Characteristics of Individuals with Spinal Cord Injury Who Use Cannabis for Therapeutic Purposes

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Background: People with spinal cord injury (SCI) are accessing cannabis for therapeutic purposes (CTP), the use of which has been legalized in more than 20 states. In the past, illicit marijuana use had positive correlations with other health risk behaviors. It is not known whether access to CTP has shifted patterns of use and altered health outcomes. **Objective:** To describe the self-reported patterns of CTP use among individuals with SCI and correlations with health behaviors and health indicators. **Method:** Secondary analysis of data from a cross-sectional study involving community-dwelling individuals with chronic SCI and neurogenic bladder and bowel, at least 5 years post injury. Data were collected via structured interviews. **Results:** 92.2% of the current sample ($n = 244$) lived in states that, at the time of the study, permitted the use of CTP. 22.5% reported using CTP at least monthly to relieve pain (70.4%) and spasticity (46.3%). Of those 54 participants, 52.7% were daily users. Whereas 23.0% of non-CTP users endorsed having prescriptions for at least one opioid-based medication, 38.1% of CTP users did so, suggesting that CTP use does not mitigate opioid use. Users were more likely to be single and live alone, report more bladder complications, and perceive their psychosocial functioning as more compromised than non-users. **Conclusion:** A relatively large percentage of individuals with chronic SCI appear to use CTP on a regular basis. Results suggest that they may be more vulnerable to complications and to risk factors for substance use disorders in SCI, such as social isolation. Although the generalizability of these findings is limited by the sampling strategies and the eligibility criteria of the larger study, CTP use should be assessed and considered when planning health interventions. **Key words:** medical marijuana, cannabinoids, health behavior, pain, prevalence, spinal cord injury, substance use

Human use of cannabis goes back thousands of years, but the discovery of its mechanism of action – the endocannabinoid system – occurred fairly recently, with the cloning of the first receptor in 1990.¹ Since then, our basic understanding of the endocannabinoid system has grown considerably, and its participation in immune, metabolic, and cognitive functioning as well as pain modulation and sleep has been established.² Neuroprotective effects of cannabinoids have been shown preclinically when administered within hours following cerebral or spinal lesions³⁻⁶ and have been broadly publicized.^{7,8} While creating visions of novel therapeutic potential, the basic

neuroscience of cannabinoids raises significant concerns: The cannabinoid system is complex and exerts direct and indirect actions upon a wide range of fundamental physiological processes. The clinical impact of chronic use of cannabis-based products is not known, especially when users' central nervous system is already compromised.⁹

Today, public advocacy and commercial interests have outpaced a systematic approach to the use of cannabinoids in clinical populations. Without evidence-based guidelines for dosing, administration, or drug-drug and drug-disease interactions, and with great uncertainty regarding short and long-term risks and benefits, 23 states and Washington, DC, have legalized cannabinoids

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Top Spinal Cord Inj Rehabil 2016;22(1):3–12
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www.thomasland.com

doi: 10.1310/sci2201-3

for therapeutic purposes (CTPs) in general, and an additional 16 states restrict therapeutic applications to cannabidiol.^{10,11} In contrast to medicinal products regulated by the US Federal Drug Administration (FDA), such as synthetic cannabinoid receptor ligands (eg, dronabinol, nabilone), plant-based CTP products that are illegal at the federal level are not receiving any oversight.^{12,13}

Because of the wide gap between clinical evidence and practice, it is important to know about the characteristics of current users of CTP as well as their self-reported reasons for use. Cross-sectional studies have repeatedly shown that chronic pain and associated conditions are the main reasons cited for cannabinoid use among medical populations.¹⁴ In the United States and the United Kingdom, younger age, male gender, and previous recreational use predict the use of CTP.¹⁵ A study of applicants for the medical marijuana card in the United States found that only a minority (<10%) of first-time applicants were naïve to cannabis.¹⁶ In an international sample of users, this number rose to 23.5%,^{17,18} suggesting that cultural differences exist in the acceptance of CTP and consideration for first-time use. In the United States, a significant percentage of CTP users have past¹⁹ or current²⁰ substance use disorders. However, these data do not describe individuals with spinal cord injury (SCI) specifically.

It has long been known that individuals with SCI tend to subjectively perceive cannabinoids as an effective alternative treatment for pain.²¹ A 2006 study on pain management in SCI found that CTP had been “tried by 32% and was being used currently by 23% of the sample.”^{22(p115)} Whereas some users report reduction in SCI-related pain and potentially spasticity for hours after administration, evidence for the efficacy of CTP use in clinical trials is mixed and complicated by the lack of methodological consistency (eg, in administration and dosing). Further challenging the interpretation of CTP use in SCI is the circumstance that many individuals with SCI have clinically significant substance use histories, just as the general users of CTP described previously.²³ The use of cannabinoid-based products may be a continuation of preexisting behavior patterns that can result in increased vulnerability to adverse health effects following

SCI, such as bladder and bowel complications.^{24,25} However, little is known about complications and potential correlations with CTP use in particular.

