Use of Protective Behavioral Strategies among Young Adult Veteran Marijuana Users

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ABSTRACT

Young adult veterans are at risk for problematic marijuana use and associated consequences, which is partially due to their high rates of Posttraumatic Stress Disorder (PTSD), depression, and problematic substance use. Veterans tend to endorse more severe and chronic mental health symptoms compared to their civilian counterparts and they identify marijuana use as a method to cope with their symptoms. Given the prevalence of marijuana use among veterans in the community and in clinical settings, it is important to explore the factors that may help minimize harm associated with use for those that choose to use the drug. The present study sought to examine the impact of protective behavioral strategies on the relationship between mental health symptoms and marijuana use and consequences in a sample of 180 young adult veteran marijuana users. Participants were recruited via social media advertisements and completed measures of marijuana use and consequences, protective behavioral strategies, and PTSD and depression symptoms. Findings indicated that more frequent use of protective behavioral strategies was associated with less marijuana use and consequences. Participants who screened positive for PTSD or depression reported more marijuana consequences than did those not positive on these screeners. Regression analyses revealed protective strategies moderated the relationship between PTSD and marijuana consequences such that young veterans who endorsed more PTSD symptoms and infrequent use of protective strategies reported the most marijuana consequences. No moderating effects were found for the relationship between depression and marijuana consequences. Findings have clinical implications for working with young veterans.

Key words: cannabis, marijuana, veterans, young adult, protective behavioral strategies, Posttraumatic Stress Disorder, depression, PBSM

Marijuana Use among Young Adults in the United States

Approximately 10% of the American population reports past year marijuana use, with young adults between the ages of 18 and 29 reporting the highest annual prevalence rates (21%; Hasin et al., 2015). About 7% of young adults ages 19 to 28 report daily use of marijuana (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2016). The annual prevalence rates for marijuana use have increased over the past 10 years, as has the frequency of days used and the rates of daily use among marijuana users (Compton, Han, Jones, Blanco, & Hughes, 2016; Hasin et al., 2015). It is estimated that 8% of 18-29 year olds and 3% of all 30-34 year olds meet

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criteria for a cannabis use disorder; among marijuana users these rates are 35% and 29% for 18-29 year olds and 30-34 year olds, respectively (Hasin et al., 2015). The Substance Abuse and Mental Health Services Administration (SAMHSA, 2014) has identified marijuana as one of the most frequently abused substances in the United States and as a result, researchers have sought to identify those individuals at risk for developing a cannabis use disorder.

Veterans and Marijuana Use

American veterans are one such at-risk group for marijuana use and cannabis use disorder due to their tendency to experience more severe medical problems and psychiatric difficulties compared to the general population (Hoerster, Lehavot, Simpson, McFall, Reiber, & Nelson, 2012; Luncheon & Zack, 2012). While reports of prevalence rates among veterans are limited, studies of veterans seeking services at the Veterans Health Administration (VA) suggest that approximately 12% of the veteran population reports past year marijuana use (Goldman et al., 2010), with 1% of all VA patients meeting criteria for a cannabis use disorder (Bonn-Miller, Harris, & Trafton, 2012b). Though rates of cannabis use disorder among VA patients are lower than what is seen in the general population, the rates of cannabis use disorder increased by approximately 59% between 2002 and 2009 among VA patients, with the largest increases seen among younger veterans (Bonn-Miller et al., 2012b). A number of consequences have been observed among treatment seeking veterans in the VA, such as respiratory, cardiovascular, and cognitive issues (Goldman et al., 2010). Importantly, researchers found that cannabis use disorders have been significantly underdiagnosed in the VA, indicating that the prevalence rates of marijuana use and consequences among veterans may be higher than currently reported (Bonn-Miller, Bucossi, & Trafton, 2012a).

It is necessary to also expand research efforts beyond studying those diagnosed with cannabis use disorder to examine prevalence rates of marijuana use and consequences among veterans outside VA treatment settings. One attempt to better capture the marijuana prevalence rates of veterans in the community examined a sample of nearly 1,000 young adult veterans aged 19-34 recruited using social media and found that the sample was similar in demographics to the young veteran population (i.e., both VA and non-VA veterans), with the exception of race/ethnicity and former branch of service (Pedersen, Helmuth, Marshall, Schell, PunKay, & Kurz, 2015). Using percentages weighted by the population estimates of race/ethnicity and former service branch, we found that 57% of veterans reported lifetime marijuana use, with 41% of lifetime users reporting past six-month marijuana use (24% of the full sample). Using a screening measure for hazardous levels of marijuana use indicating a potential cannabis use disorder, we also found that 10% of the sample screened positive for hazardous marijuana use (Pedersen, Marshall, & Kurz, 2016b). Though this sample may not be generalizable to all veterans, these studies elucidate that marijuana use and resulting disorders are prevalent among veterans both presenting to the VA for treatment and those non-treatment seeking veterans in the community, and that prevalence is particularly high among young adult veterans.

