The Benefits and Risks of Ultraviolet Tanning and Its Alternatives: The Role of Prudent Sun Exposure

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• Tanning • Ultraviolet light • Health • Benefits • Risks • Sun • Vitamin D

Deliberate tanning is a common practice among light-skinned individuals in Europe and United States.[1–4] Many health benefits and risks have been attributed to ultraviolet (UV) exposure and tanning. This article discusses these claims in light of the growing indoor UV and non-UV tanning industries.

HEALTH BENEFITS

Several health benefit claims, such as improved appearance, enhanced mood, and increased vitamin D levels, have been attributed to tanning. Furthermore, the Indoor Tanning Association claims, "catching some rays may lengthen your life."[5]

Exposure to sunlight has been linked to improved energy and elevated mood. The belief that people look better with a tan may partially explain this phenomenon. A report on the tanning attitudes of young adults found that 81% of individuals in 2007 believed that a tan improved appearance, whereas only 58% of individuals in 1968 held the same belief.[6] Individuals who have seasonal affective disorder report improved mood status when exposed to sunlight[7] and to frequent tanning.[8] Although early studies suggested that mood elevation was linked to increased endorphin levels,[9] subsequent studies have not found such a correlation.[10–12]

The Indoor Tanning Association claims that a base tan can act as "the body's natural protection against sunburn."[5] UV-induced tans offer a sun protection factor of 3 to 4,[13,14] but additional changes besides hyperpigmentation, such as epidermal hyperplasia, likely play a role in UV-induced photoprotection. Although a sun protection factor of 3 to 4 does protect from sunburn, only approximately 65% of the erythema induced by UV radiation is blocked.[15] Therefore, a base tan does not provide adequate protection, and

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appropriate clothing, the proper use of sunscreens, and prudent sun exposure remain essential for sunburn prevention.

VITAMIN D PRODUCTION

Sunlight contains UV-B, which induces the skin to synthesize previtamin D3. Healthy individuals have seasonal variations in their vitamin D levels[16,17] and may become vitamin D deficient during winter.[17] Lower vitamin D levels are associated with increased risk for several types of cancer, heart disease, and bone disease.[18–23] Vitamin D deficiency also may play a role in autoimmune disease.[24]

The Indoor Tanning Association highlights "new research on how sunshine decreases infection,"[5] including a West African case-control study in which more patients who had tuberculosis than controls had low levels of vitamin D (hypovitaminosis defined as 25-hydroxyvitamin D3 (25(OH)D3) $\leq$ 75 nmol/L) (46% versus 39%) (relative risk [RR] 1.18; 95% CI, 1.01–1.38).[25] Even lower levels of vitamin D (vitamin D deficiency defined as 25(OH)D3 $\leq$ 50 nmol/L), however, were less common among patients who had tuberculosis than controls (8.5% versus 13.2%) (RR 0.65; 95% CI, 0.43–0.98). The causal relation of these associations is unknown.

The current recommendation for daily intake of vitamin D is 400 to 600 IU, but the required daily intake likely should be increased to 800 to 2000 IU[26,27] to maintain blood levels of 25-hydroxyvitamin D (25(OH)D) greater than 75 nmol/L. Although UV tanning leads to the endogenous synthesis of previtamin D3, several studies in human skin have shown that total previtamin D3 production in the skin plateaus with exposure time.[28] Further increases in UV exposure do not increase the total amount of previtamin D3. A moderate amount of sun exposure to the hands, face, and arms every other day produces enough cutaneous previtamin D3 to meet daily requirements in light-skinned persons, even if the daily requirements are increased to 1000 IU.[29,30] Calculations demonstrate that individuals who have lighter skin (types I–III) need 5 to 20 minutes of sun exposure depending on season. These recommendations also apply at higher latitudes where sun-induced vitamin D synthesis is less efficient.[30] Moderate sun exposure is as efficient as prolonged sun exposure for previtamin D production. Sunlight exposure as the only source of vitamin D may be impractical, however, in cold weather and for those who have darker skin types.[30] Therefore, moderate sunlight exposure should be considered in combination with a diet fortified with vitamin D for optimal vitamin D status.

In one study, UV tanners had twice the 25(OH)D levels as nontanners,[31] even after controlling for variations in ethnicity between the two groups.[32] The decreased vitamin D status of the nontanners, however, may be a reflection of inadequate daily recommendations, because the current recommended daily allowance for vitamin D may be insufficient.[26,27] Future studies are necessary to determine whether or not increased daily recommendations and intake of vitamin D would diminish the discrepancy between tanners and nontanners.

HEALTH RISKS

Although UV radiation promotes skin malignancies, such as basal cell carcinoma (BCC), squamous cell carcinoma (SCC), and melanoma, the most serious of these cancers, the association for each type of skin cancer differs.[33] Intermittent sun exposure and sunburns are associated positively with melanoma,[34,35] whereas chronic sun exposure is not.[35] A weak association and dose-response relationship exists between sunbed use and melanoma,[36] including a doubling of the risk for developing melanoma in individuals who start using tanning beds before age 35.[36] Studies may be limited by recall bias, because individuals who develop melanoma are more likely to recall a history of increased sun exposure and sunburns.[34,35] Melanoma also is strongly associated with immigration during childhood from low to high UV radiation geographic locations.[37] This ecologic study did not depend on personal recall of sun exposure and, therefore, is less susceptible to recall bias, but the role of childhood sunburns was not addressed specifically.

SCC and BCC demonstrate varying relationships between UV exposure from sunlight and UV tanning beds. A detailed review of case-control studies showed that cumulative sun exposure was associated with BCCs and SCCs, whereas intermittent sun exposure was associated with only BCCs.[38] A history of sunburn increased the risk for developing BCCs and SCCs. Childhood sunburns were associated with SCCs, whereas sunburns at any age were associated with BCCs.[38] Indoor tanning was associated with SCC but not BCCs.[36]

Frequent exposure to sunlight also accelerates skin aging. Much of this aging process has been attributed to UV exposure[39] and subsequent free radical generation,[40] with infrared radiation playing an important role. Infrared radiation likely promotes photoaging by inducing the breakdown of collagen and increasing the presence of reactive oxygen species.[41,42] Physical sun-blocking agents, such as titanium dioxide, block infrared