COMMENTARY

Scientific developments in indoor tanning and melanoma

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Key words: carcinogen; case-control; descriptive studies; dose-response; indoor tanning; melanoma; melanoma incidence; tanning beds; ultraviolet radiation.

In this month's *Journal of the American Academy of Dermatology* online, Lim et al[1] summarize a large body of evidence that relates to the regulation of indoor ultraviolet (UV) tanning. From a public health perspective, the most important aspect of this issue is the association of indoor tanning with melanoma, the leading cause of death among skin conditions. It is therefore particularly important for dermatologists to appreciate recent changes in the scientific documentation and strengthening of the evidence for this association.

More than a decade ago we knew that UV radiation from the sun was a cause of melanoma,[2] and on this basis the dermatology community counseled sun protection and advocated avoidance of indoor UV tanning. However, systematic review of the empirical verification that indoor UV exposure increased melanoma risk was quite weak, because of a variety of factors.[3] Nevertheless, even in 1998 the concern was raised that indoor UV tanning could function as a "radiation multiplier," resulting not only in damage from the artificial UV exposure in the tanning booth, but also from further damage from increased sun exposure subsequently as a result of the perceived protection from the tan obtained indoors. Hence, this results in a potentially substantial increased risk of melanoma.[3]

Abbreviations used:

CI: confidence interval
OR: odds ratio
UV: ultraviolet

In the decade since that review, additional studies have been published, leading to another systematic review and meta-analysis by the International Agency for Research on Cancer, which found a borderline association of melanoma with indoor tanning based on 19 published studies (odds ratio [OR] 1.15; 95% confidence interval [CI] 1.00-1.31), although the subset of studies examining the association with exposure before the age of 35 years noted a statistically significant link to melanoma (OR 1.75; 95% CI 1.35-2.26).[4] Largely on the basis of this analysis, the World Health Organization categorized tanning beds as carcinogenic to human beings in 2009.[5] However, many of the studies reviewed in the analysis had important limitations such as poor information on sun exposure and other potential confounding variables, lack of dose-response relationships, and inability to distinguish among different types of tanning devices. Furthermore, industry advertisements criticized the "melanoma hype" and suggested substantial uncertainty about harmful effects.

The year 2010 saw major changes. First, the Federal Trade Commission took action to limit the tanning industry's health and safety claims.[6] Then two important population-based case-control studies were published that addressed the major issues identified with prior work, and reports of melanoma incidence rates in general populations followed that suggested the potential magnitude of the effect of indoor tanning.

In the population-based Skin Health Study, researchers collected information from 1167 Minnesotans ages 25 to 59 years who were given the diagnosis of melanoma between 2004 and 2007 and compared them with age- and gender-matched

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Funding sources: None.
Conflicts of interest: None declared.
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Published online February 02, 2011.
J Am Acad Dermatol 2011;■■:■-■.
0190-9622/$36.00

doi:10.1016/j.jaad.2010.12.042

control subjects drawn from the state list of driver's license holders. Information on ever-use of indoor tanning, types of device used, initiation age, period of use, dose duration, and various potentially confounding variables were collected. Overall, indoor tanning use was associated with an adjusted OR of 1.74 (95% CI 1.42-2.14) for developing melanoma compared with never-users. Furthermore, melanoma risk increased with frequency of use measured by total hours, sessions, or years. For example, a person with more than 50 hours, more than 100 sessions, or 10 or more years was 2.5 to 3 times more likely to develop melanoma than a person who had never tanned indoors. All types of tanning devices increased risk of developing melanoma. Thus, no device should be considered "safe." The risk was higher for those who used UVB-enhanced devices (adjusted OR 2.86; 95% CI 2.03-4.03) and for users of primarily UVA-emitting devices (adjusted OR 4.44; 95% CI 2.45-8.02).[7]

Shortly after the Minnesota study, the Australian Melanoma Family Study was published. It focused on a younger population, collecting data from 604 patients with melanoma given a diagnosis between ages 18 and 39 years and compared them with age- and gender-matched control subjects from a voting list. Compared with never-users of tanning beds, the OR for melanoma associated with ever-use was 1.41 (95% CI 1.01-1.96). They also confirmed a dose-response relationship (OR 2.01; 95% CI 1.22-3.31) for more than 10 lifetime sessions. The associated risk was stronger for earlier age at first use. The risk associated with more than 10 tanning bed sessions was over 4 times greater for melanoma diagnosed at age 18 to 29 years (OR 6.57; 95% CI 1.41-30.49) than for melanoma diagnosed at age 30 to 39 years (OR 1.60; 95% CI 0.92-2.77). The OR associated with ever-use compared with never-use was 4.12 (95% CI 1.57-10.81) for melanoma diagnosed when aged 18 to 29 years and 1.15 (95% CI 0.79-1.65) for melanoma diagnosed when aged 30 to 39 years. Particularly noteworthy was that among those who had ever used a tanning bed, 76% of melanomas diagnosed between 18 and 29 years of age were attributable to tanning bed use.[8]

The risks highlighted by these case-control studies were underscored by descriptive studies of melanoma incidence in the United States and Europe, also published in 2010. Analysis of data from the US National Cancer Institute Surveillance, Epidemiology, and End Results program revealed that melanoma of the trunk in women is increasing at a greater rate than for other sites in the United States.[9] This may be a result of the exposure of the trunk to UV radiation without protection during indoor tanning sessions.

Tanning bed use may have also played an important role in melanoma incidence trends in Iceland. A 2002 survey indicated that 70% of women and 35% of men had used a tanning bed. Beginning in 1992, there was a sharp increase in melanoma incidence rates among young women (>15% per year) that peaked in 2001, followed by a sharp decrease in those rates. The increase was associated with a change in availability of indoor tanning in the Reykjavik area (the largest population center in Iceland) from 3 tanning bed facilities in 1970 to 56 facilities with 207 tanning beds in 1998. The decrease in melanoma incidence rates after 2001 was related to public health campaigns and the consequent decline in available tanning beds by more than 50% after these campaigns.[10] The published observation of melanoma incidence trends in the United States and Iceland do not prove that indoor tanning was the culprit, but they suggest it could be a cause, and further impel appropriate public health measures.

Major progress has been made in documenting the nature of the association between indoor tanning and melanoma. Indoor tanning may not cause anything close to the death and illness burden of smoking, but the industries behind both are similar in the sense that they make profits by selling carcinogens to teens and young adults. The widespread use of indoor tanning was a huge experiment on the human population. We are now able to document its effects on health, and take appropriate public health action based on scientific documentation.

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