The purpose of the current cross-sectional study was to describe the characteristics of individuals with chronic SCI who self-reported use of cannabinoid-based products and to examine their stated reasons for use, self-reported SCI-related complications and health behaviors, and relationships with health care providers. When sample size allowed, comparisons were made between CTP users and non-users within this sample.

Methods

Participants

This study represents a secondary analysis of data collected as part of an ongoing investigation of bowel and bladder complications and their impact on quality of life (QOL) in SCI. Participants with chronic SCI were recruited via the SCI Research Registry of a large medical center in the Midwest region of the United States, advertisements in SCI-related newsletters, lectures at rehabilitative settings, and from SCI outpatient clinics at this medical center. Effectively, participants were recruited across the United States, regardless of whether a state had legalized medical cannabis use at the time of the interviews. Potential participants were screened for the following inclusion criteria: (a) at least 18 years old; (b) neurogenic bowel and/or bladder; (c) having incurred a traumatic SCI at least 5 years before the time of the interview; (d) English-speaking; (e) American Spinal Injury Association (ASIA) Impairment Scale grades of A-D inclusive; and (f) not having cognitive limitations impairing their ability to complete the study interview.

Procedure

Trained interviewers conducted telephone and in-person interviews. Face-to-face interviews were conducted at the local site only. The assessments used in this study occurred over a period of 27 months.

Measures

Measures included demographic information (gender, age, race/ethnicity, education, vocational

status, marital status, primary living situation) and characteristics of the SCI (years since injury, neurological status, level of injury).

Functional status and QOL were assessed with the following instruments:

(a) Selected items from the Bowel and Bladder Treatment Index (BBTI)²⁶: Degree of bowel assistance needed, degree to which bowel management, bladder management, sexual functioning changes, and pain interfered with daily life. Scores ranged from 1 (*no effect*) to 10 (*worst effect*).

(b) Medication use, self-reported and recorded by interviewers as part of the Bowel and Bladder Treatment Index (BBTI): Two authors of the study (C.D., M.F.) independently coded opioids, with 97% interrater agreement. Other drug classes were coded by C.D.

(c) The SF-Qualiveen²⁷: 8-item questionnaire that assesses the interference of urinary problems with QOL, with 2 items addressing each of the following areas: feeling bothered by limitations, frequency of limitations, fears, and feelings. Item scores range from 0 to 4, and lower average scores indicate less interference. The total score is the mean of the subscales means scores.

(d) Spinal Cord Injury Multidimensional Quality of Life (SCI-QOL)²⁸: Computerized adaptive test that produces T-scores for bladder complications, distress due to bladder management, distress due to bowel management, and ability to participate in social roles and activities. Higher T-scores reflect higher levels of the concepts measured (eg, if distress due to bowel management is measured, higher scores present greater disruption with functioning; if ability to participate is measured, higher scores present less disruption).

(e) Life Satisfaction Index, Form Z (LSI-Z)²⁹: 13-item measure that assesses life satisfaction in retrospective. Responses take on values 0 (*disagree*), 1 (*unsure*), and 2 (*agree*) and total scores range from 0 to 26, with higher scores reflecting greater life satisfaction.

In addition, the degree of perceived social and instrumental support was assessed with a subscale of the Quality of Caregiving (QoC)³⁰ measure (ie, relationship with the primary caregiver, 4 items) among those persons receiving caregiver services. The Working Alliance Inventory (WAI)³¹ was used

to gauge the client-provider relationship. The WAI short-form is a 12-item measure that produces 3 subscales of 4 items each (alliance in terms of tasks, the client-provider bond, and the client's goals). Items are presented on a Likert scale (1-7, where 7 represents a greater alliance).

Health behaviors that may have an indirect effect on complications were assessed with the Spinal Cord Injury Lifestyle Scale (SCI-LS).³² The SCI-LS is a 25-item questionnaire that asks about behavior over the last 3 months relevant to long-term cardiovascular (4 items), genitourinary (4 items), neuromusculoskeletal (8 items), skin (6 items), and psychosocial (2 items) health. Higher scores are indicative of greater health promotion. Self-reports of other behaviors related to bowel and bladder management, including cannabis use, were also obtained.

