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A Preliminary Investigation of the Predictors of Tanning Dependence

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Abstract

Objectives—To investigate possible predictors of tanning dependence including demographic variables, exposure and protective behaviors, and other health-related behaviors.

Methods—This study consisted of an online survey of 400 students and other volunteers from a university community.

Results—Twenty-seven percent of the sample was classified as tanning dependent. Tanning dependence was predicted by ethnicity and skin type, indoor and outdoor tanning and burning, and lower skin protective behaviors, as well as smoking and body mass index.

Conclusions—Young adults are at risk for tanning dependence, which can be predicted by specific demographic and behavioral variables.

Keywords

tanning; skin cancer prevention; addiction

Skin cancer is the most common form of cancer in the United States, accounting for half of all human cancers,[1] with over a million new cases diagnosed yearly.[2] Ninety percent of all skin cancers are due to ultraviolet radiation (UVR).[2] Thanks to recent media attention, the US public has demonstrated increased awareness of the harmful effects of UVR.[3] Unfortunately, studies have also demonstrated that people, particularly young adults, continue to use minimal skin protection strategies yet receive large amounts of intentional and incidental exposure to UVR, either through sun exposure or from the use of tanning

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salons.[3–7] As suggested by the continued exposure to UVR without adequate protection despite increasing awareness of risks, clearly there are strong motivations for such exposure and/ or significant barriers to engaging in protective behaviors. Most of the recent literature suggests that the effect on appearance is the primary motivation for sunbathing and tanning booth use.[3–11] It is no wonder then that educational interventions targeting skin safety and cancer knowledge have fallen short in terms of changing actual tanning behavior.[11–16] However, there may be some individuals who tan excessively for reasons other than appearance. Like other health-risk behaviors, tanning behavior probably has multiple determinants.

Similarities between excessive tanning and substance use disorders or addiction have been discussed formally in the literature recently and anecdotally for years.[17] In the lay media, the term *tanorexia* has been used to describe a preoccupation with the desire to be tan paired with excessive tanning, similar to anorexia nervosa or an obsessive desire to be thin paired with compulsive dietary behavior.[18] Tanorexia is illustrated by the recent explosion in media images of tan celebrities[18] and numbers of tanning salons[7,19] as well as sunless tanning products on the market. However, tanorexia may be a misnomer, as substance dependence or addiction may be a better model for understanding excessive tanning than an eating disorder model.

Several similarities exist between tanning and substance use. They are both prevalent in youth, are often initially perceived as image enhancing, and are health-risk behaviors that people participate in despite warnings.[20–25] A primary motivation for tanning behavior is appearance enhancement. However, tanners report other benefits such as mood enhancement, relaxation, and socialization, also consistent with addiction in which behaviors are reinforcing in specific, pleasurable ways.[26–28] For example, Hillhouse and Turrisi[21] have found that a subset of “hardcore” frequent tanners have seasonal affective disorder. These individuals may be using tanning for self-medication purposes.

A possible mechanism for tanning dependence (TD) is the release of endogenous opioids during UVR exposure.[26,27,29,30] There is some evidence supporting this hypothesis.[26,27,29,30] Feldman et al[26] investigated UVR as a reinforcer among 14 regular indoor tanners. The participants demonstrated a preference for a UVR versus a non-UVR tanning bed despite successful blinding in terms of visual or tactile cues. UVR exposure was associated with a more relaxed and less tense mood than non-UVR exposure. Kaur et al[27] compared 8 frequent and 8 infrequent tanners. Frequent tanners demonstrated a preference for a UVR versus a non-UVR tanning bed. This preference was reduced with increasing doses of naltrexone, an opioid antagonist. Moreover, as the dose increased, 4 of the 8 frequent tanners experienced withdrawal-like symptoms (nausea and/or jitteriness), and 2 dropped out of the study entirely due to these symptoms. Infrequent tanners demonstrated less preference for the UVR bed and reported no adverse events at any dose of naltrexone. These withdrawal symptoms, dose-response relationship, and opioid antagonism are reminiscent of traditional substance use disorders. However, although 2 studies found increased plasma levels of endorphins during UVR exposure,[29,30] 2 other studies have failed to demonstrate this effect.[31,32]

A few other studies have noted associations and similarities between tanning and substance use. Demko et al[22] found that among 6903 nationally representative white adolescents, those who used 2 or 3 substances were 3 times more likely to be indoor tanners than others. Several other studies have found relationships between tanning and substance use such as cigarette smoking.[24,33] Zeller et al[25] found that 29% of a sample of 267 teens aged 14–17 who tanned indoors more than once in the last year reported that they would have difficulty quitting indoor tanning. Variables associated with anticipated quitting difficulty were younger age at initiation and higher frequency of use, characteristics often found among substance-dependent individuals.

