

Understanding At-Risk Photobehavior

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At the 2006 World Congress of the International Academy of Cosmetic Dermatology, held in Melbourne, Australia, a session was chaired by Robin Marks, MD, evaluating the success of sun-protective messages. In this point-counterpoint session, I chose to support the contention that dermatologists were failing in our sun-protective messages because we were unable to alter at-risk photobehaviors. I defined these at-risk photobehaviors as living in a sunny locale, extensive outdoor activity, and use of a tanning booth. I believed that we were unable to alter these at-risk photobehaviors because our sun-protective messages were unsuccessful as a result of the reasons listed in Table 1.

However, at the time of the oral presentation, I had no data to support my definition of at-risk photobehaviors. With the help of my son, Mark, I was able to perform an epidemiologic study to determine whether living in a sunny locale, extensive outdoor activity, and use of a tanning booth comprised at-risk photobehaviors as defined by the medical end point of dysplastic nevus formation in adolescents. We chose dysplastic nevus formation as our end point because dramatic evidence of photodamage, which includes rhagades and carcinogenesis, typically does not occur until after 40 years of age. It was our contention that young adults who live in a sunny locale, participate in extensive outdoor activities, and use tanning booths exhibit more dysplastic nevi than their counterparts of the same age and sex.

Introduction

The most damaging radiation to an adolescent's skin is UVA radiation, which is found in natural sunlight and artificial light from tanning booths. UVA exposure causes the skin to tan and is responsible for photoaging and the promotion of skin cancer.¹ UVA radiation occurs

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year-round and does not induce sunburn pain. The effects of UVA exposure are delayed by 20 or more years, depending on an individual's skin type and the cumulative exposure amount²; therefore, adolescents and young adults see no immediate physical reason to avoid UVA exposure. UVA exposure is extremely injurious to the skin, but the delay in the visible cutaneous effects of damage creates a false sense of security, particularly in impressionable adolescents and young adults.

Cutaneous photodamage in the United States used to be limited by the cold climate in northern latitudes, which minimized outdoor activities to 3 to 6 months out of the year. However, the development of artificial UVA light sources, such as those used in commercial tanning booths, has provided the opportunity for users to get a high dose of UVA exposure year-round. Also, clothing styles have changed, allowing increased sun exposure to reach a greater surface area of the body. Increased photodamage is also due to the fashionability of being tan, especially among adolescents and young adults. The media promotes tanned male and female images as desirable, influencing adolescents and young adults to try to achieve darker-colored skin. Unfortunately, this type of misinformation is hard to counteract.

TABLE 1

Reasons for Photobehavior Message Failure

- Lack of behavioral sun-avoidance reinforcement
- Tanned media images
- Positive view of sun exposure
- Misinformation regarding tanning
- Delay in visible photodamage
- Photoprotection is not fashionable

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The relationship between cumulative photoexposure and squamous cell or basal cell carcinoma is well established, but the relationship between photoexposure and melanoma has only been partially established.³ Melanoma appears to be related to sun exposure, but other unknown factors are also operative. A premalignant precursor to melanoma is the dysplastic nevus, also known as Clark nevus. Melanoma is relatively rare among adolescents and young adults, but its incidence is increasing.⁴ It is difficult to encourage adolescents and young adults to protect themselves from UVA exposure from tanning booths or natural sunlight since the dangers are not immediately apparent. In order to encourage adolescents and young adults to practice healthy photobehavior, some other issue of importance must be raised that is age relevant. One such factor might be the development of premalignant lesions, such as the dysplastic nevus, that could transform into melanoma with continued UVA exposure.

Methods

This investigation utilized a retrospective, nested, case-control study of males and females aged 14 to 30 years. A cohort of 62 subjects was selected for analysis with 31 subjects comprising the test group and 31 subjects comprising the control group. All subjects were examined for at-risk photobehavior, which was defined as living in a sunny locale, extensive outdoor activity, and use of a tanning booth. Living in a sunny locale was characterized by residing in the southern United States for more than 5 years. Extensive outdoor activity was defined as sun exposure in excess of 3 hours daily during youth. Such activities would include lifeguarding outdoors or working as a landscaper. Use of a tanning booth was defined as a minimum of 3 tanning-booth UVA exposures a month for at least 3 months a year during youth. This study was retrospective because a prospective study would have been unethical; exposing subjects to UVA radiation would have potentially increased their lifetime risk of cancerous skin growths.

