Tanning Addiction in Adolescents: Directions for Measurement and Intervention Development

Mary K. Tripp1

Little is known about tanning addiction in adolescents. Miller et al. found that 7.0% of 11th grade students met addiction criteria. After adjusting for all other comorbidities, the odds of addiction were two times greater for students who reported problem use of marijuana or obsessive-compulsive disorder symptoms. The likelihood of addiction increased with problem substance use and psychological symptoms.


Miller et al. (2019) make a significant contribution to our understanding of tanning addiction and related comorbidities in adolescents (Miller et al., 2018). There is evidence for biological addiction to UV exposure, potentially mediated by the UV-induced release of β-endorphin, which is an endogenous opioid (Fell et al., 2014). However, it is not clear to what extent physical dependence on UV exposure may explain a pattern of frequent or repetitive tanning behavior. Very little is known about tanning addiction in adolescents; virtually all research on tanning addiction has been conducted in samples of adults. Indoor tanning during adolescence increases melanoma risk (Lazovich et al., 2010); thus, it is important to study tanning addiction in adolescents. Major strengths of the study by Miller et al. were the assessment of tanning addiction in a multiethnic sample of adolescents and the analysis of a comprehensive set of behavioral health conditions including problem substance use and psychological symptoms for their associations with tanning addiction.

Prevalence of Tanning Addiction in Adolescents

Miller et al. (2018) found that 7.0% of the 11th grade students in their study met the criteria for tanning addiction as assessed by a modified version of the Cut down, Annoyed, Guilty, Eye-opener (CAGE) instrument, referred to as mCAGE (Table 1). The indoor or outdoor tanning behavior of students was not assessed in this study, so the proportion of tanners who were classified as addicted is not known. According to the 2015 Youth Risk Behavior Survey (YRBS), 9.0% of 11th grade students in the United States reported using an indoor tanning device at least once during the past year (Kann et al., 2016). In light of this statistic, the prevalence of tanning addiction in the current study is striking, because it may suggest that a large proportion of 11th grade students who report any indoor tanning behavior may be characterized as addicted to tanning. However, differences in sample designs and characteristics between the Miller et al. study and YRBS limit direct comparisons of prevalence estimates. The prevalence of indoor tanning behavior in Los Angeles, California, where this study was conducted, may differ from national estimates. Less is known about the outdoor tanning practices of adolescents, and it is not clear if tanners in this study were mostly engaged in indoor or outdoor tanning behaviors.

There has been much work in recent years to develop and psychometrically evaluate measures that are valid and reliable to assess tanning addiction, but currently there is no recognized criterion standard. Several measures have been used across studies, and there is a lack of consensus on which measure, or combination of measures, may be most useful. Some tanning addiction instruments have been adapted from widely used tools designed to screen for substance dependence. For example, the CAGE has been used to assess problem drinking (Ewing, 1984) and has been modified (i.e., mCAGE) to assess tanning addiction (Warthan et al., 2005). The mCAGE has a total of four items and, given its brevity, was selected for use in the Miller et al. (2018) study. Indeed, an advantage of the mCAGE is its potential for use as a brief screening tool, which would facilitate the triage of tanners to treatment strategies for tanning addiction. However, evidence is lacking for the use of mCAGE in assessing tanning addiction in adolescents. Adolescents are an understudied group in the measurement literature on tanning addiction; thus, the study by Miller et al. provides a valuable opportunity to gain

1Department of Behavioral Science, The University of Texas MD Anderson Cancer Center, Houston, Texas, USA

Correspondence: Mary K. Tripp, PhD, Department of Behavioral Science—Unit 1330, The University of Texas MD Anderson Cancer Center, PO Box 301439, Houston, Texas 77230-1439, USA. E-mail: mtripp@mdanderson.org

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Clinical Implications

- Overall, 7% of 11th grade students met criteria for tanning addiction.
- Several problem substance use and psychological factors were associated with tanning addiction in adolescents.
- Interventions that address comorbidities of tanning addiction may be more effective in reducing tanning behavior.

a better understanding of the utility of the mCAGE in this group.

Warthan et al. (2005) originally modified CAGE items with respect to suntanning, because their study involved assessing tanning addiction among beachgoers (Warthan et al., 2005). Later studies have adapted the mCAGE to assess tanning, as in the study by Miller et al. (2018), or indoor tanning specifically (Mosher & Danoff-Burg, 2010). However, the wording of the mCAGE items in the Miller et al. study is slightly different than the wording found in other studies to assess tanning addiction, possibly given Miller et al.’s focus on adolescents. As a result, it may be challenging to compare the findings of the Miller et al. study with those of other studies that have used the mCAGE. Furthermore, students in the Miller et al. study may have interpreted the mCAGE items differently than did respondents in other studies. Further evaluation of the mCAGE items by use of cognitive interviewing or other instrument testing methods appears warranted. Such a study would enable researchers to assess whether adolescents interpret the questions as intended by developers.

Measure development and refinement is a continual process, and the field would benefit from additional work on the conceptualization of tanning addiction to enhance screening tools such as the mCAGE. In the Miller et al. (2018) study, 10.9% of adolescents endorsed the “cut down” question (Table 1), which suggests that a significant number believed that they need to cut down on their tanning. Additional developmental work grounded in samples of tanners who are or are not attempting to quit tanning would facilitate our understanding of whether this “cut down” question, or any others, should be refined to better assess tanning addiction in adolescents or the general population. To what extent is “cutting down,” as captured by this item, similar within the contexts of tanning behavior and alcohol use? Additionally, it would enhance measure validity to determine whether the mCAGE differentiates between biological addiction to tanning and appearance concerns related to tanning. As written, some of the mCAGE questions used in the Miller et al. study could be interpreted as pertaining to appearance concerns instead of exclusively pertaining to biological addiction.

