
American College of Preventive Medicine Practice Policy Statement: Skin Protection from Ultraviolet Light Exposure

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Based on a review of current literature and recommendations, the American College of Preventive Medicine presents a practice policy statement on skin protection from ultraviolet light exposure. (Am J Prev Med 1998;14:83-86) © 1998 American Journal of Preventive Medicine

Burden of Suffering

Solar radiation, and ultraviolet (UV) light in particular, is increasing worldwide with the thinning of the protective ozone layer. Over 90% of ultraviolet radiation is UVA, which is most intense in early morning and afternoon, can pass through window glass, penetrates into the dermis, and causes tanning and wrinkling. UVB is most pronounced midday, does not penetrate window glass, and is associated with sunburn. Ultraviolet light has been implicated in multiple human diseases from skin cancer to cataracts to immune suppression.

The alarming increase in skin cancer incidence over the last few decades has been associated with increased exposure of Americans to UV light in both descriptive and analytic studies; however, most evidence is indirect.¹ Basal and squamous cell carcinoma (non-melanoma skin cancers—NMSC) are the most common of all cancers; more than 800,000 cases are diagnosed annually.² These cancers rarely invade or metastasize but do require surgical excision. Risk factors for NMSC include exposure to sun or radiation, fair skin, advancing age, and male sex.

Malignant melanoma (MM), the most serious of all skin cancers, is increasing faster than any cancer except lung cancer, more than doubling in the last decade. In 1997, some 40,300 cases will be diagnosed and 7,300 people will die of MM.³ By the year 2000, the lifetime risk of MM for whites in United States is expected to be 1 in 90.⁴ Melanoma risk is increased in men, fair-skinned individuals, those with a family history, those living nearer the equator, those with multiple pigmented nevi, the immunosuppressed, and is more than doubled in those with one or more severe sunburns in

childhood.⁵ Although sun exposure contributes to MM, the exact role of UV light in the pathogenesis of MM is unknown.⁶ Some evidence suggests that intermittent sunlight exposure or childhood sunburn is more important than cumulative adult sun exposure as evidenced by the lower incidence of MM among outdoor workers.^{5,7}

Description of Preventive Measures

Preventive measures for limiting sun exposure include sun avoidance (especially during midday), use of protective clothing and hats, and application of sunscreens. Protective clothing can include pants, hats, long-sleeved shirts, and newer sun-resistant fabrics. Physical sunscreens (e.g., zinc oxide) are opaque, often greasy formulations that reflect both UVA and UVB. Chemical sunscreens are non-opaque and absorb UVA, UVB, or both. Sunscreens are classified according to Sun Protection Factor (SPF), an index of protection against skin erythema. SPF ranges from 1-45 or above and quantifies UVB protection.⁸ A sunscreen with SPF 15 filters 92% of the UVB. SPF is determined indoors using a light spectrum meant to mimic noontime sun; when tested outdoors, SPF may over-estimate sun protection by a factor of two, especially when the sun is close to the horizon owing to a changed ratio of UVA to UVB.⁹ There is currently no uniform measure for UVA absorption. The UV index, a public health education tool reported by meteorologists in 58 U.S. cities, offers a daily report of UV light levels on a scale from 1-10+ (minimal to very high exposure).

Evidence of Effectiveness

Sun avoidance and use of protective clothing have been associated with reduced risk of both melanoma and non-melanoma skin cancers in multiple animal, cohort,

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and case-control studies^{4,10-12}; however, not all studies find an effect.¹³ Experimental studies quantify degree of protection of various types of clothing; for example, nylon stockings allow sun protection at the level of SPF of 2,¹⁴ hats offer SPF of 3-6,¹⁵ summer-weight clothing offers SPF of 6.5,¹⁶ and sun-protective clothing offers an SPF of up to 30.¹⁶

