Measuring Nonsolar Tanning Behavior

Indoor and Sunless Tanning

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Objective: To develop items to measure indoor tanning and sunless tanning that can be used to monitor trends in population surveys or to assess changes in behavior in intervention studies.

Design: A group of experts on indoor tanning convened in December 2005, as part of a national workshop to review the state of the evidence, define measurement issues, and develop items for ever tanned indoors, lifetime frequency, and past-year frequency for both indoor tanning and sunless tanning. Each item was subsequently assessed via in-person interviews for clarity, specificity, recall, and appropriateness of wording.

Setting: Universities in Tennessee and Virginia, a medical center in Massachusetts, and a high school in New Hampshire.

Participants: The study population comprised 24 adults and 7 adolescents.

Results: Participants understood indoor tanning to represent tanning from beds, booths, and lamps that emit artificial UV radiation, rather than sunless tanning, even though both can be obtained from a booth. Two items were required to distinguish manually applied from booth-applied sunless tanning products. Frequency of use was easier for participants to recall in the past year than for a lifetime.

Conclusions: While indoor tanning items may be recommended with confidence for clarity, sunless tanning items require additional testing. Memory aids may be necessary to facilitate recall of lifetime use of nonsolar tanning. In addition, studies that assess reliability and validity of these measures are needed. Since study participants were primarily young and female, testing in other populations should also be considered.

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Skin Cancer Continues to Be a Growing Public Health Concern, with More Than a Million Americans Affected Each Year

The mean annual percentage of change for melanoma incidence was 2.4% per year from 1992 through 2002; an increase in incidence of basal and squamous cell cancers has also been reported in New Hampshire, New Mexico, and Olmsted County, Minnesota. Solar UV radiation (UVR) is an established risk factor for both melanoma and nonmelanoma skin cancers and is thought to account, in part, for the observed trends.

Tanning beds, booths, and lamps, referred to hereon as indoor tanning, provide an artificial source of UVR that can be used indoors year round to obtain a tan. The US indoor tanning industry was established in the early 1980s, with an average of 50 facilities per large city. These devices can also be found in private homes, apartment buildings, recreational facilities, and beauty salons. Although touted by the industry as a safer alternative to solar UVR because of its controlled, regulated environment, use of indoor tanning is associated with a range of immediate and long-term health effects, including skin burns, induction or exacerbation of skin conditions, corneal damage, premature wrinkling, melanoma, and nonmelanoma skin cancers. In 2003, indoor tanning use in the past 12 months among US adults was reported to be about 10%. Prevalence of past-year use among US adolescents is similar to that of adults (approximately 10%), but approximately 50% of college-aged adults have reported current use in some samples. Less is known about sunless tanning products, including creams, lotions, and sprays (available in tanning salons since

See also page 217

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1999). These products result in tanned skin without UVR and are offered as a substitute for indoor tanning or as an enhancement to a UVR-induced tan. Although various tanning agents have been available for years, only those containing dihydroxyacetone, which reacts with amino acids in the keratinized stratum corneum to darken the skin, are approved by the Food and Drug Administration. A recent report documented that 11% of US adults have used sunless tanning products; 75% of users reported 10 or fewer applications.

Measurement of indoor tanning has varied in terms of description of the behavior, time frame, and response options. This inconsistent approach makes it difficult to compare prevalence rates across time, geographic regions, or populations or to compare the effectiveness of different interventions to reduce use. Moreover, information regarding the reliability and validity of these measures is limited. Sunless tanning research is too scarce at this time to draw conclusions. Thus, the development of uniform, reliable, and valid measures—for indoor tanning and sunless tanning—is an essential and timely step in the future progress of the skin cancer prevention field.

To that end, the National Cancer Institute (NCI) and Emory University cosponsored a meeting in December 2005, comprised of researchers from academia, the Centers for Disease Control and Prevention (CDC), the American Cancer Society (ACS), and the NCI with expertise in skin cancer prevention research, to develop a consensus about core survey items to assess self-reported skin cancer prevention behaviors among children and adults. Participants were divided into 2 work groups, one that focused on sun exposure and sun protection behaviors and one that focused on measurement of indoor tanning and sunless tanning, the subject of this report. The outcomes of this workshop included (1) a set of proposed survey items to measure use of indoor tanning and tanning creams, lotions, or sprays; and (2) a plan to cognitively test these items. In the present study, we first summarize our work group’s review of the state of the field as it relates to the measurement of these behaviors. We then describe the methods for development of survey items and results of cognitive interviews. Finally, we discuss issues to consider as this field evolves.