In another attempt to explore a possible relationship between excessive tanning and addiction, Warthan et al[17] modified the substance dependence criteria from the American Psychiatric Association's Diagnostic and Statistical Manual-IV-TR34 (DSM-IV-TR) and those of the 4-item CAGE scale,[35] traditionally used to screen for potential problems with alcohol use. CAGE is an acronym that refers to the 4 yes or no items regarding trying to **C**ut down on drinking (or in this case tanning), feeling **A**nnoyed when told not to do a behavior, feeling **G**uilty when doing the behavior too much, and wanting to participate in the behavior first thing in the morning (**E**ye opener). Using these scales, Warthan et al[17] found that in a sample of 145 Texas beachgoers, 26% met the modified CAGE criteria and 53% met the modified DSM-IV-TR criteria for tanning dependence. Using a chi-square test, Warthan et al[17] found that the results from the 2 scales "were significantly associated (P = .03, p 964)." Their study provides some evidence for construct validity in that women were more likely to have positive CAGE results, and participants who scored positive on the DSM-IV-TR reported tanning more often and going to the beach more often to tan than did others. Likewise, Poorsattar and Hornung[28] found that 12% of their undergraduate sample met the CAGE criteria.

Based on our review of the literature, no other psychometric studies have been conducted on these TD measures, but previous studies have examined the psychometrics of the CAGE and DSM-IV-TR criteria for substance disorder screening and diagnosis. A number of studies have demonstrated good reliability, sensitivity (77–86%), specificity (93–94%), and validity of the CAGE to screen for alcohol disorders.[36,37] There are several strong and widely used instruments used to assess DSM-IV criteria for the diagnosis of substance dependence. For example, the Structured Clinical Interview for DSM-IV (SCID) and the Composite International Diagnostic Interview (CIDI) have been found to have excellent interrater reliability, good test-retest reliability, and superior validity to standard clinical interviews.[38,39] There is much more evidence supporting the use of DSM-IV criteria for diagnosis of substance dependence than for use of the CAGE screener. However, DSM-IV measures are typically administered as structured interviews rather than questionnaires as was done with the TD measure in the study by Warthan et al.[17]

The purpose of the current study was to replicate and extend the work of Warthan et al[17] by further investigating possible predictors of tanning dependence such as demographic variables, exposure and protective behaviors, and other health-related behaviors (smoking and exercise) in a general young adult sample. We were interested in demographic associations with tanning dependence that might be used clinically to identify individuals at

risk of being or becoming tanning dependent. We were also interested in sun exposure and protective associations with tanning dependence that might support the construct validity of the tanning dependence measures. Finally, we were interested in the other health behaviors potentially related to tanning dependence that might provide insight into the type of theoretical model most applicable to individuals who are preoccupied with tanning.

METHODS

Participants

Participants were students and other volunteers (n = 400) from a southeastern metropolitan university community who were recruited during the 2006 spring semester. College-aged participants were selected for this study because teens and young adults are known to be frequent tanners and at risk for substance abuse and dependence.[8,21,40–43] Participants were recruited from the community in addition to the Psychology 101 subject pool in order to enhance generalizability.

Measures

Tanning dependence—Warthan et al[17] modified CAGE and DSM-IV-TR scales (mCAGE and mDSM-IV-TR) were used to measure TD. These instruments are the only formal scales currently available to measure the construct. As mentioned previously, CAGE is an acronym that refers to the 4 yes or no items regarding unsuccessful attempts at Cutting down, Annoyance with admonitions, Guilt about the behavior, and using the behavior as an Eye-opener. The modified 7-item DSM-IV-TR criteria address tolerance, withdrawal, and tanning despite negative consequences, key criteria of substance dependence. Sample items are “Do you think you need to spend more and more time in the sun to maintain your perfect tan?”, “Do you continue tanning so your tan will not fade?”, “Does this [your belief that tanning can cause skin cancer] keep you from spending time in the sun or going to tanning beds?” Most of the mDSM-IV-TR items had yes or no responses, but 2 items asked about days per week spent tanning in salons and the sun. Scoring was conducted as in the study by Warthan et al[17] in which 2 or more positive items on the mCAGE or 3 or more on the mDSM-IV-TR were deemed to indicate TD. This scoring scheme is the same that is used for substance dependence screening with the original measures.

Demographic variables—Participants reported their sex, age, year in school, race/ethnicity, whether they were psychology students, and their likelihood of burning and tanning. Their skin type was classified according to Fitzpatrick.[44] There are 6 skin types with Type I being the fairest and most likely to burn and Type VI being the darkest and least likely to burn.

Outdoor tanning, indoor tanning, and skin protection—The following items/scales were modified from similar ones in the literature.[15,45–51] Participants were queried about their level of intentional and incidental summer sun exposure, tanning booth use, and chemical sunless tanner use. A protective behaviors scale was used to assess a range of skin protection behaviors: wearing clothing, staying in the shade, avoiding or limiting midday sun, and using sunscreen. The scale had 7 Likert-type items ranging from 1 = never to 5 =

always use such protection, for a possible range of scores from 7 to 35. This scale was divided into tertiles (low, medium, and high protection) for the logistic regression analyses.

