Objective: To describe the prevalence and correlates of the use of sunless tanning products among US adolescents and their association with UV radiation exposure behaviors, including indoor tanning, sunburn experiences, and use of sunscreen while outdoors.

Design: Telephone-based, random-digit-dialed, cross-sectional survey conducted from July 1 through October 30, 2004.

Setting: Telephone-accessible households with resident adolescents living with parents or caregivers in the mainland United States.

Participants: Nationally representative, population-based sample of 1600 adolescents aged 11 to 18 years and their caregivers.

Main Outcome Measure: Prevalence of recent (past-year) use of sunless tanning products and UV radiation exposure behaviors.

Results: The prevalence of self-reported use of sunless tanning products in the past year among US adolescents was 10.8%. Adolescent users of these products were more likely to be older and female, to perceive a tanned appearance as desirable, to have a parent or caregiver who used sunless tanning products, and to hold positive beliefs or attitudes about these products. Use of sunless tanning products was independently associated with indoor tanning and higher frequency of sunburn but not with use of sunscreen.

Conclusions: Among US adolescents, 10.8% used sunless tanning products in the past year; this practice was associated with risky UV radiation exposure-related behaviors. Adolescents, therefore, must be educated about these products and the importance of avoiding indoor tanning and practicing sun-protective behaviors.

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Exposure to UV radiation (UVR) is the most common avoidable cause of skin cancer.1,2 Despite awareness that UVR exposure increases skin cancer risk, intentional suntanning and indoor tanning behaviors are prevalent among many young white adults and adolescents.3-6 These practices persist largely because of the prevailing sociocultural value and perceived attractiveness of tanned skin.5,7,8

See also pages 979 and 1029

Among US adults, approximately 11% report having used sunless tanning products.9 However, to our knowledge, no available studies in adolescents have assessed sunless tanning product use. Sunless tanning products are promoted as a way to achieve tanned skin without UVR exposure and are regarded as a safer alternative than suntanning or indoor tanning.8,10-12 Marketed in the form of lotions or sprays, most of these products contain the skin-darkening agent dihydroxyacetone, which combines with amino acids in the stratum corneum to stain the skin, producing a color that resembles tanned skin.10,13 As the chief sunless tanning solution, dihydroxyacetone has been approved by the Food and Drug Administration; there are other non-dihydroxyacetone sunless tanning products that contain temporary coloring agents (bronzers) that wash off. On the basis of a few investigations in the United States conducted in adults,9,11,14 extant findings show that use of sunless tanning products has been associated with attitudes and beliefs (eg, tanned appearance factors and perceptions that these products are a safer way to tan) and with behavioral factors (eg, indoor tanning, sunburns, and use of sunscreens). Thus far, these products have been investigated in only a few behavioral modification interventions aimed at changing intentional tanning behaviors in young
adults,15-17 and comparable adolescent-targeted interventions exploring the effects of using sunless tanning products are not available. Given the limited amount of systematic investigations of these products, their potential role in reducing UVR exposure in the population is still unclear.8,12 In this study, our objective was to assess the prevalence of the use of sunless tanning products among US adolescents and factors associated with the use of these products. This information may be useful for counseling given by dermatologists and health care professionals designing UVR exposure reduction interventions for this population.

METHODS

The Sun Survey was conducted by the American Cancer Society from July 1 through October 30, 2004, to provide nationally representative baseline estimates of sun exposure and sun protection practices and related factors among adolescents aged 11 to 18 years and their primary caregivers. The Sun Survey was approved by the institutional review board of The University of North Carolina at Chapel Hill. Data were collected from July 1 through October 30, 2004, using a telephone-based survey and random-digit-dialing methods. The complete sample of participants consisted of 1600 youth and 1589 primary caregiver paired interviews using nearly identical questionnaires. The overall response rate was 44.0%. Because of the complex sampling scheme, sampling weights were applied, which account for potential imbalance owing to differential response rates and incomplete frame coverage. A detailed description of the American Cancer Society Sun Survey methods has been published elsewhere.5

MAIN OUTCOME MEASURES

Demographics and Skin Type

We determined participants’ age, sex, race, and sun sensitivity index score (Table 1). The latter index is a composite measure of 4 questions that asked about the participants’ skin ability to burn, ability to tan, natural skin color, and hair color; it is a validated measure, and its derivation for use in this study has been reported elsewhere.5

Use of Sunless Tanning Products

The adolescent and parent surveys had questions to assess respondents’ use of sunless tanning products in the past year. The following preface was read to participants, and then they were asked whether they had heard about self-tanners or sunless tanning products (sunless tanners): “sunless tanners are self-applied products that develop color without the sun and last for several days.” A follow-up question asked whether they had used sunless tanning products in the past year (recent use). The prevalence of recent use was categorized as those who had both heard about and used sunless tanning products in the past year. Reliability studies18 suggest that participants are able to consistently report whether they used these products.