Cannabis use was self-reported by participants during the interview ("Have you ever used marijuana to make you feel better? All responses are kept absolutely confidential."). "Yes," "no," and "refuse to say" answers were recorded by interviewers, who did not probe further about whether use occurred in legal or illicit contexts (eg, the status of marijuana card holders was neither assessed nor verified). Instead, the interview focused on purpose and mode of administration. Specifically, interviewees were asked if they used cannabis for bladder or bowel management, spasticity, pain, anxiety, or other purposes, including recreational use. If they answered "other," they were asked to provide the reason. Participants were able to endorse more than one purpose and more than one mode of administration. Recreational use of cannabis was not independently assessed nor were alcohol use and other illicit drug use (eg, stimulants).

Data analyses

Descriptive statistics, including frequency, means ($\bar{x}$), standard deviations (*SD*), and percentages, were computed for relevant variables using IBM SPSS Statistics, Version 23 (IBM, Armonk, NY). The quality and quantity of data available specified the type of analyses performed. Because of the small number of participants, categories of some demographic variables were combined when possible to facilitate statistical analysis. When not

limited by the small sample or cell sizes, differential statistics were used, including chi-square tests and tests of means (t tests, Mann-Whitney U tests). Because the current study is exploratory in nature, multiple test corrections for experiment-wise error rates were not conducted. The significance level was set at $P < .01$.

Results

Of all the individuals included in the sampling pool so far for the ongoing larger study on bowel and bladder functioning and QOL, about half met inclusion criteria and were eligible to participate and about one-third were enrolled. The total sample of the current secondary data analysis included 246 participants with chronic SCI and neurogenic bowel and bladder at least 5 years post injury. Most of these participants (93.9%) were recruited via the SCI Research Registry of a large medical center in the Midwest region of the United States ($n = 138$), from SCI outpatient clinics at that medical center ($n = 86$), and from research registries at other centers ($n = 7$). Fifteen participants were recruited from other sources: advertisements in SCI-related newsletters and lectures at rehabilitative settings ($n = 14$) and via social media ($n = 1$). The sample consisted of 182 men (74%) and 64 women (26%). They were on average 49.7 years old (range, 21-94 years old). Average age at injury was 31.1 years old (range, 2-83). One hundred and thirty-five participants (54.9%) had tetraplegia and 111 (45.1%) had paraplegia. The data from 2 individuals were excluded from further analysis because of the extent of missing data and refusal to provide information related to cannabis use.

Of the remaining 244 participants, 225 (92.9%) lived in states that had legalized the use of medical cannabis at the time of the study (ie, most were recruited in Michigan and California). Fifty-five (22.5%) endorsed cannabis use, and 53 of these participants lived in states where use had been legalized. Of 54 participants who provided reasons for and frequency of their cannabinoid use, 38 users of CTP (70.4%) stated they used cannabinoids for pain relief. Additional endorsed uses were spasticity reduction (46.3%, $n = 25$), anxiety (29.6%, $n = 16$), bowel management (11.1%, $n = 6$), bladder

management (5.6%, $n = 3$), and other non-listed uses (29.6%, $n = 16$), for example, loss of appetite and insomnia (20.4%, $n = 11$) and recreational use (9.3%, $n = 5$). Users reported an average of 1.85 reasons for use (range, 1-6). Cannabinoid use frequency varied from once a month to 4 or more times per day (monthly, 16.4%, $n = 9$; weekly, 29.1%, $n = 16$; and daily, 52.7%, $n = 29$). Among those who used cannabinoids daily, 15 used once daily, 10 used 2 to 3 times per day, and 4 individuals used 4 or more times daily.

The most common mode of administration was smoking (80%, $n = 44$), followed by eating (27.3%, $n = 15$) and vaporizing (20%, $n = 11$). Note that 16 individuals endorsed more than one administration method. One person (1.8%) endorsed the use of tinctures.

CTP users' and non-users' demographic characteristics are shown in **Table 1**, for comparison purposes. They did not differ in terms of age ($\bar{x}_{\text{CTP}} = 47.73$, $\bar{x}_{\text{Non-user}} = 50.37$; $t(242) = 1.35$, $P = .179$), race/ethnicity (87.3% vs 86.8% White), or vocational status. Note that, while a greater percentage of non-CTP users held graduate degrees, differences in education were not statistically significant at the chosen significance level. Most users of CTP fell into demographic brackets between 35 and 60 years old; they had obtained a high school degree or equivalent and characterized their vocational status as unemployed. In contrast to non-users of CTP, users were more likely to be single (56.4% vs 32.8%) and to live alone (43.6% vs 23.8%).

Table 2 summarizes SCI characteristics and factors related to functional status of the 2 groups within our sample. Most individuals sustained their injury more than 20 years ago (40% and 38.1% for CTP users and non-users, respectively). There was no difference between users and non-users of CTP in neurological status or the amount of bowel assistance needed.

