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The relationships between chronic pain and changes in health with cannabis consumption patterns

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Abstract

Background: Pain is the most common reason endorsed by patients seeking medical cannabis. Given the nature of chronic pain, it is particularly important to understand consumption patterns for patients who use cannabis for chronic health conditions to evaluate how frequency of use might impact overall health and functioning. This analysis examines whether levels of chronic pain were associated with cannabis consumption patterns, after controlling for patient-level differences in demographics.

Methods: Our sample included 295 medical cannabis patients. Logistic regression models were fit to evaluate the association between pain (low, moderate and high) and dichotomous measures of cannabis consumption (daily vs. nondaily; 3 times per day vs. <3 times per day). Additionally, two ordered logit models were fit to evaluate the association between past-year health status change (better, same, or worse) and cannabis consumption.

Results: A significantly higher proportion of respondents in the high pain category used cannabis 3 or more times per day, compared to lower pain categories. Pain level was not significantly associated with daily cannabis use. However, pain level was significantly associated with log odds of using cannabis 3 times per day, such that respondents with both high pain and moderate pain had significantly higher log odds of consuming cannabis 3 times per day compared to low pain group.

Conclusion: While the efficacy of cannabis for various medical conditions continues to be evaluated, the best available evidence suggests a possible benefit for the treatment of chronic pain. The results of this study indicate that individuals with high pain are more likely to consume cannabis multiple times a day, but this use may not be related to better health. Our results point to

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a need for more research on the health impacts of frequency of cannabis use among medical cannabis dispensary patients.

Keywords

Cannabis; chronic-pain; cannabis consumption

Background:

Pain is the most common reason endorsed by patients seeking medical cannabis (Ilgen et al., 2013; Nussbaum, Boyer, & Kondrad, 2011; Nussbaum, Thurstone, McGarry, Walker, & Sabel, 2015; Reiman, Welty, & Solomon, 2017). Studies on patients who use cannabis for pain find samples to be mostly male, have multiple comorbidities, and also use or have previously used opioids to manage pain (Aggarwal et al., 2008; Boehnke, Litinas, & Clauw, 2016; Ware, Doyle, Woods, Lynch, & Clark, 2003; Ware et al., 2015). A recent study of 244 patients who used medical cannabis to treat chronic pain found 79% of patients smoked cannabis daily. However, frequent (e.g., daily or near-daily) cannabis use is associated with higher risks of adverse health outcomes (Fischer, Russell, et al., 2017). While some research points to efficacy of cannabis for pain management, findings regarding the efficacy of cannabis in managing chronic pain are inconclusive (Ilgen et al., 2013; Webb & Webb, 2014).

Given the nature of chronic pain, it is particularly important to understand consumption patterns for patients who use cannabis for chronic health conditions to understand how frequency of use might impact overall health and functioning. Recent research points to problems associated with the long term use of cannabis and its association with negative health outcomes later in life (Terry-McElrath et al., 2017). In terms of mental and physical functioning, a sample of patients who use medical cannabis for chronic health conditions reported lower physical and mental functioning compared to the general population (Fischer, Ialomiteanu, et al., 2017). In a recent longitudinal study, chronic pain patients who used cannabis had greater pain, greater generalized anxiety disorder severity score and lower pain-self-efficacy scores, potentially suggesting poorer coping mechanisms, compared to those with no cannabis use at 4-year follow up (Campbell et al., 2018).

There is clear evidence that patients are engaging in cannabis use to treat pain, however the utility of cannabis in treating different levels of pain, particularly related to its association with health status change remains unclear. While it is documented that patients with pain consume cannabis, there is little evidence regarding the consumption patterns of patients with pain, or regarding how pain impacts frequency of use. The objectives of the present study were to (1) determine whether levels of chronic pain were associated with cannabis consumption patterns, after controlling for patient-level differences in demographics, and to examine (2) whether pain level moderated the relationship between consumption and past-year change in health status. We hypothesized that patients with high levels chronic pain would use cannabis more often. Further, we hypothesized that chronic pain level would moderate the relationship between health consumption and past year change such that those with high levels of cannabis use and chronic pain would report better health.