Regular sunscreen use is postulated to reduce photodamage to skin, decrease incidence of nonmelanoma skin cancers, and possibly reduce incidence of malignant melanoma. In both animal and human models, broad-spectrum sunscreen preparations offer at least partial protection against sun-induced immune depression, which is unrelated to SPF.¹⁷⁻²⁰ Use of makeup products containing sunscreens, particularly lipstick, has been associated with a decreased risk of cancer of the lip in one case-control study involving women.²¹

Evidence for sunscreen effectiveness in reducing NMSC is based on epidemiologic evidence linking UV light exposure to skin cancer and sunscreen ability to block UV light^{22,23} and animal studies finding a reduction in sun-induced NMSC tumors with sunscreen use,^{20,24,25} although one prospective study found an increased risk of basal cell cancers among those using sunscreens.²⁶ A randomized double-blind placebo-controlled trial of broad-spectrum sunscreen in high-risk adults (those with precursor skin lesions or history of NMSC) reported a reduction in new actinic keratosis and more remissions in individuals with precursor lesions.^{27,28}

There is significant concern that sunscreens may not protect against MM. Animal studies report no change in incidence of MM despite prevention of sunburn with broad-spectrum sunscreens.²⁹ In addition, several case-control and cohort studies reported either no effect or an increased risk of MM among sunscreen users.³⁰⁻³² One population-based case-control study in southern Sweden showed an 80% increase in malignant melanoma among those who used sunscreens, with a suggestion of a dose-response ratio.³³ At least part of this negative association may be due to confounding; those more likely to use sunscreens are those with increased susceptibility to skin cancer and sunscreen use may be associated with tanning behaviors. Most studies, however, controlled for skin type, sun exposure, and other confounding variables. Further, older sunscreen preparations were less potent and offered less UVA protection.

Sunscreen use may be associated with adverse effects. Some experts hypothesize that sunscreen users may increase time spent in the sun, avoiding sunburn, but exposing themselves to harmful solar radiation, which may be carcinogenic or decrease immune function.⁷ Others fear that some compounds in sunscreen preparations may be mutagenic or carcinogenic, e.g., p-dimethylamino-*O*-octyl dimethyl PABA³⁴ and alpha tocopherol

acetate.³⁵ Sunscreen use may be associated with reduced synthesis of vitamin D; although in one randomized controlled trial in Australia during the summer, sunscreen users maintained vitamin D levels in the normal range.³⁶ Sunscreens may cause skin reactions; in one randomized clinical trial, 19% of daily sunscreen users had a skin reaction (predominantly irritant; only a minority were allergic).³⁷ Little is known about potential long-term effects of sunscreen use.

The effectiveness of physician advice on increasing sunscreen use is unknown. Those with increased knowledge regarding UV light are more likely to use sunscreen or protective clothing³⁸; however, education does not always translate into compliance with sun-protective behaviors. Physician advice regarding sunscreen use, even among patients with previous skin cancers, has been found to be relatively ineffective, reducing tanning only 1% after 2 to 6 years of annual education.^{39,40}

Public Policy Considerations

It is estimated that 80% of a person's sun exposure occurs before age 21.⁴¹ However, at-risk children and adolescents rarely limit sun exposure or use sunscreen; one study found only 9% of adolescents always use sunscreen and 33% never do.⁴¹ Studies of adults report 26% to 70% compliance with sunscreen use, with lower use among men and those of lower socioeconomic status.⁴² Those at highest risk of skin cancers—men and older people—are even less likely to use appropriate sun protection.³⁸ Multifaceted community campaigns using media, role modeling, advertising, and school-based behavioral interventions may be more effective at changing behavior than physician advice.⁴³ An Australian campaign combined public education, structural changes (e.g., shade in open spaces), and public policy (low-cost and sales-tax-free sunscreens, and scheduling sporting events for evenings) and noted a change in attitudes, beliefs, and reporting of recent severe sunburn.⁴⁴ A similar intervention in another part of the country, however, reported no change in frequency of sunburn despite self-reported use of sun protection.⁴⁵ Some experts fear a further increase in skin cancer incidence with the ozone depletion, which is occurring globally secondary to chlorofluorocarbons and other chemicals;⁴⁶ this protective layer around the earth decreases passage of UV radiation.

