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Prevalence of tanning addiction and associations with behavioral health conditions among multiethnic adolescents

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Abstract

Evidence indicates that tanning may be addictive and is associated with other behavioral health conditions. Few studies have examined tanning addiction among adolescents. We performed a cross-sectional study to explore the relationship between tanning addiction, substance use, and psychological conditions among ethnographically diverse 16–17 year-olds. Tanning addiction was assessed using the modified (m) CAGE measure among 11th grade students in Los Angeles (N=2,637; response rate 78%). Overall, 7.02% of the sample met tanning addiction criteria. Tanning addiction was significantly associated with past 30-day smoking and marijuana use, problem substance use, depression, panic disorder, obsessive compulsive disorder (OCD), and bipolar disorder in regression models. After controlling for all significant substance use and psychological variables, problem marijuana use and OCD remained significantly associated with tanning addiction (odds ratio 2.06, 95% confidence interval 1.03–4.09; and 2.54, 1.73–3.72, respectively.) Tanning addiction was also significantly associated with multiple problem substance

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CONFLICT OF INTEREST

The authors state no conflict of interest.

This work was conducted in Los Angeles, California, USA.

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use and behavioral health conditions. Our findings indicate an appreciable prevalence of tanning addiction among multiethnic adolescents, and suggest the importance of addressing tanning addiction in the context of comorbid behavioral conditions to reduce this high-risk behavior among diverse youth.

INTRODUCTION

Tanning behaviors, both outdoor sunbathing and indoor sunbed use, are prevalent in young adult populations and are strongly associated with increased risk of both non-melanoma and melanoma skin cancer (Fisher and James, 2010, Gandini et al., 2014). Non-Hispanic white (NHW) women ages 18–34 make up the majority of the indoor tanning population; among NHW females aged 18–21 in the U.S., the annual prevalence of indoor tanning is estimated at 20.4% (Guy et al., 2017b). Data on outdoor tanning are less available, however, sunbathing may be more a more widespread practice than indoor sunbed use among young adults (Gillen and Markey, 2012).

Recent studies of “tanning addiction,” a compulsive drive to frequently use indoor tanning beds, suggest that a sizeable proportion of young adults who tan have symptoms indicative of addiction (Mosher and Danoff-Burg, 2010a, Nolan et al., 2009, Petit et al., 2014). The prevalence of tanning addiction ranges from 4% in the general population to 33% among frequent indoor tanners (Banerjee et al., 2013, Heckman et al., 2014). Addictive tanning has been related to physical appearance and pro-tanning beliefs (Mays et al., 2017) and may have a physiological basis, as exposure to ultraviolet (UV) light stimulates the production of beta-endorphin, an endogenous opioid peptide with mood-elevating effects (Feldman et al., 2004, Kaur et al., 2005, Kourosch et al., 2010).

In cross-sectional studies, tanning addiction has also been associated with substance use and psychological disorders, including alcohol, tobacco, marijuana and other drugs as well as obsessive compulsive disorder (OCD), anxiety disorders, depression, seasonal affective disorder (SAD), and body dysmorphic disorder (BDD) (Ashrafioun and Bonar, 2014, Heckman et al., 2008, Hillhouse et al., 1999, Kourosch et al., 2010, Leary et al., 1997, Mays et al., 2017, Mosher and Danoff-Burg, 2010a, Phillips et al., 2006). However, it remains unclear what substances and mental health conditions are most strongly and consistently associated with tanning addiction (Petit et al., 2014).

To date, most studies regarding tanning addiction have been conducted among convenience samples of college-aged NHW females (Mosher and Danoff-Burg, 2010a, Petit et al., 2014). The evidence base is therefore thin regarding the relationship of tanning addiction to substance use and mental health conditions among youth, despite the fact that mid-adolescence is a period of high risk for developing addictive behaviors and the age where tanning norms are first initiated (Cokkinides et al., 2006, Guy et al., 2017a, Guy et al., 2017b, Steinberg, 2008). Moreover, while non-white populations have a lower incidence of skin cancer than NHWs, they are susceptible to both NMSC and melanoma, and experience poorer disease outcomes (Dawes et al., 2016, Garnett et al., 2016). However, ethnoracially diverse populations have been underrepresented in the tanning literature.

