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Daily Marijuana Use and Suicidality: The Unique Impact of Social Anxiety

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Abstract

Despite a clear relationship between marijuana use and suicidality, little is known about psychological vulnerability factors that may interact with marijuana use to increase suicidality among this high-risk group. The present study examined the moderational impact of social anxiety on the relationship between marijuana use status (current users vs abstainers) and suicidality among 343 community adults. We also examined whether social anxiety moderated the relation between more frequent use (daily vs less frequent) among the 134 current marijuana users. Although social anxiety did not moderate the relation between use status and suicidality, it did moderate the relation between daily use status and suicidality after controlling for a wide range of relevant variables (e.g., demographics, depression, negative affect, other types of anxiety). The overall model accounted for 59% of the variance in suicidality such that daily marijuana users with elevated social anxiety reported the highest suicidality. Findings highlight the importance of considering social anxiety in efforts to understand and prevent suicidality among this high-risk population.

Keywords

marijuana; cannabis; suicidality; social anxiety; social anxiety disorder; social phobia

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Conflict of Interest

The authors have no conflicts of interest to declare.

Contributors

Drs. Michael Zvolensky and Norman Schmidt designed the original study and wrote the protocol. Dr. Julia Buckner designed the current study, managed the literature searches, and conducted statistical analyses. All authors contributed to and have approved the final manuscript.

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1. Introduction

Marijuana use remains the most commonly used illicit substance in the U.S., with approximately 6% of the population reporting current (past-month) use (Substance Abuse and Mental Health Administration [SAMSHA]; 2009). These high rates of marijuana use are concerning given that current marijuana use is related to greater suicidality (e.g., Ilgen et al., 2009). Suicide attempters are more likely to endorse lifetime marijuana use (Afifi, Cox, & Katz, 2007; Price, Hemmingsson, Lewis, Zammit, & Allebeck, 2009) and regular recent (i.e., using ≥ 10 times in the past 12 months) marijuana use (Pagès, Arvers, Hassler, & Choquet, 2004). Prospectively, past-year marijuana was related to greater risk of suicidal ideation and suicide attempts over a six year period among young adults (Pedersen, 2008). This risk of suicide attempts was particularly evident among regular (i.e., using ≥ 10 times) marijuana users, who were *nearly five times* more likely to attempt suicide than marijuana abstainers after controlling for relevant demographic and psychosocial variables (Pedersen, 2008).

Marijuana use is also linked to greater likelihood of dying by suicide. Compared to those who died of natural causes, those who died by suicide were two-four times more likely to have used marijuana (Kung, Pearson, & Liu, 2003; Kung, Pearson, & Wei, 2005). Marijuana is the most common illicit substance reported in toxicology reports of people who died by suicide (Darke, Duflou, & Torok, 2009; Eksborg & Rajs, 2008; Perret, Abudurehman, Perret-Catipovic, Flomenbaum, & La Harpe, 2006). In fact, toxicology screens were more likely to be positive for marijuana than for all other illicit substances combined (e.g., Eksborg & Rajs, 2008) and the rate of positive marijuana toxicology screens among people who died by suicide nearly doubled between 1997–2006 (Darke et al., 2009).

Despite the clear relationship between marijuana use and suicidality, there remain several limitations to our understanding of this relationship. First, much of the literature is based on lifetime marijuana use (e.g., Afifi et al., 2007; Price et al., 2009), making it difficult to know whether marijuana use is proximally related to suicidality. Second, studies that have examined current use tend to compare users to non-users (e.g., Chabrol, Chauchard, & Girabet, 2008; Pedersen, 2008) and we know little about whether more frequent use is related to even higher suicidality among current users. There are some indirect data suggesting that more frequent use is related to greater suicidality (Pedersen, 2008), yet we know of no published studies examining whether daily use is related to greater suicidality than less frequent use. Lack of data regarding suicidality among daily users is concerning given that 36% of current marijuana users (or 3.9 million people) are daily users (SAMSHA; 2009). Further, daily marijuana use is linked to greater anxiety and depression (Oyefeso, 1991; Patton et al., 2006), suggesting these users may be especially vulnerable to greater suicidality. Taken together, these data suggest that examination of variables that may be related to greater suicidality among daily users could provide important information for the prevention of suicide in this prevalent yet understudied group.