Use of Marijuana to Cope with Mental Health Problems

Given that veterans also report high rates of mental health problems, most frequently depression and Posttraumatic Stress Disorder (PTSD; Schell & Marshall, 2008; Seal et al., 2011), it is possible that veterans may use marijuana to cope with mental health symptoms. First, there is much overlap between substance use disorders and depression and PTSD among veterans (Seal et al., 2010). For example, since 2009, cannabis use disorder has been the most frequently diagnosed substance use disorder among veterans seeking care at the VA for PTSD and substance use problems (Bonn-Miller & Rousseau, 2017). Marijuana use has been linked to increased mood, anxiety, PTSD symptoms, and psychotic disorders among VA veterans (Boden et al., 2013; Bonn-Miller et al., 2013; Galang, Babson, Boden, & Bonn-Miller, 2015; Goldman et al., 2010). Gentes and colleagues (2016) found that among veterans seeking PTSD treatment, those who used marijuana in the past six months were more likely to experience more severe PTSD, depression, and suicidality than those who did not use. Among VA

patients with a cannabis use disorder in 2009, nearly three-quarters (71%) met criteria for co-occurring mental health diagnoses; more specifically, 23% also met criteria for depression and 29% also met criteria for PTSD (Bonn-Miller et al., 2012b). For comparison, we found that in our community sample, 6% of veterans screened positive for both PTSD and hazardous marijuana use and 5% screened positive for both depression and hazardous marijuana use (Pedersen et al., 2016b). Among those who screened positive for hazardous marijuana use, 60% also screened positive for PTSD and 50% also screened positive for depression. We also observed greater rates of lifetime and past month marijuana use among those screening positive for PTSD than among young adult veterans not screening for PTSD such that past month use was 2.3 times higher for those screening for PTSD than those not screening for PTSD (Grant, Pedersen, & Neighbors, 2015).

Although rates of overlap between mental health problems and marijuana use indicate veterans may be using the drug to cope with negative affect (e.g., Bonn-Miller et al., 2012b), more direct research supports the idea. Information gathered from veteran focus groups revealed most veterans believed marijuana helped reduce PTSD symptoms (Elliot, Golub, Bennett, & Guarino, 2015). In addition to reporting higher levels of marijuana use, cravings, and problems, those with cannabis use disorder and PTSD reported more use of marijuana to cope compared to those with cannabis use disorder without PTSD (Boden et al., 2013). Grant and colleagues (2015) found that young adult veterans' beliefs about the relaxation and tension-reduction effects of marijuana (i.e., marijuana expectancies) moderated the association between PTSD and marijuana use, such that those who screened positive for a PTSD diagnosis and reported high relaxation and tension reduction marijuana expectancies were more likely to report past-month marijuana use. A veteran may believe that marijuana can lead to feeling calm and relaxed, thus reducing PTSD and depression symptoms such as hyperarousal (e.g., being on high alert), depressed mood, anger/irritability, or difficulties with sleep (e.g., trouble falling sleep, nightmares). It may be the short-term relief associated with marijuana use that then contributes to heavier use and the eventual experience of problems from such use.