The Miller et al. (2018) study found that tanning addiction prevalence was highest in Native Hawaiians or Pacific Islanders (10.5%), and similar proportions of non-Hispanic whites (7.9%) and Hispanics (7.6%) met the criteria for tanning addiction. The reason for these findings is not clear from this study. For example, similar estimates of tanning addiction prevalence in non-Hispanic whites and Hispanics may be unexpected, given that indoor tanning behavior is more prevalent in non-Hispanic whites than in other racial and ethnic groups. In the 2015 YRBS, the prevalence of indoor tanning behavior (across all high school grades) was higher in non-Hispanic whites (9.4%) than in non-Hispanic blacks (3.7%) or Hispanics (4.7%) (Kann et al., 2016). However, we lack information on the outdoor tanning behavior of adolescents. It is critical that the ongoing development and evaluation of measurement tools for tanning addiction include diverse respondent samples to lay the groundwork for identifying any racial or ethnic differences in tanning addiction. Miller et al.’s study is an important step forward in this research.

### Table 1. Endorsement of items from the tanning-modified Cut down, Annoyed, Guilty, Eye-opener (mCAGE) instrument by adolescents in the study by Miller et al. (2018)

<table>
<thead>
<tr>
<th>mCAGE Item</th>
<th>Endorsed (%)</th>
</tr>
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<tbody>
<tr>
<td>Have you ever felt you needed to cut down on your tanning?</td>
<td>10.9</td>
</tr>
<tr>
<td>Have people annoyed you by criticizing your tanning?</td>
<td>7.9</td>
</tr>
<tr>
<td>Have you ever felt guilty about tanning?</td>
<td>7.3</td>
</tr>
<tr>
<td>Have you ever felt you needed to tan first thing in the morning (eye-opener)?</td>
<td>4.4</td>
</tr>
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limits their ability to assess whether tanning addiction is a causal or correlative factor relative to the behavioral health conditions assessed in this study. Future research will benefit from longitudinal studies to determine whether tanning addiction is a predictor or indicator of these comorbidities (for example, whether tanning addiction leads to OCD or is a symptom of OCD). Examining potential mediators of the associations between tanning addiction and behavioral health conditions will facilitate the evaluation of mechanisms of interventions to address tanning addiction. The Miller et al. study is an important first step in identifying targets for intervention.

**Intervention Directions**

The U.S. Preventive Services Task Force (USPSTF) recommends behavioral counseling for the primary prevention of skin cancer (USPSTF et al., 2018). The USPSTF defines behavioral counseling interventions as those that reduce UV exposure, which would include those that promote the avoidance of indoor tanning (USPSTF et al., 2018). However, the literature on tanning behavior lacks interventions designed to address tanning addiction specifically. Research to design, implement, and disseminate effective interventions for tanning addiction is of paramount importance.

Miller et al. (2018) call for further research to develop intervention approaches to address tanning addiction in the context of the comorbidities identified in their study. Research is needed to further elucidate common factors that influence tanning addiction and behavioral health conditions. Indoor tanning-specific interventions likely will be needed in addition to, or as a component of, interventions that address comorbidities. Miller et al. extend previous research by describing the prevalence of tanning addiction in adolescents and examining behavioral health conditions that are associated with tanning addiction to inform interventions. Alongside this focus on interventions, continued advancement of measurement tools to screen for tanning addiction, in adolescents and the general population, will enhance research to assess prevalence of tanning addiction, identify correlative or causal factors, and evaluate the effectiveness of interventions.

**CONFLICT OF INTEREST**
The author states no conflict of interest.

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**REFERENCES**


**IL-17C: A Unique Epithelial Cytokine with Potential for Targeting across the Spectrum of Atopic Dermatitis and Psoriasis**

Emma Guttman-Yassky1 and James G. Krueger2

Both atopic dermatitis (AD) and psoriasis are characterized by complex inflammatory circuits that may be regulated through “feed-forward” mechanisms in the epidermis that amplify cellular immune responses through production of keratinocyte-derived cytokines and inflammatory mediators. IL-17C is a unique cytokine that is produced by keratinocytes and that is involved in such synergistic loops that may be responsible for amplifying the inflammation in both diseases. This may ultimately lead to induction of S100As and other molecules that accompany epidermal hyperplasia. Thus, antagonism of IL-17C may be beneficial in both psoriasis and AD patients. The IL-17C neutralizing antibody MOR 106 was able to inhibit both T helper type 2 cells and T helper type 17/T helper type 22-skewed inflammatory loops that drive different features of AD and psoriasis. The therapeutic potential of IL-17C antagonism in AD is supported by a recently reported small phase 1 clinical trial in patients with AD.


1Department of Dermatology, Icahn School of Medicine at Mount Sinai, New York, New York, USA; and 2Laboratory for Investigative Dermatology, The Rockefeller University, New York, New York, USA

Correspondence: Emma Guttman-Yassky, Department of Dermatology, Icahn School of Medicine at Mount Sinai, 5 East 98th Street, New York, New York 10029, USA. E-mail: Emma.Guttman@mountsinai.org

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