Other health-related behaviors—In order to perform a preliminary assessment of other potential health-related predictors of TD, ever or current use of tobacco and exercise items from the Center for Disease Control and Prevention's 1995 National College Health Risk Behavior Survey were used.[52] The following items were divided into tertiles (low, medium, high): body mass index (via self-report height and weight), days per week exercising aerobically, and days per week exercising anaerobically (strengthening or toning muscles).

Procedures

The current study was an online survey of volunteer participants from a university community. Participants were recruited via a university psychology student subject pool, flyers, and advertisements. Students went to a website to choose among the experiments, and if they selected the current study, they were connected directly to the survey URL. The URL was also posted on flyers and ads around the university and surrounding area so that other community members could access it. Psychology 101 students could earn research points for their classes by signing up for any of a variety of experiments. A raffle for department store merchandise gift cards was offered as an incentive. This study was approved by the university institutional review board.

Analyses

The purpose of the analyses was to identify predictors of TD as measured by Warthan et al's[17] modified substance dependence scales. Three separate multiple logistic regression models were created to predict TD: one including demographic variables, one including other UVR exposure and protective behaviors, and one including other health behavior variables. We used 3 regressions to separately investigate (1) the demographic variables associated with tanning dependence, (2) the UVR-related behavior variables that would support the construct validity of tanning dependence, and (3) the other health-related variables that would indicate the type of theoretical model (for example, eating disorder versus addiction) that would be most associated with tanning preoccupation. For ease of presentation and to allow for nonlinear effects, we categorized continuous variables into 3-level ordinal variables representing low, moderate, and high values of the variables. For the 2 continuous UVR-related variables that were found to be statistically associated with tanning dependence when categorized, we refit the models but included the 2 variables using restricted cubic splines[53] with knots (cutpoints allowing changes in the underlying basis curves) at the same cut-points as used to create the categorical variables. We used figures to display the effects of the variables on tanning dependence when entered into the model using restricted cubic splines. Restricted cubic splines are a more flexible method of modeling nonlinear effects than the inclusion of categorized continuous variables in regressions. Although restricted cubic splines allow for better estimation of nonlinear effects, the parameters from the models in which they are included are largely uninterpretable due to the scaling of the spline basis functions. For this reason, we present the point estimates of the parameters when the variables were categorized, but display the

impact from the spline models visually to give a more accurate representation of the relationship of the variables with tanning dependence.

Our study had power to detect modest effects; with the distribution of tanning-dependent and nondependent participants in our study, we had 80% power to detect an approximate 0.3 unit standardized effect (a standardized effect is an effect in standard deviation units) between the 2 groups using a t-test with a 2-sided hypothesis test and a 5% Type I error rate and 90% power to detect an approximate 0.4 unit standardized effect. Cohen[54] has defined a small effect as one of 0.2 standardized units and a medium one of 0.5 units. We did not power the study explicitly to detect effects in a multiple logistic regression. Hence, the findings from the regression analyses should be considered exploratory and hypothesis generating. Therefore, it is possible that the nonsignificant findings in the regression analyses may not necessarily represent true negative findings but merely effects that we did not have the power to detect.

RESULTS

Descriptive Characteristics

Participants were 400 individuals, 79% (n = 316) of whom were Psychology 101 students and 21% (n = 84) of whom were other members of the university community. Seventy-five percent (n = 300) of the sample was female, and the mean age of participants was 21 years (SD = 5.42). Sixty percent (n = 240) of the sample were first-year students, 25% (n = 100) were upper-class students, 8% (n = 32) were graduate or special students, and 7% (n = 28) were not in school. Sixty-six percent (n = 264) of participants were white, 17% (n = 68) were African American, 11% (n = 44) were Asian American, and 6% (n = 24) were other races/ethnicities or multiracial/ethnic. Table 1 includes participant characteristics by TD status.

The Cronbach alpha for the mCAGE was .57 and for the mDSM-IV-TR was .56, both of which are relatively low but reflect the diversity of behaviors assessed by the instruments and their brevity. Further reliability testing and/or modifications of the measures should be conducted in future studies. The mean of the mCAGE scores was 0.47 (SD = 0.84) out of 4, and the mean of the mDSM-IV-TR scores was 1.51 (SD = 1.31) out of 7. Based on the mCAGE criteria, a small minority of the sample (11%, n = 44) was identified as tanning dependent. The most commonly endorsed item referred to being annoyed with people's advice against tanning (17%, n = 68). mDSM-IV-TR criteria identified 93 (23% of the sample) tanning-dependent individuals. The most commonly endorsed item had to do with tanning despite cancer awareness (45%, n = 178).

The measures successfully agreed in classifying 80% (n = 320) of the participants: 294 (73%) as not tanning dependent, and 30 (7.5%) as tanning dependent. Seventy-seven (19%) participants were identified as tanning dependent by only one of the 2 scales, either the mCAGE or the mDSM-IV-TR. Because it is not yet clear which scale measures TD more accurately and due to the relatively low hit rate, TD was defined for this study as meeting criteria on either the mCAGE or the mDSM-IV-TR. The following analyses compare TDs (n = 106, 26.5%) with non-TDs (n = 294, 73.5%) on a variety of characteristics and behaviors.