In terms of perceived disruption of one's daily life by pain, users of CTP were more likely to describe their lives as limited by chronic pain (81.8% vs 58.2%). There was no significant difference in the degree to which bowel and bladder management as well as changes in sexual functioning interfered with their everyday lives. In general, more than one-third of participants indicated severely disrupted sexual functioning. While there was no significant

Table 1. Comparison of demographic characteristics

	CTP users, % (<i>n</i>)	Non-users, % (<i>n</i>)	Pearson chi-square
Gender, male	80 (44)	73 (138)	$\chi^2(1) = 1.296$ $P = .295$
Age, years			
≤34	5.5 (3)	14.8 (28)	
35-50	38.2 (21)	37.0 (70)	
51-60	41.8 (23)	26.5 (50)	
≥61	14.5 (8)	21.7 (41)	
Race			
White	87.3 (48)	86.8 (164)	
Black	12.7 (7)	11.1 (21)	
Other	—	1.0 (2)	
No report	—	1.1 (2)	
Ethnicity			
Hispanic	5.5 (3)	3.7 (7)	
Education			
≤High school or GED	60.0 (33)	43.9 (83)	$\chi^2(2) = 8.03$
College degree	34.6 (19)	35.5 (67)	$P = .018$
Graduate degree	5.4 (3)	20.6 (39)	
Vocational status			
Employed	21.8 (12)	29.1 (55)	$\chi^2(2) = 4.55$
Unemployed	49.1 (27)	33.3 (63)	$P = .103$
Retired/disability	29.1 (16)	37.6 (71)	
Marital status			
Single	56.4 (31)	32.8 (62)	$\chi^2(2) = 11.45$
Separated/divorced/ widowed	20.0 (11) 23.6 (13)	21.2 (40) 46.1 (87)	$P = .0033^*$
Partnered/married			
Primary living situation			
Alone	43.6 (24)	23.8 (45)	$\chi^2(2) = 9.68$ (df = 2)
w/ partner/spouse	27.3 (15)	46.6 (88)	$P = .0079^*$
w/ others	29.1 (16)	29.6 (56)	

Note: Asterisks indicate statistical significance at $P < .01$. Chi-square statistics were not computed when cells had expected values of smaller or equal to 5. CTP = cannabis for therapeutic purposes.

difference in overall QOL reported by users of CTP and non-users as measured by the LSI-Z, individuals using CTP endorsed more bladder complications (SCI-QOL Bladder Complications), greater fear of urinary difficulties (SF-Qualiveen Fears), and less ability to participate in usual social roles (SCI-QOL Ability – Social Roles).

Further investigation of the patterns of CTP use showed no clear relationship between self-reported life disruption by pain and frequency of CTP use. Individuals who indicated a severe disruption of their lives by pain used cannabinoids monthly, weekly, or daily. A number of participants ($n = 12$) reported daily use of CTP with no to mild disruption of their lives by chronic pain.

Table 2. Comparison of spinal cord injury characteristics and functional status

	CTP users, % (n)	Non-users, % (n)	Pearson chi-square
Years since injury			
≤10	21.8 (12)	24.3 (46)	$\chi^2(3) = 0.24$ $P = .9709$
≤15	21.8 (12)	22.8 (43)	
≤20	16.4 (9)	14.8 (28)	
>20	40.0 (22)	38.1 (72)	
Neurological status			
Complete paraplegia	32.7 (18)	30.7 (58)	$\chi^2(3) = 4.35$ $P = .2261$
Incomplete paraplegia	5.5 (3)	16.4 (31)	
Complete tetraplegia	30.9 (17)	27.0 (51)	
Incomplete tetraplegia	30.9 (17)	25.9 (49)	
BBTI, Level of bowel assistance			
Total assistance	36.4 (20)	34.9 (66)	$\chi^2(2) = 0.98$ $P = .6126$ $n = 187$
Some assistance	16.3 (9)	11.6 (22)	
Independent	47.3 (26)	52.4 (99)	
Missing	—	1.1 (2)	
Interference with daily life			
BBTI, Pain			
None/does not apply	18.2 (10)	41.8 (79)	$\chi^2(2) = 10.64$ $P = .0049^*$
Some	58.2 (32)	38.6 (73)	
Severe	23.6 (13)	19.6 (37)	
BBTI, Bowel management			
Not at all	49.1 (27)	48.7 (92)	$\chi^2(2) = 1.06$ $P = .5886$
A little	32.7 (18)	38.1 (72)	
A lot	18.2 (10)	13.2 (25)	
BBTI, Bladder management			
Not at all	50.9 (28)	53.4 (101)	
A little	40.0 (22)	38.6 (73)	
A lot	9.1 (5)	7.9 (15)	
BBTI, Sexual functioning			
Not at all/does not apply	34.5 (19)	28.6 (54)	$\chi^2(2) = 0.88$ $P = .6440$ $n = 187$
Some	30.9 (17)	36.5 (69)	
Severe	34.5 (19)	33.9 (64)	
Missing	—	1.1 (2)	
Quality of life measures	Mean (SD)	Mean (SD)	Tests of means
LSI-Z	14.65 (6.57)	16.28 (6.41)	$t(242) = -1.646, P = .101$
SF-Qualiveen			
Bothered by limitations	1.14 (.96)	1.06 (.94)	$t(242) = .564, P = .574$ $Z = -.585, P = .558$
Frequency of limitations	2.73 (.93)	2.47 (1.18)	
Fears	1.55 (1.11)	1.05 (.99)	$t(242) = 3.244, P = .001^*$
Feelings	1.18 (1.10)	1.00 (.97)	$t(242) = 1.148, P = .252$
Total	1.58 (.59)	1.40 (.54)	$t(242) = 2.123, P = .035$
SCI-QOL (T-scores)			
Bladder complications	49.35 (9.22)	45.32 (7.20)	$Z = -2.761, P = .006^*$
Bladder management	55.59 (8.15)	53.60 (7.78)	$t(242) = 1.640, P = .102$
Distress due to bowel	53.03 (6.66)	51.45 (7.91)	$Z = -1.459, P = .145$
Ability - social roles	46.16 (7.64)	50.41 (7.95)	$t(242) = -3.493, P = .001^*$

