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Pain, cannabis use, and physical and mental health indicators among veterans and non-veterans: results from National Epidemiologic Survey on Alcohol and Related Conditions-III

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INTRODUCTION

Pain is a major reason for health care visits [34] and accounts for substantial morbidity in the United States (U.S.) [8]. Findings from the National Health Interview Survey suggest that U.S. veterans experience pain and severe pain at higher rates than individuals in the general population [26]. For many reasons, including the increased risk of overdose fatality [5,46], opioid prescriptions to treat pain have decreased overall in the U.S. since 2012 [22,47]. The rate of opioid prescriptions has also decreased in the Veterans Health Administration (VHA) [23], which is the largest integrated healthcare system in the U.S. This decline has left a gap in the treatment of pain. Cannabis is considered by some as a potential treatment to fill this gap [32]. Indeed, in 2014, an estimated 9% of veterans in the general population reported using cannabis in the past year, and 41% of those with past-year use reported using for medical reasons [9]. Among veterans using cannabis for medical reasons, pain is a common self-reported indication [25].

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Systematic reviews and meta-analyses show mixed evidence on the use of cannabis to treat pain, with some low quality evidence supporting use in neuropathic pain and insufficient evidence on the use of cannabis to treat musculoskeletal pain [30,37,45], Professional debate regarding such use continues [28,30]. At the same time, an increasing number of U.S. adults see cannabis use as harmless [7] and as beneficial in treating a wide variety of medical problems, including pain [20]. However, people who report regular and heavy non-medical cannabis use are at increased risk for numerous physical and mental health consequences, including vehicle crashes, respiratory symptoms, emergency department visits, psychiatric symptoms, cannabis withdrawal, and cannabis use disorder (CUD) [14]. We and others have shown that frequent cannabis use and CUD are more common in U.S. adults residing in states with medical cannabis laws (MCL) than in those residing in states without such laws [17,24,44] and that in recent years, U.S. adults with pain are at increased risk of frequent non-medical cannabis use and CUD [18].

Given the frequency and salience of pain as a health condition among U.S. veterans, we undertook a study to better understand pain, non-medical cannabis use and CUD among this population using data from the 2012–2013 National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III; [12]). We addressed five specific research questions: (1) does prevalence of non-medical cannabis use and CUD differ between veterans and non-veterans reporting recent pain? (2) does prevalence of non-medical cannabis use and CUD differ among veterans reporting and not reporting recent pain? (3) is residence in a state with MCL associated with a difference in prevalence of non-medical cannabis use and CUD among veterans and non-veterans? (4) is residence in an MCL state associated with a difference in prevalence of non-medical cannabis use and CUD between veterans reporting and not reporting recent pain, and finally, to explore potential benefits of cannabis use, (5) among veterans reporting recent pain, do indicators of physical or mental health differ between cannabis users and non-users?

METHODS

Sample and procedures

The NESARC-III target population included US noninstitutionalized civilians, ≥18 years, in households and selected group quarters, including group homes and workers' dormitories [11,13]. Respondents were selected using multistage probability sampling, including primary (counties/groups of contiguous counties), secondary (Census-defined blocks), and tertiary sampling units (households within secondary sampling units), with oversampling of Black, Asian, and Hispanic respondents. Interviews were conducted from April 2012 to June 2013. NESARC-III interviewers were thoroughly trained through home-study and in-class training and received ongoing direct supervision by trained supervisors [16,17]. Random respondent callbacks were used as an additional check to verify interview data. Data were adjusted for nonresponse and weighted to represent the US population [39]. Weighting adjustments adequately compensated for nonresponse [13]. The NESARC-III response rate was 60.1%, similar to other nationally representative surveys that were completed during this period [1,38]. Veterans were defined as those who reported that they had ever served on active duty in the US Armed Forces, Military Reserves, or National Guard (excluding

training only but including activation) and were no longer on active duty at the time of data collection. The total sample (N=36,289) included 3,117 veterans and 33,172 non-veterans all reporting data on any recent pain; 20 respondents were excluded because pain data were missing.