To address these research gaps, we examined cross-sectional associations between addictive tanning and behavioral health conditions among a multiethnic sample of high school students ages 16–17 in Los Angeles. To assess tanning addiction, we used the modified (m) CAGE measure, a 4-item scale adapted for tanning from a screening questionnaire for alcohol abuse (Ewing, 1984, Warthan et al., 2005). The mCAGE is a widely-used tanning addiction measure that was chosen for its brevity, feasibility for self-administration in a school-based setting, and potential utility as a brief clinical screening measure. We focused on a comprehensive set of behavioral health conditions including substance use, anxiety disorders, depression, bipolar disorder, attention deficient hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD). Because interventions to address tanning addiction are lacking, we sought to understand the most prevalent substance use and psychological symptoms that present with tanning addiction among multiethnic youth to inform the development of treatment strategies to prevent and reduce this risk behavior and its dermatologic sequelae.

RESULTS

A total of 3,874 high school adolescents assented to participate in the study, with an overall survey response rate of 82.5%. The mCAGE tanning measure was administered during a single study wave in 2013, when students were in the 11th grade (N=2,637; response rate 78%).

Prevalence of tanning addiction

Tables 1 and 2 present the sample characteristics of participants, percentage of adolescents meeting the mCAGE criteria for tanning addiction, and the percentage endorsing individual items. Overall, 7.02% of students met mCAGE criteria for tanning addiction (endorsing 2 items). This figure was slightly higher for females than males (8.62% versus 5.10%, respectively), and similar between adolescents who identified as Hispanic compared to those who identified as NHW (7.57% versus 7.91%, respectively). Asian and Asian-American students had the lowest prevalence of tanning addiction at 4.27%, while Native Hawaiian/Pacific Islanders had the highest at 10.53%. The most highly endorsed item of the mCAGE was the question regarding problems with cutting down tanning; 10.89% of the sample responded affirmatively to this question.

Associations between substance use and tanning addiction

Table 3 presents the prevalence of and logistic regression analyses of the association between substance use variables and tanning addiction. Of substance use, past 30-day alcohol use had the highest prevalence in the sample at 20%. In unadjusted analysis (Model 1), all substance use variables were significantly associated with tanning addiction except for past 30-day use of e-cigarettes (vaping). The magnitude of association was more pronounced between the three problem substance use scales (RAPI, CAST, and DAST) and tanning addiction.

In univariable analyses adjusted for covariates (Model 2), neither past 30-day vaping nor alcohol use were significantly associated with tanning addiction; however, past 30-day

tobacco and marijuana use remained significant. As in Model 1, the magnitude of association between problem substance use and tanning addiction remained more pronounced, e.g., adolescents who scored in the range of problem drinking were 3.40 (95% CI 2.13–5.42) times as likely to meet tanning addiction criteria compared to those below this range. In both unadjusted and adjusted analyses, all variables significant at $p < 0.05$ remained so after Benjamini-Hochberg (Type 1 error) correction.

Associations between psychological symptoms and tanning addiction

Table 3 presents the prevalence of and logistic regression analyses of the association between psychological variables and tanning addiction. Of psychological symptoms, depression and panic disorder had the highest prevalence at 22% and 20%, respectively. All psychological symptoms were significantly associated with tanning addiction in unadjusted analysis except for generalized anxiety and ADHD (Model 1).

In analyses adjusted for covariates (Model 2), this pattern remained consistent; however, social phobia was no longer significant. As in unadjusted analyses, the magnitude of association was more pronounced for panic disorder and OCD with tanning addiction; adolescents with symptoms of panic disorder were 2.35 (95% CI 1.45–3.81) times as likely to meet tanning addiction criteria compared to those without symptoms, and those with OCD symptoms were 3.39 (95% CI 2.10–5.49) times as likely to meet tanning addiction criteria as adolescents without symptoms. In both unadjusted and adjusted analyses, all variables significant at $p < 0.05$ remained so after Benjamini-Hochberg correction.

Associations between all comorbidities and tanning addiction

Model 3 included all comorbidities significant in Model 2 after Benjamini-Hochberg correction (Table 3). After adjusting for all comorbidities, problem use of marijuana and OCD remained significantly associated with tanning addiction. Adolescents who screened positive for the problem use of marijuana were 2.06 (95% CI 1.03–4.09) times as likely to meet tanning addiction criteria as those were not problem users, and adolescents with OCD symptoms were 2.54 (95% CI 1.73–3.72) as likely to meet tanning addiction criteria compared to those without symptoms. Both associations remained significant after Benjamini-Hochberg correction.