Demographics

The following variables were entered into the demographic logistic regression model predicting TD: gender, ethnicity, year in school, Fitzpatrick skin type, and psychology student or not (Table 2). Significant independent predictors of TD were ethnicity and skin type. As expected, whites had 7.60 times greater odds of being TD compared to African Americans (95% CI = 2.49–23.19) conditional on other covariates in the model. Thirty-four percent (n = 90) of whites, 7% (n = 5) of African Americans, and 16% (n = 11) of other races/ethnicities were classified as TD. Additionally, individuals with moderate skin types were more likely to be TD than those with the fairest or darkest skin types with ORs ranging from 3.08 to 4.06 in the model for Fitzpatrick skin types 3 through 5 compared to the fairest skin type (skin type 1). TD rates were 16% (n = 7) for Type I's, 21% (n = 11) for Type II's, 39% (n = 28) for Type III's, 32% (n = 31) for Type IV's, 26% (n = 28) for Type V's, and 4% (n = 1) for Type VI's. Surprisingly, gender was not a significant independent predictor of TD status.

Exposure and Protective Behaviors

The following variables were entered into the UVR logistic regression model predicting TD: time spent sunbathing, incidental sun exposure, sunburns, indoor tanning, sunless tanners, and protective behaviors (Table 3). Significant independent predictors of TD were hours per week spent sunbathing in the summer, sunburns during the last year, indoor tanning during warm weather, and protective behaviors. Participants spent a mean of 3.77 (SD = 6.34) hours per week tanning in the summer. As expected, those with the highest levels of summer sunbathing had 7.54 (95% CI = 3.34–17.02) greater odds of being TD than did those with the lowest levels conditional on other covariates in the model. Participants reported a mean of 0.92 (SD = 1.46) sunburn during the last year. Those with the highest number of sunburns had 2.85 (95% CI = 1.37–5.91) greater odds of being TD in the model compared with those with the fewest sunburns. The mean score on the protective behaviors scale was 22.41 out of 35 (SD = 5.52), suggesting moderate levels of skin protection. As expected, those who protected themselves from sun exposure were less likely to be TD in the model with ORs of 0.27 (95% CI = 0.13–0.56) and 0.36 (95% CI = 0.17–0.74) among the moderate and high protectors, respectively.

Figure 1 displays the impact of hours per week sunbathing and sun protective score on the odds of being classified as tanning dependent conditional on the other variables in the model. The odds of being tanning dependent, compared to those who do not spend any time sunbathing increases as the hours per week spent sunbathing, increases except at very high levels in which little tanning dependence was found. Because of sparse data, the 95% confidence interval at the highest levels becomes very wide, however, reflecting high uncertainty in the point estimates at the highest level. The relationship of sun protective behavior with the odds of being tanning dependent is more consistent as protective behavior increases. Relative to those who have the least protective behavior, those with more sun protective behavior are less likely to be tanning dependent.

Thirty-eight percent (n = 152) of the sample had tanned indoors, and only 23% (n = 92) of the sample had used sunless tanners during the last year. The mean age of tanning booth

initiation was 17.26 years (SD = 3.91). The mean number of lifetime tanning booth uses was 56.74 (SD = 87.99). It is important to note that the mean age of participants was 21, so the typical participant had used a tanning booth 14 times per year during the past 4 years since age 17. Those who tanned indoors during warm weather had 3.39 times the odds of being TD compared to those who did not (95% CI = 1.33–8.64), conditional on other covariates in the model. Surprisingly, use of chemical sunless tanners and overall rates of indoor tanning did not predict TD.

Other Health-Related Behaviors

The following variables were entered into the other health behaviors logistic regression model predicting TD: smoking status, body mass index (BMI) group, aerobic exercising, and anaerobic exercising (Table 4). Twenty-five percent (n = 100) of the sample reported having been a regular smoker at some point in time, and 23% (n = 93) reported smoking during the past month. Those who were current smokers had greater odds of being TD compared to those who had never smoked (OR=1.81, 95% CI= 1.10–2.98). The mean body mass index (BMI) of the sample was 24.63 (SD = 5.23), which is in the healthy range. In the model, those who were obese (BMI>=30) were less likely to be TD than those who were underweight or normal weight (BMI<25), OR=0.34 (95% CI =0.14–0.85). Sixty four percent (n=258) of the sample was underweight or normal weight (BMI<25), 23% (n = 93) overweight (BMI>=25 and BMI<30), and 13% (n = 51) obese (BMI>=30). The mean number of days per week spent doing aerobic exercise was 2.16 (SD = 2.06), and the mean number of days spent doing strengthening exercises was 1.68 (SD = 1.94).