Measures

The Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS), a structured diagnostic interview administered via computer, was used to assess both medical and non-medical cannabis use and DSM-5 CUD. AUDADIS responses were used to generate three cannabis groups for the previous 12-month period: (1) any non-medical use, (2) frequent non-medical use, and (3) past 12-month DSM-5 CUD. Non-medical use was defined as the use of cannabis without a prescription or other than how it was prescribed, for example, to get high [16]. Frequent non-medical use was defined as ≥3 occurrences of non-medical use per week. CUD was defined as endorsing at least 2 of the 11 DSM-5 CUD criteria within a 12-month period [15].

Pain was measured using a single item from the Medical Outcomes Study 12-item Short Form Health Survey, Version 2 (SF-12; [43]). The SF-12 is a well-validated measure used widely in clinical [21] and general population surveys [31]. The SF-12 pain item assessed pain during the previous four weeks using a 5-point Likert scale (not at all, a little bit, moderately, quite a bit, extremely). Survey respondents were asked the degree of interference their pain caused related to “your normal work, including both work outside the home and housework.” Consistent with previous studies [2,18], responses were dichotomized, coding moderate to extreme interference as positive and other responses as negative. While dichotomizing does result in a loss of statistical power, dichotomization makes results more directly comparable to previous studies of pain from the NESARC [2,10,18,27,36]. Additionally, prior research has demonstrated that the dichotomized variable retains strong associations with medical conditions, higher health care expenditures, more missed days of work, and lower productivity [2].

MCL determination was used to create a binary variable with 0 indicating non-MCL and 1 corresponding to MCL as determined by legal and economic experts and used in prior studies. Legal and economic expert evaluations have determined that Arizona, California, Colorado, Connecticut, Hawaii, Maine, Maryland, Massachusetts, Michigan, Montana, New Jersey, Nevada, New Mexico, Oregon, Vermont, and Washington had MCL at the time of NESARC-III data collection [16,17,19].

In order to capture how cannabis use related to health, physical and mental health indicators were assessed using the Physical and Mental Component Summary scales (PCS; MCS) from the SF-12. Component Summary scores from the SF-12 are omnibus instruments that reliably discriminate between respondents who differ in physical and mental health (e.g., general health, vitality, and social functioning) according to a variety of validated clinical measures [43]. The PCS and MCS are norm-based scores ranging from 0 to 100, with 0 corresponding to the lowest level of health and 100 to the highest and transformed to have the same mean and standard deviation (50 and 10, respectively). The MCS and PCS have demonstrated validity as indicators of physical and mental health outcomes [42,43].

Control covariates included gender; age (18–29; 30–44; 45–64; ≥65 years, which are standard age categories used in NESARC studies); race/ethnicity (Hispanic; Non-Hispanic White and Black; Native American; Asian/Pacific Islander); and education (<high school; high school graduate or GED; ≥some college).