Use of Protective Behavioral Strategies to Mitigate Harms of Marijuana Use

With high prevalence rates of marijuana use and mental health problems among veterans, it is important to better understand what factors may limit the harms associated with marijuana use among those veterans who choose to use the drug. One such factor is the use of protective behavioral strategies, which, generally, are practices used by substance users to protect against heavy and problematic use. Marijuana protective behavioral strategies are behaviors used before, during, after, or instead of using marijuana, such as taking periodic breaks if one feels like they are using marijuana too frequently, limiting the amount of marijuana one uses in one sitting, and avoiding using marijuana before work or school (Pedersen et al., 2017a; Pedersen, Hummer, Rinker, Traylor, & Neighbors, 2016a). Recent work has identified that use of these strategies by young adult college students are associated with fewer consequences and less frequent use (Bravo, Anthenien, Prince, Pearson, & the Marijuana Outcomes Study Team, 2017a; Bravo, Prince, Pearson, & the Marijuana Outcomes Study Team, 2017b; Pedersen et al., 2017a; 2016a) but no study to date has looked at use of marijuana protective strategies among veterans or among those with mental health symptoms. Use of these strategies may be particularly important for marijuana users who report symptoms of PTSD and depression as use of strategies may help protect them from further distressing consequences in their life as well as from exacerbation of symptoms. Thus, it is important to examine if use of protective strategies by veterans with mental health problems moderates the relationships between symptoms and marijuana use or consequences. To date, no study has addressed the moderating effect of protective behavioral strategies on the relationship between mental health symptoms and marijuana outcomes in any population, making an initial examination of veterans an important contribution to the emerging area of protective behavioral strategy use among marijuana users.

The Present Study

The present study was designed to examine how protective strategies practiced before, during, after, or instead of using marijuana moderated the effects of mental health symptoms on marijuana use and consequences among a sample of 180 young adult veteran marijuana users. The potential for marijuana problems among young veterans is particularly worthy of further study. Studies have documented that rates of PTSD, depression, and problem substance use are higher in young veteran samples than they are in active duty and civilian samples (Bray & Hourani, 2007; Kessler, Chiu, Demler, Merikangas, & Walters, 2005; Ramchand et al., 2011; Schell & Marshall, 2008) and young adult veterans are more likely than young adult civilians to report mental health problems (Grossbard et al., 2013). As such, this study focused on a young adult sample of veterans aged 19 to 34. Three key questions guided the analyses for this study: (1) Do veterans who use marijuana report more frequent use and/or more consequences based on depression/PTSD screening?, (2) Do veterans who use marijuana report more frequent use of protective behavioral strategies based on depression/PTSD screening?, and (3) Does frequency of use of protective behaviors moderate the relationship between depression/PTSD and marijuana use and consequences?

METHOD

Participants and Procedures

Participants were part of a larger randomized controlled trial of a brief online alcohol intervention for young adult veteran drinkers (Pedersen, Marshall, & Schell, 2016c; Pedersen, Parast, Marshall, Schell, & Neighbors, 2017c). As such, all participants in this sample met screening criteria for the larger study: (1) between the ages of 18 and 34, (2) a United States veteran of the Air Force, Army, Marine Corps, or Navy, and (3) score on the 10-item Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993) of 3 or greater for women and 4 or greater for men. The larger study enrolled 784 participants, of which 622 (79%) completed an online follow-up survey one month after the intervention. Data from the present study were collected as part of the follow-up survey after main outcomes (past month drinking and drinking consequences) from the study were collected.

Recruitment of study participants was facilitated through Facebook advertising and we have described the sample and the recruitment procedures in detail elsewhere (Pedersen, Naranjo, & Marshall, 2017b). In the full sample of 622 young adult veterans, 180 reported using marijuana in the past six months (28.9%). These past six month users completed the follow-up measures including the items described below and were included in the analyses.

Measures

Demographics. Participants reported their age, ethnicity (Hispanic or not), race, prior branch of service, marital status, and years of active service in the military.

Marijuana Use and Consequences. Participants were asked if they had ever used marijuana (in any form, including edibles and vaping) in the past six months, with response options of never, once or twice in the past six months, two to five times in the past six months, about once per month, about two to four times per month, about once per week, and a few times per week to daily. Those who reported any response option besides never were asked follow-up questions about their past month use and experience of consequences in the past six months. Past month use was assessed by asking participants to indicate how many days during the past month they used marijuana. They then completed the brief version of the Marijuana Consequences Questionnaire (B-MACQ; Simons et al., 2012), which features 21 items of consequences specific to marijuana, such as spending too much time using marijuana; feeling tired because of too much marijuana use; and losing motivation because of marijuana use. Participants indicated whether they experienced each of the consequences (yes/no) in the past six months. Reliability of the scale was adequate in the present sample ($\alpha = 0.84$). Responses on the scale were summed to reveal a composite score.