Attitudes and Perceptions of Sunless Tanning Products

In the adolescent survey, the attitudes and perceptions of sunless tanning products were assessed with 3 items using a 4-point

Table 1. Sample Demographics of US Adolescents and Their Parents or Caregivers and Prevalence of Use of Sunless Tanning Products in the Past Yeara

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Adolescents, No. (%)</th>
<th>Parents or Caregivers, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample Size (n=1600)</td>
<td>Prevalence of Sunless Tanning Product Use (n=202)</td>
</tr>
<tr>
<td>Total</td>
<td>NA</td>
<td>22 (10.8)</td>
</tr>
<tr>
<td>Age of adolescents, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-13</td>
<td>535 (33.4)</td>
<td>13 (6.3)</td>
</tr>
<tr>
<td>14-15</td>
<td>441 (27.6)</td>
<td>25 (12.6)</td>
</tr>
<tr>
<td>16-18</td>
<td>624 (39.0)</td>
<td>28 (13.7)</td>
</tr>
<tr>
<td>Age of parents or caregivers, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27-40</td>
<td>364 (22.9)</td>
<td>37 (13.7)</td>
</tr>
<tr>
<td>≥41</td>
<td>486 (30.6)</td>
<td>47 (17.4)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>366 (23.0)a</td>
<td>37 (13.7)</td>
</tr>
<tr>
<td>Female</td>
<td>1180 (74.3)a</td>
<td>48 (17.8)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>207 (13.0)a</td>
<td>23 (8.7)</td>
</tr>
<tr>
<td>Multiracial</td>
<td>43 (16.0)</td>
<td>51 (18.9)</td>
</tr>
<tr>
<td>Some college</td>
<td>500 (31.5)a</td>
<td>43 (16.0)</td>
</tr>
<tr>
<td>College graduate</td>
<td>747 (47.0)a</td>
<td>51 (18.9)</td>
</tr>
<tr>
<td>Sun sensitivity index score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>415 (26.1)</td>
<td>28 (10.4)</td>
</tr>
<tr>
<td>Moderate</td>
<td>713 (44.9)</td>
<td>45 (16.7)</td>
</tr>
<tr>
<td>High</td>
<td>461 (29.0)</td>
<td>51 (19.1)</td>
</tr>
</tbody>
</table>

Abbreviation: NA, not applicable.

a Percentages may not total 100 because of rounding and cell sample size may not add up to total because of missing data.
Likert scale, ranging from strongly agree to strongly disagree. The 3 items were as follows: “sunless tanning is a safer way to tan than suntanning or indoor tanning,” “if I wanted to get a tan, I would prefer to use a sunless tanner rather than get a tan from the sun or an indoor tanning salon,” and “a sunless tan looks as good as a suntan or an indoor tan” (Cronbach α = 0.56).

**OTHER OUTCOME MEASURES**

On the basis of the literature, we also considered the following attitudinal and behavioral factors for the study’s analysis. The first factor was attitudinal appeal of a tan. As in previous work, 3 items (Cronbach α = 0.77), rated on separate 4-point scales (1 indicating strongly disagree to 4 indicating strongly agree), assessed attitudinal appeal for a tan (eg, “I look better when I have a tan,” “I feel healthy when I have a nice tan,” and “Even though it may not be good for me, I still like to tan”). Responses were summarized into a single score; a high tertile score indicates stronger appeal for a tan. The second factor was recent use of indoor tanning. One question asked whether the participant had used indoor tanning booths or sunlamps in the past year. The third factor was frequency of sunscreen use during the most recent summer. Separate questions, anchored on a 5-point Likert scale, asked about the frequency of sunscreen use when outdoors in the most recent summers and when at the beach or pool in the summer. The fourth factor was adolescents’ experience of sunburns in the past year. A question asked about the number of sunburns (ie, a sunburn was defined as reddening of the skin that lasted at least 12 hours) experienced during the most recent summer.

**STATISTICAL ANALYSIS**

To provide national estimates of the prevalence of sunless tanning product use, responses were weighted to reflect the probability of selection with adjustments for nonresponse and post-stratification. Measures of association (odds ratios [ORs] with 95% confidence intervals [CIs]) and adjusted proportions with percentages (predictive margins) were computed from multilevel logistic regression models controlling for all of the covariates (age, sex, skin’s sun sensitivity, attitudinal appeal for a tan, parent or caregiver use of sunless tanning products, and attitudes or beliefs about sunless tanning products) listed in Table 2. Predictive margins are a type of direct standardization that averages the predicted values from the logistic regression models over the covariate distribution in the study population.