Statistical analysis

Logistic regression was used to test whether the prevalence of pain differed between veterans and non-veterans. Predicted marginal prevalences within veteran and non-veteran groups were calculated from the logistic regression by averaging over back-transformed estimates from the logit scale across the observed distribution of sociodemographic characteristics in a model adjusted for gender, age, race/ethnicity, and education. To determine whether prevalence estimates differed between the veterans and non-veterans we calculated both the prevalence difference (PD), the difference in predicted marginal prevalences, and the prevalence ratio (PR), which is the prevalence of the outcome in one group divided by the prevalence of the outcome in the other group. Similar models were then used to test whether the prevalence of non-medical cannabis use, frequent cannabis use, and CUD differed between veterans and non-veterans reporting recent pain and to test whether the prevalence of these three cannabis outcomes differed between veterans reporting and not reporting recent pain. To determine whether MCL status was associated with the prevalence of non-medical cannabis use and CUD, we included a group x MCL status interaction term in two subsequent models and formed an interaction contrast on the additive (i.e., prevalence difference) scale. This tested whether the difference in absolute prevalence for non-medical cannabis use and CUD differed between those in states with MCL laws and those in states without MCL laws among veterans and non-veterans reporting recent pain, and among veterans reporting and not reporting recent pain (i.e. Difference in Difference [DiD] test). A DiD estimate whose 95% CI does not include 0.0 (i.e., no different in absolute prevalence) is statistically significant at $p<.05$. Finally, among veterans reporting recent pain, the mean SF-12 PCS and MCS scores were calculated among veterans with and without non-medical cannabis use, frequent non-medical cannabis use, and CUD. T-tests were used to determine whether PCS and MCS scores differed between the two veteran groups. Linear regression was then used to test which cannabis variables were associated with the PCS and MCS scores,adjusting for the sociodemographic covariates, first using the full scores, and separately excluding the pain item from the PCS. All models incorporated survey weights and used SUDAAN 11.0.1 to adjust for the complex sampling design. Significance was set at $p<.05$, and all tests were 2-tailed.

The Bonferroni correction was used to correct for inflated Type-I error rates in cases of multiple comparisons. Thus, in cases where prevalence of each of three cannabis outcomes were estimated within the sub-sample, the corrected alpha level was set to 0.017, and 98% confidence intervals were used.

RESULTS

Respondent demographics (i.e., sex, age, race/ethnicity, education, and residence in a MCL state) by veteran status are available in Table 1.

Predicted prevalence of pain among veterans and non-veterans

The prevalence of reported recent pain among non-veterans and veterans was 17.4% and 24.7%, respectively (Table 2). The prevalence difference (PD) was 7.25% (95% CI=4.90, 9.60), and the prevalence ratio (PR) was 1.38 (95% CI=1.25, 1.51), indicating greater prevalence of reported pain among veterans than among non-veterans.

Predicted prevalence of cannabis use, frequent use, and CUD among those reporting recent pain

No significant differences in proportions of any cannabis use, frequent use, or CUD were observed between veterans and non-veterans reporting recent pain. The predicted prevalence of any non-medical cannabis use among veterans and non-veterans reporting recent pain was 14.2% and 13.7%, respectively. The prevalence of frequent non-medical cannabis use among veterans and non-veterans was 6.8% and 5.7%. The prevalence of CUD among veterans and non-veterans was 5.7% and 4.3%.

Predicted prevalence among veterans reporting and not reporting recent pain

The prevalence estimates of frequent cannabis use was significantly greater among veterans reporting recent pain than among veterans not reporting recent pain (Table 3). The prevalence of frequent non-medical cannabis use among veterans reporting and not reporting recent pain was 3.9% and 1.9% (PD = 1.9, 98% CI [0.21, 3.63]). The significant prevalence ratio reflects greater prevalence of frequent non-medical cannabis use among veterans reporting recent pain (PR = 1.9, 98% CI [1.16, 3.44]). The difference in predicted prevalence of any non-medical cannabis use and CUD among veterans reporting and not reporting recent pain was not significant.

Estimated association of MCL with prevalence of non-medical cannabis use and CUD among those reporting recent pain

There was no significant interaction between veteran status and MCL when estimating prevalence of any cannabis use or frequent cannabis use among veterans and non-veterans reporting recent pain

Estimated association of MCL with prevalence among veterans reporting and not reporting recent pain

Among veterans who resided in MCL states the prevalence of CUD was greater for those who reported recent pain than for those who did not report pain (PD=3.88%, 98% CI[0.36, 7.39]). However, the DiD was not significant, indicating there was not an interaction between pain and residing in a MCL state (Table 4). Within MCL states, the prevalence of CUD was significantly greater for veterans reporting recent pain than for veterans not reporting pain (Figure 1). MCL did not moderate the association between pain and prevalence of any cannabis use or frequent cannabis use among veterans reporting and not reporting recent pain.

