

WHITE PAPER

**Research Shows No Connection
Between Tanning and Melanoma:
Why This Is Misunderstood**



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Research Shows No Connection Between Tanning and Melanoma: Why This is Misunderstood

Melanoma skin cancer is the most aggressive of the three major categories of skin cancer, accounting for only five percent of all skin cancer cases each year, but responsible for a majority of skin cancer fatalities. An estimated 62,000 cases of melanoma will be diagnosed in 2006, with 7,900 fatalities.¹ While melanoma has captured a great deal of public attention in the past 15 years, much of the discussion has been oversimplified in stating that melanoma is caused by overexposure to sunlight. In fact, the exact nature of the relationship between melanoma and ultraviolet light remains unclear, and the mechanism by which the two are related is still unknown.

PART I: EXECUTIVE SUMMARY

■ Melanoma is Not Directly Related to UV Exposure

1. While it is believed that melanoma is somehow related to ultraviolet light exposure, this relationship is not straight-forward and the photobiology research community still does not know how it works.
2. Melanoma is more common in people who work indoors than in those who work outdoors, and those who work both indoors and outdoors get the fewest melanomas.² Because this is true, the relationship between melanoma and sunlight cannot possibly be clear-cut. If it were a clear-cut relationship, outside workers would have higher incidence than inside workers. But the opposite is true.
3. Melanoma most commonly appears on parts of the body that do not receive regular exposure to sunlight.³ Again, because this is true, the relationship between melanoma and sunlight cannot be clear-cut. If it were, melanomas would appear most often on parts of the body that receive the most sunlight.
4. There is no actual data substantively linking indoor tanning equipment with an increased risk of melanoma. Indeed, 18 of 22 epidemiological studies ever conducted on this topic show no significant association, including the largest and most recent.
5. The reported increase in melanoma incidence in the United States may be largely explained by an increase in surveillance, an increase in the number of dermatologists per capita and the increasing number of people who see dermatologists today.
6. The fact that melanoma incidence is increasing but mortality rates are declining suggests that increased surveillance is detecting more melanomas that, in previous years, were never detected. This phenomenon cannot merely be discounted.

■ What is Melanoma Skin Cancer?

Melanoma is the least common form of skin cancer, accounting for only 3 percent of all skin cancer cases, but it is this most deadly form of skin cancer, accounting for 75 percent of all skin cancer deaths. It affects the skin's melanocytes, which are biologically active skin cells, which is why the tumor can spread quickly. Still, melanoma can be treated with excellent prognosis if detected early. When identified early, prognosis for recovery is nearly 100 percent.

There are a number of different types of melanoma, and they can occur in the eye, internal organs and on any skin surface, including under nails, and in the palms or soles of people with darker complexion. Melanoma first appears as a mole that has changed in shape, color, sensitivity and size, or as newly formed moles or pigmented spots on skin. It is usually asymmetrical (or irregularly shaped), has uneven borders, mixed colors and a diameter bigger than one-quarter of an inch, or a little larger than the size of a pencil eraser.

Melanoma is the most important of the three skin cancers in public health policy discussions. About 7,900 Americans die of melanoma skin cancer annually. Many of these could have been prevented through earlier detection of the disease.

It is believed that ultraviolet light exposure is related to the induction of melanoma, but – importantly – it is not yet understood how that relationship works. No research at this time clearly explains a link between sun exposure and melanoma, although some anti-sun pundits have promoted that theory. The biggest confounding variable: melanoma occurs most often on parts of the body that usually aren't exposed to ultraviolet light, such as the backs of the legs. This could not be possible if the relationship with UV light were straightforward.

Studies also show that people whose occupations expose them to large amounts of ultraviolet light are at lower risk for developing melanoma than people whose jobs do not. So while some research may suggest a connection, that connection is still mysterious. This document will present evidence showing why this relationship is not straightforward as is often mistakenly presumed.