Methods

Study Design and Procedures

The present study used survey data collected from medical cannabis dispensary patients in Los Angeles, California to conduct two sets of secondary analyses. First, we evaluated the association between pain and dichotomous measures of cannabis consumption. Additionally, we evaluated the association between past-year health status change and cannabis consumption. The survey utilized a multi-stage sampling design (Thomas & Freisthler, 2016). A census of all medical cannabis dispensaries was first conducted, followed by site visits that identified 476 operating medical cannabis dispensaries within Los Angeles at the time of the study (April to June of 2013). The list of operating dispensaries was used as a sampling frame for medical cannabis dispensary recruitment. Locations were contacted in random order until 16 sites agreed to participate (response rate 28.6% among sites approached). At participating sites, a second-stage survey was conducted in which patients exiting the dispensary were asked to complete 5-minute brief surveys. Respondents received a \$20 cash incentive for participating in the exit survey and were given a unique study identifier and asked to participate in a second, longer patient survey. Patients could either complete this additional survey immediately in person (either tablet or pen and paper) and receive a \$30 Target gift card or could complete the survey online at a later time and receive a \$30 Amazon gift card delivered via email. For the exit survey, we had a response rate of 84.5% (600 of 710 completed the survey) in Los Angeles. Of the 600, 426 completed the patient survey. However, three of those survey participants were duplicates. The final number of participants who participated in the longer patient survey was 423, for a 70.5% conversion rate (Thomas & Freisthler, 2016). The study was approved by the institutional review board at the University of California Los Angeles and the Ohio State University.

Measures

Pain Level—Pain level (Low, Moderate, High) was the first dependent variable of interest, and was constructed based on two survey items from the RAND 36-item Short Form Survey (SF-36) assessing pain symptoms (J. Ware Jr & Sherbourne, 1992). Respondents were asked to report, in the past four weeks how much pain “interfered with their normal work” (not at all, moderately, quite a bit, extremely). In addition, respondents were asked how much pain they had experienced in the past four weeks (none, very mild, mild, moderate, or severe). Individual item scores were averaged to obtain a total pain score (0–100 points), following scoring instructions, where a higher score indicates a more favorable outcome, e.g. less pain. The total score was then used to create the categorical variable for pain level using the U.S. general population mean score as a reference (mean=75.2, SD=23.7) (J. E. Ware Jr, 2000). Individuals’ pain scores at or above the population mean score were categorized as “low pain,” scores within one standard deviation of the mean were categorized as “moderate pain,” and scores more than two standard deviations below the mean were categorized as “high pain.”

Change in health status—The second dependent variable of interest was a single item measure, also from the RAND 36-Item health Survey. Respondents were asked, “Compared to a year ago, how would you rate your health in general now?” Response options included

“much better,” “somewhat better,” “same,” “somewhat worse,” and “much worse.” However, due to low cell sizes for some responses and for the purposes of interpretability, responses were collapsed into a 3-level categorical variable for the analysis, with change in health status categories of “better,” “same,” or “worse.”

Cannabis consumption—Two measures of cannabis consumption were constructed as the independent variable of interest, *daily consumption* and *frequency per day*. *Daily consumption* was based on the survey item asking respondents to report “how many days in the past four weeks (28 days) did you use cannabis, hashish, edibles, beverages, honey oil, tinctures, or kief?” A dichotomous measure for “daily consumption” was constructed where responses were categorized as reporting either “daily use,” if cannabis was consumed on 28 days, or “nondaily use,” if cannabis was consumed <28 days. A second *frequency per day* measure of cannabis consumption was based on the following survey item: “On the days you use cannabis, hashish, edibles, beverages, honey oil, tinctures, or kief, how many different times a day do you typically use it?” A dichotomous measure was constructed whereby, on days respondents used cannabis, consumption was categorized as either 3 times per day or <3 times per day. These two measures of cannabis consumption were moderately correlated ($r=0.35$)

