y, Han L, Xie Y, Wan M. Global, regional, and national trends in the burden of melanoma and non-melanoma skin cancer: insights from the global burden of disease study 1990–2021. *Sci Rep*. 2025;15(1):5996. Published 2025 Feb 18. doi:10.1038/s41598-025-90485-3
- Stern RS; PUVA Follow-Up Study. The risk of squamous cell and basal cell cancer associated with psoralen and ultraviolet A therapy: a 30-year prospective study. *J Am Acad Dermatol*. 2012;66(4):553–562. doi:10.1016/j.jaad.2011.04.004

The authors have no financial disclosures to report; this study received no funding from any sources.