Data were collected from dermatopathology reports over a 6-month period between June 2006 and December 2006. Each subject who had a nevus removed between the ages of 14 and 30 years was categorized as possessing typical nevi or atypical nevi. Subjects who had both typical and atypical nevi were placed in the atypical nevi category. Each subject in the atypical nevi category was matched by age and sex to another subject in the typical nevi category in order to form the control group. Information regarding subjects' at-risk photobehavior was obtained from patient records. This information

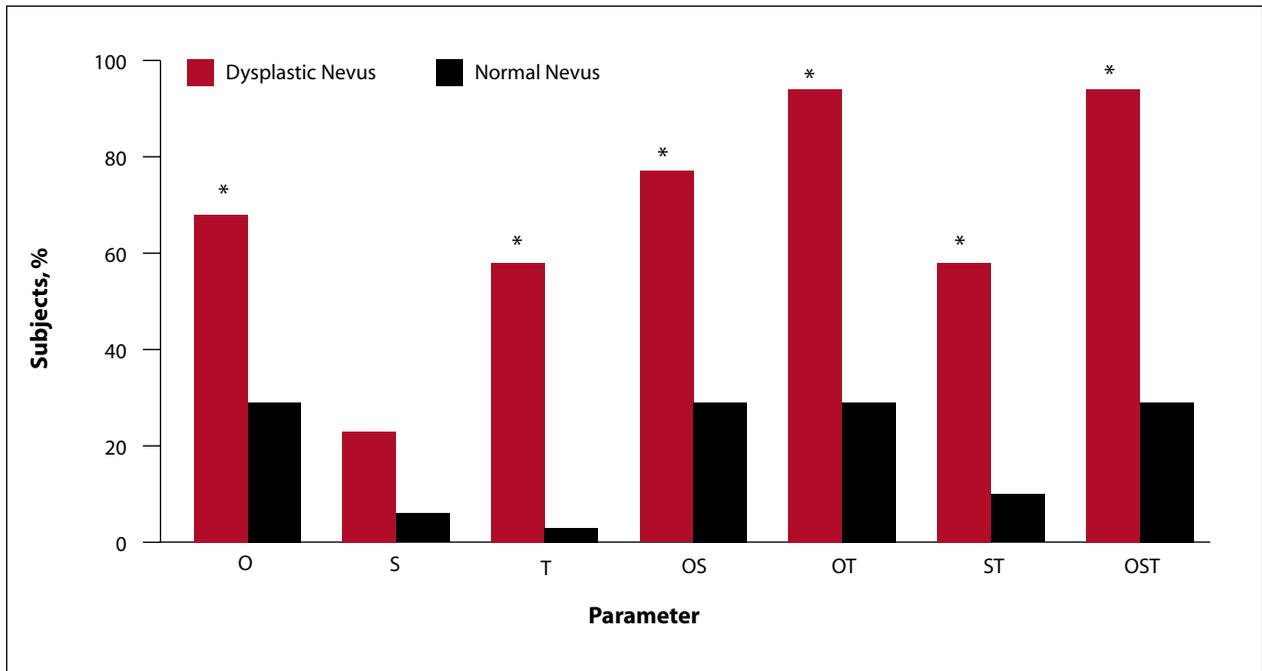
was grouped into the 3 at-risk photobehaviors of living in a sunny locale, extensive outdoor activity, and use of a tanning booth. The presence or absence of these 3 photobehaviors was used to perform statistical analysis of effects of these types of at-risk photobehaviors on the occurrence of dysplasia. This analysis produced a risk ratio, which was examined for statistical significance using a chi-square test in which the 2 groups consisted of subjects with combinations of the 3 photobehaviors and the parameter was the presence or absence of dysplasia in the removed nevus tissue. Data were analyzed to evaluate the number of subjects with dysplastic nevi who exhibited at-risk photobehavior and the number of subjects with at-risk photobehavior who exhibited dysplastic nevi. Statistical significance was defined as $P \leq .05$.

Results

A review of 1200 dermatopathology records collected over a 6-month period yielded 31 qualified subjects. The subject study group consisted of 10 males and 21 females aged 14 to 30 years (mean age, 23 years). Each subject with at least 1 dysplastic nevus was matched by age and sex to a control subject with only normal nevi. Subjects were divided into 3 groups based on their exhibited at-risk photobehaviors. Subjects exhibiting 2 or more at-risk photobehaviors were included in multiple groups. These groups were then analyzed individually for subjects who were living in a sunny locale, participating in extensive outdoor activities, using a tanning booth, and any combination consisting of 2 of the at-risk photobehaviors or all 3 of the photobehaviors simultaneously.

Statistical analysis consisted of determining the percentage of subjects in the dysplastic and normal nevi categories exhibiting the at-risk photobehaviors individually and combined. The statistical significance of these percentages was evaluated using a chi-square test in which the groups consisted of those with and without dysplasia and the parameter was the presence of at-risk photobehaviors. The Figure demonstrates the percentage of subjects with at-risk photobehaviors who possessed dysplastic and normal nevi.