To guide the development of core items (see the “Methods” section), we first reviewed indoor tanning items administered in US surveys that had been described in peer-reviewed publications or were otherwise known to us.

Examples of items:

- Lifetime: Have you ever used a sun bed, a sunlamp, or a tanning booth?⁎
- Recent: Have you ever used an indoor tanning booth or sunlamp in the last 12 months?⁎
- Frequency: How many times in your life have you used a sunlamp or a tanning booth at a tanning parlor or salon?⁎
- Age of initiation: How old were you the first time you used a sun bed, a sunlamp, or a tanning booth?⁎
- Variations in wording:
  - Indoor tanning:
    - Any indoor tanning equipment⁎
    - A tanning bed or booth at a tanning salon or other business⁎
    - A tanning bed or booth with tanning or UV lamps (written communication from Joni A. Mayer, PhD, December 2005)
    - A sunlamp, tanning lamp, or sun bed in order to get a tan⁎

Time period:
- During the past year⁎

This list does not include all available studies or instruments that contain indoor tanning items. Rather, we focused on representative national or state-based samples with published data, community-based samples, and risk factor studies that reported reliability and validity for indoor tanning use items. Although most existing items for indoor tanning represented variations on a theme, as shown in the aforementioned list, the review highlighted issues to be considered during the development of items, such as whether to specify types of devices, booths, or location or define patterns of use to enhance accuracy.

We found only 4 reports related to the psychometric properties of indoor tanning measures and 1 report for sunless tanning (Table). No items from the national or state population–based surveys had accompanying reliability or validity data. Of the few studies that reported test-retest reliability data, items for lifetime use and past-year use showed high levels of consistency, but except for 1 study, the interval between administrations was 4 weeks or less. To our knowledge, no items measuring indoor tanning use (during any time frame) or sunless tanning have been validated against objective measures of use.

**CORE SURVEY ITEMS FOR COGNITIVE TESTING**

Cognitive interviewing is a technique used to explore the extent to which individuals understand, mentally process, and respond to materials and is commonly applied to survey development. When developing the phrasing for new items, we tried to balance simplicity of wording with clarity of meaning for the participant. To maximize flexibility of the items, we opted for a nonprefixed version with just enough description of devices that incorporate tanning lamps to make clear the intent of the item. According to our unpublished data, indoor tanning devices are primarily used in businesses; therefore, we decided against specifying location. We limited core items for frequency of use to lifetime or use in the last 12 months; these could easily be modified for shorter or longer periods. To decide on response options for frequency or age of initiation, we examined data from an ACS study of adolescents (written communication, December 2005) and from a survey of adults (written communication, D.L., January 2006). Approximately 65% of adolescents and 42% of adults reported indoor tanning frequency of 10 times or less. However, since frequency among adults depended on age and sex, we decided on an open-ended response option rather than predefined categories.

We were aware of only a few surveys on sunless tanning products—one from the 2005 Health Information National Trends Survey, one developed by a member of our work group (L.K.D.), and one from the ACS survey of adolescents. An
other work group member (S.P.) was conducting a study of sunless tanning users and supplied questions from her survey to be included in our cognitive testing study.

**COGNITIVE INTERVIEWS**

Cognitive interviews were conducted from January to June 2006, at universities in Tennessee and Virginia, a medical center in Massachusetts, and a high school in New Hampshire. Each site received approval from their respective institutional research boards. In Virginia, participants were recruited from an undergraduate psychology seminar and a convenience sample of young adult staff and friends. In Massachusetts, flyers posted in community businesses, announcements in online classified sites, and advertisements on the University of Massachusetts Medical School employee intranet were used. Participants in Tennessee were drawn from the Psychology Department Research Subject pool, while in New Hampshire, high school age girls were recruited through posters placed in their school. Individuals who had either used sunless tanning products or indoor tanning devices in the past were targeted for interviews. Participants were offered $10, except in Virginia, where students received course credit.