Recommendations of Other Groups

The American Cancer Society, the American Academy of Dermatology, the American Medical Association, and the NIH consensus panel all recommend patient education concerning sun avoidance and sunscreen use. The American Academy of Family Physicians rec-

ommends sun protection for all with increased sun exposure, and the Canadian Task Force on the Periodic Health Examination recommends sun avoidance and protective clothing but does not recommend for or against sunscreen use. The U.S. Preventive Services Task Force recommends physician counseling on sun avoidance and use of protective clothing for adults and children at high risk of skin cancer, but finds insufficient evidence to recommend for or against sunscreen use.

Rationale Statement

Although skin cancer is increasing, the vast majority of these cancers are NMSC, which has a very low mortality rate. The incidence of MM is increasing faster than any other cancer; however, the exact role of UV light in the pathogenesis of this deadly cancer is unclear. Sun avoidance and use of sun protection has been shown in animal, observational, and case-controlled studies to be protective against malignant melanoma and nonmelanoma skin cancers. Evidence that sunscreen protects against nonmelanoma skin cancer is based on epidemiological associations of UV light exposure to cancer of the skin, animal studies showing a reduction in tumors with sunscreen use, and randomized, placebo-controlled intervention studies of high-risk populations showing a decrease in new precursor lesions and regression of old lesions with initiation of daily sunscreen use. Evidence supporting no effect or a negative effect on risk of MM with sunscreen use is compiled from animal, observational, and case-controlled studies. Sunscreen users may spend more time in the sun, preparations may incompletely block the type of rays that initiate melanoma, or components may have mutagenic effects. No randomized controlled trial has investigated the role of sunscreen use in the etiology of malignant melanoma. Evidence supporting a role for the physician in discussing or recommending sun protection or sunscreen is sparse.

Recommendations of the American College of Preventive Medicine

Sun avoidance and other sun-protective measures (e.g., clothing, hats, opaque sunscreens) are probably effective in reducing skin cancer and should be recommended. The American College of Preventive Medicine finds insufficient evidence to recommend for or against sunscreen use. Nonmelanoma skin cancers may be reduced with regular, daily sunscreen use. There is insufficient evidence that chemical sunscreens protect against MM and they may, in fact, increase risk.

The American College of Preventive Medicine does not believe the evidence supports discussion of sun-

screen and sun protection with every patient. However, the College recommends that physicians remain informed on the issue and be able to discuss sun protection with patients who have questions or who are at particular risk (e.g., family history of melanoma, precursor lesions, or markedly increased sun exposure). For those at high risk, providers should caution against prolonged tanning and sunburn and encourage the use of protective clothing. Because of the importance of preventing sunburn in childhood and the increased UV exposure among children and adolescents, the College recommends discussion of sun protection during routine preventive check-ups. The College also recommends increasing research be undertaken into the association of UV radiation and malignant melanoma, the relative efficacy of sunscreens in reducing UVA exposure, and possible carcinogenic effects of sunscreen components. Finally, the College supports studies on the effectiveness of community-wide health-promotion campaigns and/or effective physician counseling strategies to educate the public about UV radiation.