■ 18 of 22 Epidemiological Studies Show No Association with Indoor Tanning

We have identified 22 case-control epidemiological studies that have been conducted attempting to link tanning bed usage with an increase in melanoma risk. Of those 22 studies, 18 show no statistically significant association, and each of the four that did show some association have different irregularities that prevent the outcome from being conclusive in any way. Dr. Anthony J. Swerdlow and Dr. Martin Weinstock, both of the Brown University School of Medicine, published a paper in 1998 examining 19 of these 20 studies.⁴ Swerdlow and Weinstock, who are not affiliated with the indoor tanning industry and were not funded by the industry, concluded, “At this time, the published data are insufficient to determine whether tanning lamps cause melanoma.” The authors cite seven specific reasons why current research falls short of making a connection:

INDOOR TANNING IS NOT LINKED TO MELANOMA: Epidemiological Studies To Date Assessing the Relationship Between Indoor Tanning Facilities and Melanoma Skin Cancer

Author	Year	Country	Results	Comments
Klepp & Magnus	1979	Norway	No association	Small sample size.
Adam et al	1981	England	Increase in risk	Small study. Fair-skinned sample not applicable to the U.S. . Does not control variables.
Holman et al	1982	Australia	No association	Larger study.
Gallagher et al	1986	Canada	No association	Larger study.
Elwood et al	1986	England	No association	Small sample size.
Holly et al	1987	USA	No association	First U.S. study.
Osterlind et al	1988	Denmark	No association	Tanning bed users actually had lower risk than non-tanners.
Swerdlow et al	1988	Scotland	Increase in risk	Small study. Fair-skinned sample not applicable to the U.S. Wide variation in results is unexplained.
Zanetti et al	1988	Italy	No association	Wide variation in results.
MacKie et al	1989	Scotland	No association	Fair-skinned sample. Wide variation in results.
Dubin et al	1989	USA	No association	Included medical use of tanning equipment.
Beitner et al	1990	Sweden	No association	Larger study. Did not control For variables.
Walter et al	1990	Canada	No association [#]	Only risk was home units.
Autier et al	1991	Belgium	Increase in risk	Relative risk increased 4.1 times for males, but 1.8 times for females. No explanation. Results of this study conflict with Autier's 2002 data which show no association.
Garbe et al	1993	Germany	No association	Results varied widely. Did not control for variables.
Dunn-Lane et al	1993	Ireland	No association	Small study. Variables uncontrolled.
Westerdahl et al	1994	Sweden	No association	Results varied. Variables uncontrolled.**
Autier et al	1994	Belgium	No association	Some showed a reduction in risk. Some showed a minor increase.
Holly et al	1995	USA	No association	Included medical use of tanning equipment.
Chen, et al	1998	USA	No association	Only risk was home units.
Westerdahl et al	2000	Sweden	Increase in risk	Risk declined for those who tanned most frequently. Result is unexplained.
Autier, et al	2002	Belgium	No association	No association in any category.

* 18 of the 22 epidemiological studies conducted on this topic show no statistically significant association between indoor tanning and melanoma skin cancer. The four that do show an association do not control for confounding variables such as recreational exposure to sunlight, occupational exposure to sunlight, childhood recollection of sunburns and family history of skin cancer in such a way as to isolate indoor tanning usage as the cause of the increase in risk.

** Westerdahl's 1994 survey was widely misreported – one sub-group in the study showed an increased risk, but the sample was less than a dozen, and the confidence interval of the statistic was well beyond statistical tolerance. The study as a whole showed no statistically significant association, and the same survey also showed that those who used sunscreens on a regular basis had nearly twice the risk of melanoma as those who didn't use sunscreen – a divergent conclusion that is also unexplained.

Use of tanning units at a commercial indoor tanning facility did not increase risk. According to the authors, "Sunlamp use in commercial settings was not associated with subsequent development of melanoma."