We opted for an oral interview because it would more likely reveal cognitive difficulties in the questions. Participants first answered all questions. Then, we asked participants to repeat each question in their own words and to describe what they understood when they first heard it. We wanted to be certain that “tanning bed or booth with tanning lamps” was not confused with sunless tanning booths, light boxes for treatment of depression, or table top sunlamps. Similarly, we wanted to assure that the phrase “sunless tanning creams or lotions” was not interpreted to mean cosmetics like blush or bronzing powders that do not contain dihydroxyacetone. We assessed whether a full description of the behavior was necessary for every question in a cluster of related items. Regarding frequency of use, we asked about ease or difficulty in providing a frequency, whether the answer was calculated or estimated, and level of certainty about the accuracy of their response. For questions about use in the past 12 months, we asked how participants interpreted the time frame, for example, whether they were thinking of the most recent year, months, we asked how participants interpreted the time frame, for example, whether they were thinking of the most recent year, some other 12-month period.

We conducted interviews in phases to address major sources of confusion before the next round of interviews. Interviews were tape recorded and subsequently transcribed or paraphrased. For each item, we assessed clarity, memory, and appropriateness of wording. Responses from each participant were grouped according to these categories for each question and then summarized.

**RESULTS**

We interviewed 31 participants. Among 18 participants for whom race/ethnicity was recorded, 17 were white. Twenty-seven participants (87%) were female, including all 7 adolescents; participants ranged in age from 15 to 62 years (mean age, 25 years). Twenty-three of the participants (74%) reported that they had used indoor tanning at some point in their lifetime; 18 participants (58%) reported using sunless tanning.

**INDOOR TANNING ITEMS**

The phrase “tanning bed or booth with tanning lamps” was universally understood. None thought that the phrase referred to light boxes used to treat seasonal affect disorder or to spray-on tanning booths. Four participants suggested that “booth with tanning lamps” be removed. However, since all 4 were indoor tanners, it is not clear that nonusers would understand the question if the phrase was limited to “tanning bed.”

All indoor tanners were asked how the omission of “with tanning lamps” from subsequent related questions affected what they considered to be indoor tanning. While many thought the question was easily understandable in either format, 5 participants thought its omission made the subsequent questions more understandable. Three participants thought that “with tanning lamps” should be included in every indoor tanning question. Two participants reported that it did not matter whether booths or tanning lamps were included because they only thought about beds, which was what they had used in the past.

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**Table. Reliability and Validity of Existing Indoor and Sunless Tanning Items**

<table>
<thead>
<tr>
<th>Source</th>
<th>Population</th>
<th>Measure</th>
<th>Method</th>
<th>Reliability</th>
<th>Validity</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westerdahl et al,1996</td>
<td>Female adults</td>
<td>Have you ever used or do you ever use sun beds? If yes, number of times per year? (never, 1-10 times, &gt; 10 times)</td>
<td>Self-administered questionnaire</td>
<td>Yes</td>
<td>No</td>
<td>$\kappa = 0.73$, 1- to 3-y interval between tests</td>
</tr>
<tr>
<td>Hillhouse et al,2000</td>
<td>Male and female college students</td>
<td>Please give me your best estimate of how many times you have tanned indoors in the last 12 months</td>
<td>Self-administered questionnaire</td>
<td>Yes</td>
<td>No</td>
<td>$\kappa = 0.95$, 2-wk interval between tests</td>
</tr>
<tr>
<td>Beane Freeman et al,2005</td>
<td>(1) Adult melanoma cases and adult colorectal cancer (2) Controls</td>
<td>(1) Have you ever used a sunlamp, tanning lamp, or sun bed in order to get a tan? (2) Have you ever used self-tanning creams in order to get a tan?</td>
<td>Self-administered questionnaire</td>
<td>(1) Yes (2) Yes</td>
<td>(1) No (2) No</td>
<td>(1) $\kappa = 0.83$, overall $\kappa = 0.71$, controls $\kappa = 0.94$, overall $\kappa = 1.00$, cases (2) $\kappa = 0.87$, controls $\kappa = 2$- to 4-wk interval between tests</td>
</tr>
<tr>
<td>Pichon et al,2005</td>
<td>Female college students</td>
<td>Have you ever used a tanning bed or booth at a tanning salon or other business?</td>
<td>Telephone interview</td>
<td>Yes</td>
<td>No</td>
<td>$\kappa = 1.0$, 1-wk interval between tests</td>
</tr>
</tbody>
</table>

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Participants universally understood the time period of indoor tanning use, whether recent or lifetime. However, with the exception of a few infrequent indoor tanners, participants had difficulty providing lifetime frequency. Most admitted that they guessed at the answer. One recommended the question be framed in terms of minutes rather than occasions. Of the 23 indoor tanners, those responding with confidence had used indoor tanning facilities less than 15 times.