Next, we conducted 4 separate multivariate logistic and multinomial regression models (Table 3) to derive the unadjusted and adjusted ORs for the association between each of the 4 behavioral outcomes (ie, frequency of sunburns, use of indoor tanning, and 2 measures of sunscreen use) and adolescents’ use of sunless tanning products (main predictor variable). These models adjusted for a parsimonious set of confounders, including age, sex, sun sensitivity index, and attitudinal appeal of a tan (Table 3). The significance of association between main predictor variable and outcome was based on the Wald χ² test.
OR, 2.61; 95% CI, 1.64-4.15) after adjusting for demographic and phenotypic confounders. Also, sunless tanning product use was associated with the odds of having experienced 5 or more sunburns during the previous summer (adjusted OR, 2.60; 95% CI, 1.37-4.90). The additional adjustment for tanning appeal attitudes attenuated the associations but
remained significant for indoor tanning and marginally significant for sunburn frequency.

The study’s main finding showed that an estimated 10.8% of US adolescents reported using (self-applied) sunless tanning products in the past year. The prevalence of use of these products among parents of adolescents was 14.0%. The latter estimate is generally consistent with the few previously reported estimates for US adults, ranging from 11% to 22%. Variation in prevalence estimates for this non-UVR tanning practice may relate not only to methodological differences among studies but also to whether the assessment about sunless tanning practices reflects use of self-applied products and/or spray-on sunless tanning products from specialized commercial services. Thus, the observed estimates from this study should be regarded as conservative because we did not query participants on whether they had also sought (or used) sunless tanning products from specialized commercial services. Future studies exploring this practice in adolescents may help determine whether certain users have used or plan to use these products exclusively and ascertain motivational differences across those who use these products exclusively vs those who combine it with UVR tanning modalities (ie, sunbathing or indoor tanning).

We found that use of sunless tanning products among adolescents is independently correlated with the following characteristics: older age, female sex, and high desirability for a tanned appearance. These correlates have been similarly reported across many studies of adolescents’ risky UVR tanning practices, such as indoor tanning. We found that adolescents’ use of sunless tanning products is positively correlated with parental/caretaker use of these products, possibly reflecting ease of access to the product and/or familial influence. In addition, we found that adolescent users of sunless tanning products hold certain beliefs and attitudes about these products compared with nonusers, for instance, that these products are a safer way to tan than suntanning or indoor tanning. Such beliefs have also been reported in a few other investigations of young adults. In addition, this belief among adolescent users of sunless tanning products is consistent with our observation (noted in the “Prevalence of Sunless Tanning Product Use in Adolescents and Parents and Caregivers” subsection of the “Results” section) that a subset (two-thirds) of them did not report engaging in indoor tanning in the past year, thereby contributing to a reduction of their UVR exposure. Thus, offering a safer tanning alternative, such as sunless tanning products, particularly to those motivated to obtain a tanned appearance, could be helpful in lowering their UVR tanning behaviors; this effect has been demonstrated in a few investigations in young adults. Although our study lacked information with regard to other factors or sources related to how adolescents acquire their positive beliefs and attitudes about sunless tanning products, a plausible source may be exposure to media and/or cosmetic marketing. Also, our study had no additional information with regard to other potential psychosocial factors (such as peer norms or perceived susceptibility to photoaging from UVR exposure) that may influence decisions to use these products exclusively rather than as an adjunct to other risky tanning practices; hence, more studies on adolescents’ decisions about the use or nonuse of these products are needed to assist communication efforts to educate adolescents about these products. Qualitative studies in adolescents are needed to help delineate their motivation and decision making for the use of non-UVR alternative methods for tanning.

Our findings suggest that in adolescents, use of sunless tanning products appears independently correlated with risky UVR exposure behaviors (indoor tanning and having had sunburns in the previous summer) but not with routine use of sunscreen. Studies show that sunless tanning products provide only minimal and transient protection against UVR exposure. Our observations are generally consistent with those of another prior cross-sectional survey of young adults. Although these observations are limited by the inability to clarify the causal association between sunless tanning and these behaviors, we suggest that users be counseled to practice recommended UV protective measures (eg, routine sunscreen use and clothing coverage) and avoid indoor tanning exposure.

The current study has several limitations. First, our use of a cross-sectional design means that directionality and causality cannot be assumed. Second, we relied on self-reported data, which may have biases; we tried to minimize potential recall biases by considering recent (in the past year) behavioral practices. Third, the response rate was moderately low, and the extent to which nonresponse may affect our findings is not known. The important strengths of our study were that it has a population-based and representative sample of adolescents in the continental United States. In addition, it examined the influence of important attitudinal and parental roles on adolescent use of sunless tanning products while controlling for potential confounders.

In conclusion, this study found that approximately 1 in 10 US adolescents uses sunless tanning products and that many users perceive sunless tanning as a safer way to tan than suntanning or indoor tanning. Moreover, the findings suggest that this non-UVR tanning practice is associated with indoor tanning and frequent sunburns, highlighting the need to counsel adolescents about these products and the importance of avoiding indoor tanning and practicing sun-protective behaviors.

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Additional Contributions: The American Cancer Society staff and coinvestigators were involved in 1 or more of the following: design and conduct of the study; collection, analysis, and interpretation of data; or preparation, review, or approval of the manuscript.

REFERENCES