Sensitivity analyses were also conducted in order to assess whether changing the cut-points of the CAGE and DSM-IV-TR scales used to define TD would change our inferences. Tightening and loosening the criteria for TD did not change the general inferences compared to the original criteria, although some variables did become less statistically significant. The one major exception was the relationship of indoor tanning in warm weather with tanning dependence. With stricter criteria for TD, the point estimate of indoor tanning in warm weather was protective, whereas it was a risk factor with a looser definition. This relationship should be examined more closely in future studies.

DISCUSSION

These data demonstrated several predictors of tanning dependence, but some measurement issues still need to be addressed. TD was predicted by ethnicity and skin type, lack of skin protective behaviors, and outdoor and indoor tanning behaviors among young adults, as well as smoking and body mass index. These findings may offer new avenues for research as well as skin protection and skin cancer prevention interventions. However, the internal reliability of the measures was relatively low, and future research should include more in-depth psychometric development and analyses such as test-retest reliability or factor analysis.

The current study found slightly less than half the rates of TD as in the Warthan et al17 study, and both studies obtained higher TD rates on the mDSM-IV-TR than the mCAGE. Using the same scoring system, 11% of the current participants scored tanning dependent on

the mCAGE (versus 26% in Warthan et al17), and 23% scored dependent on the mDSM-IV-TR (versus 53% in Warthan et al[17]). The proportion meeting the CAGE criterion is very similar to the 12% found by Poorsattar and Hornung[28] in their sample of Seattle undergraduates. These rates are also similar to undergraduates' meeting CAGE criteria for alcohol (18%) and tobacco use (16%).[28] The higher rates observed by Warthan et al[17] make sense given that their sample was recruited directly from a beach as opposed to sampling from a general population. TD rates would also be likely to vary based on age, with older individuals being less at risk due to lower rates of tanning in general.[55,56] It was interesting that TD did not vary by gender as in the Warthan et al[17] study. Women were overrepresented in the current sample, so it may be that men who were not particularly interested in tanning did not choose to participate in this study.

In the current study, TD was related to race/ethnicity and Fitzpatrick[44] skin type. As expected, whites were more likely than nonwhites to be tanning dependent, but nonwhites were also represented in the TD group. It is interesting to note that a few African Americans screened positive for TD. These tended to be lighterskinned individuals, but this trend was not significant (probably due to the small sample size of this group). Therefore, non-whites should not be ignored in skin protection efforts.

Regarding Fitzpatrick[44] skin type, Type I and Type VI participants were least at risk for TD. Dark individuals (ie, Type VI) may not need to make an effort to tan or do not perceive tanning as culturally appropriate, and very fair individuals may not be able to tan or refrain from tanning because they are aware of their high risk for burning and other skin damage. The TD rates among Types V (26%) and VI (4%) were somewhat surprising, but it is important to note that Fitzpatrick skin type was self-reported. Therefore, some individuals may have rated their tanned skin rather than their natural skin color or minimized their risk for burning. This is suggested by the lifetime use of tanning booths by 57% of Types V and VI.

As expected, TD was associated with sun tanning, tanning booth use, sunburns, and lower likelihood of protecting the skin. These constructs are somewhat overlapping, but the findings still support the construct validity of the measures. A lack of association would raise serious validity concerns. The amount of intentional sun tanning was relatively low; however, the amount of incidental exposure was high and widespread. Interestingly, sun tanning appeared to be more closely related to TD than indoor tanning, which was only related during warm weather. It was not known a priori whether chemical sunless tanner use would be associated with TD or not, as sunless tanner use could be viewed as a protective behavior or as a UVR tanning enhancer. Sunless tanning was associated with TD in univariate analysis but was not as strongly related to TD as the other variables included in the multivariable model (Tables 1 and 3). However, sunless tanners could be recommended as an alternative to UVR tanning, particularly for TDs. An overwhelming majority of studies have demonstrated UVR to be harmful to the skin, but very few have found sunless tanners to be dangerous.[57]

The finding that almost 40% of the sample had used tanning booths is alarming, particularly when considering that the mean age of the participants was 21, the mean age of initiation

was 17, and the mean number of lifetime uses was 57. Tanning booth initiation at age 17 is probably notable given that it likely corresponds with the high school prom season or spring break trips. An ideal prevention opportunity may thus occur at a high school just before prom time or spring break. A previous study of 1275 adolescents found an average age of initiation of 15 years; however, that was a randomized household survey of teens from Boston and Minneapolis-St. Paul, 2 northern locales with cold climates.[25] Participants in the current study were more likely to use tanning booths during cold than warm weather. That the risk for tanning booth use increases during cold weather could be related to greater difficulty sun tanning at that time of year, preparing for winter vacations in warm locales, self-treatment for seasonal affective disorder,[21] and so on. However in the current study, TD was more closely related to indoor tanning during warm weather. This suggests that TDs may be utilizing all possible means to tan regardless of the time of year. These issues should be studied further and interventions tailored accordingly.

