Perceptions of Tanning Risk Among Melanoma Patients With a History of Indoor Tanning

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PRACTICE **POINTS**

- Despite US Food and Drug Administration reclassification and publicity of the risks of skin cancer, many patients continue to use sunbeds.
- It is important to assess how patients are obtaining information regarding sunbed safety, as indoor tanning companies are promoting sunbeds as "safe" tans.
- The increased combination of sunbed use and outdoor tanning is putting people at greater risk for the development of melanoma and nonmelanoma skin cancer.

A new US Food and Drug Administration (FDA) regulation classified tanning beds as class II, requiring indoor tanning facilities to inform users of the risk of skin cancer in efforts to reverse the growing trend in indoor tanning. However, little is known from the patient's perspective on whether knowledge of the risk of skin cancer development is a deterrent to indoor tanning. There also is conflicting literature regarding the relationship among frequency of indoor tanning, age at onset of melanoma diagnosis, and characteristics of diagnosis in melanoma patients with a history of indoor tanning. An international survey was conducted in patients 18 years and older who self-reported being diagnosed with melanoma after indoor tanning. The purpose of this study was to investigate the patients' perspective on indoor-tanning behaviors as associated with the severity of their melanomas and the time frame in which they were diagnosed as well as their perceived views on the safety of indoor tanning and the frequency in which they continue to tan indoors.

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The incidence of melanoma is increasing at a rate greater than any other cancer,[1] possibly due to the increasing use of indoor tanning devices. These devices emit unnaturally high levels of UVA and low levels of UVA and UVB rays.[2] The risks of using these devices include increased incidence of melanoma (3438 cases attributed to indoor tanning in 2008) and keratinocytes cancer (increased risk of squamous cell carcinoma by 67% and basal cell carcinoma by 29%), severe sunburns (61.1% of female users and 44.6% of male users have reported sunburns), and aggravation of underlying disorders such as systemic lupus erythematosus.[3-5]

The literature varies in its explanation of how indoor tanning increases the risk of developing melanoma. Some authors suggest it is due to increased frequency of use, duration of sessions, and years of using tanning devices.[1,6] Others suggest the increased cancer risk is the result of starting to tan at an earlier age.[2,3,6-10] There is conflicting literature on the level of increased risk of melanoma in those who tan indoors at a young age (<35 years). Although the estimated rate of increased skin cancer risk varies, with rates up to 75% compared to nonusers, nearly all sources support an increased rate.[6] Despite the growing body of knowledge that indoor tanning is dangerous, as well as the academic publication of these risks (eg, carcinogenesis, short-term and long-term eye injury, burns, UV sensitivity when combined with certain medications), teenagers in the United States and affluent countries appear to disregard the risks of tanning.[11]

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The eTable is available in the Appendix online at www.cutis.com.

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Tanning companies have promoted the misconception that only UVB rays cause cell damage and UVA rays, which the devices emit, result in "damage-free" or "safe" tans.[2,3] Until 2013, indoor tanning devices were classified by the US Food and Drug Administration (FDA) as class I, indicating that they are safe in terms of electrical shock. Many indoor tanning facilities have promoted the FDA "safe" label without clarifying that the safety indications only referred to electrical-shock potential. Nonetheless, it is known now that these devices, which emit high UVA and low UVB rays, promote melanoma, nonmelanoma skin cancers, and severe sunburns, as well as aggravate existing conditions (eg, systemic lupus erythematosus).[4] As a result of an unacceptably high incidence of these disease complications, a 2014 FDA regulation categorized tanning beds as class II, requiring that tanning bed users be informed of the risk of skin cancer in an effort to reverse the growing trend of indoor tanning.[12] Despite these regulatory interventions, it is not clear if this knowledge of cancer risk deters patients from indoor tanning.

The purpose of this study was to investigate the patients' perspective on indoor tanning behaviors as associated with the severity of their melanoma and the time frame in which they were diagnosed as well as their perceived views on the safety of indoor tanning and the frequency in which they continue to tan indoors. This information is highly relevant in helping to determine if requiring a warning of the risk of skin cancer will deter patients from this unhealthy habit, especially given recent reclassification of sunbeds as class II by the FDA. Additional insights from these data may clarify if indoor tanning decreases the time frame in which melanoma is diagnosed or increases the severity of the resulting melanoma. Moreover, it will help elucidate whether or not the age at which indoor tanning is initiated affects the time frame to melanoma onset and corresponding severity.