Protective Behaviors for Marijuana Use Scale (PBSM). The PBSM was developed and validated in our prior work (Pedersen et al., 2016a; 2017a). We utilized the brief version of the scale (the PBSM-17), which contains 17 items from the larger 36 item bank that were determined with

item response theory analyses to be free from bias regarding gender (male/female), race (White/non-White), ethnicity (Hispanic or Latino(a)/non-Hispanic or Latino(a), and state legalization status (i.e., whether respondents lived in states that had laws regarding legal recreational marijuana or not) in a large young adult college sample. Participants were asked to "Please indicate the degree to which you engage in the following behaviors when using marijuana/cannabis" using response options of 1 = never, 2 = rarely, 3 = occasionally, 4 = sometimes, 5 = usually, and 6 = always. The scale displayed adequate internal reliability (α = 0.95). Scores on the PBSM were computed as a continuous value by summing responses and converting raw scores to T-scores as advised by Pedersen and colleagues (2017a).

Mental Health Symptoms. Symptoms of depression were assessed with the Patient Health Questionnaire 8-item (PHQ-8; Kroenke et al., 2009; α = 0.92), which contains items corresponding to the symptoms of depression such as little interest or pleasure and feeling down or depressed. Items are rated from 0 = not at all to 3 = nearly every day in the past two weeks. Scores on the measure range from 0 to 24. Scores of 10 or greater are indicative of a positive screen for depression, with 100% sensitivity and 95% specificity for major depressive disorder in the general population (Kroenke et al., 2009). PTSD symptoms were assessed with the PTSD Checklist for DSM-V (PCL-5; Blevins et al., 2015; α = 0.97). The PCL-5 contains 20 items corresponding to how much participants had been bothered by the symptoms of PTSD in the past month, with response options ranging from 0 = not at all to 4 = extremely. Scores on the measure range from 0 to 80. Scores of 33 or greater are indicative of a positive screen for PTSD, with 88% sensitivity and 69% specificity for predicting a PTSD diagnosis among veterans (Bovin et al., 2015).

Data Analytic Plan

To describe the sample and to answer our first two key questions, we ran a series of descriptive analyses to document means and frequencies of marijuana use, consequences, and PBSM item endorsement. Using independent samples t-tests, we then compared veterans who screened positive for depression using the PHQ-8 criterion score of 10 (Kroenke et al., 2009) to those who did not screen positive for depression on marijuana use, marijuana use consequences, and protective strategies.

Next, we compared veterans who screened positive for PTSD using the PCL criterion score of 33 (Bovin et al., 2015) to those who did not screen positive for PTSD on marijuana use, marijuana use consequences, and protective strategies.

To evaluate our third key question, we ran two regression models predicting marijuana use and marijuana use consequences. Both count outcomes were positively skewed (marijuana use skew = 0.83, marijuana consequences skew = 2.26) and greater than or equal to zero; thus, we ran a series of negative binomial regression analyses (Hilbe, 2011). To determine which count distribution best fit our data, we compared analyses with Poisson, zero inflated negative binomial, and normal distributions, finding that a negative binomial model fit the data best. Covariates of age, gender (male versus female), and race/ethnicity (White versus other) were included. Both depression and PTSD were included in the two models given the overlap between the two mental health problems in the veteran population. Two interaction terms were included in the models to determine moderation: depression screening (PHQ-8 categorical score) x PBSM continuous score and PTSD screening (PCL-5 categorical score) x PBSM continuous score.

RESULTS

Sample Description

Among the 180 past six month users, 144 (80%) reported using marijuana in the past month (see Table 1). The sample of past six month marijuana users reported using a mean of 9.95 (SD = 11.83) days per month, ranging from

Table 1. Sample Description

	Past six-month marijuana users (N = 180)
Age	28.40 (3.34)
Male gender	83.3%
Ethnicity	
Non-Hispanic	86.7%
Hispanic	13.3%
Race	
White	85.0%
Black	4.4%
Other†	10.6%
Married	41.7%
Branch of service	
Army	65.6%
Navy	9.4%
Air Force	6.7%
Marine Corps	18.3%
Years served in the Armed Forces	5.11 (2.43)
Positive depression screen	33.0%
Positive PTSD screen	37.1%
Marijuana use (days, past month)	9.92 (11.83)
Marijuana use consequences (sum, past 6 months)	1.89 (2.81)
PBSM (sum converted to *t*-score)	47.70 (13.45)

Note. †Category includes Asian (n = 2), Native Hawaiian/Pacific Islander (n = 1), American Indian/Alaska Native (n = 5), multiracial (n = 7), and other unspecified (n = 4). PBSM: Protective Behavioral Strategies for Marijuana scale (17 item version).

one day (15% of the sample) to 30 days (17% of the sample). Frequency of use ranged from once or twice in the past six months (27%) to a few times per week or daily (34%). Participants reported a mean of 1.89 (SD = 2.81) consequences in the past six months, ranging from 0 to 16 consequences.