1. **Lack of Relevant Intensity and Output Data.** According to Swerdlow and Weinstock, “The published studies gave no information on the intensity and spectral outputs of the tanning lamps to which exposure had occurred. Furthermore, because the prevalent type of lamp has changed over time, there is some uncertainty in extrapolation from historical exposure to exposure in the population today.” What this means is that the authors of the 19 studies reviewed did not account for the differences in sunbeds, lamps and exposure times, which means they could not calculate total irradiance values. Also, the authors refer to the high-UVB lamps used in the early days of the tanning industry, compared to the combinations that are in use today.
2. **Recall Bias Potential.** According to Swerdlow and Weinstock, “All of the studies depended on the recall of exposures by the study participants and this recall may potentially be biased.” For example, many researchers believe patients with melanoma might exaggerate their past exposures or recall more of them than control participants. It is also possible that such a recall bias could affect the outcome in other ways.
3. **Studies Lack Specificity Regarding Exposure.** According to Swerdlow and Weinstock, “Many of the studies reported only a comparison between persons who were ever exposed to tanning lamps and those who were never so exposed; or between undefined “use” and “non-use” of tanning lamps.”
4. **Failure to Control Lamp and Exposure Location Variables.** According to Swerdlow and Weinstock, “Relatively few of the reports described their variables on tanning beds and the analyses of the data in detail or with precision. For example, some included medical in addition to cosmetic UV lamp exposure in their analyses, without distinction and others did not and for several reasons it was not clear whether medical exposure had been included. Ideally, both of these sources, and occupational exposures, would be included in the data collection and analysis.”
5. **Possibility of Confounding Errors.** According to Swerdlow and Weinstock, “Interpretation is also complicated by the possibility of ‘confounding’ (which is an epidemiologist’s way to describe the mixing of apples and oranges in a study). For instance, sun exposure – particularly recreational sun exposure – is a potential confounding variable because it seems likely that tanning lamp users may also be more likely to sunbathe. In addition, sun sensitivity and socioeconomic-related factors are also potentially confounding variables.”
6. **Publication Bias.** According to Swerdlow and Weinstock, “There may be a substantial publication bias in this area of literature. Case-control studies that support the null hypothesis (that tanning lamps are not associated with the later development of melanoma or that tanning might be beneficial) may be less likely to mention this aspect of their data or to describe in detail the resulting publication than those that found an association between sunbed use and melanoma.” Furthermore, the authors stated that “based on the 19 studies reviewed herein, it does appear that those studies that were interpreted as ‘negative’ were less likely to have published detailed analyses (e.g. on duration and age associations) than those with positive findings.”

7. **Inadequate Sample Size.** According to Swerdlow and Weinstock, “Many studies appear to have low power to detect a plausible size of association.”

■ What the Federal Government Has To Say About the Research

The U.S. Food and Drug Administration’s Center for Devices and Radiological Health, which sets rules governing the manufacture of indoor tanning equipment in the United States, has conducted perhaps the most thorough investigation of the potential risks associated with overexposure to ultraviolet light.

Dr. Howard Cyr, senior research biophysicist with FDA who has led CDRH’s ongoing investigation into research concerning sunlamps and ultraviolet light, has stated the following⁵:

“What do we know about (skin cancer)? Non-melanoma skin cancer -- we know that there is a connection with solar exposure, and it is fairly well defined. There’s lots of studies. In particular, non-melanoma skin cancer or the basal cell in part is probably connected with intermittent exposures to sunlight...The situation with tanning salons is even less defined. There are a few studies out there – probably less than a dozen, maybe four or five of which have a positive connection between tanning salon exposure and skin cancer. The confidence limits of – these studies are mostly (epidemiological) studies – the confidence limits for odds ratios are enormous, lots of problems with each and every study...We don’t know what the risk is actually with sunlamps, but whatever the risk is, we need to compare it with the risk from solar exposures. One of our concerns way at the very beginning, and now, is these people who are going to tanning salons, if you didn’t go there, could get the same thing by going outdoors for the most part during the summer, maybe here in the wintertime you are not going to get a tan, but you can get a tan from the sun too, the traditional way, and we also think much more data is needed before the risk from sunlamps can be better defined.”