A third limitation of our understanding of the relation between marijuana use and suicidality lies in the observation that although many studies found a robust relationship between marijuana and suicidality that remains even after relevant variables (e.g., demographic variables, anxiety, depression, alcohol-related problems, tobacco use) were considered (e.g., Afifi et al., 2007; Chabrol et al., 2008; Kung et al., 2003; Pedersen, 2008), others do not (e.g., Beautrais, Joyce, & Mulder, 1999; Price et al., 2009). These disparate findings may be due at least in part to the lack of attention to psychological vulnerabilities that may work in concert with more frequent marijuana use to produce greater suicidality. Social anxiety (i.e., fear of scrutiny in social situations) is one psychological vulnerability that appears especially related to marijuana-related behaviors (Agosti, Nunes, & Levin, 2002; Buckner,

Bonn-Miller, Zvolensky, & Schmidt, 2007; Buckner, Heimberg, & Schmidt, 2011; Buckner, Mallott, Schmidt, & Taylor, 2006; Buckner & Schmidt, 2008, 2009; Buckner, Schmidt, Bobadilla, & Taylor, 2006; Buckner, Silgado, & Schmidt, 2011; Stinson, Ruan, Pickering, & Grant, 2006). To illustrate, relative to adolescents without clinically elevated social anxiety (i.e., social anxiety disorder or SAD), those with SAD were nearly *five times* more likely to develop marijuana dependence as young adults after controlling for relevant demographic and psychiatric variables (Buckner et al., 2008). Among marijuana users, SAD was also related to faster transition from first use to marijuana-related problems among adolescent boys even after controlling for delinquency (Marmorstein, White, Loeber, & Stouthamer-Loeber, 2010).

Social anxiety is also related to high rates of suicidality (e.g., Coffey, Carlin, Lynskey, Li, & Patton, 2003; Davidson, Hughes, George, & Blazer, 1993) even after controlling for co-occurring depression (Norton, Temple, & Pettit, 2008). Additionally, social avoidance, a hallmark feature of pathological social anxiety, is related to problematic marijuana use (Buckner, Heimberg, et al., 2011). Social avoidance could result in a low sense of belongingness (i.e., a greater sense of alienation from others) which appears robustly related to suicidality among substance users (Conner, Britton, Sworts, & Joiner, 2007). These data suggest that social anxiety may play an especially important role in the relationship between marijuana use and suicidality.

The aim of the present study was to examine whether social anxiety moderated the relationship between marijuana use status (current use vs never users) and suicidality in a community sample. We next examined whether social anxiety moderated the relationship between frequency of marijuana use (daily vs. less frequent use) and suicidality among current marijuana users. In light of some data suggesting that demographic and psychosocial variables may better account for observed relations between marijuana use and suicidality (e.g., Beautrais et al., 1999; Price et al., 2009), moderational analyses controlled for a wide array of demographic and psychosocial variables found to be related to suicidality and/or marijuana use: depression, anxiety sensitivity, panic, worry, obsessive-compulsiveness, negative affect, and tobacco and alcohol use (e.g., Agosti et al., 2002; Buckner, Keough, & Schmidt, 2007; Buckner, Leen-Feldner, Zvolensky, & Schmidt, 2009; Kung et al., 2003; Pedersen, 2008; Schmidt, Woolaway-Bickel, & Bates, 2001; Zvolensky et al., 2006). We also examined whether SAD status moderated these relationships after controlling for these covariates.

