The Effect of Sunless Tanning on Behavior in the Sun: A Pilot Study

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Background: In the United States, indoor tanning is a booming industry and contributes to the ultraviolet light (UVL) burden that ultimately leads to skin cancer. "Sunless" tanning methods that avoid UVL exposure may represent a safe alternative. However, the effects of sunless tanning methods on ultraviolet light-related behaviors have never been investigated.


Results: Women completed 107 surveys. Men completed 14 surveys. The majority of individuals reported that they had not or would not change their time spent outdoors or their sunscreen use as a result of undergoing sunless tanning. However, 73% of individuals who had used UVL tanning beds said they had decreased or would decrease their UVL tanning bed use.

Conclusion: Sunless tanning is associated with a self-reported decrease in traditional UVL tanning bed use among tanning bed users. Physicians should advocate the use of sunless tanning to their patients who use traditional UVL tanning beds as a means of decreasing their UVL exposure and cancer risk.

Key Words: tanning, sunless tanning, dihydroxyacetone

As a society, Americans love the outdoors and have been preoccupied with maintaining a tanned appearance since the 1920s. We seek out the ultraviolet light (UVL) that yields the tanned look in many formats including outdoor sun bathing and indoor tanning booths. Adolescents in particular have a strong desire to achieve a tanned appearance and get high daily levels of UVL exposure. Recent studies suggest that tanning is an addictive behavior, much like cigarette smoking or alcohol consumption, and the UVL appears to serve as the reinforcing stimulus. Unfortunately, UVL exposure also contributes to the formation of skin cancers in a number of ways, including tumor initiation, tumor promotion, and suppression of immune function of the skin.

Traditional UVL tanning bed use has been linked to melanoma and nonmelanoma skin cancers by recent case-control studies. Given this fact, the growth in popularity of indoor UVL tanning is alarming to dermatologists. Presently, tanning salons represent a $5 billion a year industry. In addition, research has shown that UVL tanning bed operators consistently exceed federally recommended exposure limits with regards to safe levels of UVA and UVB radiation exposure.

"Sunless" tanning methods using the chemical dihydroxyacetone (DHA) represent an alternative to using UVL for tanning. Although the popularity of these sunless tanning methods has fluctuated over the last 45 years, both research and extensive use have demonstrated them to be very safe methods of changing skin color. Despite significant use by the public beginning as far back as the late 1950s, to our knowledge no investigator has examined whether the use of sunless tanning products changes the behavior of the user with relation to UVL exposure. In this pilot study survey of people undergoing sunless tanning, we examine whether or not self-reported outdoor sun exposure or sunscreen use changed as a result of undergoing sunless tanning.

Key Points

- Sunless tanning methods using dihydroxyacetone are a safe way of achieving a tanned skin appearance without ultraviolet light exposure.
- This study demonstrated that use of sunless tanning methods were not associated with a change in self-reported outdoor sun exposure or sunscreen use, but sunless tanning methods were associated with a self-reported decrease in ultraviolet tanning bed use.
- Physicians should recommend sunless tanning methods to their patients who want a tanned appearance, as this may lead to a decrease in ultraviolet light exposure and long-term risk of skin cancer.
not the use of one sunless tanning product changes the amount of sun exposure, the amount of sunscreen use, or the frequency of indoor UVL tanning bed use.

**Methods**

A written anonymous survey was completed by patrons undergoing spray-on sunless tanning (MYSTIC TAN®) at two indoor tanning salons in Augusta, Georgia from February 2004 through May 2004. The surveys were completed on a voluntary basis without any material reward for participation. The study was approved by the Institutional Review Board (Human Assurance Committee) at the Medical College of Georgia.

Study subjects completed their survey immediately after undergoing the spray-on tanning treatment. Participants were asked their age, their sex, and whether or not they had used this sunless tanning method before (Fig.). They were asked whether the sunless tanning had changed or would change their outdoor sun exposure, and whether it had changed or would change the amount of sunscreen they use. The possible responses for each question included “increase,” “decrease,” and “no change” as choices. Finally, they were asked if they had used UVL tanning beds in the past, and if their tanning bed use had changed or would change. Again “increase,” “decrease,” and “no change” were the options.