Note: Asterisks indicate statistical significance at $P < .01$. Chi-square statistics were not computed for cells when cells had expected values of smaller or equal to 5. BBTI = Bowel and Bladder Treatment Index; CTP = cannabis for therapeutic purposes; SCI-QOL = Spinal Cord Injury Multidimensional Quality of Life; LSI-Z = Life Satisfaction Index, Form Z.

Figure 1. Percentage of participants reporting at least one prescription from each drug category ($n = 241$).

Measures of social and instrumental support assessing quality of caregiving and the client-provider alliance (WAI) showed that individuals who used CTP generally did not significantly differ from non-users in their evaluation of the relationships. Typically, working alliance with providers was described as positive [$\bar{x}_{CTP} = 66.22$, $\bar{x}_{Non-user} = 69.56$; $t(240) = -1.810$, $P = .072$]. Those participants who received formal or informal assistance ($n_{CTP} = 33$ [60%], $n_{Non-user} = 103$ [54.5%]) generally characterized the relationship with their primary caregiver as close (range, 4 to 16; $\bar{x}_{CTP} = 12.94$ [$SD = 3.02$]; $\bar{x}_{Non-user} = 14.10$ [$SD = 2.10$], $z = -1.9$, $P = .057$); very few participants (3 CTP users vs 6 non-users) reported negative or non-supportive relationships with their caregivers. Users and non-users also did not differ in terms of the years elapsed since they had last seen their provider [$\bar{x}_{CTP} = .17$ ($SD = .54$), $\bar{x}_{Non-user} = .21$ ($SD = 1.07$); $t(211) = .293$, $P = .77$]. The most common primary care provider specialties identified by participants ($n = 196$) were family medicine (41.3%) followed by psychiatry

(32.1%). A greater percentage of CTP users than non-users reported prescriptions for medications in drug classes that target SCI-related pain, spasticity, and neuropathy—such as opioids, sedative-hypnotics, anticonvulsants, and antidepressants (Figure 1).

However, considering all of the drug classes shown in Figure 1, this difference was not statistically significant [$\chi^2(4) = 3.81$, $P = .4323$]. Additionally, there was no difference in the number of drug classes that were spanned by the reported prescriptions [range, 0 to 5; $\bar{x}_{CTP} = 1.7$ ($SD = 1.2$); $\bar{x}_{Non-user} = 1.4$ ($SD = 1.2$); $t(239) = -1.63$, $P = .104$].

Regarding health behavior management, CTP users did not significantly differ from non-users as assessed by the SCILS (cardiovascular: $\bar{x}_{CTP} = 8.71$, $\bar{x}_{Non-user} = 8.95$; genitourinary: $\bar{x}_{CTP} = 12.96$, $\bar{x}_{Non-user} = 12.30$; skin: $\bar{x}_{CTP} = 23.22$, $\bar{x}_{Non-user} = 22.54$; psychosocial: $\bar{x}_{CTP} = 7.54$, $\bar{x}_{Non-user} = 7.49$; neuro: $\bar{x}_{CTP} = 17.38$, $\bar{x}_{Non-user} = 18.34$; total: $\bar{x}_{CTP} = 69.87$, $\bar{x}_{Non-user} = 69.61$; all P values $< .15$).