Other Measures—Demographic characteristics included respondent age, gender, race (White Non-Hispanic, Black Non-Hispanic, Hispanic, and other), education level (high school or less, some college, college or more), household income (\$10,000, \$10,001 to \$40,000, \$40,001 to \$80,000, and \$80,001 or more), and marital status (married or unmarried). In addition, respondents reported whether or not they had received a recommendation for the following conditions, including anorexia, anxiety, arthritis, cachexia/wasting, cancer, crohn’s disease, epilepsy, glaucoma, HIV/AIDS, migraine, sleep, spasticity/multiple sclerosis, depression, appetite, or other. The total number of conditions reported were summed for each respondent. Finally, a variable for past-year receipt of recommendation was created, which was based on self-report of whether they had received their recommendation within the past year (yes/no).

Analyses

Descriptive statistics were used to describe demographic and other characteristics of the study sample, overall, and separately by pain categories. Chi-square statistics for categorical variables, or ANOVA for linear variables, were used to compare differences in sample characteristics by pain categories (low, moderate, high). Two separate logistic regression models were fit to evaluate the association between the independent variable of interest, a 3-level pain categorical independent variable, and the two dichotomous dependent variables of interest, cannabis consumption outcomes (daily vs. nondaily; 3 times per day vs. <3 times per day), adjusting for demographic and other characteristics. Two ordered logit models were fit to evaluate the association between two cannabis consumption independent variables of interest (daily vs. nondaily; 3 times per day vs. <3 times per day) and the limited dependent variable of past-year health status change (worse, same, better), adjusting for demographic and other characteristics. Interaction terms between each dichotomous cannabis consumption variable and the 3-level categorical pain variable were added to

ordered logit models. Post-estimation Wald tests were used to evaluate whether the interaction was significant. Two-sided significance tests were used and $p < 0.05$ was considered significant. In all analyses, cluster robust standard errors were used to account for the correlation of individuals within dispensary sites ($n=16$). To further examine interaction effects of cannabis consumption and pain categories for health status change, average adjusted probabilities of health change categories were estimated with the *margins* command in Stata 14.0. All analyses were conducted in Stata.

Results

Sample

The sample for the present analysis included all Los Angeles medical cannabis dispensary patients who participated in both the exit and patient surveys and completed the measures needed for the analyses. In total, 423 patients completed both surveys. However, due to technical issues only 420 surveys were usable. The final analytic sample included 295 participants with complete responses to all items needed. The most frequently missing survey items were cannabis consumption measures (days per month, and frequency per day) and income, which were missing among 11%, 16%, and 15% of surveys, respectively. Compared to those who completed all survey items needed for the analysis, a significantly higher proportion of those who did not complete all items were Black Non-Hispanic or Hispanic (32% vs. 28% and 34% vs. 23%) but a lower proportion had a college degree (24% vs. 41%). However, there were no significant differences based on age, gender, income, marital status, or pain level. The average age was 35, about three-quarters of the respondents were male; 28% were non-Hispanic Black, 22% were Hispanic and 37% were White (see Table 1). With respect to education 27% of the sample completed high-school or less, about one-third completed some college, and 41% completed college or more. Of the sample the majority (61%) had a medicinal cannabis recommendation for a year or longer, while 38% had a recommendation for less than one year. Daily cannabis use was reported by 45% and use 3 or more times per day was reported by 48% of the sample.

Among the 295 survey respondents included in the analytic sample, 31% reported bodily pain scores in the highest pain level, 24% in the moderate pain category, and 44% in the lowest pain category. There were few differences in demographics across the pain categories, with the exception of age (Table 1). Respondents in the high pain category were significantly older than other groups. A significantly higher proportion of respondents in the high pain category used cannabis 3 or more times per day, compared to lower pain categories. However, the proportion of respondents using cannabis daily did not differ based on pain category.

In logistic regression models that adjusted for covariates, pain level was not significantly associated with daily cannabis use ($p=0.39$) (Table 2). However, pain level was significantly associated with log odds of using cannabis 3 times per day, such that respondents with both high pain and moderate pain had significantly higher log odds of consuming cannabis 3 times per day compared to low pain group.