Methods

An original unvalidated online survey was conducted worldwide via a link distributed to the following supporting institutions: Advanced Dermatology & Cosmetic Surgery, Ameriderm Research, Melanoma Research Foundation (a melanoma patient advocacy group), Florida State University Department of Dermatology, Moffitt Cancer Center Cutaneous Oncology Program, Cleveland Clinic, Ohio State University Division of Medical Oncology, Harvard Medical School Department of Dermatology, The University of Texas MD Anderson Cancer Center Department of Dermatology, University of Colorado Department of Dermatology, and Northwestern University Department of Dermatology. However, there was not confirmation that all of these institutions promoted the survey. Additionally, respondents were recruited through patient advocacy groups and social media sites including Facebook, Twitter, LinkedIn, Tumblr, and Instagram. The patient advocacy groups and social media sites invited participation through recruitment announcements, including DermNetNZ (a global dermatology patient information site), with additional help from the International Federation of Dermatology Clinical Trial Network.

The survey was restricted to those who were self-identified as 18 years or older and who self-reported a diagnosis of melanoma following the use of indoor tanning devices. The survey was hosted by SurveyMonkey, which allowed consent to be obtained and responses to remain anonymous. Access to the survey was sponsored by the Basal Cell Carcinoma Nevus Syndrome Life Support Network. The University of Central Florida (Orlando, Florida) institutional review board reviewed and approved this study as exempt human research.

Survey responses collected from January 2014 to June 2015 were analyzed herein. The survey contained 58 questions and was divided into different topics including indoor tanning background (eg, states/countries in which participants tanned indoors, age when they first tanned, frequency of tanning), consenting process (eg, length, did someone review the consent with participants, what was contained in the consent), indoor tanning and melanoma (eg, how long after tanning did melanoma develop, age at development, location of melanoma), indoor tanning postmelanoma (eg, did participants tan after diagnosis and why), and other risk factors (eg, did participants smoke or drink pre- or postmelanoma).

Statistical Analysis—The data consist of both categorical and continuous variables. The categorical variables included age (<35 years or ≥35 years), frequency of indoor tanning (≤1 time weekly or >1 time weekly), and onset of melanoma diagnosis (within or after 5 years of indoor tanning). The continuous variables consisted of current age, age at start of indoor tanning, age at melanoma diagnosis, Breslow depth, and Clark level. Frequency of indoor tanning and warning of the risk of skin cancer were converted to be used as both categorical and continuous variables. For frequency of indoor tanning, the variables less than or equal to once weekly and more than once weekly were used as categorical variables, whereas less than monthly, 1 time monthly, 4 times monthly, 2 times weekly, and more than 2 times weekly were used as continuous variables. For warning of the risk of skin cancer, no and yes were converted to 0 and 1 for use in the Spearman correlations, which allowed for greater analyses among other variables. Spearman correlation was used to determine if a significant relationship existed among the age at melanoma diagnosis, age at start of indoor tanning, Breslow depth, Clark level, frequency of indoor and outdoor tanning, and knowledge and warning of the risk of skin cancer. All data were analyzed by use of IBM SPSS Statistics (version 21.0).

Difference in proportions among groups, age, frequency of tanning, onset of melanoma diagnosis within or after 5 years of starting indoor tanning, and knowledge of cancer risks was tested for significance using the χ^2 test. Reported P values were 2-tailed, corresponding with a significance level of $P<.05$. All data were

analyzed using SPSS (version 21.0). All statistical analyses were conducted independent of the participants' sex.

Results

Of the 454 participants who accessed the survey, 448 were analyzed in this study; 6 participants did not complete the questionnaire. Both males and females were analyzed: 289 females, 12 males, and 153 who did not report gender. The age range of participants was 18 to 69 years. The age at start of indoor tanning ranged from 8 to 54 years, with a mean of 22 years. Additional participant characteristics are described in Table 1. The mean frequency of indoor tanning was reported as 2 times weekly. When participants were asked if they were warned of the risk of skin cancer, 21.5% reported yes while 78.4% reported not being told of the risk. This knowledge was compared to their frequency of indoor tanning. Having the knowledge of the risk of skin cancer had no influence on their frequency of indoor tanning (Table 2).