Physical and mental health among veterans reporting recent pain

Non-medical cannabis use and CUD were not significantly associated with PCS and MCS scores among veterans reporting recent pain ($ps > .05$). Results were also not significant when the pain item was excluded from the PCS calculation.

DISCUSSION

Previous research suggests veterans are more likely to have pain than non-veterans [26], and pain was recently shown to be an emerging risk factor for CUD in U.S. adults [18]. In the current study, we aimed to better understand prevalence of non-medical cannabis use and CUD among veterans and non-veterans participating in the NESARC-III survey. Results of the study provide further evidence that the prevalence of pain is greater among veterans than non-veterans. Additionally, the prevalence of frequent non-medical cannabis use was two-fold greater among veterans reporting recent pain compared to those not reporting recent pain, and among veterans residing in a state with medical cannabis laws the prevalence of CUD was greater among those reporting recent pain. However, among US adults reporting recent pain, the differences between veterans and non-veterans were not significant for any of the three outcomes: the prevalence of cannabis use, frequent use, and CUD. Finally, we did not find differences in physical or mental health indicators as a function of cannabis use, frequent use, or CUD among veterans reporting recent pain.

Consistent with prior work, this study indicates that U.S military veterans report pain at higher levels than non-veterans. Explanations for this observation include elevated risk for serious injuries during active military duty, exposure to environmental and psychological stressors, and higher likelihood of other chronic health conditions including diabetes and cancer among veterans [26].

New knowledge contributed by this study includes the evidence that, among veterans, there is greater prevalence of *non-medical* frequent cannabis use for those veterans reporting recent pain and greater prevalence of CUD among veterans in MCL states. This finding is consistent with prior work showing that the legalization of cannabis for medical purposes is associated with increased non-medical cannabis use and risk for CUD [6,14,24,44]. Additionally, there was no evidence among veterans reporting recent pain of an association between cannabis use and physical or mental health. These findings are consistent with related findings that pain is a common reason for veterans to use cannabis for medical purposes [25], and pain is a risk factor for CUD in U.S. adults [18]. Moreover, more frequent cannabis use and CUD have several possible consequences that can easily supersede any potential benefits cannabis use might have for pain. These consequences include frequent cannabis craving [29], intoxication [35]; injury risk while intoxicated; withdrawal symptoms that can disrupt sleep, appetite, and affect mood [4]; and cognitive dysfunction during periods of use [41]. A major expectation of a pharmacotherapy for pain is not only that it will reduce pain but perhaps even more importantly improve functional status [40]. Our findings did not indicate that physical or mental health indicators among veterans reporting recent pain were related to cannabis use or CUD. Further research is needed using longitudinal designs to investigate directionality and individual-level effects of medical and non-medical cannabis use on physical and mental well-being in veterans

reporting recent pain. Although not conclusive, this finding does not support the idea that cannabis use improves health status among veterans with pain.

Study limitations are noted. Pain interference was assessed with a single, self-reported item in the NESARC, and information on pain duration was not collected. Cannabis use variables relied entirely on self-report and were not validated with biological markers. Veteran status also relied on self-report. Since NESARC-III did not distinguish between veterans who accessed health care through the VHA and those who did not, the findings might not generalize to veterans receiving VHA health care. Prior research has demonstrated a similar pattern of increased prevalence of cannabis use and CUD in general population samples [14] and VHA samples [3] since the early 2000s, and the prevalence of recent pain is also greater among veterans than similar aged non-veterans [26]. However, no studies have directly compared prevalence estimates of cannabis use, frequent use, or CUD between those reporting recent pain who are veterans in the VHA and other veterans reporting recent pain. In addition, NESARC-III was conducted prior to the era in which several U.S. states legalized recreational cannabis, and thus this study cannot address the impact of legalized recreational cannabis use among veterans reporting or not reporting recent pain. However, given that a previous study showed that among adults, recreational cannabis laws had similar effects on frequent non-medical cannabis use and CUD [6] as the effects previously found for MCL [14,24,44], the impact of recreational cannabis laws on veterans reporting and not reporting recent pain is an important topic for future research. We observed a number of additional results following the same trend wherein prevalence of cannabis outcomes were positively associated with veteran status, pain, and residing in a MCL state. With the expansion of cannabis legalization across the US since the time of the survey, future research may have adequate power to detect these effects. While the analysis adjusted for the effect of gender, we note that the gender composition of the veteran and non-veteran samples was markedly different. This is a cross-sectional, population-level study, and the results related to the efficacy of pharmacotherapy for pain are thus limited and exploratory.