In ordered logistic regression models that adjusted for covariates, there was a significant interaction between daily cannabis use and pain level ($p=0.0091$), such that the association between daily consumption and change in health status depended on pain level. There was no significant association between daily cannabis use and change in health status among those with low pain level (Table 3). Significant associations between daily cannabis association and change in health status was limited to those with high pain levels (Figure 1). However, there was a significant association between consuming cannabis 3 times per day and change in health status category ($p=0.003$), after adjusting for covariates and pain level. The interaction between pain level and times per day of use was not significant ($p=0.63$), showing that the relationship between consuming cannabis 3 times per day and change in health status from the past year did not differ based on pain level (Table 3).

Discussion

Our study examined how levels of chronic pain are related to cannabis consumption, as well as associations between chronic pain, cannabis consumption and health status change from the past year. Our results did not indicate a relationship between pain-level and daily cannabis use, but we did observe a relationship between pain level and frequent cannabis use (3+ times/day). Our analyses used the SF-36 as a measure of pain, rather than the reason patients listed for their medical recommendation to better assess the relationship between chronic pain and cannabis consumption. While the efficacy of cannabis for various medical conditions continues to be evaluated, the best available evidence suggests a possible benefit for the treatment of chronic pain (Hill, Palastro, Johnson, & Ditre, 2017; National Academies of Sciences, Medicine, & others, 2017). Despite this data health care providers may have concerns about the legitimacy of medical cannabis recommendations, or question if patients' cannabis use is recreational rather than medicinal. In this study, those with high bodily pain scores are more likely to use cannabis multiple times per day which might point to a need for more frequent dosing for high pain patients or might also indicate that cannabis is not adequately treating pain for this population.

This is the first study to evaluate whether pain severity moderated the association of daily or frequent cannabis consumption with change in health status. The results of this study indicate that an association between worsened health status and daily cannabis use was limited to individuals with high pain, suggesting that daily cannabis use did not result in better health for these patients. Given that the two measures of cannabis use (daily consumption and frequency per day) were differentially associated with pain and health status, our results also highlight the challenges of measuring cannabis. Research indicates that long-term, frequent use of cannabis contributes to poor health (Hall & Degenhardt, 2014). Additionally, chronic pain is associated with depression, anxiety, and limited physical activity (Domenichiello & Ramsden, 2019; Gormsen, Rosenberg, Bach, & Jensen, 2010; Lerman, Rudich, Brill, Shalev, & Shahar, 2015; Wilson & Palermo, 2012). High-pain patients in this study were less likely to see improvements in health, however, it is unclear if this relationship might be due to the adverse health impacts of chronic cannabis use, the adverse health impacts of chronic pain, or some combination. While pain treatments (cannabis or otherwise) may address pain symptoms, these treatments alone may not result

in overall improvements to health. In evaluating the efficacy of cannabis in treating chronic pain, it will be important to evaluate potential efficacy across a range of health impacts.

This study does have some limitations. The cross-sectional nature of this study does limit our ability to make definitive conclusions about causation. This leaves us with the classic “which came first dilemma?” For example, it is not clear if the frequency with which people who have high pain use cannabis might depress general health, or are they using cannabis because they are experiencing poor health. Although the respondents for the study had medical recommendations for cannabis use, some portion of the sample may be using recreationally. The proportion of recreational users in the study may skew the results of how cannabis use is related to pain and change in health status. Participants’ changes in health status was self-reported retrospectively, potentially leading to recall bias. Additionally, we did not collect information on the types of chronic pain respondents were managing. The management of chronic pain is complex, and the impacts of cannabis use may be influenced by the type of pain patients have (e.g. nociceptive vs. neuropathic pain).