It was expected that TD would be associated with other health-related variables such as smoking, weight, and exercise. Because Demko et al[22] found that substance use was related to indoor tanning, it was hypothesized that tobacco use would be related to TD. Smokers may be more likely to be TD due to a similar addictive process or because both of these behaviors are often viewed as image enhancing. We expected low- to average-weight individuals to be at greater risk for TD than overweight or obese persons. It is likely that obese individuals are more concerned about their weight than having tanned skin and may not feel comfortable exposing their bodies in the manner necessary to receive high levels of UVR. We also expected that exercise would be related to TD, but the direction of the relationship was uncertain. Demko et al22 found that dieters wore more likely to use tanning booths but that exercising girls were less likely to do so. It would make sense that dieters or exercisers would tan more often because they are concerned about their appearance or, alternatively, that dieters/exercisers may tan less because they are concerned about their health.[22–24,58,59] However, we found no independent relationship between TD and exercise. Overall, these results provide evidence for conceptualizing tanning preoccupation as an addiction but do not rule out potential relationships to eating disorders or other psychiatric problems such as obsessive-compulsive disorder.

There are several ways in which the mDSM-IV-TR scale could be made more consistent with the original American Psychiatric Association substance dependence criteria.[34] A withdrawal syndrome is really not discussed in the modified scale An item such as “Do you experience jitteriness or nausea when you don’t tan for a while after a period of regular tanning?” could be added. One of the substance dependence criteria is spending a great deal of time in activities related to the substance. It appears that Warthan et al[10] arbitrarily decided to use one or more days per week spent tanning to define “a great deal of time,” but an appropriate amount remains an empirical question. Finally, the item referring to missing work due to sunburns seems to fit better conceptually with the item referring to missing activities due to tanning, rather than the items with which it is currently grouped that all refer to the amount of time spent tanning. Moreover, the cut scores used for substances may need to be modified for tanning. For example, 26% of individuals with skin Type V were found to be tanning dependent in the current sample. Because such dark-skinned individuals are typically not found to have high tanning rates, TD may have been overestimated.

Moreover, the mDSM-IV-TR and mCAGE agreed on 80% of the classifications, but the mDSM-IV-TR was much more inclusive. Further psychometric development could raise agreement between the scales. Likewise, because the items were originally developed to assess substance use, more indepth testing of the items, such as cognitive interviewing, might help strengthen their validity for use with tanners.

The popularity of conceptualizing excessive nonsubstance behaviors (food, sex, gambling, etc) as addictions has increased in recent years.[60,61] Previous studies have provided some support for conceptualizing excessive tanning as an addiction. Excessive tanning has been measured using standard addiction measures,[10] tanning has been found to be associated with substance use,[22] tanners find tanning physiologically reinforcing,[26] tanners have been concerned about quitting tanning[25] and have also demonstrated physiologic withdrawal symptoms.[27] There are certainly some similarities among excessive tanning and traditional addictions, suggesting possible biopsychosocial links. It may be that many tanners are first exposed incidentally to the sun during childhood activities, then tan intentionally for primarily psychosocial reasons such as appearance, relaxation, or socialization; and then a small subgroup experiences a strong physiologic reaction to tanning, which in some cases may be related to an underlying addictive or mood disorder. It is important to note that not all tanning behavior or even frequent behavior should be seen as indicative of TD. People tan for a variety of reasons, and only a subset would meet criteria for TD including having tanning-related problems such as tolerance, withdrawal, and other negative consequences. In addition, similarities could be drawn between excessive tanning and obsessive-compulsive disorders,[62] eating disorders,[18] and body dysmorphic disorder,[59] each of which also has biopsychosocial components. Which conceptualization is most useful has not yet been determined.

Limitations of the current study include that it used a convenience sample, is cross-sectional, and based on self-report data. It is possible that the sample of primarily Virginia psychology students is not generalizable to some other populations. Due to the single administration of the survey, it was not possible to monitor changes in patterns of UVR exposure over time. Additionally, all data were self-report and did not measure actual time spent tanning or skin damage levels. However, because the survey was conducted online, responses may have been more truthful than an in-person interview in which demand characteristics are greater. As the literature expands in this area, future research should further refine and validate measures of TD. For example, objective measures of UVR exposure could be used (eg, spectrophotometry). Other possible directions for future research would be to further explore TD prevalence in various populations. The relationship between TD and other addictive, eating, obsessive-compulsive disorders should be investigated. For example, TD could be compared with drugs other than tobacco use. Researchers should further explore tanning motivations and tailor interventions accordingly. For example, intervention studies might attempt to intervene prior to age 17 and focus on school-related events such as prom and spring break in order to prevent future TD. Ideally, interventions would reduce the importance placed on appearance in general and, specifically, the importance placed on tanning as an appearance enhancer.