All but 1 participant thought that the word “last” was equivalent to using the word “past.” With 1 exception, participants thought of the “last 12 months” as the period ranging from date of the interview to the preceding 12 months. All participants were fairly certain that they were able to correctly estimate the number of times they had tanned in the past year.

SUNLESS TANNING ITEMS

Ten participants were asked about sunless tanning creams or sprays in the original format, “have you ever used sunless tanning creams or sprays—also known as self-tanning or fake tanning?” Because only 2 participants thought the item asked about commercial sunless tanning booths, we revised it to 2 questions to distinguish home or self from commercial use. On subsequent testing, only 1 of 21 participants thought of businesses during the self-application question. One thought the phrase “apply by yourself” was confusing because it suggested an activity performed alone rather than with friends or family. Only 4 of 21 participants reported thinking of powders or makeup bronzers. Participants unanimously understood that a spray-on or mist tan was obtained from a business; none thought that the question referred to use of indoor tanning beds or booths.

Suggested survey items for indoor tanning and sunless tanning are described in the Figure.

While expert evaluation has been used to summarize and study measurement issues pertaining to colorectal cancer screening, diet, and sun-related behavior,17-20 to our knowledge, our report is the first to apply this approach to nonsolar sources of tanning. Because research interest in these behaviors is recent, our report is timely, albeit preliminary owing to limitations of a small sample size and recruitment methods that likely yielded a highly select group. Nevertheless, we offer some conclusions and recommendations. In doing so, we hope to motivate ongoing efforts that will ultimately lead to more standardized, valid, and reliable measurement of these behaviors.

The results of the cognitive interviewing suggest that the wording of the indoor tanning questions is appropriate. Our interviews provide support that it is unnecessary to distinguish indoor tanning that uses artificial UVR vs tanning from sunless products, despite the fact that both can take place in a booth. However, this could change if sunless tanning becomes more popular as a substitute for indoor tanning. If a definition of indoor tanning is included initially, subsequent items could eliminate qualifiers about the types of devices considered to be indoor tanning to shorten the interview. The wording for sunless tanning items, on the other hand, may need additional testing. While we relied on 2 separate questions to address home and commercial use of sunless tanning, we recognize that it may be beneficial to develop a single question for use in future research. However, the challenge will be to develop a question that can generate thoughts about both self- and booth-applied products and include descriptive words without creating an excessive cognitive burden for participants.

While indoor tanning and sunless tanning users had little difficulty understanding time frames and infrequent users could report past-year frequency with some confidence, this was not the case for lifetime frequency. One option to more accurately assess lifetime use of non-solar tanning may be to ask a series of questions, such as those that establish the pattern of indoor tanning use (eg, regular use throughout the year, seasonal use, or event-
based use)\textsuperscript{30,31} or describe various sunless tanning products, to help prompt participants' memories. Alternatively, the cognitive burden on heavy users may be reduced by providing response options rather than the open-ended approach we used. However, data from our studies suggest that this approach should be used with caution because frequency of indoor tanning use differs for men and women and by age.

Although we made progress to identify viable, clearly understood survey items, further validity and reliability data are still needed. Validation of indoor tanning behavior items using objective measures, while challenging, may be possible. Telemetrically obtained data using global positioning systems embedded in cell phones or other devices provided to research participants, in conjunction with the geocoding of tanning facilities within a geographical region, could be used to verify self-reported behavior (written communication, J.A.M., December 2006). Indirect verification of tanning by either solar or indoor tanning could be measured by changes in skin color with colorimeters.\textsuperscript{32} Verification of self-report of sunless tanning, a behavior that would not likely produce social stigma, could be achieved by collecting used containers for home-use products and sales receipts for commercial services.

As most of the participants were female and/or college students, testing of these items in other populations should be considered. We assessed only 1 format (ie, in-person interviews), so assessment of other formats may be useful. In addition to these areas for further work, we suggest that researchers measure both lifetime and past-year use in future studies of nonsolar tanning behavior. Collection of these data will make comparisons across studies and time periods more feasible. We also recommend that authors include their items verbatim in their articles or on a Web site to increase standardization across studies and provide a foundation for future improvements in the measurement of these behaviors.

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REFERENCES


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