**Results**

Of the 123 surveys, 121 were properly completed and included in this study. Women completed 107 of the surveys, while men completed 14 surveys. First-time users of the spray-on tan filled out 78 surveys, and repeat users filled out 43 surveys. Of the 121 completed surveys, 104 were completed by individuals who had used traditional UVL tanning beds in the past. The average age of individuals completing the survey was 31.3 years, with a median age of 29 years. The age of people completing surveys ranged from 14 years to 58 years.

With regard to change in the amount of time spent outdoors in the sun, 76 respondents (62.8%) said they had not and would not change their current sun exposure behavior.

In terms of sunscreen usage, 85 respondents, (70.2%) said that they had not, or would not change the amount of sunscreen they use (Table 1); 23.1% said they had (or would) increase their sunscreen use, while 6.6% said they had (or would) decrease their sunscreen use (Table 1).

1. What is your age? ______
2. What is your sex? M___ F____
3. Have you had this method of sunless tanning before? Yes___ No____
4. How has (or how will) sunless tanning affected (affect) the amount of time you spend outdoors getting sun exposure?
   ______ It has increased or will increase my time outdoors
   ______ It has decreased or will decrease my time outdoors
   ______ It has not or will not change the time I spend outdoors
5. How has (or how will) sunless tanning affected (affect) the amount of sunscreen you use?
   ______ It has increased or will increase my sunscreen use
   ______ It has decreased or will decrease my sunscreen use
   ______ It has not or will not change my sunscreen use
6. Have you ever used a tanning bed before? Yes____ No____
7. If you have used a tanning bed before, how has or how will sunless tanning affect your tanning bed use?
   ______ It has increased or will increase my tanning bed use
   ______ It has decreased or will decrease my tanning bed use
   ______ It has not or will not change my tanning bed use

Fig. Survey instrument.
Table 1. Survey results

<table>
<thead>
<tr>
<th>Survey answers</th>
<th>Number of responders</th>
<th>Percentage of responders (%)</th>
<th>Margin of error (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased time outdoors getting sun exposure</td>
<td>13</td>
<td>10.7</td>
<td>± 5.5</td>
</tr>
<tr>
<td>Decreased time outdoors getting sun exposure</td>
<td>32</td>
<td>26.4</td>
<td>± 7.9</td>
</tr>
<tr>
<td>No change in time outdoors getting sun exposure</td>
<td>76</td>
<td>62.8</td>
<td>± 8.6</td>
</tr>
<tr>
<td>Increased sunscreen use</td>
<td>28</td>
<td>23.1</td>
<td>± 7.5</td>
</tr>
<tr>
<td>Decreased sunscreen use</td>
<td>8</td>
<td>6.6</td>
<td>± 4.4</td>
</tr>
<tr>
<td>No change in sunscreen use</td>
<td>85</td>
<td>70.2</td>
<td>± 8.1</td>
</tr>
<tr>
<td>Increased tanning bed use</td>
<td>7</td>
<td>6.7</td>
<td>± 4.8</td>
</tr>
<tr>
<td>Decreased tanning bed use</td>
<td>76</td>
<td>73.1</td>
<td>± 8.5</td>
</tr>
<tr>
<td>No change in tanning bed use</td>
<td>21</td>
<td>20.2</td>
<td>± 7.7</td>
</tr>
</tbody>
</table>

*Based on 95% confidence interval.

104 out of 121 participants had used tanning beds in the past.

Finally, when asked about traditional UVL tanning bed use, 76 of the 104 (73.1%) who had previously used UVL tanning beds said they had, or would, decrease their UVL tanning bed usage as a result of using the spray-on tan (Table 1).

In comparing the results for first-time users of the spray-on tan to repeat users of the spray-on tan, only two statistically significant differences arise using the $\chi^2$ test (Table 2). First, the percentage of first-time users who expected to decrease their UVL tanning bed use (as implied in the wording of the survey) was larger than the percentage of repeat users who had decreased their UVL tanning bed use. Secondly, the percentage of first-time users who expected to decrease their time outdoors getting sun exposure was smaller than the percentage of repeat users who had decreased their time outdoors getting sun exposure. Each of these differences was statistically significant with a $P$ value of less than 0.05. There were no statistically significant differences between the responses for teenagers and the responses for individuals 20 years old or older.