Discussion

The current study replicates results from previous studies in finding that almost a quarter of individuals with chronic SCI self-report being users of CTP. Pain tended to be the most frequently cited reason for use, followed by spasticity, anxiety, and other non-specified uses. The current study further suggests that CTP users differ from non-users along distinctive demographic and functional domains.

CTP users endorsed greater disruptions of daily life by pain, and CTP may represent a complementary route to pain management for the majority of its users. Extending the literature, the current data show that the use of CTP did not mitigate prescriptions for other potentially SCI-related pain medications³³ but rather appeared to fulfill a supplementary function. Because cannabinoid use by itself carries risks for adverse events,³⁴⁻³⁶ clinicians should encourage patients to disclose their patterns of CTP use to allow close monitoring for adverse drug or drug interaction effects.

According to the current study, more than half of the CTP users endorsed daily use of CTP; however, frequency of use did not match self-reported disruption of daily activities by pain. First, as pointed out earlier, individuals use CTP for more than one reason, including factors unrelated to pain and spasticity. Second, this lack of a relationship may reflect differences in dosing, route of administration, or compound content, as there was great variability in frequency of use even among those participants who indicated severe disruption of life by pain. Finally, a lack of a relationship between disruption of activities by pain and frequency of use of CTP may mirror the impact and effectiveness of other existing pain regimens.

CTP users in our study reported more bladder complications and fear of urinary accidents than non-users. Previous studies of complications in SCI have suggested that a history of alcohol problems with subsequent abstinence is associated with an increased risk of urinary tract infections.^{24,25} Hawkins and colleagues related these bladder complications to histories of poor self-care and continuing deficient self-management.²⁴ Our data suggest that the health behavior management of individuals with current CTP use does not

significantly differ from that of non-users, yet users appear to experience a higher rate of complications. While there are studies on the role of CTP in managing urge incontinence in multiple sclerosis,³⁷ only 3 participants in the present study linked their CTP use to bladder management. Conversely, there are currently no data available that would predict bladder complications from CTP use, and adverse events related to CTP may differ in aging individuals with already chronically compromised central nervous system functioning.³⁸ Because other studies have shown that CTP use tends to correlate with a history of alcohol and other drug use,²³ which were not assessed in this study, it is unclear whether the reported complications reflect the effects of other substances.

In terms of their psychosocial functioning, CTP users were more likely to be single and live alone than non-users. Like non-users, users who had a primary caregiver reported a generally good relationship with him or her. However, the current assessments were focused on instrumental caregiving relationships and did not probe whether individuals accessed emotionally meaningful relationships.

Recent conceptualizations of substance use from a behavioral science perspective have emphasized a crucial role for lack of social support.³⁹ In these models, the progressive narrowing of alternative, meaningful relationships and activities is characteristic of situations that give rise to and support the use of mood-altering substances. Accordingly, relationship status has been shown to correlate with increases in the risk for the use of mood-altering substances in SCI.^{23,40} In addition, one might speculate that increased anxiety after SCI, including fear of bowel and bladder accidents, could lead to a long-term spiral of social withdrawal, a narrowing range of activities with concurrent lack of distraction from pain, and a general perception of a decreased ability to master everyday social roles. Based upon these findings, future studies should focus on the link between social support, anxiety sensitivity and pain,⁴¹ and CTP use in SCI.

The current study was limited by its relatively small sample size, its cross-sectional and descriptive nature, and the lack of information about past history of substance use and mental health history and related measures. Of note, participants were not recruited to participate in a study of cannabis

use in SCI; rather, recruitment occurred for an ongoing large investigation of the relationship between bowel and bladder functioning and QOL. Thus, the characteristics of the sample reported were directly affected by the inclusion criteria of the study in the context of which these data were collected (ie, chronic SCI and at least 5 years post injury, with neurogenic bladder and bowel). Because of sampling strategies (more than 90% of the current participants were recruited from SCI research registries and SCI clinics) and the eligibility criteria of the larger study, the current sample may not be representative of the population of individuals with SCI as a whole. It may be that some individuals with SCI who use cannabis for therapeutic or recreational purposes were reluctant to admit their use (particularly those 19 individuals who lived in states that had not legalized the use of CTP at the time of the study) or to participate in a clinical research study; thus it appears likely that the figure of 22.5% is actually an underestimation of the prevalence of cannabinoid use in SCI.

It will be important for future studies about CTP to gather more information including duration of use, perceived effectiveness of use, and many other factors. As such, both qualitative studies as well as clinical research that incorporates objective assessments of health variables will be important to provide insights into who uses CTP, how it is used and why it is used and – as such – better

inform the clinical conversations that need to occur around this issue.