Associations between multiple problem substance use and psychological symptoms and tanning addiction

Separate models examined whether multiple behavioral health conditions increased the likelihood of tanning addiction (Table 3). In unadjusted analyses (Model 1), an increasing number of problem substance use and psychological symptoms were significantly associated with greater likelihood of tanning addiction. After adjustment for covariates (Model 2), for each additional problem substance use, adolescents were 1.67 (95% CI 1.41–2.01) times as likely to meet tanning addiction criteria. For each additional psychological symptom, adolescents were 1.30 (95% CI 1.10–1.53) times as likely to meet tanning addiction criteria. Only increasing problem substance use remained significant at $p < 0.05$ after Benjamini-Hochberg correction in analyses adjusted for covariates.

In a model accounting for both multiple problem substance use and psychological symptoms (Model 4), for each additional substance use adolescents were 1.13 (95% CI 1.02–1.25) times as likely to meet tanning addiction criteria, while for each additional psychological symptom, adolescents were 1.29 (95% CI 1.09–1.52) times as likely to meet tanning addiction criteria. Both remained significant after Benjamini-Hochberg correction.

DISCUSSION

Our cross-sectional study examined associations between substance use, mental health conditions and tanning addiction among a sample of multiethnic 16–17 year-old high school students. We observed statistically significant associations of tanning addiction with behavioral health comorbidities of clinically significant magnitude and pervasive across numerous psychological conditions and problem use of substances. Estimates were robust to adjustment for Type I error correction.

While the prevalence of indoor tanning has been assessed in high school samples (Guy et al., 2017a), little research has focused on tanning as an addiction in this age group. We found associations between tanning addiction and use of substances including past-30 day smoking and marijuana as well as the problem use of alcohol, marijuana, and other drugs. In addition, we observed pronounced associations between tanning addiction and specific mental health conditions including depressive symptoms, panic disorder, OCD, and bipolar disorder. After taking other substance use and psychiatric variables into account, adolescents who reported problem use of marijuana use and OCD symptoms were more than twice as likely to meet tanning addiction criteria. This finding is notable, as marijuana may possess the strongest mood-elevating effects among the three most commonly abused substances by adolescents (which also includes tobacco and alcohol) (Zeiger et al., 2012). Among adolescents, OCD is frequently characterized by pervasive anxiety, impaired social functioning, and poor impulse control, and is often associated with substance use disorders (Langley et al., 2010). OCD has also been linked to addictive tanning among college-aged young adults in prior research (Ashrafioun and Bonar, 2014). Thus, the relation of tanning addiction to marijuana use disorder and OCD symptoms may indicate adolescents' attempts to self-medicate and alleviate anxiety and stabilize mood.

Tanning addiction increased with multiple behavioral health conditions among the sample. With each additional problem use of substances, the likelihood of tanning addiction was increased by 67% for adolescents; for each additional psychological symptom, this figure was 30%. Consistent with other studies, our findings suggest that tanning addiction is a phenomenon of concurrent behavioral health conditions (Mays et al., 2017). The present study contributes to this growing evidence by demonstrating that such comorbidity is present as early as mid-adolescence.

As such, this study offers insights into prevention and treatment strategies for this age group. Treatments that attend to the complex psychological conditions and problem substance use that area comorbid with addictive tanning may reduce this risk behavior more effectively than patient counseling alone; for example, approaches which address the common underlying motives between co-occurring addictions and that augment emotional and mood

regulation skills for adolescents (Stapleton et al., 2017, Sussman et al., 2014, Sussman, 2017). Further, the co-occurrence of tanning addiction with serious behavioral comorbidities makes policy efforts to restrict indoor tanning for minors particularly critical, as such adolescents may have impaired decision-making abilities (Balogh et al., 2013). Currently, while 43 states in the U.S. have enacted some legislation to restrict indoor tanning for minors, only 17 have enacted indoor tanning bans for youth under age 18, and nearly two million U.S. high school students continue to tan indoors each year (Guy et al., 2015, National Conference of State Legislatures).

