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ASSOCIATIONS BETWEEN SEASONAL SLEEP CHANGE AND INDOOR TANNING^{1,2}

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Summary

Identification of risk factors for indoor tanning may ultimately aid the development of better indoor tanning prevention strategies, which is pertinent given the association between indoor tanning and skin cancer. This study aimed to examine the relationship between seasonal sleep change and indoor tanning. Women tanners ($N = 139$) completed self-report measures including items relating to seasonal sleep changes, seasonal affective disorder (SAD), reasons for tanning, tanning during the winter months, and the Tanning Pathology Scale (TAPS), which measures problematic tanning motives and symptoms of tanning dependence. It was hypothesized that seasonal sleep change and SAD would be associated with greater indoor tanning during the winter, more tanning to improve mood and to relax, and higher scores on the TAPS. Findings indicated that more seasonal sleep change was associated with tanning to improve mood and higher scores on the TAPS. Similarly, the presence of SAD was related to tanning to improve mood, tanning to relax, and more problematic tanning.

Melanoma is a pervasive and life-threatening malignant tumor of the melanocytes, which produce the dark pigment, melanin, responsible for the color of skin (Volkovova, Bilanicova, Bartonova, Letašiová, & Dusinska, 2012). Among women ages 15–39 yr., 26,036 melanomas were diagnosed between the years of 1999 and 2006 (Weir, Marrett, Cokkinides, Barnholtz-Sloan, Patel, Tai, *et al.*, 2011). This widespread prevalence among young women calls our attention toward identifying modifiable risk factors to prevent this pervasive and life-threatening cancer. Melanoma is predominantly caused by exposure to ultraviolet rays (UVR), which are primarily accumulated through sun exposure, but more recently, through the widespread use of tanning beds (Rigel, 2010). College students and college-aged individuals are particularly prone to engage in indoor tanning (Hillhouse,

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Turrisi, & Shields, 2007; Centers for Disease Control and Prevention, 2012; Guy, Berkowitz, Watson, Holman, & Richardson, 2013). Despite the introduction of tanning alternatives (e.g., sunless tanning lotions), high rates of indoor tanning persist. While college students tan indoors largely for appearance reasons (Neenan, Lea, & Lesesky, 2012), continued high rates of tanning may indicate that such practices may also be maintained by psychological incentives other than becoming tan (Kourosh, Harrington, & Adinoff, 2010), such as the desire to relax and/or to improve one's mood (Poorsattar & Hornung, 2007). Identifying the perceived benefits of indoor tanning among young women may prove helpful in developing strategies to curb indoor tanning and ultimately prevent future cases of skin cancer.

Demographic and psychosocial correlates of indoor tanning have been previously studied. Research has demonstrated higher rates of indoor tanning among those who are female, Caucasian (Heckman, 2008; Centers for Disease Control and Prevention, 2012), and sunbathe outdoors more often (Lostritto, Ferrucci, Cartmel, Leffell, Molinaro, Bale, *et al.*, 2012). In addition, people who tan indoors also report greater use of tobacco, marijuana, cocaine, amphetamine (Mosher & Danoff-Burg, 2010), and alcohol (Mosher, *et al.*, 2010; Lostritto, *et al.*, 2012) compared to people who do not tan indoors.

Frequent indoor tanning has also been associated with symptoms of seasonal affective disorder (SAD; Hillhouse, Stapleton, & Turrisi, 2005). This is a seasonal depression, most typically experienced in the fall and winter that is associated with hyperphagia, hypersomnia, and fatigue (Lewy, Emens, Songer, Sims, Laurie, Fiala, *et al.*, 2009). Hillhouse and colleagues posited that frequent tanners may engage in indoor tanning to "self-medicate" and to improve mood. It is plausible that indoor tanning may alter mood through the effects that UVR has on the skin. UVR elicits increases of proopiomelanocortin (POMC), which increases beta-endorphin, an endogenous opioid (Kourosh, 2010). Subjective effects of opioids include increased feelings of well-being (Balk, Fisher, & Geller, 2013), which may result in problematic tanning, conceptualized as problematic tanning motives and symptoms of tanning dependence (Hillhouse, *et al.*, 2007). Thus, it can be postulated that people with SAD may seek *temporary* relief from SAD symptoms through the mood-altering properties of indoor tanning; however, it is important to note that indoor tanning would not be expected to ameliorate SAD.