Cyr has been outspoken that the process of evaluating the risks versus the benefits of indoor tanning equipment needs to be pursued in a dispassionate way⁶:

“Policies should be based on science. They should be based on risk assessment. If you think your case is so good and you start to go beyond the data, then you start to lose your credibility.”

■ Evaluating Melanoma Incidence Data: The Statistical Anomaly

While the incidence of melanoma continues to be a public health concern (despite the fact that it has not been substantively linked to indoor tanning equipment) there is one troubling inconsistency in melanoma incidence data: the death rate is not rising in a commensurate fashion with the incidence rate.⁷

No one to date has offered a plausible explanation to account for the possibility that the alleged “epidemic” of melanoma in the United States today may not be caused, at least in part, by an aggressive increase in surveillance for the disease.

Dr. Robert Swerlick, M.D., and Dr. Suephy Chen, M.D., wrote in their 1997 paper, published in the Mayo Clinic Proceedings, that “The large increase in the diagnosis of melanoma without commensurate increases in advanced tumors and mortality are not compatible with presumed malignant behavior or thin melanomas. Increased intensity of melanoma surveillance may artificially increase the incidence of melanoma by harvesting histologically ‘malignant’ but biologically benign tumors. Little available evidence suggests the presence of an actual increase in the frequency of biologically malignant tumors.”

The authors introduce what they call “The Melanoma Paradox”: “If most melanomas are discovered by the person affected or by a family member (55 percent are detected by the patient, according to the Journal of the American Medical Association) and if half of the population never participate in self-examination – and of those who do look for skin lesions, less than half actually report changes to their physician – why are we not seeing a large increase in thick melanomas and mortality in the segment of the population that does not participate in early surveillance activity? At the time of initial assessment, these persons should have thick lesions that cause death. If that is the case, why is the incidence of thick tumors and mortality from melanoma increasing at a rate that is only a small fraction of the growth from diagnosis?”

Swerlick and Chen are not alone in posing this question. Dr. Jonathan Rees, a research dermatologist at Newcastle University in England, has written on the same subject. “Once you excise a pigmented lesion and know its histology you forfeit the chance of knowing what would have happened if you had left it in situ; progression, metastasis, or even involution are all possible. Removal of pigmented lesions is now one of the commonest surgical procedures and has radically changed the pattern of referrals to dermatologists. Epidemiological studies show a dramatic increase in histologically confirmed melanomas and raise the important questions of whether the increase is real or a diagnostic artifact and whether we should reconsider the relation between sun exposure and melanoma.”

Rees refers to a paper written by Australian research dermatologist Dr. Bruce Armstrong: “In the case of New South Wales,” Rees wrote, “since the increase in the detection and removal of thin lesions has not been followed by a reduction in the incidence of thicker lesions (which one might expect if the increase was due to earlier case ascertainment), this apparent epidemic of melanoma represents in part an increasing recognition of a pre-existing non-metastasizing but invasive form of melanoma.”

Rees continues, “Does questioning the relation between histopathological description and clinical behavior have implications for those seeking to persuade people to change their attitude to sun exposure? The answer is surely ‘yes.’ The arguments relating melanoma to sun exposure are well rehearsed, but the relation is not nearly as clear cut as it is between sun exposure and squamous cell malignancy. Most melanomas occur on skin that is only intermittently exposed; individuals with higher continuous sun exposure have lower rates than those exposed

intermittently, and there seems to be an important interaction between skin type and incidence of melanoma.”

Rees concludes, “It has been suggested that the antithesis of science is not art but politics. Melanoma is perhaps an example of the two having become mistakenly intertwined. An amicable separation is required.”

The questions raised by Swerlick, Chen, Rees and Armstrong call into question the quantification of the increase in melanoma in the United States today, which, as the authors suggest, is not commensurate to the death rate. No conclusions about melanoma can be made until this inconsistency is addressed.