Among responders, those who perceived indoor tanning as safer than outdoor tanning tanned indoors more frequently than those who do not (Spearman $r=-0.224$; $P<.05$)(Table 3). The frequency of indoor tanning was divided into those who tanned indoors more than once weekly and those who tanned indoors once a week or less. This study showed that the frequency of indoor tanning had no effect on the latency time between the commencement of indoor tanning and diagnosis of melanoma (Table 4). The time frame from the onset of melanoma diagnosis also was compared to the age at which the participants started to tan indoors. Age was divided into those younger than 35 years and those 35 years and older. There was no correlation between the age when indoor tanning began and the time frame in which the melanoma was diagnosed (eTable).

Table 5 shows the correlations between indoor tanning behaviors and melanoma characteristics. Those who started indoor tanning at an earlier age were diagnosed with melanoma at an earlier age compared to those who started indoor tanning later in life ($r=0.549$; $P<.01$). Moreover, those who started indoor tanning at a later age reported being diagnosed with a melanoma of greater Breslow depth ($r=0.173$; $P<.01$). Those who reported being diagnosed with a greater Breslow depth also reported a higher Clark level ($r=0.608$; $P<.01$). Among responders, those who more frequently tanned indoors also reported greater frequency of outdoor tanning ($r=0.197$; $P<.01$). This study showed no correlation between the age at melanoma diagnosis and the frequency of indoor ($r=0.004$; $P>.05$ not significant) or outdoor ($r=0.093$; $P>.05$ not significant) tanning. Having the knowledge of the risk of skin cancer had no relationship on the frequency of indoor tanning ($r=-0.04$; $P>.05$ not significant).

TABLE 1. Participant Characteristics

Variable	Participant Response	Total No. of Responses
Mean age (SD), y	41.4 (9.6)	301
Mean age (SD) at start of indoor tanning, y	22.0 (8.5)	292
Patient age at start of indoor tanning, n (%)		292
<35 y	270 (92.5)	
≥35 y	22 (7.5)	
Frequency of indoor tanning, n (%)		298
>1 time weekly	170 (57.0)	
≤1 time weekly	128 (43.0)	
Onset of melanoma diagnosis, n (%)		265
Within 5 y of starting indoor tanning	41 (15.5)	
After 5 y of starting indoor tanning	224 (84.5)	
Mean age (SD) at melanoma diagnosis, y	37.6 (9.4)	266

TABLE 2. Patients Warned of the Risks of Skin Cancer and Its Effect on Frequency of Indoor Tanning

	Knowledge of Cancer Risks[a]	No Knowledge of Cancer Risks[a]	*P* Value	OR	95% CI
Frequency of indoor tanning			0.241	0.588	0.240-1.438
>1 time weekly	13 (52.0)	59 (64.8)			
≤1 time weekly	12 (48.0)	32 (35.2)			

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]Categorical variables expressed as n (%).

Comment

Thirty million Americans utilize indoor tanning devices at least once a year.[13] UVA light comprises the majority of the spectrum used by indoor tanning devices, with a fraction (<5%) being UVB light. Until recently, UVB light was the only solar spectrum considered carcinogenic. In 2009, the International Agency for Research on Cancer classified the whole spectrum as carcinogenic to humans.[5,11] Despite this evidence, indoor tanning facilities have promoted indoor tanning as damage free.[3] The goal of this study was to collect the patient perspective on the safety of indoor tanning, indoor tanning behaviors, time frame of onset of melanoma, and the severity (ie, Breslow depth) of those melanomas.

Melanoma is the most prevalent cancer in females aged 25 to 29 years.[3] The median age of diagnosis of melanoma (with and without the use of indoor tanning devices) is approximately 60 years[14] versus our study, which found the average age at diagnosis was 37.6 years. Our findings are consistent with other literature in that those who start indoor tanning earlier (<35 years of age) develop melanoma at an earlier age.[14,15] Cust et al[14] also promoted the idea that patients develop melanoma earlier because younger individuals are more biologically susceptible to the carcinogenic effects of artificial UV light. However, our study found that those who started indoor tanning at an older age reported being diagnosed with a melanoma of greater Breslow depth, seemingly incongruent with the aforementioned hypothesis. One limitation is the age range for this research sample (18–69 years). The young age range may be attributable to the recruitment through social media, which is geared toward a younger population. Additionally, indoor tanning is a relatively new phenomenon practiced since the 1980s,[2] which may contribute to the younger sample size. However, 2.7 billion individuals use social media worldwide with 40% of those older than 65 years on social media.[16]

Prior research has shown that those who start indoor tanning before the age of 35 years have a 75% increased risk of developing melanoma.[14] Another study also has suggested that UVA-rich sunlamps may shorten the latency period for induction of melanoma and nonmelanoma skin cancers.[3] Our study used similar age cutoffs in concluding that there was no earlier onset of melanoma diagnosis between those who started indoor tanning before the age of 35 years and those who started at the age of 35 years or older. Limitations include that our study is cross-sectional, and therefore time course cannot be established. Also, survey responses were self-reported, allowing the possibility of recall bias.