Conclusion

Data for this study were collected at a time when only medicinal cannabis use was legalized in California. Since the passage of Proposition 64 many cannabis dispensaries in California hold medical and recreational licenses. Additionally medical cannabis use often co-occurs with recreational use and boundaries between therapeutic and non-therapeutic uses of cannabis are not always clear (Kondrad & Reid, 2013). The benefits of cannabis in treating chronic pain may be dependent on dose-response effects as well as the route of administration (Hill et al., 2017; Romero-Sandoval, Kolano, & Alvarado-Vázquez, 2017). However, it is unclear how patients make decisions related to frequency of cannabis consumption, or how consumption patterns might affect the health of chronic pain patients. Given the complex nature of chronic pain, effective pain management often requires a combination of approaches including pharmacologic and nonpharmacologic options (Chou & Huffman, 2007; Turk, Wilson, & Cahana, 2011). Chronic pain remains a significant public health issue, patients will continue to seek out treatments to address their unmet pain needs. As legalization expands, the lines between recreational and medicinal cannabis use will continue to blur and cannabis may be a particularly attractive and accessible option for those with chronic pain. More research is needed to develop scientifically sound measures of cannabis use that can be applied to both recreational and medicinal cannabis use. Our results point to a need for more research on the health impacts of frequency of cannabis use in patients who are experiencing pain symptoms.

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Figure 1.
Interaction between Daily Cannabis Consumption and Pain Level

Table 1.

Sample Characteristics by SF-36 Pain Level

	SF-36 Pain Level						Total	
	Low		Moderate		High		N=295	
	N=130		N=73		N=92			
	n (%) or Mean (sd)		n (%) or Mean (sd)		n (%) or Mean (sd)		n (%) or Mean (sd)	
Age	31.6	(113)	33.3	(115)	40.1	(13.5) **	34.8	(12.6)
Sex								
Female	26	(20.0)	17	(23.3)	31	(33.7)	74	(25.1)
Male	104	(80.0)	56	(76.7)	61	(66.3)	221	(74.9)
Racial/Ethnic Group								
White Non-Hispanic	44	(33.8)	26	(35.6)	40	(43.5)	110	(37.3)
Black Non-Hispanic	30	(23.1)	25	(34.2)	30	(32.6)	85	(28.8)
Hispanic	40	(30.8)	15	(20.5)	12	(13.0)	67	(22.7)
Other	16	(12.3)	7	(9.6)	10	(10.9)	33	(11.2)
Education								
High School or Less	39	(30.0)	22	(30.1)	19	(20.7)	80	(27.1)
Some College	45	(34.6)	18	(24.7)	31	(33.7)	94	(31.9)
College or More	46	(35.4)	33	(45.2)	42	(45.7)	121	(41.0)
Household Income								
10,000	21	(16.2)	20	(27.4)	21	(22.8)	62	(21.0)
10,001 to 40,000	45	(34.6)	21	(28.8)	32	(34.8)	98	(33.2)
40,001 to 80,000	42	(32.3)	24	(32.9)	29	(31.5)	95	(32.2)
80,001 or more	22	(16.9)	8	(11.0)	10	(10.9)	40	(13.6)
Married	31	(23.8)	18	(24.7)	31	(33.7)	80	(27.1)
Had Cannabis								
Recommendation >1 Yr								
no	55	(42.3)	27	(37.0)	31	(33.7)	113	(38.3)
yes	75	(57.7)	46	(63.0)	61	(66.3)	182	(61.7)
Number of Recommendation	1.8	(0.9)	1.8	(0.9)	2.2	(1.3) *	1.9	(1.1)
Conditions								
Cannabis Consumption								
Daily Use	50	(38.5)	37	(50.7)	47	(51.1)	134	(45.4)
3 times per day	51	(39.2)	37	(50.7)	55	(59.8) *	143	(48.5)

*
p<0.05,**
p<0.001;

Chi-square test for categorical variables, ANOVA for continuous variables (Age, Number of Recommended Conditions)

Table 2.