Taken together, this work underscores previously voiced concerns about the risks of cannabis use to manage pain [33]. Specifically, this study did not show differences in physical and mental health indicators among veterans reporting recent pain who used cannabis non-medically or had CUD and those who did not. Of note, the prevalence for cannabis use and CUD does not appear to differ among veterans reporting recent pain when compared to non-veterans reporting recent pain for any of the three cannabis outcomes. However, findings indicate that frequent use was more prevalent among veterans reporting recent pain than veterans without pain, and CUD was more prevalent among veterans with pain if they reside in a state with MCL. This pattern suggests that MCL states may anticipate greater prevalence of CUD among veterans reporting recent pain and thus may see greater public health benefits from early prevention and intervention efforts to address the expected increase in burden of disease. Longitudinal research is needed to examine the associations between pain, cannabis use and CUD, especially among veterans, who are especially likely to have pain [26]. Such research could clarify directionality and provide useful guidance regarding risk and clinical care. Clinicians working with veterans reporting recent pain, particularly those residing in states with MCL, are encouraged to regularly assess and monitor cannabis use and related problems in order to identify and treat frequently co-

occurring CUD. Future research should continue to elucidate the prevalence and correlates of cannabis use and CUD, MCL, and recreational cannabis laws among veterans, including those engaged in VHA health care, in order to determine the impacts of such laws on veteran health-related outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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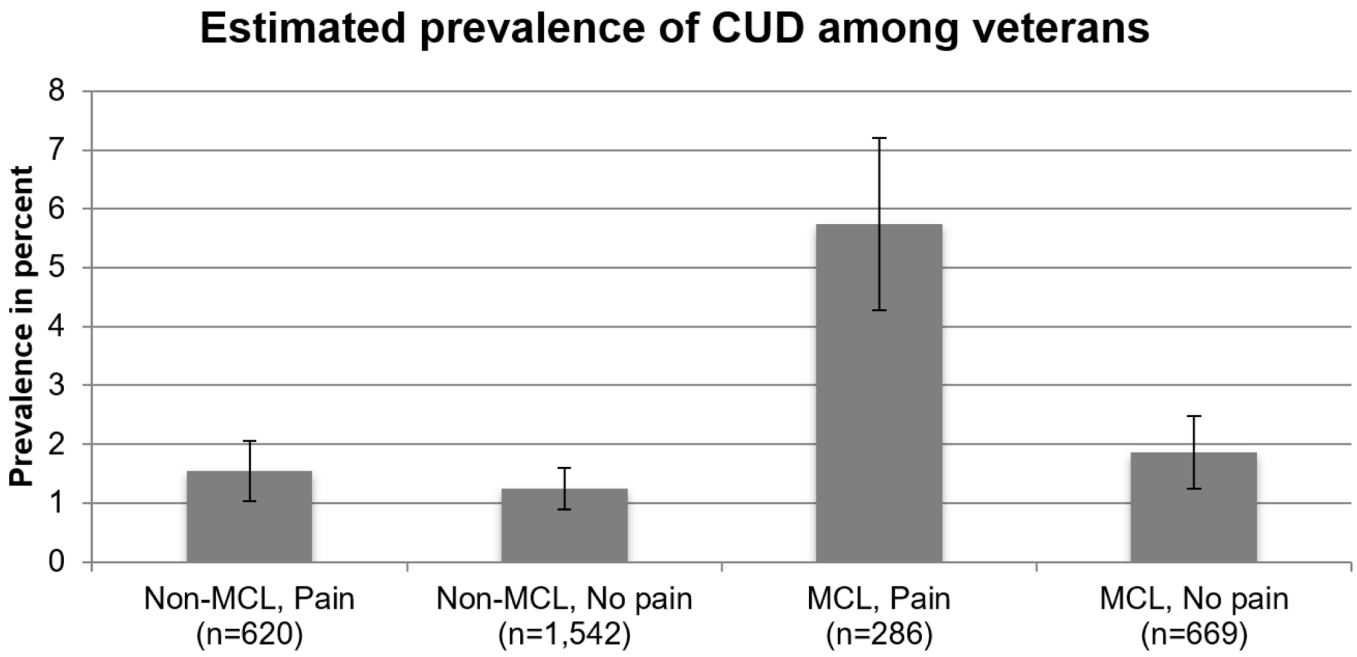