As states continue to legalize use of cannabis for therapeutic and recreational purposes, it will be critical for health care providers to be able to ask about and knowledgeably discuss related issues with their patients with SCI. Findings from this study suggest that, at least within the United States, it may be particularly important to discuss decisions about use (including type, frequency, and amount of use) with individuals who may be more vulnerable to potential use disorders as well as adverse effects.

Acknowledgments

This work was developed under the University of Michigan Spinal Cord Injury Model System (SCIMS) grant 90SI5000-0103 from the National Institute on Disability and Independent Living Rehabilitation Research (NIDILRR), US Department of Health and Human Services (HHS). The contents of this article do not necessarily represent the policy of NIDILRR, HHS, and you should not assume endorsement by the Federal Government. None of the authors have a financial or other relationship that might signify a conflict of interest.

The researchers followed all ethical guidelines in the conduct of this study, and respondents gave informed consent to participate. This study was reviewed and approved by the University of Michigan Institutional Review Board.

REFERENCES

1. Matsuda LA, Lolait SJ, Brownstein MJ, Young AC, Bonner TI. Structure of a cannabinoid receptor and functional expression of the cloned cDNA. *Nature*. 1990;346:561-564.
2. Meyer JS, Quenzer LF. Marijuana and the cannabinoids. In: Meyer JS, Quenzer LF, eds. *Psychopharmacology: Drugs, the Brain, and Behavior*. Sunderland, MA: Sinauer Associates; 2013:401-426.
3. Arevalo-Martin A, Molina-Holgado E, Garcia-Ovejero D. Cannabinoids to treat spinal cord injury. *Prog Neuro-Psychopharmacol Biol Psychiatry*. 2016;64:190-199.
4. Di Marzo V, Stella N, Zimmer A. Endocannabinoid signalling and the deteriorating brain. *Nature Rev Neurosci*. 2015;16:30-42.
5. Maccarrone M, Guzmán M, Mackie K, Doherty P, Harkany T. Programming of neural cells by (endo) cannabinoids: From physiological rules to emerging therapies. *Nature Rev Neurosci*. 2014;15:786-801.
6. Wright S. Cannabinoid-based medicines for neurological disorders – clinical evidence. *Mol Neurobiol*. 2007;36:129-136.
7. Fox News Network LLC. Research study neuroprotective properties in cannabis. 2012. <http://www.foxnews.com/health/2012/03/20/researchers-study-neuroprotective-properties-in-cannabis/>.
8. Fox News Network LLC. Is juicing raw marijuana the next green drink? 2015. <http://www.foxnews.com/health/2015/07/13/is-juicing-raw-marijuana-next-green-drink/>.
9. Koppel BS, Brust JCM, Fife T, et al. Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders. Report of the Guideline Development Subcommittee of the American Academy of Neurology. *Neurology*. 2014;82:1556-1563.
10. Hosking R, Zajicek J. Cannabis in neurology – a potted review. *Nature Rev Neurol*. 2014;10:429-430.

