Update on tanning: More risks, fewer benefits

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The tanning response, classically defined as increased cutaneous pigmentation after solar ultraviolet light exposure, encompasses a variety of protective, reparative, and cosmetic issues. The tanning story is continuously evolving as basic science, clinical research, and public health studies shed light on topics involving: the physiologic mechanisms of tanning, the medical benefits of tanning, the role of sunscreens, the development of "sunless" self-tanners, the use of photocarcinogenic indoor tanning services, and the relatively recent development and promulgation of α-melanocyte-stimulating hormone analogues. High-risk tanning behaviors have become increasingly popular and the incidence of melanoma has risen more rapidly than any other cancer. This review will focus on the risks and benefits of each type of tanning, with an emphasis on issues pertinent to dermatologists who care for adolescents and young adults. (J Am Acad Dermatol 2014;70:562-8.)

Key words: α-melanocyte-stimulating hormone analogues; indoor tanning; melanotan; self-tanners; sunscreen; tanning benefits; tanning pills; tanning risks.

PHYSIOLOGIC MECHANISMS OF TANNING

The human tanning response is divided into constitutive and facultative responses. Constitutive pigmentation is the genetically predetermined standard of pigmentation that characterizes ethnic differences in skin. Melanocytes synthesize brown-black eumelanin and red-yellow pheomelanin pigment in melanosomes. Darkly pigmented skin contains higher levels of eumelanin and pheomelanin, and has the lowest pheomelanin/eumelanin ratio.[1] Eumelanin provides more effective photoprotection, and production increases in response to α-melanocyte-stimulating hormone (MSH) and ultraviolet (UV)-induced skin tanning. Mature melanosomes are transported via melanocytic dendrites into neighboring keratinocytes. Melanin settles above the nucleus of keratinocytes, increasing skin pigmentation and preventing DNA damage.[2,3] The photoprotection provided by constitutive pigmentation is exemplified by the fact that black individuals are at a 1000 times lesser risk of developing skin cancer than albino individuals.[4]

Facultative pigmentation, also genetically predetermined, depends on exogenous factors including: UV light dosage, photosensitizing agents, endogenous hormones and metabolites, and, recently, α-MSH analogues. UV-induced DNA damage stimulates facultative pigmentation by activating a protein 53—mediated response, triggering pro-opiomelanocortin transcription within keratinocytes.[2] The pro-opiomelanocortin protein is cleaved into α-MSH, adrenocorticotropic hormone, and β-endorphin. The α-MSH binds to melanocortin type 1 receptor on nearby melanocytes, stimulating the production of melanin.[3] Facultative pigmentation induced by repetitive UV radiation (UVR) exposure provides an estimated sun-protection factor of 2.[5]

Abbreviations used:

FDA: Food and Drug Administration
MSH: melanocyte-stimulating hormone
UV: ultraviolet
UVR: ultraviolet radiation

UV RADIATION

The spectrum of radiation emitted from the sun includes UV, visible, and infrared rays. UV is divided into UVC (200-290 nm), which does not reach the

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Earth's surface; UVB (290-320 nm), most responsible for acute sunburns, but also for other acute and chronic skin damage; and UVA (320-400 nm), increasingly implicated in skin aging and photocarcinogenesis.

The depth of UV light penetration is wavelength dependent; shorter UVB wavelengths penetrate into the epidermis and papillary dermis, and longer UVA wavelengths penetrate deeper, through the epidermis and full thickness of the dermis. UVR is absorbed by hemoglobin in red blood cells, melanin in melanocytes, and DNA in all nucleated cells.

CAPSULE SUMMARY

- As the popularity of high-risk tanning behaviors has increased, so too has the incidence of skin cancer.
- Public demand has short-circuited standard safety mechanisms, allowing for unregulated use of tanning agents with significant health risks.
- Understanding the risks and benefits of current tanning methods can prevent devastating outcomes.

MEDICAL BENEFITS OF UV EXPOSURE AND TANNING

UV light exposure and tanning are reported to have many health benefits, some evidence-based and others less so. Over 90% of women believe tanned skin is more attractive than untanned skin.[6] Subjective reports associate tanned skin with increased energy and higher self-confidence. Sunlight has also been reported to improve mood in patients with seasonal affective disorder.[7] The β-endorphin, produced along with α-MSH from a pro-opiomelanocortin precursor, is thought to be responsible for the so-called "tanner's high" and tanning dependency,[8] although it remains unproven.

Tanning is also associated with feelings of warmth and relaxation.[9] Frequent tanners can detect differences between (otherwise identical) UV and non-UV radiating tanning beds, suggesting that the relaxing effects of UV light may contribute to tanning behavior.[10] Indeed, frequent indoor tanners report difficulty quitting, and up to 53% meet criteria for a UVR-associated substance-related disorder.[11] Opiate receptor antagonists induce withdrawal-like symptoms in 50% of frequent tanners.[12]

UVB exposure may correlate with a reduced risk of about 20 different types of cancer. The cancers that are reported to have the strongest correlation include: colon cancer, breast cancer, prostate cancer, non-Hodgkin lymphoma, endometrial cancer, and renal cancer.[13] Latitudinal differences in the incidence of multiple sclerosis, seasonal patterns of influenza epidemics, case fatality rates from the 1918 to 1919 influenza pandemic, epidemiology of septicemia, and incidence of dental caries are all likely related to solar UVB exposure.[13-18] The majority of these beneficial effects arise from the production of vitamin D, which is crucial for bone health, cancer prevention, immune activity, and cardiovascular function.[19-22]

SUNSCREENS: A BRIEF OVERVIEW

Routine sunscreen use prevents photoaging and the development of both actinic keratoses and squamous cell carcinoma. However, the evidence regarding basal cell carcinoma incidence is inconclusive, and the role of sunscreen in preventing melanoma remains controversial.[21-27] Early meta-analyses found no association between sunscreen use and melanoma incidence; the authors suggested that the decreased likelihood of sunburn with sunscreen use was associated with increased UV exposure.[28,29] Two studies provided indirect evidence that sunscreens lessen the risk of developing melanoma by studying acquired melanocytic nevi in children.[30,31] Green et al[32] and Lazovich et al[33] each published studies in 2011, suggesting routine sunscreen use was associated with a decreased risk of developing melanoma. However, serious limitations in study design and end point assessment keep the controversy active.[34]

INDOOR TANNING

Indoor tanning was introduced in the United States in 1979. Fluorescent lamps with phosphor blends that emit UVR (approximately 97% UVA and 3% UVB) are used. The safety measures defined in 1986 have changed little, and were predominantly limited to lamp compliance, warning labels, and eye protection. Indoor tanning devices can be found in tanning salons, fitness centers, and even private households. An estimated 50,000 indoor tanning facilities in the United States generate over $5 billion in annual revenue.[8]

Approximately 10% of the US population uses indoor tanning devices; highest use is seen in young, non-Hispanic white women.[35] Data show 29.3% of non-Hispanic white female high school students and 24.9% of non-Hispanic white women between the ages of 18 and 34 years used indoor tanning within the last 12 months.[36] Users of indoor tanning do so because they believe they look healthier and feel better with a tan, not because they lack knowledge about the dangers.[37]