Finally, we observed a prevalence of tanning addiction similar to or exceeding NHWs among several ethnic/racial minority groups in the sample. Although indoor tanning is most common among NHWs (Guy et al., 2015), studies have found that Hispanic adolescents exhibit risky UV behaviors and hold views of tanning attractiveness similar to NHW peers (Cheng et al., 2010, Heckman and Cohen-Filipic, 2012). While our finding may stem from geographic factors (e.g., the present study was conducted in a high UV environment where adolescents may hold more positive tanning attitudes or engage in more frequent sunbathing and tanning behaviors), it underlines the need for research that extends beyond NHW populations to examine tanning norms and practices that may lead to tanning addiction among diverse ethnic and racial groups.

Limitations to the study include the cross-sectional design which does not allow causal inference; thus it is not clear if tanning addiction is a precursor to, or symptom of, substance use or psychological symptomology. We did not assess tanning behaviors; given the age of the sample and reports of California's high compliance with state legislation banning the use of tanning salons for minors (Grewal et al., 2013, Williams et al., 2017), we assumed that students who met the criteria for tanning addiction were primarily practicing outdoor sunbathing. However, is it possible that respondents could be circumventing the under-18 tanning ban, or using tanning devices at home or in settings that may receive less monitoring for compliance.

The self-reported data may lead to response bias including under-reporting of the risk behaviors and mental health conditions examined here, resulting in inaccurate estimates of association. Several variables of potential importance to tanning addiction, including BDD and SAD, were beyond the scope of the current study; further research should assess these factors in relation to tanning addiction in this age group. While the mCAGE is one of the most widely-used measures, consensus has not been reached regarding the most valid method to assess tanning addiction. For future studies, using the mCAGE in combination with the tanning modified Diagnostic and Statistical Manual for Mental Disorders-IV (DSM-IV-TR) may provide a more reliable estimate of addictive tanning (Heckman et al., 2014, Hillhouse et al., 2012). Further, our measure had relatively low internal consistency with a Cronbach's alpha of 0.55; however, this alpha was comparable to other studies using the mCAGE (Heckman et al., 2014) and may reflect the brevity of the 4-item scale as alpha increases with increasing number of items. Finally, all participants were sampled from Los Angeles, and generalizability may therefore be limited. Strengths of the study include a large multiethnic adolescent population, and the use of a spectrum of well-validated substance use and psychological measures.

In conclusion, among multiethnic high school students residing in Los Angeles, the prevalence of tanning addiction was appreciably high and associated with a range of problem substance use and psychological symptoms. Further research and development of treatment approaches that address tanning addiction in the context of specific co-occurring behavioral conditions among multiethnic samples are needed to reduce this high-risk behavior in youth.

MATERIALS & METHODS

Participants and Procedures

We used cross-sectional survey data from the Happiness and Health study, a longitudinal survey of substance use and mental health among 10 public high schools in Los Angeles, CA. Full details on school recruitment, student recruitment, and survey procedures have been reported elsewhere (Leventhal et al., 2015). Adolescents' race and ethnicity were obtained via self-report from a list comprising ethnic and racial categories; participants were asked to choose one term that described them. Participants surveyed did not differ on any of the measured variables from the full sample at baseline, indicating representativeness of the sample. The study was approved by the Institutional Review Board at the University of Southern California, and all students participating in the study provided written parental permission and assent.

Measures

Table 4 presents Cronbach's alphas for the mCAGE measure, as well as means, standard deviations, and alphas for continuous substance use and psychological variables.

Tanning addiction—Tanning addiction was measured by the modified (m) CAGE measure, a tanning modified version of the Cut-down, Guilty, Annoyed, Eye-Opener (CAGE) measure, a validated scale to assess problem drinking and alcohol abuse (Ewing, 1984, Warthan et al., 2005). The mCAGE includes four questions that indicate addiction-like behaviors related to tanning: 1) Have you ever felt you needed to **cut down** on your tanning? 2) Have people **annoyed** you by criticizing your tanning? 3) Have you ever felt **guilty** about tanning? 4) Have you ever felt you needed to tan first thing in the morning (**eye-opener**)? Each question is dichotomous (yes/no). As per the scoring for the original CAGE screener, "yes" responses were summed, and endorsement of 2 or more questions indicates tanning addiction.