Figure 1.

Among veterans (N=3,117), prevalence of CUD for those reporting pain, residing in states with and without MCL.

Table 1.

Demographic characteristics of veterans and non veterans, N= 36,289.

	Veterans (n=3,117) % (SE)	Non-Veterans (n= 33,172) % (SE)	Chi-square p-value[a]
Sex			
Male	90.18 (0.55)	43.60 (0.33)	**<.0001**
Age			
18–29	3.91 (0.33)	23.58 (0.39)	**<.0001**
30–44	14.94 (0.80)	26.88 (0.34)	
45–64	38.26 (1.10)	34.69 (0.36)	
65+	42.89 (1.24)	14.85 (0.33)	
Race/ ethnicity			
White	79.52 (1.04)	64.77 (0.79)	**<.0001**
Black	10.42 (0.78)	11.94 (0.68)	
Hispanic	6.50 (0.63)	15.61 (0.72)	
Other	3.56 (0.45)	7.68 (0.50)	
Education			
Less than High School	6.15 (0.56)	13.73 (0.44)	**<.0001**
High School Graduate/	25.80 (0.93)	25.78 (0.55)	
GED	68.05 (0.99)	60.49 (0.80)	
Some college or higher			
MCL			
Never-MCL states	70.42 (2.20)	67.50 (1.98)	0.036
Ever-MCL states	29.58 (2.20)	32.50 (1.98)	

[a]After adjusting for multiple comparisons using the Bonferroni correction, the alpha level is 0.01. Statistically significant p-values are bolded.

Table 2.

Prevalence of pain among veterans and non-veterans, unadjusted and adjusted estimates, N= 36,289.

	Unadjusted (%SE)	Adjusted[1] (%SE)	p-value[a]
Veterans (n=3,117)	28.11 (1.14)	24.69 (1.25)	
Non-veterans (n= 33,172)	19.16 (0.44)	17.39 (0.38)	
Prevalence Difference (95% CI)	**8.95 (6.75, 11.14)**	**7.25 (4.90, 9.60)**	**<.0001 / <.0001**
Prevalence Ratio (95% CI)	**1.47 (1.35, 1.59)**	**1.38 (1.25, 1.51)**	**<.0001 / <.0001**

[1]Adjusted for sex, age, race/ethnicity, education

Note: Prevalence difference (PD) estimates with confidence intervals (CIs) that do not overlap 0 are significant at alpha level .05. Prevalence ratio (PR) estimates with CIs that do not overlap 1 are significant at alpha level .05.

[a]The first p-value is from the unadjusted model, the second from the adjusted model.

Table 3.

Past-year cannabis outcomes among U.S. veterans with and without pain, 2012–2013[a].