Marijuana Use and Consequences among Those Screening for PTSD and Depression

Participants who screened positive for depression (33% of sample) reported marijuana use on 8.33 (SD = 10.97) days in the past month, while participants not screening for depression reported use on 10.82 (SD = 12.21) days; a non-significant difference (p = 0.174). Participants who screened positive for depression reported significantly more marijuana use problems (M = 2.76, SD = 3.90) than participants not screening positive for depression (M = 1.48, SD = 1.97), t (177) = 2.37, p = 0.020. Participants who screened positive for PTSD (37% of sample) reported marijuana use on 9.55 (SD = 11.30) days in the past month, while participants not screening for PTSD reported use on 10.22 (SD = 12.24) days; a non-significant difference (p = 0.709). Participants who screened positive for PTSD reported significantly more marijuana use problems (M = 2.54, SD = 3.13) than participants not screening positive for PTSD (M = 1.54, SD = 2.56), t (176) = 2.20, p = 0.030.

Use of Protective Strategies among Those Screening for PTSD and Depression

Participants screening positive for depression (M = 47.27, SD = 14.18) did not significantly differ in the overall use of protective behavioral strategies from those not screening positive for depression (M = 47.91, SD = 13.13), p = 0.765. Likewise, participants screening positive for PTSD (M = 48.29, SD = 12.64) did not significantly differ in the overall use of protective behavioral strategies from those not screening positive for PTSD (M = 47.44, SD = 13.98), p = 0.689. There were also no differences in frequency of each of the 17 specific strategies used between those screening positive for depression and those not screening positive for depression, as well as between those screening positive for PTSD and those not screening positive for PTSD.

Models for Marijuana Use and Consequences

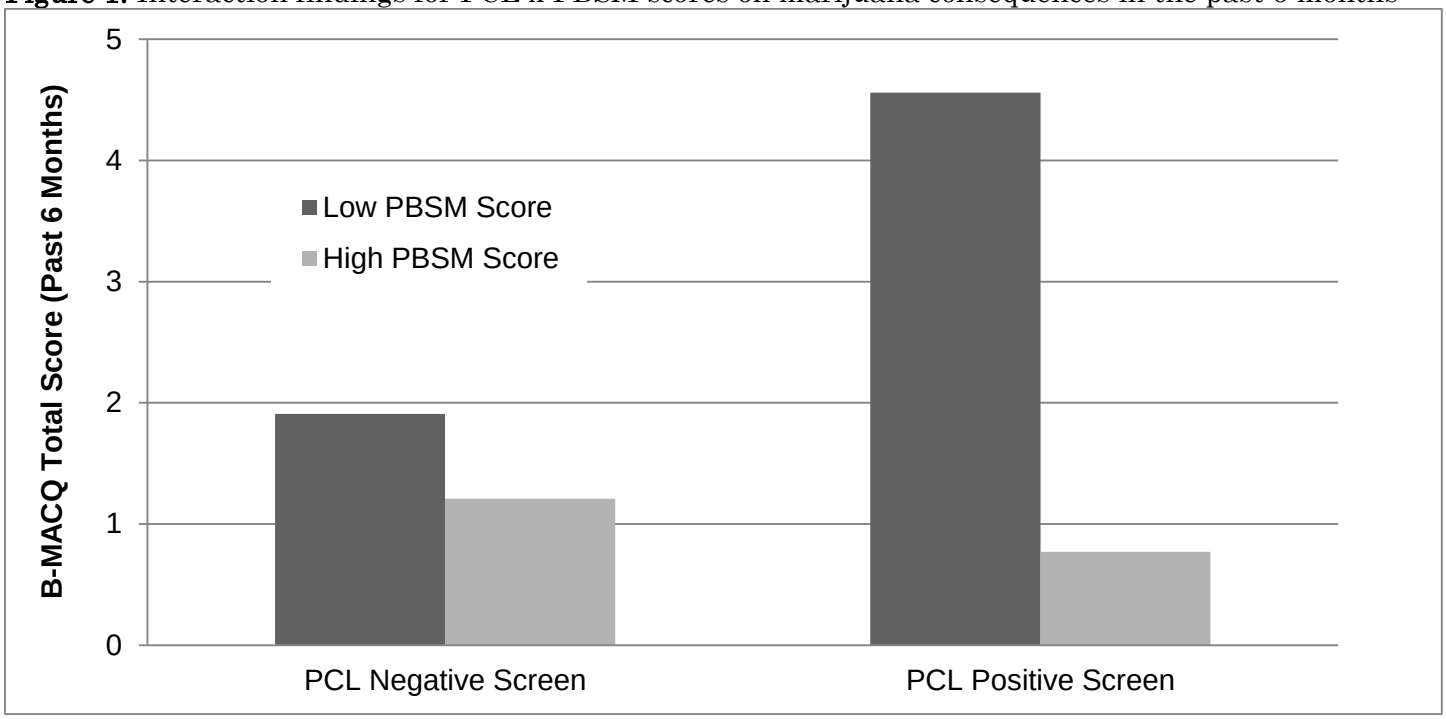
Parameter estimates for the count regression models for marijuana use and consequences can be found in Table 2. For marijuana use in the past month, male gender (estimate = -0.75, incident rate ratio [IRR] = 0.47, SE = 0.23) and PBSM score (estimate = -0.05, IRR = 0.95, SE = 0.01) IRR = 0.95, SE = 0.01) predicted marijuana use, such that females reported 53% less marijuana use compared to males and for each additional unit of protective strategy use frequency participants reported 5% less use in the past 30 days. Neither positive depression nor positive PTSD screens were associated with marijuana use, nor did either of the interactions between depression or PTSD screening and PBSM scores.