2. Method

2.1 Participants and Procedure

Participants were 343 (44.0% female) adult daily tobacco smokers who responded to community-based advertisements (e.g., flyers, newspaper ads, radio announcements) to participate in a larger study examining the efficacy of a 4-session tobacco smoking-based behavioral intervention program. To participate, individuals had to report smoking 8 or more cig/day on average for at least 1 year, provide a carbon monoxide breath sample of 10 ppm or higher at the baseline session, and be at least 18 years old. Participants were excluded if they were currently considered at high-risk for suicidal behaviors, psychotic, had an inability to give informed consent, or were currently using any other tobacco smoking cessation treatment. Ages ranged from 18–65 and the racial/ethnic composition was: 1.2% Asian or Asian American, 84.5% Caucasian, 9.3% Black/non-Hispanic, 0.3% Black/Hispanic, 1.8% non-Black/Hispanic, and 2.3% “other.” Regarding education, 29.0% had a high school diploma (or equivalent) or less, 34.3% reported some college education, 9.0% graduated for a two-year college, 14.1% graduated from a four year college, and 13.5% attended and/or

graduated from graduate school. The majority (65.7%) was currently employed, 14.8% were full-time students, 1.2% were retired, and 16.9% were unemployed.

Of the 343 participants, 66 (19.2%) reported never using marijuana and were classified as “marijuana abstainers”; 134 (39.1%) endorsed current (past-month) marijuana use. Of these 134, 32.1% reported daily use and approximately 14% met DSM-IV-TR criteria for SAD.

All participants provided informed consent prior to data collection. The study protocol was approved by the universities’ Institutional Review Boards. Participants completed computerized versions of the below measures at the baseline assessment session.

2.2 Measures

2.2.1 Suicidality—Suicidality was assessed using the 6-item suicidality subscale of the *Inventory of Depression and Anxiety Symptoms* (IDAS; Watson et al., 2007). Sample suicidality items include: “I had thoughts of suicide” and “I hurt myself on purpose.” The IDAS suicidality subscale has demonstrated adequate internal consistency, convergent validity (correlations with anxiety and depression), discriminant validity (more strongly related to depression than anxiety), and test-retest reliability in psychiatric, community adult, and college student samples (Watson et al., 2008; Watson et al., 2007). The IDAS suicidality subscale strongly correlated with an interview assessment of suicidality (Watson et al., 2007).

2.2.2 Marijuana use—*The Marijuana Smoking History Questionnaire* (MSHQ; Bonn-Miller & Zvolensky, 2009) is a 21-item questionnaire which assesses current and lifetime marijuana use. The item used to measure current marijuana use frequency consisted of participants’ rating frequency of past-month use on an eight-point Likert-type scale (0 = *no use* to 8 = *more than once a day*). Current marijuana use status was defined as responses of one or greater on this item.

2.2.3 Social anxiety—The *Social Interaction Anxiety Scale* (SIAS; Mattick & Clarke, 1998) was used to assess general social interaction fears. The scale demonstrates high levels of internal consistency across clinical, community, and student samples (Heimberg, Mueller, Holt, Hope, & Liebowitz, 1992; Mattick & Clarke, 1998; Osman, Gutierrez, Barrios, Kopper, & Chiro, 1998) and test-retest reliability in clinical and non-clinical samples (Heimberg et al., 1992; Osman et al., 1998).

2.2.4 Clinical Interview—Diagnosis of social anxiety disorder was assessed using the *Structured Clinical Interview for DSM-IV Axis I Disorders (Non-Patient Version)* (SCID-I; First, Spitzer, Gibbon, & Williams, 1995). All SCID-I interviews were administered by trained research assistants or doctoral level staff and supervised by independent doctoral-level professionals. Interviews were audio-taped and the reliability of a random selection of 12.5% of interviews were checked (MJZ) for accuracy; no cases of (diagnostic coding) disagreement were noted.

2.2.5 Covariates—Depression was assessed with the *Beck Depression Inventory-Second Edition* (BDI-II; Beck, Steer, & Brown, 1996), a widely used measure of depression severity with adequate reliability and validity (Steer, Brown, Beck, & Sanderson, 2001). Negative affect was measured with the Negative Affectivity scale of the *Positive and Negative Affect Schedule* (PANAS; Watson, Clark, & Tellegen, 1988), a widely used and well-validated measure (for review see Watson, 2000). Nicotine dependence severity was measured with the *Fagerstrom Test for Nicotine Dependence* (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) which has shown good internal consistency, a unidimensional structure,