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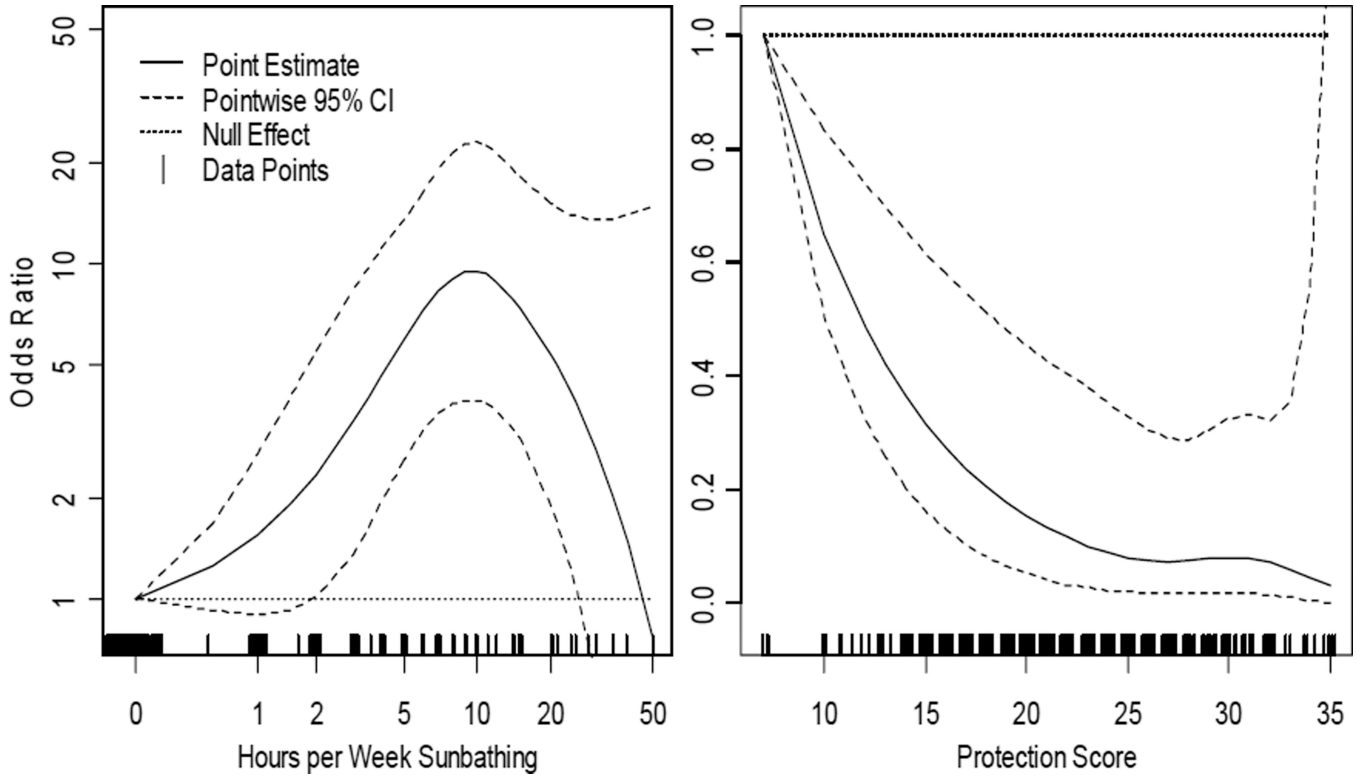

Figure 1.

Odds Ratio of Being Tanning Dependent Relative to Baseline

Note.

Baseline is no time spent sunbathing and the lowest sun protection score, from the model in which the 2 variables were included as restricted cubic splines. The effects relative to baseline are statistically significant where the confidence intervals do not cross 1. The distribution of the data is depicted by the bars on the bottom of the chart; for ease of display, the bars were slightly jittered because of overlap.

Table 1

Participant Characteristics by Tanning Dependence (N=400)

	Dependent % (n)	Not Dependent % (n)	P-value
Overall Sample	**26.5 (106)**	**73.5 (294)**	
Female Sex	77 (82)	74 (217)	NS
Psychology 101	78 (83)	79 (232)	NS
1st Year Student	60 (64)	59 (173)	NS
White	85 (90)	59 (172)	< .0001
Fitzpatrick Skin Type			.0015
1	7 (7)	13 (37)	
2	10 (11)	14 (32)	
3	26 (28)	15 (43)	
4	29 (31)	23 (68)	
5	26 (28)	27 (79)	
6	1 (1)	8 (24)	
Sunless Last Year	32 (34)	20 (59)	.0142
Ever Indoor	65 (68)	29 (85)	< .0001
Body Mass Index			0.039
<25	70 (73)	63 (183)	
25 to 30	25 (26)	22 (64)	
30+	6 (6)	15 (45)	
	M (SE)	**M (SE)**	**P-value**
Age	21.11 (.53)	20.92 (.32)	NS
Protection Score	19.53 (.52)	23.47 (.31)	< .0001
Indoor Tanning			
# Lifetime	83.15 (10)	35.93 (9)	.0009
Age Started	16.98 (.48)	17.47 (.43)	NS
# Last Year	24.20 (3.18)	5.75 (2.83)	<.0001
# Per Month If Warm	6.90 (1.22)	.87 (1.09)	.0003
# Per Month If Cool	8.08 (1.27)	2.35 (1.14)	.0010
Hrs per Week Sunbathing	7.50 (.58)	2.44 (.35)	<.0001
Hrs per Week Incidental	11.33 (1.31)	9.84 (.79)	NS
Lifetime Burns	2.29 (.39)	1.86 (.23)	NS
Burns Last Year	1.60 (.14)	.67 (.08)	<.0001
Days Smoked of last 30 days	6.38 (.95)	3.89 (.57)	.0250
# Cigarettes per Day	2.42 (.59)	1.40 (.35)	NS
Days Aerobics	2.43 (.20)	2.06 (.12)	NS
Days Anaerobics	2.02 (.19)	1.56 (.11)	.0360