Table 2. Negative binomial regression for marijuana use and marijuana use consequences outcomes

Marijuana Use Past 30 Days	Parameter estimate	Standard Error	Wald Chi-Square	Incident rate ratio	*p*-value
(Intercept)	6.01	0.98	37.81	409.12	0.000
Age	-0.03	0.03	1.27	0.97	0.260
Male gender[1]	-0.75	0.23	10.97	0.47	0.001
White	0.21	0.23	0.82	1.23	0.366
PBSM	-0.05	0.01	20.90	0.95	0.000
PHQ-8 positive screen	-1.35	0.97	1.92	0.26	0.166
PCL positive screen	0.59	0.97	0.37	1.80	0.545
PBSM x PHQ-8 interaction	0.02	0.02	1.10	1.02	0.294
PBSM x PCL interaction	-0.01	0.02	0.32	0.99	0.570
Marijuana Consequences Past 6 Months					
(Intercept)	2.91	1.14	6.44	18.27	0.011
Age	-0.06	0.03	3.13	0.95	0.077
Male gender[1]	-0.06	0.27	0.05	0.94	0.816
White	0.28	0.28	1.02	1.33	0.313
PBSM	-0.03	0.01	5.61	0.97	0.018
PHQ-8 positive screen	-0.87	0.97	0.81	0.42	0.368
PCL positive screen	2.55	0.97	6.93	12.85	0.008
PBSM x PHQ-8 interaction	0.03	0.02	2.31	1.03	0.129
PBSM x PCL interaction	-0.05	0.02	5.76	0.95	0.016

Note: Gender was coded 0 for males, 1 for females. White was coded 1 for White race, 0 for non-White race. PHQ-8: Patient Health Questionnaire – 8 item. PCL: Posttraumatic Stress Disorder Checklist for DSM-5. PBSM: Protective Behavioral Strategies for Marijuana scale (17 item version).

Figure 1. Interaction findings for PCL x PBSM scores on marijuana consequences in the past 6 months



Note: B-MACQ: Brief Marijuana Consequences Questionnaire. PCL: Posttraumatic Stress Disorder Checklist for DSM-5. PBSM: Protective Behavioral Strategies for Marijuana scale (17 item version)

For marijuana use consequences in the past six months, PBSM score (estimate = -0.03, IRR = 0.97, SE = 0.01) and PTSD screening (estimate = 2.55, IRR = 12.85, SE = 0.97) predicted marijuana use consequences, such that each unit increase in frequency of protective strategy use was associated with 3% less marijuana consequences in the past six months, and those screening positive for PTSD reported 12.8 times more marijuana consequences compared to those who did not screen positive for PTSD. The interaction effect between PBSM score and PTSD screening was significant (estimate = -0.05, SE = 0.02), indicating that the relationship between PTSD and marijuana consequences was moderated by frequency of protective behavioral strategies. Graphing this interaction showed that participants who screened positive for PTSD and who reported low frequency of protective behavioral strategies (1 standard deviation below the mean) were at higher risk for consequences (see Figure 1). Simple effects tests further confirmed that the relation between the PCL and marijuana use consequences was stronger at low levels of protective strategy use: -2 SD on the PBSM estimate = 0.58, IRR = 1.79, SE = 0.25, -1 SD on the PBSM estimate = 0.59, IRR = 1.80, SE = 0.25, +1 SD on the PBSM estimate = 0.60, IRR = 1.82, SE = 0.25, and +2 SD on the PBSM estimate = 0.61, IRR = 1.84, SE = 0.25. Neither the positive depression screens nor the interaction between depression screening and PBSM scores associated with marijuana consequences.