and positive relationships with nicotine intake (Heatherton et al., 1991). Alcohol related problems were assessed with the *Alcohol Use Disorders Identification Test* (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). Regarding other types of anxiety: anxiety sensitivity was assessed with the *Anxiety Sensitivity Index* (ASI; Reiss, Peterson, Gursky, & McNally, 1986), which measures the degree to which participants were concerned about possible negative consequences of anxiety symptoms; panic disorder severity was measured with the *Panic Disorder Severity Scale* (PDSS; Shear et al., 1992); worry was assessed with the *Penn State Worry Questionnaire* (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990); and obsessive-compulsiveness was measured with the *Obsessive-Compulsive Inventory-Revised* (Foa et al., 2002), a self-report measure of common OCD symptoms found to demonstrate good test-retest reliability, and good internal consistency (Foa et al., 2002).

3. Results

Means, standard deviations, Chronbach's alpha coefficients, and bivariate correlations among continuous study variables are presented in Table 1 for all participants and for current marijuana users. In the entire sample, the following variables were significantly, positively correlated with suicidality (at the Bonferroni corrected level of $p = .05/12 = .004$): social anxiety, depression, anxiety sensitivity, panic disorder severity, worry, and obsessive-compulsiveness. These variables were also significantly, positively correlated with suicidality among current users as was negative affect (severity of neither nicotine dependence nor alcohol problems was significantly related to suicidality).

A hierarchical linear regression analysis was conducted to examine whether social anxiety interacted with marijuana use status (current users vs abstainers) to predict suicidality. Predictor variables were: Step 1: covariates (sex, age, race, employment status, education level, depression, anxiety sensitivity, panic disorder severity, worry, obsessive-compulsiveness, negative affect, nicotine dependence severity, and alcohol problems severity); Step 2: the main effects of social anxiety and marijuana use status; and Step 3: the social anxiety X marijuana use status interaction term. This strategy ensured that effects at Step 2 and 3 cannot be attributed to variance shared with variables in the preceding steps (Cohen & Cohen, 1983). This interaction in Step 3 was not significant, $\Delta F(1, 94) = 2.24$, $\Delta p = .138$, $\Delta R^2 = 0.01$.

A second hierarchical linear regression analysis was conducted to examine whether social anxiety interacted with daily marijuana use status (no vs. yes) to predict suicidality. Predictor variables were: Step 1: covariates; Step 2: the main effects of social anxiety and daily marijuana use status; and Step 3: the social anxiety X daily marijuana use status interaction term. As evidenced in Table 2, the social anxiety X daily marijuana use status interaction was significant. Overall, this model accounted for 59.0% of the variance in suicidality, with covariates accounting for 52.5%, the main effects of social anxiety and daily marijuana use status uniquely accounting for an additional 2.0%, and the social anxiety X daily marijuana use status interaction uniquely accounting for an additional 4.5%.

As per Cohen and Cohen (1983), the form of the interaction was examined by inserting values one standard deviation above and below the mean for social anxiety into the regression equations associated with the described analysis. The form of the interaction was consistent with expectation such that daily users with higher social anxiety reported the highest suicidality (see Figure 1). To further probe the nature of the interaction, the simple slopes were tested using the strategy described by Aiken and West (1991) and Holmbeck (2002). Only the simple slope of the social anxiety variable for daily users was significant ($t = 3.96$, $p < .001$; simple slope for less frequent users: $t = 1.24$, $p = .218$). This pattern of

findings suggests that having higher levels of social anxiety makes it particularly likely for daily users to endorse more suicidality.

To determine whether clinical levels of social anxiety interacted with daily use, a third hierarchical linear regression analysis was conducted. Predictor variables were entered into three steps as described above. The SAD status (SAD- = 0 vs. SAD+ = 1) X daily marijuana use status interaction was significant, $\Delta F(1, 58) = 10.43$, $\Delta p = .002$. Overall, this model accounted for 62.1% of the variance in suicidality, with the SAD status X daily marijuana use status interaction uniquely accounting for 6.8%. The form of the interaction was similar to that obtained with the continuous social anxiety measure.