A plethora of research has been conducted to determine if there is a connection between the use of indoor tanning devices and developing melanoma. Cust et al[14] suggested the risk of melanoma was 41% higher for those who had ever used a sunbed in comparison to those who had not. Other studies describe the difficulty in making the connection between indoor tanning and melanoma, as those who more frequently tan indoors also more frequently tan outdoors,[11] as suggested by this study. However, there is a paucity of literature on the patients' perspectives on the safety of indoor tanning. This study determined that those who more frequently tan indoors believed that indoor tanning is safer than outdoor tanning. With this altered perception promoted by the indoor tanning industry, the FDA has added a warning label to all indoor tanning devices about the risk of skin cancer. Our study revealed that having the knowledge of the risk of skin cancer had no influence on the

TABLE 3. Correlation Between Frequency of Tanning and Perception of Indoor Tanning Safety

	Indoor Tanning Is Safer Than Outdoor Tanning
Frequency of outdoor tanning	−0.084
Frequency of indoor tanning	0.247[a]

[a]$P<.05$

TABLE 4. Frequency of Indoor Tanning and Onset of Melanoma Diagnosis After Starting Indoor Tanning

	Indoor Tanning >1 Time Weekly[a]	Indoor Tanning ≤1 Time Weekly[a]	*P* Value	OR	95% CI
Melanoma diagnosis			0.441	0.769	0.394-1.503
Within 5 y of starting indoor tanning	22 (14.1)	19 (17.6)			
After 5 y of starting indoor tanning	134 (85.9)	89 (82.4)			

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]Categorical variables expressed as n (%).

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TABLE 5. Correlations Between Indoor Tanning Behaviors and Melanoma Characteristics[a]

Cross-comparison of Factors	Age at Melanoma Diagnosis	Age at Start of Indoor Tanning	Breslow Depth[b]	Clark Level[c]	Indoor Tanning[d]	Knowledge[e]	Outdoor Tanning[f]	Knowledge of the Risk of Skin Cancer
Age at Melanoma Diagnosis	1	–	–	–	–	–	–	–
Age at Start of Indoor Tanning	0.549[g]	1	–	–	–	–	–	–
Breslow Depth[b]	0.017	0.173[g]	1	–	–	–	–	–
Clark Level[c]	−0.041	0.018	0.608[g]	1	–	–	–	–
Indoor Tanning[d]	0.004	−0.103	0.047	−0.027	1	–	–	–
Knowledge[e]	−0.055	0.022	0.047	0.028	0.056	1	–	–
Outdoor Tanning[f]	0.093	−0.085	−0.107	−0.076	0.197[g]	−0.052	1	–
Knowledge of the Risk of Skin Cancer	−0.014	0.071	−0.045	−0.021	−0.04	0.643[g]	−0.062	1

[a]Correlations made using Spearman rank correlation coefficient.
[b]Breslow depth indicates depth of melanoma on a scale of 0 to 4.
[c]Clark level indicates depth of melanoma on a scale of 0 to IV.
[d]Frequency of indoor tanning.
[e]Knowledge score was determined by adding up responses to questions about the dangers of indoor tanning.
[f]Frequency of outdoor tanning.
[g]$P<.01$.

frequency of indoor tanning. This concerning finding highlights a pressing need for an alternative approach to increase awareness of the harmful consequences that accompany indoor tanning. Further studies may elaborate on potential effective methods and messages to relate to an indoor tanning population comprised mostly of young females.

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APPENDIX

eTABLE. Onset of Melanoma Diagnosis After Starting Indoor Tanning in Those Who Started Indoor Tanning at <35 Years or ≥35 Years

	Started Indoor Tanning at <35 y[a]	Started Indoor Tanning at ≥35 y[a]	*P* Value	OR	95% CI
Melanoma diagnosis			0.19	0.492	0.167-1.449
Within 5 y of starting indoor tanning	36 (14.9)	5 (26.3)			
After 5 y of starting indoor tanning	205 (85.1)	14 (73.7)			

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]Categorical variables expressed as n (%).