Discussion

Most sunless tanning products contain the active ingredient dihydroxyacetone, which is a 3-carbon sugar that combines covalently with basic groups of proteins in the stratum corneum in a browning reaction known as the Maillard reaction. The phenomenon of skin coloration with DHA was discovered in the mid-1950s at the University of Cincinnati by Eva Wittgenstein. She noted that when the patients spit up the DHA taken orally it left pigmented spots where it splashed on the skin. Industry took notice and brought the first sunless tanning product to the market in 1959. This product enjoyed success for a brief period but the suboptimal cosmetic results led to a decline in its use. In recent years the American public has become more aware of sunless tanning methods as an alternative to UVL tanning, and as the newer sunless tanning formulations provide a cosmetically improved color, their use has increased.

The results of our study suggest that the majority of individuals who undergo sunless tanning report that they do not change their time spent outdoors or their sunscreen use. However, the majority of sunless tanning users who have used traditional UVL tanning beds in the past report a decrease in their tanning bed usage. Given the extent of the problem that UVL tanning bed use poses to our society, we feel that this decreased UVL tanning bed use is remarkable and needs to be exploited further. In addition, 37% of repeat sunless tanning users said they had decreased their time outdoors as a result of using the sunless tanning (Table 2), and this figure was statistically significantly higher than the 20% of first-time users who anticipated that their time outdoors would decrease. Also, 23% of the study participants said that they had increased or would increase their sunscreen use as a result of undergoing sunless tanning (Table 1). These figures suggest that decreased sun exposure and increased sunscreen use may represent additional benefits to sunless tanning, aside from the statistically significant decreased UVL tanning bed use.

Table 2. First-time users compared to repeat users

<table>
<thead>
<tr>
<th>Survey answers</th>
<th>First-time users (%)</th>
<th>Repeat users (%)</th>
<th>$P$ value $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased tanning bed use</td>
<td>52 out of 65 (80)</td>
<td>24 out of 39 (61)</td>
<td>0.040</td>
</tr>
<tr>
<td>Decreased time outdoors</td>
<td>16 out of 78 (20)</td>
<td>16 out of 43 (37)</td>
<td>0.046</td>
</tr>
<tr>
<td>Increased sunscreen use</td>
<td>19 out of 78 (24)</td>
<td>9 out of 43 (21)</td>
<td>0.669</td>
</tr>
</tbody>
</table>

$^a$Using the chi-square test.
There are numerous limitations to our study. First, a survey is not the ideal study format in most circumstances. In our situation, we are not documenting actual changes in people’s behavior but rather their impression of changes, or intended changes, in their own behavior at one moment in time. However, the survey is affordable, convenient and easy to perform. The ideal study to determine the changes in tanning bed use with sunless tanning would likely involve a randomized, controlled study giving people free access either to UVL tanning beds or to a choice between UVL tanning beds or sunless tanning. One could then determine if the individuals with access to sunless tanning actually used tanning beds less often than the control group. However, this study would be logistically challenging, particularly with regards to funding.

Another potential limitation to our study is that it was performed during the spring season. Perhaps the results would have been different if the study had been done during the summer, fall, or winter, reflecting seasonal differences in behavior. In addition, we employed a convenience sample of volunteers in our study whose personality characteristics and motivations may differ significantly from those of nonvolunteer controls. Finally, since only 14 of 121 surveys were completed by men, our results may not be applicable to men.

There are cost and patient education factors to consider when recommending sunless tanning to patients. First, at approximately $20 or more per session, the cost of spray-on sunless tanning in tanning salons is not trivial. It is still much cheaper to use traditional UVL tanning beds or to tan outdoors. Fortunately, similar results can be obtained using more affordable over-the-counter sunless tanning preparations in the form of lotions, gels, and mousses, and at-home spray units are being marketed in some cities. Secondly, we know that the darkened skin color obtained with the use of DHA does not protect against UVI and protects only modestly against UVA, so patients still need education regarding the use of sun protection when outdoors.

Conclusion

This survey demonstrates that the majority of individuals undergoing spray-on sunless tanning do not alter their sun exposure or their sunscreen use as a result of using sunless tanning. However, the majority of individuals who have used UVL tanning beds in our study report a decrease in their tanning bed usage as a result of sunless tanning. Given the prevalence of tanning bed use in our country, physicians should advocate the use of sunless tanning to their patients and their community as a means of decreasing UVL exposure.

Acknowledgments

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References

22. USA Today. June 10, 2004, p 9D.