	Adjusted[1] % (SE)	Adjusted[2] % (SE)	p-value[b]
Any non-medical cannabis use			
Veterans with pain (n=906)	8.95 (1.25)	8.83 (1.23)	
Veterans without pain (n=2,211)	6.21 (0.59)	6.24 (0.60)	
Prevalence Difference (98% CI)	2.75 (−0.51, 6.01)	2.59 (−0.67. 5.84)	0.053 / 0.067
Prevalence Ratio (98% CI)	1.44 (0.96, 2.16)	1.41 (0.93, 2.13)	0.036 / 0.051
Frequent non-medical cannabis use			
Veterans with pain (n=906)	3.92 (0.71)	3.85 (0.69)	
Veterans without pain (n=2,211)	1.91 (0.30)	1.92 (0.30)	
Prevalence Difference (98% CI)	**2.01 (0.24, 3.78)**	**1.92 (0.21, 3.63)**	**0.0092 / 0.010**
Prevalence Ratio (98% CI)	**2.05 (1.18, 3.56)**	**1.99 (1.16, 3.44)**	**0.0026 / 0.0034**
DSM-IV Cannabis Use Disorder			
Veterans with pain (n=906)	2.72 (0.58)	2.68 (0.56)	
Veterans without pain (n=2,211)	1.40 (0.31)	1.40 (0.31)	
Prevalence Difference (98% CI)	1.32 (−0.15, 2.79)	1.28 (−0.16, 2.72)	0.038 / 0.040
Prevalence Ratio (98% CI)	1.95 (0.98, 3.87)	1.91 (0.96, 3.79)	0.024 / 0.027

[1] Adjusted for sociodemographic characteristics only (sex, age, race/ethnicity, education)

[2] Adjusted for sociodemographic characteristics and state MCL status

Note: PD estimates with CIs that do not overlap 0 are significant at alpha level .02. PR estimates with CIs that do not overlap 1 are significant at alpha level .02.

[a] After adjusting for multiple comparisons, p-values are significant at an alpha level of 0.017.

[b] The first p-value reflects prevalence difference or prevalence ratio for the model adjusted only for sociodemographics and the second for the model that additionally includes state MCL status.

Table 4.

State of residence MCL as a moderator of pain and cannabis outcomes among veterans[a].

Outcome	Never-MCL states [24 states] No MCL before 2012 (n=955)	Ever-MCL states [15 states] Passed MCL By 2012 (n=2,162)	
Any non-medical cannabis use		**Prevalence (SE)**	**p-value** [b]
Veterans w\ Pain (n=906)	4.97 (0.65)	9.60 (1.31)	
Veterans w\ No Pain (n=2,211)	6.27 (0.96)	15.39 (3.44)	
Prevalence Difference (98%CI)	1.30 (−1.63, 4.24)	5.79 (−2.19, 13.77)	0.30 / 0.09
Difference in Difference (DiD)[1]			
DiD (98% CI)	(reference)	4.49 (−3.76, 12.73)	0.21
Frequent cannabis use	**Prevalence (SE)**		
Veterans w\ Pain (n=906)	2.29 (0.57)	7.99 (1.99)	
Veterans w\ No Pain (n=2,211)	1.34 (0.29)	3.51 (0.84)	
Prevalence Difference (98%CI)	0.95 (−0.52, 2.42)	4.47 (−0.40, 9.34)	0.14 / 0.035
Difference in Difference (DiD)[1]			
DiD (98% CI)	-(reference)	3.52 (−1.58, 8.62)	0.11
Cannabis Use Disorder	**Prevalence (SE)**		
Veterans w\ Pain (n=906)	1.54 (0.51)	5.74 (1.46)	
Veterans w\ No Pain (n=2,211)	1.24 (0.35)	1.86 (0.61)	
Prevalence Difference (98%CI)	0.30 (−0.92, 1.52)	**3.88 (0.36, 7.39)**	0.62 / 0.011
Difference in Difference (DiD)[1]			
DiD (98% CI)	(reference)	3.57 (−0.20, 7.34)	0.03

[1] Ever- vs. Never-MCL states

Note: PD and DiD estimates with CIs that do not overlap 0 are significant at alpha level .02.

[a] After adjusting for multiple comparisons, p-values are significant at an alpha level of 0.017.

[b] When two p-values are listed, the first p-value reflects prevalence difference in the Never MCL-states and the second in the Ever-MCL states.