4. Discussion

This is the first known investigation of the impact of social anxiety on the relationship between marijuana use and suicidality. Results suggest that the relation between marijuana use status (current users vs abstainers) and suicidality does not vary as a function of social anxiety. However, marijuana users who use marijuana daily and experience elevated social anxiety are especially likely to experience elevated suicidality. This relationship was particularly robust as the moderational effects remained after controlling for a wide range of demographic and psychological variables that have been related to suicidality and/or marijuana use behaviors (e.g., Agosti et al., 2002; Buckner et al., 2009; Kung et al., 2003; Stinson et al., 2006; Zvolensky et al., 2006), including depression, negative affect broadly, and other types of anxiety. In fact, it is noteworthy that the overall model accounted for 59% of the variance in suicidality, the majority of which was (52.5%) accounted for by these important covariates. That the interaction term accounted for an additional 4.5% of the variance beyond the large percentage attributable to the covariates illustrates the potential importance of this moderational relationship (see Abelson, 1985).

An important next step in this line of research will be to identify why socially anxious daily users are especially vulnerable to suicidality. One possibility is that these users are especially likely to become socially withdrawn, which may result in a low sense of belongingness. Lower belongingness has been found to be strongly related to suicidal behaviors among other substance use samples (i.e., those with opioid dependence; Conner et al., 2007). Additionally, socially anxious users may perceive they are a greater burden on friends and/or family than users with less social anxiety or those who engage in less risky use (perhaps as a result of their greater marijuana-related impairment; e.g., Buckner et al., 2008). Perceived burdensomeness has also been linked to greater suicidal behaviors in other substance use samples (Conner et al., 2007) and future work examining the roles belongingness and/or burdensomeness may play in suicidality among socially anxious marijuana users will be an important next step in this line of work. A third possibility is that more socially anxious users with elevated suicidality use marijuana to cope with the distress associated with their suicidal thoughts. Social anxiety has been related to coping-motivated marijuana use (Buckner, Bonn-Miller, et al., 2007) and prospective work will be important step in to delineate the temporal relations among social anxiety, suicidality, and marijuana use.

Our findings have important implications for the treatment of marijuana and the prevention of suicide. Studies examining the relations between marijuana dependence and suicidality in twins find that individuals with marijuana dependence were nearly three times more likely to experience suicidal ideation and make a suicide attempt than their non-marijuana dependent co-twin (Lynskey et al., 2004). The finding that nearly 30% of people with marijuana dependence suffer from co-occurring SAD (Agosti et al., 2002) combined with data from the present study suggest that clinicians may consider monitoring and addressing social anxiety

during the treatment of marijuana dependence. Further, clinicians treating patients with marijuana dependence and/or social anxiety are encouraged to perform comprehensive assessments of suicidal ideation, self-injurious behaviors, and other suicide risk factors using the assessment procedures described by Rudd and colleagues (2006)..

Findings should be considered in light of limitations. First, participants voluntarily sought tobacco smoking cessation treatment. Given smokers report higher rates of suicidal ideation than non-smokers (Clarke et al., 2010), replication with other marijuana-using samples is necessary. Second, the study's dependent variable (the IDAS suicidality subscale) is a self-reported measure that includes both suicidal thoughts and behaviors and future work could benefit from teasing apart whether social anxiety acts in concert with daily marijuana use to increase suicidal ideation and/or suicidal behaviors. Third, data regarding history of suicide attempts were not collected so we were unable to examine the impact of this very important variable (see Joiner et al., 2005). Fourth, the study's cross-sectional nature precludes our ability to make causal inferences and disentangle the directionality of the observed effects.

Despite these limitations, this study serves as one of the only known studies examining the interactive nature of marijuana use and a psychological vulnerability factor (in this case social anxiety) as it relates to suicidality. Data suggest that social anxiety may play a particularly important role in suicidality among daily marijuana users. Future work examining the mechanism underlying why socially anxious daily users are especially likely to experience elevated suicidality will be an important next step in this area. Additionally, future work could benefit from the development and examination of interventions designed to address daily marijuana use and social anxiety in a manner that will best alleviate suicidality in this high-risk group.

