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Mediating processes between stress and problematic marijuana use

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HIGHLIGHTS

- The relationship between early-life stress and problematic marijuana use is mediated by depression.
- Depression mediates the relationship between early life stress and problematic marijuana use.
- The presence of depression and anxiety in problematic marijuana users should be addressed in treatment for marijuana use.

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ABSTRACT

Background: The literature widely reports that stress is associated with marijuana use, yet, to date, the path from stress to marijuana-related problems has not been tested. In this study, we evaluated whether negative affect mediates the relationship between stress and marijuana use.
Methods: To that end, we tested models to determine mediators between problems with marijuana use (via Marijuana Problem Scale), stress (via Early Life Stress Questionnaire, Perceived Stress Scale), and negative affect (via Beck Depression Inventory; Beck Anxiety Inventory) in 157 current heavy marijuana users. Mediation tests and bootstrap confidence intervals were carried out via the "Mediation" package in R.
Results: Depression and anxiety scores both significantly mediated the relationship between perceived stress and problematic marijuana use. Only depression significantly mediated the relationship between early life stress and problematic marijuana use. Early life stress, perceived stress and problematic marijuana use were significant only as independent variables and dependent variables.
Conclusions: These findings demonstrate that (1) depression mediated both early life stress and perceived stress, and problematic marijuana use, and, (2) anxiety mediated perceived stress and problematic marijuana use. This mediation analysis represents a strong first step toward understanding the relationship between these variables; however, longitudinal studies are needed to determine causality between these variables. To conclude, addressing concomitant depression and anxiety in those who report either perceived stress or early life stress is important for the prevention of cannabis use disorders.

1. Introduction

In the last decade, while most adolescent drug and alcohol use patterns have had a steady or declining trend, marijuana use is on the rise (Brooks-Russel, Farhat, Haynie, Simons-Morton, 2013; Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2014). An estimated 9% of people who try marijuana (MJ) become dependent on it (Anthony, Warner, & Kessler, 1994), which underlines the need to elucidate factors that lead to cannabis use disorders. Previous studies have established a significant co-occurrence of cannabis use disorders (CUDs) with increased life stress, both in terms of childhood trauma and the perception of current life stress (Bonn-Miller, Vujanovic, & Zvolensky, 2008; Conway, Compton, Stinson, & Grant, 2006; De Bellis, 2002). Additionally, not only has childhood trauma been linked to marijuana use later in life (Chu, 2012), but it has also been linked to increased anxiety and depression (Hovens et al., 2012). Thus, stress also leads to greater negative affect (i.e., depression or anxiety), which overlaps substantially with drug dependence (Hovens et al., 2012; Kessler, 1997).

In general, an estimated 20% of individuals with negative affect also demonstrate substance use disorders, while 18–28% of those with substance use disorders also have an affective disorder (Grant et al., 2004). This comorbidity may be partly related to stress. For example, the association between stress and MJ use was found to be due to a mediating role of ability to regulate negative affect. Specifically, Bonn-Miller et al. found that scores on the Difficulties in Emotional Regulation questionnaire (Gratz & Roemer, 2004) mediated the relationship between stress and MJ use in individuals with post-traumatic stress disorder (Bonn-Miller, Vujanovic, Boden, & Gross, 2011). Similar associations were tested by Johnson, Bonn-Miller, Leyro, and Zvolensky (2009) where they

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reported that coping motives (i.e. "to forget my worries") for MJ use mediated the relationship between anxious arousal and frequency of MJ use (Johnson et al., 2009). These studies suggest that aspects of negative affect play a role in the relationship between stress and MJ use. However, to our knowledge, a mediation model testing the path from stress to negative affect to indicators of marijuana dependence has not yet been examined.

The existing literature describes a link between stress, negative affect, and subsequent problematic marijuana use. In this study, we examined the comorbidity between stress and marijuana use by testing mediation models that examined the relationship between marijuana problems, early life stress, perceived stress, depression, and anxiety. We hypothesized that both depression and anxiety mediate the relationship between stress and problems associated with marijuana use.

2. Methods

The Institutional Review Board of the Mind Research Network approved all of the study procedures.

2.1. Participants

The participants for this study took part in a larger study of marijuana use focused on determining the neurobiological antecedents of substance use disorders (described in Filbey, Schacht, Myers, Chavez, & Hutchison, 2009). The participants were recruited from the general community in the Albuquerque-metro area via media advertisements and were financially compensated for their participation. Overall, 157 heavy marijuana users were recruited. Of those, five were excluded because of missing data (Table 1).