To decrease indoor tanning, a thorough understanding for the reasons why people tan indoors is needed. The previous examination of SAD and indoor tanning is of particular interest as it suggests a novel, but understudied, pathway for understanding one such motivation for indoor tanning. As such, examination of additional factors that may underlie the relationship between SAD and indoor tanning may be pertinent. According to the phase-shift hypothesis, SAD may indicate a vulnerability to circadian misalignment (e.g., a delay in the propensity to sleep due to delays of the release of soporific hormones that function on circadian rhythms), as the seasons shift (Lewy, *et al.*, 2009). One important behavioral marker of SAD, and therefore, of circadian misalignment, is a change in the onset and duration of sleep. Sleep length (or total sleep time) varies based on the circadian phase at the midpoint of sleep (Dijk & Czeisler, 1995). Therefore, if the circadian system is phased differently depending on the season, one of the greatest indicators of this will be a change in

sleep length as the seasons shift. Hence, measuring the relationship between indoor tanning and seasonal sleep change allows linking tanning with the proposed underlying mechanism of SAD. To our knowledge, sleep changes have yet to be studied in relation to indoor tanning. If such a relationship is established, it would be important to investigate not only circadian dysrhythmias, but also concomitant sleep changes (e.g., shortened sleep duration, less sleep continuity), in relation to indoor tanning.

A subset of data from a parent study on correlates of tanning (Heckman, Darlow, Cohen-Filipic, Kloss, Manne, Munshi, *et al.*, 2012; Heckman, Cohen-Filipic, Darlow, Kloss, Manne, & Munshi, 2014) was used to conduct a preliminary investigation. The primary goal was to examine the relationship of seasonal sleep change with several indices of indoor tanning behavior. The secondary goal was to build on the work of Hillhouse and colleagues to further assess the relationship between SAD and indoor tanning behaviors. Should sleep or circadian factors be implicated in tanning behaviors, future studies could examine novel clinical avenues (e.g., sleep or circadian therapies) for reducing this significant health risk.

- Hypothesis 1** Greater seasonal sleep change would be associated with increased indoor tanning in the winter, higher levels of problematic tanning, and more tanning to improve mood and relax.
- Hypothesis 2** SAD will be related to increased indoor tanning in the winter, higher levels of problematic tanning, and more tanning to improve mood and relax.

Method

Participants

Study participants were 139 female psychology students from a university in the Northeastern United States, ages 18–25 yr., who reported having ever tanned indoors. On average, participants were 20.2 yr. old ($SD=1.7$). The majority of the sample was Caucasian (92.1%; $n=128$), followed by other/mixed (4.3%; $n=6$), Asian American (2.2%; $n=3$), Hispanic/Latina 2.2% ($n=3$), and African American/Black (0.7%; $n=1$). One participant did not provide information regarding their race.

Procedure

Study recruitment was conducted through e-mail and the university's online survey research system (SONA). More specifically, all women enrolled in psychology courses were invited to participate in the study via e-mail. Additionally, psychology students could log on to the department website and view study information and subsequently enroll in the study. Once participants enrolled, they completed an online consent, followed by online versions of each questionnaire. The study was available for participants to complete during the spring, summer, fall, and winter. A total of 92 participated during the fall and winter and 47 participated during the spring and summer. Remuneration for participating in the study included psychoeducation regarding indoor tanning, extra credit for a psychology course, and a \$20.00 PayPal voucher. This study was approved by the university's institutional review board.