DISCUSSION

The present study examined the use of protective behavioral strategies among a sample of 180 young adult veteran marijuana users. Like college students (Bravo et al., 2017a; 2017b; Pedersen et al., 2017; 2016), we found that for young veteran marijuana users, use of protective behavioral strategies reduced risk for frequent marijuana use and negative marijuana-related consequences. Male veterans reported more frequent marijuana use compared to female veterans, which fits with prior work that young adult males use marijuana more frequently than young females (Haberstick et al., 2014; Hasin et al., 2015; Johnson et al., 2015). Also, as in prior work with veterans specifically (Bonn-Miller et al., 2012; Bonn-Miller & Rousseau, 2017, Gentes et al., 2016), PTSD was associated with more problematic marijuana use. Yet protective behavioral strategies moderated the relationship between PTSD and marijuana-related

consequences, such that those young veterans who screened positive for PTSD and who reported low use of protective behavioral strategies were at the most risk for consequences in the past six months. In other words, the use of protective behavioral strategies somewhat safeguarded young veterans with PTSD from experiencing marijuana-related consequences.

Despite findings for PTSD and consequences in regression models, we did not observe any effects for depression when controlling for PTSD and other factors. As such, it appears that after controlling for depression (which overlaps much with PTSD in veteran samples; Seal et al., 2010), PTSD was the specific problem driving the experience of marijuana consequences. This may be due to the cognitive and physiological effects that marijuana has on an individual, which may vary depending on mental health symptoms. For example, an individual with PTSD may use marijuana to cope with intrusive or hyperarousal symptoms, such as flashbacks and feeling on guard. Supporting the anecdotal claims of veterans that marijuana helps to alleviate PTSD symptoms (Elliot et al., 2015), there is evidence that the neurobiological effects of marijuana may make it easier for individuals to feel less anxious, fall asleep, or be less reactive to flashbacks and traumatic memories (Passie et al., 2012). Yet, the short-term reductions in PTSD symptoms experienced after using marijuana are not well understood in the context of the PTSD diagnosis as a whole (National Academies of Sciences, Engineering, and Medicine, 2017), such as whether a marijuana user with PTSD is maintaining symptoms through avoidance and is not treating the core components of PTSD that could be addressed in more intensive pharmacological or psychological treatment (Foa, Keane, Friedman, & Cohen, 2009; Steenkamp, Litz, Hoge, & Marmar, 2015). For some of these psychological treatments, emotional processing of the traumatic event is an essential component of therapeutic success, and marijuana use may inhibit intrusive and arousal symptoms; thereby preventing recovery from PTSD and perhaps leading to further exacerbation of marijuana-related consequences. To date, there is no evidence from clinical trials that marijuana can be used as an effective pharmacological treatment for either PTSD or depression (National Academies of Sciences, Engineering, and Medicine, 2017).

Use of protective strategies among veterans was particularly important for those veterans screening positive for PTSD. As such, helping veterans to practice protective strategies before, during, after, and instead of using marijuana may be helpful in clinical settings. Protective behavioral strategies are consistent with a harm reduction philosophy of drug use, such that any level of reduced use or avoidance of consequences is seen as a step in the right direction to reducing harm. However, clinicians and users themselves may believe that abstinence is the best way to reduce harm and it is unclear if such strategies are helpful to achieving an abstinence goal. Additionally, marijuana is still illegal for medical and recreational use at the federal level, which means that the federal institution where most veterans receive PTSD and substance use care (i.e., the VA) does not support the use of marijuana in any form. That is, VA clinicians are not permitted to offer recommendations for medical marijuana use. Moreover, if veterans are in treatment for PTSD, exacerbation of PTSD symptoms that often accompany initial sessions of PTSD treatment could trigger cravings for marijuana use, which in turn could hinder the efficacy of PTSD treatment or lead to relapse (Back et al., 2014; Boden et al., 2013; Bonn-Miller et al., 2007, 2011). For example, veterans with cannabis use disorder have a poorer prognosis for mental health treatment (Bonn-Miller, Boden, Vujanovic, & Drescher, 2013).

