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Are tanning beds “safe”? Human studies of melanoma

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Summary

Controversy continues over the carcinogenic properties of tanning beds. The tanning industry “sells” tanning beds as a safe alternative to UV exposure for both tanning as well as vitamin D biosynthesis. But, how safe are tanning beds? Epidemiologic data – incomplete and unsatisfactory – suggests that tanning beds are not safer than solar ultraviolet radiation and that they may have independent effects from solar exposure that increase risk for melanoma.

Wavelengths emitted over time

A major problem in evaluating the risk from tanning beds and sunlamps is that they have changed over time in terms of their usage and their spectral output. Up to the late 70’s or early 80’s, sunlamps up to were generally arc mercury lamps and used in a home setting; these emitted primarily wavelengths in the UVB (40%) and some in the UVC (20%) wavelengths (Diffey and Farr 1991). Beginning in the 1980’s indoor tanning became more popular and commercial salons used a formula that contained more UVA than UVB – somewhere in the range of 99% of UVA and 1% UVB (Diffey and Farr 1991). Summer UV sunlight contains approximately 95% UVA and 5% UVB (Diffey and Farr 1991). Therefore, human studies evaluating melanoma risk that took place in the 1980’s were likely evaluating a very different ratio of UVA:UVB than later studies, making evaluation over time quite difficult. The short wave irradiance, or UVB, in Norway, doubled between 1983–1992 to 1993–2005; when inspected these were much higher than approved (Nilsen et al. 2008). Few (1 of 52) inspected sunbed establishments were compliant with Norwegian standards. This is just one example of changes in spectral output over time that affects the evaluation of effects.

Dosage received

In addition, the dosage of UV is extremely difficult to obtain as most tanning parlors do not calibrate their equipment or measure their output. When comparing dosage of tanning lamps to solar radiation, it is also important to estimate the proportion of the body irradiated. From 15–50% of the total body is uncovered during outdoor activities, but up to 95–100% of the total body is uncovered during indoor tanning. Therefore, the dosage is likely to be far greater than from a similar amount of outdoor solar exposure.

Epidemiologic Data

The International Agency for Research on Cancer (IARC) convened an expert panel of epidemiologists in 2006 to evaluate the risks for melanoma and other skin cancers from use of sunbeds (IARC, 2007). They performed a meta-analysis of 19 studies that have evaluated the association between sunbed exposure and melanoma and other skin cancers. It is clear

from this meta-analysis that early life exposure is the most damaging. This analysis showed a significant summary, or overall, relative risk for melanoma of 1.75 (95% CI, 1.35–2.26) for “first exposure under the age of 35”; a relative risk of 1.15 that is statistically significant (95% Confidence Interval (CI) 1.00–1.31) for “ever use”; and a summary relative risk of 1.49 (95% CI, 0.93–2.38) for exposure distant in time; and a summary relative risk of 1.10 (95% CI, 0.76–1.60) for recent exposure. All of the relative risks are raised and the most persuasive study, a prospective cohort study of 106,379 women in Sweden and Norway (Veierød et al. 2003) not only found a similar level of risk but that the increased risk was not due to the type of UV lamps used prior to 1983, but likely due to more recent types of sunbeds. Prospective cohort studies are the “gold standard” for epidemiology, and these data are therefore critical for the evaluation of risk for melanoma from sunbeds.

Reproducibility

Individuals who participated in these studies had good memories as demonstrated by the test-retest analyses showing that their answers were “reliable”. Epidemiologic data is subject to multiple biases, such as recall bias, which usually biases the results to the “null”, that is to a demonstration of no risk. Veierød et al. (2008) demonstrated that the test-retest reproducibility of the question of solarium use within the last 5 years was very good, kappa (weighted kappa) = 0.71 (95% CI, 0.68–0.74) among 2,000 women randomly selected from their large cohort. The kappa statistics adjusts for simply having agreement by chance. The data presented by Veierød et al. (2008) show that a large number of individuals had given reliable answers.

Host characteristics

Those with light hair, light eyes and skin that burns easily are at most risk for developing melanoma from UV exposure whether it is from the sun or from artificial tanning devices. To the extent that young women with these characteristics feel they are “safe” using artificial tanning devices, then they need to be warned of the dangers of overexposure to all UV. Most studies reviewed did control for phenotypic factors and some for recreational sun exposure, but even then, this procedure is unlikely to achieve “complete control”.

Genetics plays a role in risk to any UV and all the factors involved have not yet been determined. Recent publications show that those exposed to solar UV have a wide variety of responses to UV (see Tran et al. 2008; Bennett, 2008) in terms of cellular response to DNA damage, DNA repair capacity (Wei et al., 2003) and vitamin D synthesis due to Vitamin D Receptor polymorphisms (Santonocito et al., 2007), among others.

Gender and Age

Females tend to use sunbeds more than males, particularly young women. Recent data from the United States National Cancer Institute show that the incidence of melanoma is growing among young females (Purdue et al. 2008). In addition, sunbed usage in the US is most prevalent among young women (Lazovich and Forster 2005). These statistics point up the fact that sunbed usage is an area for serious concern. In fact, Veierød et al.’s (2003) evaluation of use of sunbeds found that those who used sunbeds at ages 20–29 years once or more per month had a statistically significant relative risk of developing melanoma of 2.58 (1.48–4.50), the highest risk noted to date. This fact will be crucial to guide prevention in the future.

Issues

Most studies have shown an increased risk for melanoma associated with sunbed use, but there are multiple qualifications that need to be taken into account. In the first place, it is difficult to disentangle the use of artificial UV from natural UV exposure. Many authors, for example, Wester et al. (1999), have found frequent tanning in sunlight correlated with sunbed use. Secondly, to date there have been relatively small numbers of subjects exposed as it is more recently that sunbeds have become popular. Therefore, one can expect firmer results in the future.

Gallagher et al. (2005) asks the critical question: “if there is a causal relationship, how important is the risk?” This is a difficult question to respond to at this point in time for a number of reasons: (1) Assessment of sunbed use needs improvement as well as assessment of spectral output. Although we see good agreement for individual’s recall of sunbed usage, it is likely that the timing and the exposure are not all the same for all individuals. (2) It is unclear whether one can compare sunbed use and sunbathing; is there the same biological mechanism? (3) Most studies have taken place in higher latitudes in North America and Europe where the background ambient ultraviolet radiation is low; it would be useful to have more data from lower latitudes with higher levels of ambient UV, such as Australia and Southern US. (4) Ecological studies are inconsistent – even at similar latitudes with very good data. In Denmark Faurschou and Wulf (2007) concluded that sunbed risk for BCC is important, but not CMM. However, in the UK Diffey (2007) estimated that risk for sunbed risk for CMM in women is dramatic and may cause as many as 182 cases of CMM in women and 49 in males in the last 8 years.

Conclusions

Although the data appear to indicate a clear relationship between sunbed use and the development of melanoma, these data could be confounded by the lack of accurate measurement of timing and dose of sunbed exposures and lack of thorough control for concurrent sun exposure and host factors such as phenotype and genetic susceptibility. Until these factors are better characterized, we must exercise caution in evaluating the extent of the risk for cutaneous melanoma posed by sunbeds. Nonetheless, because of this very uncertainty, the data do not support a claim that sunbeds are safe, and such claims should be considered misleading.

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