Multivariate Regression model results for association between chronic pain level and cannabis consumption patterns^{*I*}

	Daily Cannabis use AOR (95% CI)	Cannabis Use 3 Times Per Day AOR (95% CI)
Pain Level (Low Reference Group)		
moderate	1.56 (0.80,3.04)	1.64 (1.03,2.62) *
high	1.12 (0.61,2.07)	2.63 (1.14,6.09) *
Age (years)	1.02 (0.99,1.05)	0.98 (0.97,1.00) *
Male	0.78 (0.46,1.31)	1.08 (0.60,1.96)
Racial/Ethnic Group (White NH Reference Group)		
Black Non-Hispanic	0.38 (0.17,0.84) *	0.76 (0.42,1.35)
Hispanic	0.38 (0.15,0.97) *	0.90 (0.52,1.56)
Other	0.84 (0.43,1.61)	1.00 (0.59,1.68)
Education (HS or Less Reference)		
Some College	0.68 (0.31,1.47)	1.09 (0.46,2.56)
College or More	0.60 (0.29,1.22)	0.97 (0.58,1.62)
Married or Cohabiting	0.78 (0.43,1.40)	1.08 (0.59,1.95)
Income (<\$10,000 reference group)		
\$10,001-\$40,000	1.42 (0.66,3.05)	0.81 (0.44,1.47)
\$40,001-\$80,000	1.17 (0.50,2.76)	0.43 (0.21,0.88) *
> \$80,001	0.43 (0.15,1.23)	0.29 (0.14,0.59) ***
Had Cannabis Recommendation >1 Yr	1.37 (0.76,2.45)	0.80 (0.48,1.33)
Number Recommended Conditions	1.59 (1.25,2.02) ***	1.07 (0.82,1.39)

*
p<0.05,

p<0.001

^{*I*}. Frequency of use refers to the number of times respondents reported cannabis use, on the days they used cannabis

Table 3.

Multivariate Ordered Logit Regression models Results for association between Cannabis Consumption Patterns and Change in Health Status from Past-Year (Better, Same, or Worse)

	Change in Health Status from Past-Year (Better, Same, or Worse)	
	Model 1 AOR (95% CI)	Model 2 AOR (95% CI)
Cannabis Consumption [§]	0.86 (0.53,1.40)	0.53 (0.35,0.80) **
Pain Level (Low Reference)		
moderate	2.01 (0.89,4.55)	1.72 (1.12,2.64) *
high	1.25 (0.64,2.43)	0.69 (0.35,1.34)
Pain Level X Cannabis Consumption		
Daily X Moderate	0.64 (0.20,2.02)	
Daily X High	0.20 (0.07,0.56) **	
Age (years)	0.99 (0.97,1.01)	0.99 (0.97,1.01)
Male	1.77 (0.90,3.51)	1.84 (0.96,3.53)
Racial/Ethnic Group (White NH Reference)		
Black Non-Hispanic	1.40 (0.87,2.26)	1.57 (0.99,2.48)
Hispanic	1.45 (0.65,3.21)	1.72 (0.85,3.47)
Other	1.30 (0.51,3.35)	1.43 (0.55,3.66)
Education (Less than HS Reference)		
Some College	1.29 (0.79,2.10)	1.43 (0.84,2.42)
College or More	1.07 (0.59,1.96)	1.18 (0.68,2.06)
Married or Cohabiting	1.42 (0.78,2.59)	1.40 (0.74,2.65)
Income (<\$10,000 Reference)		
\$10,001-\$40,000	1.89 (1.04,3.44) *	1.61 (1.00,2.59)
\$40,001-\$80,000	2.01 (1.09,3.72) *	1.67 (0.96,2.92)
> \$80,001	0.49 (0.26,0.91) *	0.46 (0.25,0.85)
Had Cannabis Recommendation >1 Yr	1.21 (0.72,2.04)	1.05 (0.66,1.70)
Number Recommended Conditions	1.12 (0.87,1.45)	1.00 (0.80,1.26)

*
p<0.05,

**
p<0.001

[§]Model 1 Cannabis Consumption Measure: Daily vs. NonDaily; Model 2 Cannabis Consumption Measure: 3 times per day vs. <3 times per day, on days used.