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Highlights

- Social anxiety was positively related to suicidality.
- Social anxiety moderated the relationship between marijuana use status and suicidality even after controlling for a wide range of relevant variables (e.g., demographics, depression, negative affect, other anxiety).
- Daily marijuana users with elevated social anxiety reported the highest suicidality.

Figure 1.
The interactive effect of social anxiety and daily marijuana use status on suicidality among current marijuana users ($N = 134$).

Table 1

Means, standard deviations, alphas, and bivariate correlations among continuous study variables.

	Entire Sample											Current Users	
	1	2	3	4	5	6	7	8	9	10	11	M	SD
1. Suicidality		.29*	.47**	.31**	.29**	.33**	.46**	.45**	.13+	.09	-.04	6.88	1.88
2. Social anxiety	.27*		.58**	.49**	.57**	.53**	.49**	.60**	.18**	.05	-.11 ⁺	22.13	14.95
3. Depression	.56*	.47*		.44**	.61**	.62**	.48**	.71**	.21**	.14+	-.10	10.12	9.92
4. Age	-.03	-.10	.02		.53**	.49**	.59**	.59**	.18**	.12	-.02	35.96	13.00
5. AS	.36*	.41*	.40*	.04		.55**	.45**	.65**	.12+	.16+	-.13 ⁺	18.20	11.13
6. Panic disorder	.34*	.55*	.58*	-.03	.59*		.50**	.72**	.17**	.05	-.14 ⁺	4.08	4.58
7. Worry	.36*	.43*	.55*	.00	.52*	.58*		.54**	.12+	.16+	-.06	43.08	14.24
8. OC	.57*	.29*	.40*	-.04	.48*	.44*	.44*		.12+	.17+	-.21**	10.61	9.80
9. Negative affect	.53*	.51*	.66*	-.13	.59*	.65*	.76*	.57*		-.05	.30**	19.22	7.32
10. FTND	.14	.19+	.26*	.35*	.16	.11	.09	.06	.14		-.30**	5.09	2.32
11. AUDIT	.09	.08	.04	-.21 ⁺	.03	.19	-.01	.20 ⁺	.06	-.03		11.07	6.13
Chronbach's α	.80	.94	.93		.90	.89	.93	.90	.90	.63	.83		

Note: OC=obsessive-compulsiveness, FTND= Fagerstrom Test for Nicotine Dependence, AUDIT= Alcohol Use Disorders Identification Test. Correlations in the shaded area concern current marijuana users.

* $p < .004$;

+ $p < .05$

Table 2

Hierarchical linear regression of the interaction of social anxiety and daily marijuana use status (no vs. yes) in the prediction of suicidality among current marijuana users (N = 134).

	<i>F</i>	ΔR^2	β	<i>t</i>	<i>sr</i> ²	<i>p</i>
Step 1: Covariates	5.27	.525				<.001
Gender			-.04	-0.32	.00	.747
Age			-.16	-1.27	.01	.210
Race			.09	0.94	.01	.351
Employment status			.03	0.26	.00	.793
Level of education			.22	1.92	.03	.060
Depression			.50	3.51	.09	<.001
Anxiety sensitivity			.01	0.11	.00	.915
Panic disorder severity			-.02	-0.12	.00	.901
Worry			-.18	-1.18	.01	.242
Obsessive-compulsiveness			.44	3.87	.11	<.001
Negative affect			.13	0.73	.00	.471
Nicotine dependence severity			.00	-0.02	.00	.988
Alcohol-related problems severity			-.06	-0.61	.00	.542
Step 2: Main effects	1.14	.020				.328
Social anxiety			-.02	-0.19	.00	.848
Daily marijuana use			.15	1.50	.02	.140
Step 3: Interaction	6.51	.045				.013
Social anxiety X Daily marijuana use			.50	2.55	.05	.013

Note. Dichotomized variables were coded as follows: sex (male=0, female=1), employment status (0 = unemployed, 1 = employed), and race (0 = non-Caucasian, 1 = Caucasian).