Substance use

Past 30-day substance use: Past 30-day substance use was assessed using standard validated items with dichotomous yes/no responses (Eaton et al., 2010). Adolescents were asked whether they had smoked a combustible cigarette, used an e-cigarette ("vaped"), used alcohol, or used marijuana in the past 30 days.

Problem use of substances: Three validated scales to assess problem use of substances among adolescents were used: the Drug Abuse Screening Test (DAST-10) (Skinner, 1982), a 10-item survey designed to measure degree of drug problems without specifying the

particular drug of abuse; the Rutgers Alcohol Problems Index (RAPI-18) (White and Labouvie, 2000), an 18-item survey designed to measure degree of alcohol problems; and the Cannabis Abuse Screening Test (CAST) (Legleye et al., 2011), a 6-item scale to assess problem use of marijuana. For the DAST, responses were dichotomized to “none/low” problem drug use (scores of 0- 2) versus “medium/high” problem drug use (scores of 3–10). For the RAPI, a cutoff of 15 for “high problem drinkers” was used, with <15 indicating “low problem and non-drinkers,” as in prior studies (Wolitzky-Taylor et al., 2016). The cutoff for the CAST used was 2, indicating possible DSM-IV cannabis use disorder.

Psychological symptomology—The Revised Children’s Anxiety and Depression Scale (RCADS) was used to assess Major Depressive Disorder (10 items), Generalized Anxiety Disorder (6 items), Social Phobia (9 items), Panic Disorder (9 items), and Obsessive-Compulsive Disorder symptoms (6 items) (Chorpita et al., 2000). The frequency of each behavior was ascertained with 4 response options ranging from “never” (0) to “always” (3). For each subscale, scores were added and converted to a T score; T scores of 65 or higher indicating borderline clinical threshold, with scores of 70 or higher meeting the clinical threshold (Chorpita et al., 2005). For the purpose of analysis, adolescents were categorized as “symptomatic” (scoring at or above the borderline clinical threshold of 65) versus “non-symptomatic” (scoring below 65). The rationale for including threshold clinical values for the RCADS was to provide broader inclusion of potential mental health conditions, as many of the disorders are characterized appropriately as a spectrum, and adolescents at the clinical threshold may be functionally impaired and eventually progress to clinical cutpoints (Merikangas et al., 2009).

The 15-item Mood Disorder Questionnaire (MDQ) (Hirschfeld et al., 2000) assessed bipolar-manic symptoms. To meet the criteria for bipolar disorder, adolescents must provide an affirmative response to 7 or more of the 13 items in the first question, as well as an affirmative response to two questions assessing whether these issues were experienced during the same time period, and whether they caused “moderate” or “serious” problems in their lives.

The 18-item Current Symptoms Scale-Self Report assessed past six-months attention-deficit/hyperactivity disorder (ADHD) on a 0–3 Likert-type scale ranging from 0=never to 3=very often (Barkley and Murphy, 1998). Each of the subscales (impulsivity and inattention) were dichotomized to clinical cut-off values (a diagnostic cutoff of 6 out of 9 items rated as “often” or “very often”).

Indices of multiple problem substance use and psychological symptoms—Two indices were created to examine associations between multiple problem substance use and psychological symptoms and tanning addiction. Scores for the three dichotomized problem substance use scales (CAST, DAST, and RAPI) were summed with a range of 0 to 3. Scores were also summed for the seven dichotomized psychological scales with a range of 0 to 7.

Covariates—Because behavioral health conditions and tanning have been shown to be associated with unique demographic profiles that could confound associations between the independent variables and the outcome (Mosher and Danoff-Burg, 2010b, Zeller et al.,

2006), we adjusted for several covariates in analyses. Demographic characteristics were measured using forced-choice survey items, including gender (male/female), ethnicity (Hispanic vs. non-Hispanic), qualification for free or reduced-price lunch (eligible versus non-eligible) as a proxy for socioeconomic status, and age.