Despite large numbers of young veterans screening for hazardous marijuana use and co-occurring mental health problems, few seek treatment. For example, we found that only 34% of those screening for hazardous marijuana use reported attending at least one appointment for substance use care in the past year at the VA or elsewhere (Pedersen et al., 2016b). In the same study, we found that only 32% of those screening positive for hazardous marijuana use received a minimally adequate course of treatment for any substance use or mental health condition. This suggests that despite the potential for marijuana use to exacerbate mental health symptoms and confound treatment progression, most veterans who use marijuana do not seek treatment. Thus, for these veterans, use of protective strategies may help to prevent heavy or frequent use and the

experience of negative consequences. Nevertheless, the use of protective strategies in preventing marijuana problems, such as medical and psychological problems (Volkow, Baler, Compton, & Weiss, 2014) among long-term users is unknown. A recent report by the U.S. Department of Justice (2014) highlighted that regular marijuana users are likely to experience cognitive impairment (e.g., memory, processing speed), increased mental health problems (e.g., psychosis or other substance use disorders), and poor psychosocial functioning (e.g., academic performance). An even more recent report from the National Academies of Sciences, Engineering, and Medicine (2017) similarly concluded that marijuana use has long term effects such as worsening respiratory symptoms (e.g., chronic cough, bronchitis), dependence on the drug, cognitive impairments (learning, memory, attention), increased risk of motor vehicle accidents when driving under the influence, and increased risk for developing social anxiety and schizophrenia. Thus, it will be important in future work to determine if protective strategies can help to prevent these consequences among long-term users.

Limitations

This study is not without limitations and several should be considered when interpreting the findings. First, as in most studies of substance use behaviors, marijuana use and consequences were assessed by self-report, and outcomes may have been reported differently by collaterals (e.g., friends, spouses) or through biomedical testing. However, there was no indication that participants underreported their use and they were assured confidentiality through a confidentiality certificate we obtained for the study. Second, the sample comprised young veterans recruited for an alcohol intervention study. As such, all participants met a screening criteria for drinking, albeit a low threshold on the AUDIT. Findings may not generalize to non-drinkers as they were excluded from the study. It should be noted that the sample was recruited from Facebook through advertisements that were meant to attract veterans not seeking alcohol treatment, which helps to assuage concerns that this was a treatment-seeking sample. We have written extensively about the recruitment method, including generalizability of the sample to the larger young veteran population and methods used to reduce participant misrepresentation, in our other work (Pedersen et al., 2017b). Lastly, we did not assess expectancies of marijuana use (e.g., does one believe marijuana relieves tension) or marijuana motives (e.g., does one use specifically to cope with negative affect) so more detailed information about why protective strategies moderated the relationship between PTSD and consequences is not well understood. Though some work indicates that those with PTSD symptoms may use marijuana to cope with, control, or momentarily alleviate symptoms; (Bonn-Miller et al., 2011; Tomlinson et al., 2006), further research that includes marijuana use motives can tease apart why veterans with varying levels of depression and PTSD symptoms use the drug (e.g., to cope with negative affect, to enhance sociability).

Conclusion

The aforementioned findings expand the college student marijuana studies using the PBSM and indicated that greater frequency of protective strategies associated with less frequent marijuana use and fewer consequences among young veterans. In addition, this study adds to the literature on mental health problems and substance use among veterans by documenting a moderating effect of protective strategy use on negative marijuana outcomes. Further, although there is evidence for the utility of protective behavioral strategies in the relationship between mental health symptoms and alcohol-related outcomes (LaBrie, Kenney, & Lac, 2010; LaBrie, Kenney, Lac, Garcia, & Ferraiolo, 2009; Martens et al., 2008; Villarosa, Messer, Madson, & Zeigler-Hill, 2018; Villarosa, Moorer, Madson, Zeigler-Hill, & Noble, 2014), this is the first study to examine the moderating effect of marijuana protective behavioral strategies on the relationship between mental health symptoms and marijuana related outcomes. Findings suggest that use of protective strategies may be important for young veterans who choose to use marijuana, in particular for those that may use marijuana to cope with symptoms of PTSD.

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