11. Borgelt LM, Franson KL, Nussbaum AM, Wang GS. The pharmacologic and clinical effects of medical cannabis. *Pharmacotherapy*. 2013;33(2):195-209.
12. D'Souza DC, Ranganathan M. Medical marijuana: Is the cart before the horse? *JAMA*. 2015;313(24):2431-2432.
13. Pacula RL, Hunt P, Bousted A. Words can be deceiving: A review of variation among legally effective medical marijuana laws in the United States. *J Drug Policy Analysis*. 2014;7(1):1-19.
14. Reinarm C, Nunberg H, Lanthier F, Heddleston T. Who are medical marijuana patients? Population characteristics from nine California assessment clinics. *J Psychoactive Drugs*. 2011;43(2):128-135.
15. Ware MA, Adams H, Guy GW. The medical use of cannabis in the UK: Results of a nationwide survey. *Int J Clin Pract*. 2005;59(3):291-295.
16. Ilgen MA, Bohnert K, Kleinberg F, et al. Characteristics of adults seeking medical marijuana certification. *Drug Alcohol Depend*. 2013;132:654-659.
17. Hazekamp A, Heerdink ER. The prevalence and incidence of medicinal cannabis on prescription in The Netherlands. *Eur J Clin Pharmacol*. 2013;69:1575-1580.
18. Hazekamp A, Ware MA, Muller-Vahl KR, Abrams D. The medicinal use of cannabis and cannabinoids -- an international cross-sectional survey on administration forms. *J Psychoactive Drugs*. 2013;45(3):199-210.
19. Reiman A. Medical cannabis patients: Patient profiles and health utilization patterns. *Compl Health Pract Rev*. 2007;12(1):31-50.
20. Harris D, Jones RT, Shank R, et al. Self-reported marijuana effects and characteristics of 100 San Francisco Medical Marijuana Club members. *J Addictive Dis*. 2000;19(3):89-103.
21. Dunn M, Davis R. The perceived effects of marijuana on spinal cord injured males. *Paraplegia*. 1974;12:175.
22. Cardenas DD, Jensen MP. Treatments for chronic pain in persons with spinal cord injury. *J Spinal Cord Med*. 2006;29:109-117.
23. Stroud MW, Bombardier CH, Dyer JR, Rimmele CT, Esselman PC. Preinjury alcohol and drug use among persons with spinal cord injury: Implications for rehabilitation. *J Spinal Cord Med*. 2011;34(5):461-472.
24. Hawkins DA, Heinemann AW. Substance abuse and medical complications following spinal cord injury. *Rehabil Psychol*. 1998;43(3):219-231.
25. Heinemann AW, Hawkins DA. Substance abuse and medical complications following spinal cord injury. *Rehabil Psychol*. 1995;40(2):125-140.
26. Tate D, Forchheimer M, Chiodo A, et al. Development of interview forms for the international spinal cord injury datasets for bowel and bladder. In: Final program and abstract book; International Spinal Cord Society 52nd Annual Meeting; October 27-30, 2013; Istanbul, Turkey.
27. Bonniaud V, Bryant D, Parratte B, Guyatt G. Development and validation of the short form of a urinary quality of life questionnaire: SF-Qualiveen. *J Urol*. 2008;180(6):2592-2598.
28. Tulskey D, Kisala P. Spinal Cord Injury multidimensional Quality of Life (SCI-QOL). 2015. https://commondataelements.ninds.nih.gov/Doc/NOC/Spinal_Cord_Injury_Multidimensional_Quality_of_Life_NOC_Link.pdf.
29. Wood V, Wylie ML, Sheafor B. An analysis of a short self-report measure of life satisfaction: Correlation with rater judgments. *J Gerontol*. 1969;24(4):465-469.
30. Warschausky S, Dixon P, Forchheimer M, et al. Quality of life in persons with long-term mechanical ventilation or tetraplegic SCI without LTMV. *Top Spinal Cord Rehabil*. 2005;10(3):94-101.
31. Tracey T, Kokotovic A. Factor structure of the Working Alliance Inventory. *Psychol Assessment*. 1989;1(3):207-210.
32. Pruitt S, Wahlgren S, Epping-Jordan J, Rossi A. Health behavior in persons with spinal cord injury: Development and initial validation of an outcome measure. *Spinal Cord*. 1998;36:724-731.
33. Bachhuber MA, Saloner B, Cunningham CO, Barry CL. Medical cannabis laws and opioid analgesic overdose mortality in the United States, 1999-2010. *JAMA Intern Med*. 2014;174(10):1668-1673.
34. Hall W, Degenhardt L. Adverse health effects of non-medical cannabis use. *The Lancet*. 2009;374(9698):1383-1391.
35. Grace T, Kloner RA, Rezkalla S. Adverse cardiovascular, cerebrovascular, and peripheral vascular effects of marijuana inhalation: What cardiologists need to know. *Am J Cardiol*. 2014;113:187-190.
36. Volkow ND, Baler RD, Compton WM, Weiss SRB. Adverse health effects of marijuana use. *New Engl J Med*. 2014;270:2219-2227.
37. Freeman RM, Adekanmi O, Waterfield MR, Waterfield AE, Wright D, Zajicek J. The effect of cannabis on urge incontinence in patients with multiple sclerosis: A multicentre, randomised placebo-controlled trial (CAMS-LUTS). *Int Urogynecol J*. 2006;17:636-641.
38. van den Elsen GAH, Ahmed AIA, Lammers M, et al. Efficacy and safety of medical cannabinoids in older subjects: A systematic review. *Ageing Res Rev*. 2014;14:56-64.
39. Rachlin H. The lonely addict. In: Bickel WK, Vuchinich RE, eds. *Reframing Health Behavior Change with Behavioral Economics*. Mahwah, NJ: Lawrence Erlbaum Associates; 2000:145-166.
40. Tate DG, Forchheimer MB, Krause JS, Meade MA, Bombardier CH. Patterns of alcohol and substance use and abuse in persons with spinal cord injury: Risk factors and correlates. *Arch Phys Med Rehabil*. 2004;85:1837-1847.
41. Ocañez KLS, McHugh RK, Otto MW. A meta-analytic review of the association between anxiety sensitivity and pain. *Depression Anxiety*. 2010;27:760-767.