Table 2

Demographic Predictors of Tanning Dependence (n=397)

Variable	OR	P-value	95% CI
Female	1.37	0.28	(0.78, 2.40)
Freshman	Reference		
Sophomore	0.97	0.94	(0.47, 2.01)
Junior	0.78	0.63	(0.28, 2.19)
Senior/Other Grade	0.54	0.22	(0.20, 1.44)
African American	Reference		
Asian American	1.93	0.33	(0.52, 7.18)
White	**7.60**	**0.00**	**(2.49, 23.19)**
Hispanic/Latino	5.50	0.06	(0.96, 31.59)
Other Race/Ethnicity	0.69	0.75	(0.07, 6.83)
Skin Type I	Reference		
Skin Type II	1.39	0.55	(0.48, 3.99)
Skin Type III	**3.51**	**0.01**	**(1.35, 9.12)**
Skin Type IV	**3.08**	**0.02**	**(1.21, 7.83)**
Skin Type V	**4.06**	**0.01**	**(1.49, 11.04)**
Skin Type VI	1.40	0.79	(0.13, 15.42)
Psychology Student	0.60	0.28	(0.24, 1.51)

Table 3

UVR-Related Predictors of Tanning Dependence (n=387)

Variable	OR	P-value	95% CI
Lifetime sunburns - Low	Reference		
Lifetime sunburns - Moderate	1.44	0.31	(0.72, 2.91)
Lifetime sunburns - High	1.15	0.72	(0.53, 2.47)
Burns Last Year - Low	Reference		
Burns Last Year - Moderate	**1.98**	**0.07**	**(0.95, 4.14)**
Burns Last Year - High	**2.85**	**0.01**	**(1.37, 5.91)**
Hours/Week Incidental Exposure - Low	Reference		
Hours/Week Incidental Exposure - Moderate	1.27	0.54	(0.59, 2.75)
Hours/Week Incidental Exposure - High	1.37	0.40	(0.66, 2.88)
Hours/Week Sunbathing - Low	Reference		
Hours/Week Sunbathing - Moderate	**2.32**	**0.06**	**(0.98, 5.50)**
Hours/Week Sunbathing - High	**7.54**	**0.00**	**(3.34, 17.02)**
Any sunless tanner in past year	1.21	0.59	(0.61, 2.40)
Lifetime indoor tanning exposure - None	Reference		
Lifetime indoor tanning exposure - Moderate	0.59	0.33	(0.20, 1.71)
Lifetime indoor tanning exposure - High	0.79	0.74	(0.19, 3.25)
Indoor tanning in last year - None	Reference		
Indoor tanning in last year - Moderate	2.15	0.18	(0.70, 6.65)
Indoor tanning in last year - High	1.73	0.40	(0.49, 6.13)
Indoor tanning in warm weather	**2.99**	**0.03**	**(1.14, 7.82)**
Indoor tanning in cool weather	1.57	0.34	(0.62, 3.95)
Sun protective behavior - Low	Reference		
Sun protective behavior - Moderate	**0.27**	**0.00**	**(0.13, 0.55)**
Sun protective behavior - High	**0.36**	**0.01**	**(0.17, 0.74)**

Table 4

Other Health Behavioral Predictors of Tanning Dependence (n=393)

Variable	OR	P-value	95% CI
Never regular smoker	Reference		
Regular smoker in past	1.14	0.80	(0.42, 3.03)
Current smoker	**1.81**	**0.02**	**(1.10, 2.98)**
Anaerobic exercise - Low	Reference		
Anaerobic exercise - Moderate	1.25	0.48	(0.67, 2.35)
Anaerobic exercise - High	1.50	0.25	(0.75, 3.02)
Aerobic exercise - Low	Reference		
Aerobic exercise - Moderate	1.83	0.07	(0.95, 3.54)
Aerobic exercise - High	1.26	0.54	(0.60, 2.63)
Low to Normal Weight, BMI <25	Reference		
Overweight, BMI>=25 and BMI<30	1.03	0.92	(0.59, 1.78)
Obese, BMI>=30	**0.34**	**0.02**	**(0.14, 0.85)**