The first at-risk photobehavior, extensive outdoor activity, was found in 68% of subjects with at least 1 dysplastic nevus compared with 29% of subjects with normal nevi. A chi-square analysis revealed a statistically significant ($P < .003$) difference between those subjects with a history of extensive outdoor activity and those subjects who spent relatively more time indoors. The second at-risk photobehavior, living in a sunny locale, was exhibited by 23% of subjects with at least 1 dysplastic nevus and 6% of subjects with normal nevi.



Subjects exhibiting at-risk photobehaviors. Asterisk indicates statistical significance ($P < .05$). O indicates extensive outdoor activity; S, living in a sunny locale; T, use of a tanning booth. Multiple parameters indicate the analysis of the combination of 2 or 3 subject groups. Note that all single parameters or combinations of parameters except S are statistically significant.

These percentages were not statistically significantly different ($P < .08$), with chi-square analysis indicating the lack of effect of living in a sunny locale on the development of dysplastic nevi. The third at-risk photobehavior, use of a tanning booth, was found in 58% of subjects with at least 1 dysplastic nevus compared with 3% of subjects with normal nevi. This difference was statistically significant ($P < .000003$) by chi-square analysis, indicating that use of a tanning booth is linked to the development of dysplastic nevi.

The previous chi-square analysis examined the at-risk photobehaviors individually; however, many of the subjects indulged in multiple at-risk photobehaviors simultaneously. Thus, all combinations of 2 at-risk photobehaviors and all 3 photobehaviors were also analyzed using a chi-square test. The combination of extensive outdoor activity and living in a sunny locale was found in 77% of subjects with at least 1 dysplastic nevus compared with 29% of subjects with normal nevi. This difference is statistically significant ($P < .0002$), indicating an additive effect of the 2 at-risk photobehaviors. The combination of extensive outdoor activity and use of a tanning booth was found in 94% of subjects with at least 1 dysplastic nevus and 29% of subjects with normal nevi. The difference between these percentages was statistically significant ($P < .0000002$), again supporting an additive effect. The final combination of living in a sunny locale

and use of a tanning booth was found in 58% of subjects with at least 1 dysplastic nevus and 10% of subjects with normal nevi. This difference was also statistically significant ($P < .00006$), confirming the additive effect of living in a sunny locale and use of a tanning booth. The combination of all at-risk photobehaviors consisting of extensive outdoor activity, living in a sunny locale, and use of a tanning booth was exhibited by 94% of subjects with at least 1 dysplastic nevus compared with 29% of subjects with normal nevi. This difference was statistically significant ($P < .0000002$).

Risk ratios calculated those subjects with dysplastic nevi who exhibited at-risk photobehavior (Table 2). This analysis most importantly revealed that subjects who used tanning booths were 18 times more likely to develop dysplastic nevi than their counterparts of the same age and sex who did not use a tanning booth.

Discussion

This research was undertaken to determine the causal relationship between at-risk photobehavior and the presence of dysplastic nevi in adolescents and young adults. Three at-risk photobehaviors were identified: extensive outdoor activity, living in a sunny locale, and use of a tanning booth. The results demonstrated that 2 of the 3 at-risk photobehaviors, tanning booth use and extensive outdoor activity, produced a statistically

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significant increase in dysplastic nevi. Both of these activities resulted in increased UV exposure to the skin. Living in a sunny locale was not found to cause a

TABLE 2

Risk Ratios Associated With Development of a Dysplastic Nevus After Exhibiting a Single or Combinations of At-Risk Photobehaviors*

Photobehavior	Risk Ratio
O	2.33 [†]
S	3.5
T	18 [†]
OS	2.67 [†]
OT	3.22 [†]
ST	6 [†]
OST	3.22 [†]

*O indicates extensive outdoor activity; S, living in a sunny locale; T, use of a tanning booth.

[†]Statistical significance ($P < .05$).

Multiple parameters indicate the analysis of the combination of 2 or 3 subject groups. Note the numerically greatest risk ratio for the tanning booth at-risk photobehavior.

statistically significant increase in dysplastic nevi because individuals who live in these locations do not necessarily spend more time outdoors than individuals who live in other areas. With proper photoprotection, sun exposure can be minimized, even in sunny locations. This finding provides an important message for dermatologists to share with adolescents. Use of a tanning booth yields an 18-fold increase in the probability of developing a dysplastic nevus, and extensive sun exposure yields a greater than 2-fold increase. A study by Demko et al⁵ found that 36.8% of females versus 11.2% of males aged 13 to 19 years had used a tanning booth. Furthermore, the number of young women who had used a tanning booth increased with age. The same study found that 47% of women aged 18 to 19 years had used a tanning booth 3 or more times compared with 11.2% of females aged 13 to 14 years. Thus, if the habit of using a tanning booth can be discouraged during youth, the number of dysplastic nevi melanoma precursors could be decreased, as evidenced by the current research.

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