■ Confounding Theories About the Connection Between UV and Melanoma

Dr. Allen J. Christophers, M.D., is a retired environmental health official in Australia who in 1998 authored a meta-analysis of melanoma research reviewing case-control studies which examined the relationship between melanoma incidence and total accumulated sun exposure.⁸ He wrote of his work: “The conclusion that can be drawn from looking at these studies as a whole is that melanoma is not due to sun exposure. Indeed the conclusion is so clear that it is difficult to understand why scientific consensus still clings to the idea that sunlight is a cause of melanoma.”

In the conclusion to his paper, Dr. Christophers stated, “The fact that melanoma has little or nothing to do with sun exposure becomes obvious when comparisons are made of the three main skin tumors (squamous cell carcinoma, basal cell carcinoma, and melanoma). This approach to the data makes it clear that sun exposure is the predominant factor in the etiology of SCC, is a somewhat less significant factor in BCC and has little or no involvement in melanoma.”

The argument against sunlight being a cause of melanoma (other than lentigo maligna melanoma and acral lentiginous melanoma) is strongly supported by the following, according to Christophers:

Age Dependence: “When incidence of SCC is plotted against age, the outcome is a roughly exponential curve which shows a large increase in incidence of approximately 450-fold from 25 to 75 years of age. By comparison, the increase over the same period for BCC is 24-fold, whereas for melanoma it is only 5-fold. Many commentators have pointed out that these findings are a stumbling block for the hypothesis that sunlight is a major cause of melanoma.”

Distribution On The Body Surface: “If a skin cancer is due to sunlight, then its site density on the areas of the body more exposed to sunlight should be greater than its site density on the less exposed areas of the body, and the difference should roughly reflect the difference in accumulated sun exposure of these areas. The more exposed areas of the body are the neck, head, ears, and the backs of the hands, and these areas constitute about 6% of the total skin area of the body and the less exposed areas constitute about 94% of the total area. Comparing the three categories of skin cancer in this respect is revealing. Consider, 87% of all

squamous cell carcinomas are found in the more exposed areas and 13% in the less exposed areas. For basal cell carcinoma 82.5% occur on the more exposed areas and 16.5% on the less exposed areas. For melanoma, however, only 22% occur on the more exposed areas and 78% on the less exposed areas.

■ Canadian Melanoma Rate is Declining

Health Canada's Cancer Bureau reported in June 1999 that the incidence of melanoma has leveled off in Canada. The incidence of melanoma in men peaked in the late 1980s, according to the agency, at about 10 per 100,000. For women, the rates peaked at about nine per 100,000 in the late 1980s and fell slightly during the 1990s. How is this possible when melanoma is being described in the United States by some as an epidemic?

Indoor tanning, per capita, is just as prevalent in Canada as it is in the United States. It isn't consistent, even with the obvious difference in latitude, for melanoma rates to be increasing in the United States (let alone described as an epidemic) while they decrease in Canada. This is one more reason why the accuracy of skin cancer statistics in the United States needs to be verified before conclusions can be drawn about this disease.

PART III: CONCLUSIONS

■ Melanoma's Relationship with UV Light is Complex, Misunderstood

The photobiology community believes that ultraviolet light exposure is somehow related to melanoma skin cancer. What is commonly missed in discussions about this topic, however, is that nobody has presented data to date to explain exactly how this relationship works or why the relationship is actually inverse when studying indoor workers and outdoor workers. Indoor workers get more melanomas than outdoor workers, which would be impossible if there were a direct relationship between sun exposure and melanoma. What's more, confounding data on this association are being left out of the discussion.

The photobiology community is in agreement that the main identifiable risk factors for melanoma are as follows: heredity, fair skin, an abnormally high number of moles on one's body (above 40) and a history of repeated sunburns early in life. These factors, independent of non-burning adult sun exposure habits, appear to place an individual in a higher-risk category for melanoma. What hasn't been established by data is that indoor tanning has any connection with melanoma skin cancer:

1. There is no actual data substantively linking indoor tanning equipment with an increased risk of melanoma skin cancer.
2. The reported increase in melanoma incidence in the United States may be largely explained by an increase in surveillance.
3. There are other risk factors involved in melanoma.

PART IV: REFERENCES

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