Measures

Seasonal Scale Index (SSI)—The SSI is a commonly-used reliable (Magnusson, Friis, & Opjordsmoen, 1997) measure of SAD symptomatology (Rosenthal, Genhart, Sack, Skwerer, & Wehr, 1987). The six-item measure asks, “To what degree do the following change with the seasons?” Participants are asked to rate seasonal variations in mood, weight, appetite, sleep length, energy, and social activity in an adjective rating format (0: No change, 1: Slight change, 2: Moderate change, 3: Marked change, or 4: Extremely marked change). Responses are summed to yield possible scores of 0 to 24, with 11 and above indicating seasonal affective disorder (Rosenthal, *et al.*, 1987). The question regarding sleep was utilized to assess seasonal sleep change. The total score from the scale was utilized to assess the presence of SAD. Cronbach’s α for this study was .81.

Past indoor tanning—To assess whether sleep change was associated with greater tanning during the winter, participants were asked, “How frequently do you typically tan indoors *per month* during the winter (please count times that you tan more than once per day as separate sessions)?” Responses were open-ended and ranged from 0–75 indoor tanning sessions per month. The distribution of these responses was highly skewed. A square root transformation was utilized in an attempt to normalize the data, however, the variable remained skewed. Therefore, this variable was dichotomized by those who did not tan in winter (those who endorsed tanning 0 times; $n=64$) and those who did tan in winter (those who endorsed tanning 1–75 times; $n=75$; Heckman, Darlow, Kloss, Cohen-Filipic, Manne, Munshi, *et al.*, 2013).

Tanning for mood and relaxation—Two questions from an investigator-created measure of reasons for tanning were utilized to assess whether individuals reported reasons for tanning consistent with the phase-shift hypothesis. Participants were asked, “Please rate how much you agree with the following reasons for why you tan intentionally.” Reasons given were “It helps my mood” and “It helps me relax”. Participants responded on a 5-point scale (1: Strongly disagree, 2: Somewhat disagree, 3: Neither agree nor disagree, 4: Somewhat agree, 5: Strongly agree) regarding if they tan to improve their mood and/or tan to relax. Participants were also allowed to mark if this item was not applicable, rather than providing a rating on the 5-point scale; however, no participants within this sample chose this option.

Tanning Pathology Scale (TAPS)—To assess whether or not sleep change was related to problematic tanning (e.g., problematic tanning motives and symptoms of tanning dependence), the Tanning Pathology Scale (TAPS), a 16-item survey, was utilized (Hillhouse, Turrisi, Stapleton, & Robinson, 2010). Questions include items such as “Tanning is a good way to improve my mood,” “My tanning is a problem for me,” and “Sometimes I think my tanning is out of control.” Participants rate each item on a 5-point Likert-type scale (1: Strongly disagree, 2: Somewhat disagree, 3: Neither agree nor disagree, 4: Somewhat agree, or 5: Strongly agree). The measure yields the four subscales of perceiving tanning as a problem, tolerance, opiate-like reactions to tanning, and dissatisfaction with skin tone. These can also be summed and averaged to yield a total scale score, which was used for an index of problematic tanning in this sample. The TAPS has

been shown to have good internal consistency reliability among college students (Heckman, *et al.*, 2013). Cronbach's α for this study was .91.

Skin tone—Skin tone was assessed by asking participants to rate the color of their untanned skin, which has been shown to correlate significantly with spectrophotometry ratings of skin tone (Daniel, Heckman, Kloss, & Manne, 2009). Participants selected from 1: Very fair, 2: Fair, 3: Medium light, 4: Medium olive, 5: Medium dark, and 6: Very dark. To ensure that participants did not assume that they were to rate their skin tone within their ethnicity, a correlation was conducted between skin tone and race/ethnicity. The variables were not correlated ($r = .12, p > .05$), indicating that participants were most likely rating the color of their untanned skin, rather than the color of their untanned skin as compared to others identifying as the same race/ethnicity.

Analyses

First, descriptive statistics and correlations were conducted to describe the study sample. Second, three linear regressions were conducted with seasonal sleep change as predictor and tanning to improve mood, tanning to relax, and TAPS score, respectively, as outcome variables. A logistic regression was conducted with seasonal sleep change as predictor variable and tanning during winter as outcome variable. Additionally, three linear regressions were conducted with SAD as predictor and tanning to improve mood, tanning to relax, and TAPS score, respectively, as outcome variables. A logistic regression was conducted with SAD as predictor variable and tanning during winter as outcome variable. In each model, skin tone and season the study was completed were included as covariates.