2.2. Inclusion/exclusion criteria

All of the participants were required to provide written informed consent in order to participate in the study. The inclusion criteria were: (1) 18–55 years of age to minimize potential aging effects, and (2) marijuana use of at least once per week. The presence of THC-COOH metabolites were verified by urinalysis and only those positive for THC-COOH were included in this study. The exclusion criteria were diagnosis of psychotic and neurological disorders including a history of traumatic brain injury. Because the larger study included an MRI scan, participants were also excluded if they had any MRI contraindications (i.e., left-handedness, pregnancy, metallic implants in the body, claustrophobia, etc.). The participants were also required to be free of other substance use besides marijuana, nicotine, and alcohol during the experiment (verified via urine toxicity screen).

Table 1
Demographic characteristics of the participants. All values are represented as mean (SD) unless otherwise indicated. Participants with excessive missing data were excluded.

	N	Mean	SD
Total	151	–	–
Male/female	109/42	–	–
Age	151	24.73	7.50
Years of education	149	13.48	2.31
Full scale IQ[a]	110	105.73	15.59
Use marijuana daily	110	–	–
Use marijuana weekly	151	–	–
Marijuana Problem Scale score	128	4.02	4.46
Years regular marijuana use	151	7.01	7.03
Age of onset of regular use	151	17.37	3.73
Alcoholic beverages per day	150	1.25	1.84
Cigarettes/day, if smoker	48	11.08	6.25
Total Beck Depression Inventory score	146	6.95	6.94
Total Beck Anxiety Inventory score	151	7.52	8.77
Early Life Stress Questionnaire score	151	3.46	2.89
Perceived Stress Scale score	112	34.55	8.59

[a] IQ was assessed using the Wechsler Adult Scale of Intelligence (WASI).

2.3. Outcome measures

Stress was operationalized as perceived stress and early life stress. Perceived stress was assessed using the Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983), a 14-item self-report questionnaire assessing how debilitating symptoms of stress are for each participant (e.g. "In the last month, how often have you felt that you were unable to control the important things in your life?"). Early stress was measured with the Early Life Stress Questionnaire (ELSQ), a 20-item scale regarding potentially traumatic events that occurred before the age of 18 (e.g. "before the age of 18, were you physically abused?") (McFarlane et al., 2005). Marijuana problems were measured using the Marijuana Problem Scale (MPS), a 19-item self-report scale identifying the manner and degree to which marijuana use may interfere with an individual's day-to-day life (e.g. memory loss, legal problems, etc.) (Stephens, Roffman, & Curtin, 2000). Negative affect was operationalized as symptoms of anxiety and depression, which were assessed using the Beck Anxiety Inventory (BAI) (Creamer, Foran, & Bell, 1995) and the Beck Depression Inventory (BDI) (Steer, Beck, Riskind, & Brown, 1986), respectively. Each questionnaire comprised 21 questions regarding symptoms of depression in the past two weeks (e.g. "I feel the future is hopeless and that things cannot improve") or anxiety in the past week (e.g. "fear of the worst happening").

2.4. Calculation

All analyses were performed in R, with basic correlation and linear regression functions, as well as the mediation package, when applicable (Hayes & Preacher, 2013; Imai, Keele, & Tingley, 2010). All variables of interest were included in a zero-order correlation analysis (Table 2). Potential confounding variables (age, sex, number of cigarettes per day, and number of alcoholic beverages per day) were examined, and those that were significantly correlated with variables of interest (PSS, ELSQ, MPS, BAI, BDI) were covaried in the mediation analyses. To determine the relationship between negative affect and marijuana use, we tested a single-mediation model according to procedures outlined by Imai, Keele, and Tingley (Imai et al., 2010). The mediation analyses began with correlation analyses between all variables (MPS, PSS, ELSQ, BAI, BDI). We then performed linear regression analyses with and without the predicted mediator to determine the effect on the relationship between the dependent variable and the independent variables. MPS, PSS, ELSQ, BAI, and BDI were all analyzed as mediators, independent and dependent variables in the model. All analyses were covaried for age and sex. The model was considered to be mediation if the relationship between the independent variable and dependent variable became insignificant when the mediator was included.

3. Results

3.1. Non-collinearity between variables

A discriminant correspondence analysis (DCA) (TExPosition and TInPosition packages in R) was performed to rule out collinearity between variables (Abdi, Edelman, Valentin, & Dowling, 2009; Beaton, Rieck, & Abdi, 2013; Beaton, Rieck, Chin Fatt, & Abdi, 2013). DCA revealed four significant components. Component 1 accounted for 50.36% of the variance, with an associated eigenvalue of 0.14, $p < 0.01$. Component 2 accounted for 22.14% of the variance, with an associated eigenvalue of 0.06, $p < 0.01$. Component 3 accounted for 17.98% of the variance, with an associated eigenvalue of 0.051, $p < 0.01$. Component 4 accounted for 9.52% of the variance, with an associated eigenvalue of 0.03, $p < 0.01$. Bootstrap confidence intervals were calculated, and all variables were distinct at the 95% confidence interval (Appendix A, Figs. 1 and 2). In sum, early life stress, perceived stress, depression, and anxiety scores are independent from each other and are therefore modeled separately in the mediation analyses.