Statistical analysis—Descriptive statistics were used to examine the characteristics of the sample and the prevalence of substance use behaviors and psychological symptoms. Unconditional binary logistic regression models were conducted to assess the associations of independent substance use and psychological variables with the tanning addiction outcome. The Benjamini-Hochberg correction was applied to control for the study-wise false discovery rate (Type 1 error) at 0.05 due to multiple comparisons in all models (Benjamini and Hochberg, 1995). Univariable (unadjusted) regression analyses were first conducted without covariates (Model 1), and then a univariable (adjusted) regression model (Model 2) was analyzed after adjusting for covariates (sex, Hispanic ethnicity, free/reduced lunch eligibility, and age). A multivariable regression model was then conducted including all variables which were significant in Model 2 after Benjamini-Hochberg correction and covariates (Model 3). For the two indices of multiple problem substance use and psychological symptoms, multivariable regression models were conducted to test whether an increasing number of problem substance use and psychological symptoms increased the odds of tanning addiction separately (Model 3) and adjusting for each index (Model 4). All 95% confidence intervals (95% CI) reported are pre-Type 1 error correction.

Since respondents were clustered within schools, multilevel analyses were conducted to take into account interdependence within the data (i.e., the error terms of regression models were not independent) to avoid an underestimation of standard errors. Missing data were managed with full information likelihood estimation (FIML). Analyses were conducted with SAS (Version 9.4) (SAS Institute; Cary, NC, USA).

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Abbreviations used

mCAGE	modified CAGE
AOR	Adjusted odds ratio
NHW	Non-Hispanic white
NMSC	Non-melanoma skin cancer
UV	Ultraviolet
SAD	Seasonal affective disorder
BDD	Body dysmorphic disorder
CI	Confidence intervals

CAST	Cannabis Abuse Screening Test
RAPI	Rutgers Alcohol Problems Index (RAPI)
DAST	Drug Abuse Screening Test
ADHD	Attention deficient hyperactivity disorder
OCD	Obsessive compulsive disorder
MDQ	Mood Disorder Questionnaire
RCADS	Revised Children's Anxiety and Depression Scale
FIML	Full information likelihood estimation

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Table 1

Demographic characteristics of sample and prevalence of tanning addiction (N=2,637)

	Mean	SD		
Age	16.06	0.43		
	Overall	mCAGE criteria (+)	mCAGE criteria (-)	P-value^a
	N(%)			
Gender				
Female	1,415 (55.02)	122 (8.62)	1,293 (91.38)	0.0005
Male	1,157 (44.98)	59 (5.10)	1,098 (94.90)	
Race/Ethnicity				
Hispanic/Latino	1,189 (46.14)	90 (7.57)	1,099 (92.43)	0.20
Non-Hispanic White	417 (16.18)	33 (7.91)	384 (92.09)	
Asian/Asian-American	468 (18.16)	20 (4.27)	448 (95.73)	
African-American	108 (4.19)	7 (6.48)	101 (93.52)	
American Indian/Alaskan Native	22 (0.85)	1 (4.55)	21 (95.45)	
Native Hawaiian/Pacific Islander	95 (3.69)	10 (10.53)	85 (89.47)	
Multiracial/Not specified	278 (10.79)	20 (7.19)	258 (92.81)	
Free/reduced price lunch				
No	1,314 (51.09)	89 (6.77)	1,225 (93.23)	0.75
Yes	1,141 (44.36)	82 (7.19)	1,059 (92.81)	
Don't know	117 (4.55)	10 (8.55)	107 (91.45)	

^aChi-square Test

Table 2

Percentage of adolescents endorsing mCAGE items (N=2,637)

N(%) [^]		
mCAGE tanning addiction criteria	Endorsed (+)	Not endorsed (-)
2 mCAGE symptoms	185 (7.02)	2,452 (92.98)
Individual items		
Q1 (<i>Cut-down</i>)	286 (10.89)	2,340 (89.11)
Q2 (<i>Annoyed</i>)	208 (7.94)	2,410 (92.06)
Q3 (<i>Guilty</i>)	190 (7.27)	2,425 (92.73)
Q4 (<i>Eye-opener</i>)	116 (4.44)	2,498 (95.56)

[^] May not sum to total due to item non-response

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Table 3

Regression models for associations between substance use and psychological symptoms and tanning addiction among multiethnic adolescents (N=2,637)