Results

Descriptive statistics are presented in Table 1. Participant skin tone varied widely, as 9.4% ($n=13$) indicated that they had extremely fair skin, 38.8% ($n=54$) indicated that they had fair skin, 32.4% ($n=45$) indicated that they had a medium light skin, 18.7% ($n=26$) indicated that they had medium olive skin, and 0.7% ($n=1$) indicated that they had medium dark skin. No participants indicated having very dark skin. The seasonal sleep change reported also varied; 16.5% ($n=23$) reported no change, 33.1% reported slight change, 33.1% ($n=46$) reported moderate change, 13.7% ($n=19$) reported marked change, and 3.6% ($n=5$) reported an extremely marked change. Presence of SAD was extremely high, with 50.4% ($n=70$) meeting the cutoff for SAD and 49.6% ($n=69$) not meeting criteria. Average score on the SSI was 10.69 ($SD=4.53$). Correlations among variables are presented in Table 1.

A linear regression indicated a significant relationship between seasonal sleep change and tanning to improve mood, controlling for skin tone and season the study was completed ($b=0.30, SE_b=0.11, p<.01, R^2=.13$). Similarly, a linear regression revealed a relationship between presence of SAD and tanning to improve mood, controlling for skin tone and the season the participant was surveyed ($b=0.64, SE_b=0.22, p<.01, R^2=.13$).

A linear regression indicated no significant association between seasonal sleep change and tanning to relax, controlling for skin tone and the season the participant was surveyed ($b=0.16, SE_b=0.11, p=.16, R^2=.05$). In contrast, linear regression indicated a relationship

between presence of SAD and tanning to relax, controlling for skin tone and the season the participant was surveyed ($b=0.48$, $SE_b=0.23$, $p=.04$, $R^2=.07$).

A linear regression revealed an association between seasonal sleep change and TAPS score, controlling for skin tone and season the study was completed ($b=0.14$, $SE_b=0.06$, $p=.02$, $R^2=.03$). Similarly, a linear regression indicated a relationship between seasonal affective disorder and TAPS score, controlling for skin tone and season the participant was surveyed ($b=0.35$, $SE_b=0.12$, $p<.01$, $R^2=.05$).

A logistic regression revealed no significant relationship between seasonal sleep change and indoor tanning during winter, holding constant the skin tone and season the study was completed ($B=0.22$, $SE=0.17$, $OR=1.25$, $95\%CI=0.89-1.76$, $p=.20$). Similarly, the presence of SAD did not predict indoor tanning during winter, holding constant the skin tone and the season the participant was surveyed ($B=0.45$, $SE=0.36$, $OR=1.57$, $95\%CI=0.78-3.15$, $p=.20$).

Discussion

To our knowledge, this is the first exploration of seasonal sleep change and indoor tanning. Findings indicated that women with more seasonal sleep change reported more tanning to improve mood and higher TAPS scores. In contrast to hypotheses, seasonal sleep change was not related to tanning to relax or indoor tanning during winter. Similarly, the presence of SAD was associated with tanning to improve mood and higher TAPS scores, but was not related to tanning during winter. However, the presence of SAD was associated with tanning to relax.

The literature has indicated that people report tanning indoors for a variety of reasons and motivations (Poorsattar & Hornung, 2007; Robinson, Baker, & Hillhouse, 2012). For instance, those who report tanning strictly for appearance may have different motivations and therefore also different patterns of tanning than those who report tanning to improve mood. This may explain why seasonal sleep change in the current sample was related to tanning to improve mood, but not tanning to relax; women with seasonal sleep change may have desired to alter and improve mood, but not to relax. In contrast, the presence of SAD was related to tanning to relax, which may indicate that assessing for both seasonal sleep change and SAD may be pertinent when examining reasons for tanning. Additionally, this study suggests that continued investigation of the correlates of indoor tanning among people with seasonal sleep change or with SAD is important, as both constructs were related to higher scores on the tanning pathology scale, which may indicate that when people with SAD or seasonal sleep change tan indoors, they may be driven to do so, in some cases, by problematic tanning motives.