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References

1. Kricger A, Armstrong BK, English DR. Sun exposure and non-melanocytic skin cancer. *Cancer Causes Control* 1994;5:367-92.
2. Parker SL, Tong T, Bolden S, Wingo PA. Cancer statistics, 1996. *CA: Cancer J Clin* 1996;46:5-27.
3. Parker SL, Tong T, Bolden S, Wingo PA. Cancer statistics, 1997. *CA: Cancer J Clin* 1997;47:5-27.
4. Koh HK, Kligler BE, Lew RA. Sunlight and cutaneous malignant melanoma: evidence for and against causation. *Photochem Photobiol* 1990;51:765-9.
5. Graham S, Marshall J, Haughey B, et al. An inquiry into the epidemiology of melanoma. *Am J Epidemiol* 1985; 122:606-19.
6. Donawho C, Wolf P. Sunburn, sunscreen and melanoma. *Curr Opin Oncol* 1996;8:159-66.
7. Garland CF, Garland FC, Gorham ED. Rising trends in melanoma: a hypothesis concerning sunscreen effectiveness. *Ann Epidemiol* 1993;3:103-10.
8. Patel NP, Highton A, Moy RL. Properties of topical sunscreen formulations. *J Dermatol Surg Oncol* 1992;18: 316-20.
9. Sayre RM, Kollias N, Ley RD, Bager AH. Changing the risk spectrum of injury and the performance of sunscreen products throughout the day. *Photodermatol Photoimmunol Photomed* 1994;10:148-53.
10. Evans RD, Kopf AW, Lew RA, et al. Risk factors for the development of malignant melanoma—I. Review of case-control studies. *J Dermatol Surg Oncol* 1988;14:393-408.
11. Urbach R. Incidence of nonmelanoma skin cancer. *Dermatol Clin* 1991;9:751-5.