	Sample prevalence	Model 1: ¹ Unadjusted OR (95% CI)	Model 2: ² Covariate-adjusted OR (95% CI)	Model 3: ³ Multivariable OR (95% CI)	Model 4: ⁴ Multivariable OR (multiple indices) (95% CI)
Past 30 day substance use (y/n)					
Smoking last 30 days	87 (3.35)	1.56 (1.17–2.09)*	1.60 (1.18–2.17)*	0.73 (0.46–1.15)	–
Vaping last 30 days	147 (5.67)	1.08 (0.71–1.64)	1.13 (0.75–1.68)	–	–
Alcohol last 30 days	520 (20.04)	1.34 (1.03–1.75)*	1.28 (0.98–1.66)	–	–
Marijuana last 30 days	287 (11.08)	1.65 (1.25–2.19)*	1.68 (1.26–2.22)*	1.02 (0.59–1.74)	–
Problem substance use⁴					
Rutgers Alcohol Problems Index	78 (3.03)	3.32 (2.11–5.22)*	3.40 (2.13–5.42)*	1.66 (0.92–2.99)	–
Cannabis Abuse Screening Test	297 (11.56)	2.36 (1.61–3.45)*	2.35 (1.58–3.49)*	2.06 (1.03–4.09)*	–
Drug Abuse Screening Test	197 (7.61)	2.14 (1.61–2.84)*	2.17 (1.60–2.93)*	0.89 (0.70–1.13)	–
Psychological symptoms⁵					
Depressive symptoms	552 (21.82)	1.80 (1.13–2.87)*	1.64 (1.08–2.71)*	0.86 (0.47–1.58)	–
Generalized anxiety symptoms	458 (18.10)	1.48 (0.93–2.34)	1.50 (0.95–2.38)	–	–
Panic disorder symptoms	514 (20.37)	2.43 (1.53–3.88)*	2.35 (1.45–3.81)*	1.63 (0.96–2.76)	–
Social phobia symptoms	381 (15.10)	1.66 (1.10–2.49)*	1.50 (0.96–2.35)	–	–
Obsessive-compulsive symptoms	269 (10.60)	3.59 (2.28–5.64)*	3.39 (2.10–5.49)*	2.54 (1.73–3.72)*	–
Bipolar disorder	124 (4.78)	3.15 (1.46–6.77)*	3.02 (1.41–6.49)*	1.57 (0.73–3.34)	–
ADHD	171 (6.48)	1.73 (0.93–3.23)	1.84 (0.98–3.46)	–	–
Multiple substance use/psychological symptoms⁶					
Problem substance use index M(SD) ⁷ (Range = 0 – 3)	0.22 (0.58)	1.68 (1.42–1.98)*	1.67 (1.41–2.01)*	–	1.13 (1.02–1.25)*
Psychological symptoms index M(SD) (Range = 0 – 7)	0.87 (1.36)	1.32 (1.14–1.54)*	1.30 (1.10–1.53)	–	1.29 (1.09–1.52)*

* Significant after Benjamini-Hochberg (Type 1) correction; confidence intervals reported are pre-correction.

¹ Unadjusted univariable analysis² Univariable analyses adjusted for sex, Hispanic ethnicity, free/reduced lunch eligibility, and age

³ Multivariable analyses adjusted for covariates and substance use and psychological symptom variables significant in Model 2

⁴ Multivariable analysis adjusted for covariates and both comorbidity indexes

⁵ Reference group: no positive screen at threshold or clinical level

⁶ Composite score of problem substance use and psychological symptoms

⁷ Mean +/- SD

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Table 4

Psychometrics for scaled measures (N=2,637)

	α^1	M/SD ²
Modified (m) CAGE	0.55	-
Rutgers Alcohol Problems Index (RAPI)	0.93	2.06 (5.04)
Cannabis Abuse Screening Test (CAST)	0.93	1.08 (3.08)
Drug Abuse Screening Test (DAST)	0.85	1.27 (0.99)
Mood Disorder Questionnaire	0.78	4.75 (3.49)
Revised Children's Anxiety and Depression Scale (RCADS)		
Depressive Symptoms	0.93	8.16 (7.05)
Generalized anxiety symptoms	0.91	7.45 (4.60)
Panic disorder symptoms	0.93	4.20 (5.40)
Social phobia symptoms	0.93	10.95 (7.49)
Obsessive-compulsive symptoms	0.86	3.58 (3.71)
Current Symptoms Scale-Self Report (ADHD)		
Impulsivity	0.87	5.40 (4.95)
Inattention	0.91	5.67 (5.42)

¹Cronbach's alpha²Mean/Standard Deviation