Hillhouse and colleagues (2005) found that people reporting symptoms consistent with SAD are more likely to be frequent indoor tanners. In contrast, the present study found no relationship between SAD and indoor tanning during winter or seasonal sleep change and indoor tanning during winter. However, this study's sample did not have a large prevalence of frequent tanners ($n = 14$; 10.1%), which differs from Hillhouse and colleagues' sample.

Thus, the relationship between SAD and indoor tanning may only exist among frequent tanners, as Hillhouse and colleagues found. Future studies should seek to include frequent tanners (those who tan 40 or more times per year; Hillhouse, *et al.*, 2005).

This study's sample had a high prevalence of SAD (50.4%), as determined by the SSI, which is similar to Reid, Towell, and Golding (2000), who found that 47% of their London university sample had scores of 11 or more on the SSI. However, others have found much lower rates of SAD when utilizing the same measure with college students assessed during the fall and spring (Rohan & Sigmon, 2000). Given these discrepancies, our finding may be best explained by the characteristics of this study sample. First, it has been demonstrated that indoor tanners may be more likely to experience psychopathology. For instance, indoor tanning has been associated with substance use (Mosher & Danoff-Burg, 2010), obsessive-compulsive disorder and body dysmorphic disorder (Ashrafioun & Bonar, 2014), and SAD (Hillhouse *et al.*, 2005). Second, our study sample was comprised solely of females. Studies on gender differences in the prevalence of SAD have indicated that women may be more likely to have SAD when compared to men (Altemus, Sarvaiya, & Epperson, 2014).

Limitations and Conclusion

While this study had several novel findings, it was not without its limitations. First, seasonal sleep change and tanning to relax and to improve mood were measured by single, self-report items. Second, while these findings indicate a seasonal component to tanning to improve mood and problematic tanning, they do not yet substantiate the claim that circadian dysregulation leads to these changes. Future studies should include an objective marker of circadian changes (e.g., salivary melatonin) in order to fully assess this relationship. Third, while it was hypothesized that seasonal sleep change and SAD would predict tanning to improve mood and tanning pathology, the correlational nature of the study does not indicate causality between these variables. Thus, future studies should seek to examine these relationships prospectively. Additionally, while it is generally thought that individuals with SAD who experience seasonal sleep change have increased sleep during the winter, the measure used did not assess the directionality of this change. Accordingly, future studies should seek to include a multi-modal approach, utilizing both standardized self-report and objective measures of sleep, when applicable, to assess sleep timing practices. Finally, the sample consisted solely of women attending college. While this population is important to study in their own right, given their increased likelihood of indoor tanning (Heckman, *et al.*, 2008), future studies should seek to include people of an expanded age range, socioeconomic background, and men.

Future studies might explore the relationship between circadian desynchrony, sleep changes, SAD, and tanning behaviors, given that this novel idea may have clinical utility. For instance, both seasonal sleep change, SAD, and problematic reasons for tanning may be lessened by bright light therapy or administration of exogenous melatonin, or behavioral strategies that enhance sleep continuity and promote adequate sleep duration. Future studies are needed to examine whether these strategies may prove fruitful.

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TABLE 1

Descriptive Statistics and Correlation Matrix Among Variables

Measure	<i>M</i>	<i>SD</i>	2	3	4	5	6
1. Seasonal Sleep Change	1.55	1.04	.63 [†]	.19*	.13	.25 [†]	.08
2. Seasonal Scale Index	10.69	4.53		.21*	.19*	.28 [†]	-.02
3. TAPS	2.06	0.74			.54 [†]	.55 [†]	.29 [†]
4. Tanning to relax	3.48	1.35				.76 [†]	.25 [†]
5. Tanning to improve mood	3.59	1.34					.28 [†]
6. Tanning during winter	5.50	10.54					

* $p < .05$.[†] $p < .01$.