12. Glass AJ, Hoover RN. The emerging epidemic of melanoma and squamous cell skin cancer. *JAMA* 1989;262:2097-2100.
13. Harvey I, Frankel S, Marks R, et al. Non-melanoma skin cancer and solar keratosis: II. Analytical results of the South Wales Skin Cancer Study. *Br J Cancer* 1996;74:1308-12.
14. Sinclair SA, Diffey BL. Sun protection provided by ladies stockings. *Br J Dermatol* 1997;136:239-41.
15. Wong JC, Airey DK, Fleming RA. Annual reduction of solar UV exposure to the facial area of outdoor workers in Southeast Queensland by wearing a hat. *Photodermatol Photoimmunol Photomed* 1996;12:131-5.
16. Menter JM, Hollins TD, Sayre RM, et al. Protection against UV photocarcinogenesis by fabric materials. *J Am Acad Dermatol* 1994;31:711-6.
17. Walker SL, Young AR. Sunscreens offer the same UVB protection factors for inflammation and immune suppression in the mouse. *J Invest Dermatol* 1997;108:133-8.
18. Roberts LK, Beasley DG. Commercial sunscreen lotions prevent ultraviolet radiation-induced immunosuppression of contact sensitivity. *J Invest Dermatol* 1995;105:339-44.
19. Whitmore SE, Morrison WC. Prevention of UVB-induced immunosuppression in humans by high sun protection factor sunscreen. *Arch Dermatol* 1995;131:1128-33.
20. Bestak R, Halliday GM. Sunscreens protect from UV-promoted squamous cell carcinoma in mice chronically irradiated with doses of UV radiation insufficient to cause edema. *Photochem Photobiol* 1996;64:188-93.
21. Pogoda JM, Preston-Martin S. Solar radiation, lip protection and lip cancer risks in Los Angeles County women. *Cancer Causes Control* 1996;7(4):450-63.
22. Armstrong BK. Epidemiology of malignant melanoma: intermittent or total accumulated exposure to the sun? *J Dermatol Surg Oncol* 1988;14:835-49.
23. Diffey BL, Farr PM. Sunscreen protection against UVA, UVB and blue light: an in vivo and in vitro comparison. *Br J Dermatol* 1991;124:258-63.
24. Gurish MF, Roberts LK, Krueger GC, Daynes RA. The effect of various sunscreen agents on skin damage and the induction of tumor susceptibility in mice subjected to ultraviolet radiation. *J Invest Dermatol* 1981;76:246-51.
25. Young AR, Gibbs NK, Thompson RJ, Magnus IA. Modification of 5-methoxypsoralen phototumorigenesis in hairless albino mice by sunscreen filters. *Br J Dermatol* 1983;109:705.
26. Hunter DJ, Golditz GA, Stampfer MJ, et al. Risk factors for basal cell carcinoma in a prospective cohort of women. *Ann Epidemiol* 1990;1:13-23.
27. Thompson SC, Jolley D, Marks R. Reduction of solar keratoses by regular sunscreen use. *N Engl J Med* 1993;329:1147-51.
28. Naylor MF, Boyd A, Smith DW, et al. High sun factor protection sunscreen in the suppression of actinic neoplasm. *Arch Dermatol* 1985;131:170-5.
29. Wolf P, Donawho CK, Kripke MC. Effect of sunscreen on UV radiation-induced enhancement of melanoma growth in mice. *J Natl Cancer Inst* 1994;86:99-105.
30. Beitner H, Norell SE, Ringborg U, et al. Malignant melanoma: aetiological importance of individual pigmentation and sun exposure. *Br J Dermatol* 1990;122:43-51.
31. Holman CDJ, Armstrong BK, Heenan PJ. Relationship of cutaneous malignant melanoma to individual sun exposure habits. *J Natl Cancer Inst* 1986;76:403-14.
32. Autier P, Dore JF, Schifflers E, Cessanni JP, et al. Melanoma and the use of sunscreens: an EORTIC case-control study in Germany, Belgium and France. The EORTIC Melanoma Cooperative Group. *Int J Cancer* 1995;61:749-55.
33. Westerdahl J, Asson H, Masback A, Ingvar C. Is the use of sunscreens a risk factor for malignant melanoma? *Melanoma Res* 1995;5:59-65.
34. Knowland J, McKenzie EA, McHugh PJ, Cridland NA. Sunlight-induced mutagenesis of a common sunscreen ingredient. *FEBS Lett* 1993;324:309-13.
35. Alberts DS, Goldman R, Xu MJ, et al. Disposition and metabolism of topically administered alpha tocopherol acetate, a common ingredient in commercially available sunscreens and cosmetics. *Nutr Cancer* 1996;26:193-201.
36. Marks R, Foley PA, Jolley D, et al. The effect of regular sunscreen use on vitamin D levels in an Australian population: results of a RCT. *Arch Dermatol* 1995;131:415-21.
37. Foley P, Nixon R, Mario R, Frowen K, et al. The frequency of reactions to sunscreens: results of a longitudinal population-based study on the regular use of sunscreens in Australia. *Br J Dermatol* 1993;128:512-8.
38. Berwick M, Fine JA, Bolognia JL. Sun exposure and sunscreen use following a community skin cancer screening. *Prev Med* 1992;21:302-10.
39. Robinson JK. Behavior modification obtained by sun protection education coupled with removal of a skin cancer. *Arch Dermatol* 1990;126:477-81.
40. Robinson JK. Compensation strategies in sun protective behaviors by a population with nonmelanoma skin cancer. *Prev Med* 1992;21:754-65.
41. Banks BA, Silverman RA, Schwartz RH, Tunnessen WW. Attitudes of teenagers toward sun exposure and sunscreen use. *Pediatrics* 1992;89:40-2.
42. Koh HK, Geller AC. Melanoma control in the United States: current status. *Recent Results Cancer Res* 1995;139:215-24.
43. Lombard D, Neubauer TE, Canfield D, Winett RA. Behavioral community interventions to reduce the risk of skin cancer. *J Appl Behav Anal* 1991;24:677-86.
44. Hill D, White V, Marks R, Borland R. Changes in sun-related attitudes and behaviors and reduced sunburn prevalence in a population at high risk for melanoma. *Eur J Cancer Prev* 1993;2:447-56.
45. Baade PD, Balanda KP, Lowe JB. Changes in skin protection behaviors, attitudes and sunburn in a population with the highest incidence of skin cancer in the world. *Cancer Detect Prev* 1996;20:566-75.
46. Rundell RD. Promotional effects of ultraviolet radiation on human basal and squamous cell carcinoma. *Photochem Photobiol* 1983;38:569-75.