

Association of Financial Wellness with Patterns of Medical Cannabis Use and Patient-reported Outcomes in Adults with Cancer

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ABSTRACT

Objective: Despite increasing use of medical cannabis to manage cancer-related symptoms, U.S. payers do not reimburse medical cannabis, leaving patients responsible for all associated costs. We assessed how self-reported financial well-being is associated with patterns of cannabis consumption, out-of-pocket costs, and impact on symptoms in patients with cancer. **Method:** From December 2021 to January 2022, we surveyed patients with cancer enrolled in the Minnesota Medical Cannabis Program. The mailed survey included cancer history, cannabis use history, symptom changes and sociodemographic questions including income and perceived financial wellness. We conducted descriptive analyses. **Results:** Of 797 eligible adults, 220 (28%) responded to the survey. Two hundred eleven answered a question about current household income as living comfortably (LC, 45%; $n = 95$) or not living comfortably (NLC, 55%; $n = 116$). The NLC group reported lower incomes (47% vs 8% with annual incomes $< \$50,000$) and were typically younger, unmarried, unemployed, or disabled. NLC group purchased more vaporizers (48% vs 27%), used products high in THC (92% vs 82%), and reported higher cannabis costs (40% vs 21% spending $\$200+$ /month). The NLC group more often stopped or used cannabis less frequently than they would like (54% versus 32%), frequently citing costs as a reason (85% vs 39%). Both NLC and LC groups typically used cannabis daily and reported a high degree of symptom improvement. **Conclusions:** Patients with cancer using cannabis report significant improvements in cancer-related symptoms. High out-of-pocket costs for cannabis may be especially burdensome among those already financially struggling, raising questions about affordability of and equitable access to this therapy.

Key words: = cannabis; marijuana; cancer; financial toxicity; patient-reported outcome; symptoms

In the United States (US), 37 states have legalized cannabis for medical and/or recreational purposes as of February 2023 with a growing number of patients with cancer using cannabis (NCSL, 2024). In recent surveys, nearly 20-25% of all patients undergoing cancer care reported current use of cannabis (Martell et al., 2018; Pergam et al., 2017), with similar prevalence rates for patients with early-stage and advanced-

stage (palliative intent) disease (Saadeh & Rustem, 2018; Zylla, 2022). Most patients report use of cannabis to alleviate symptoms of pain, nausea, insomnia and appetite loss that are related to the cancer or its treatment (Steele et al., 2019).

Most cannabis research relies on observational data using patient-reported outcomes, with only a few, small-scale

randomized controlled trials on cannabis outcomes in patients with cancer completed to date (Abrams, 2018; Fallon et al., 2017; Good et al., 2019; Lichtman et al., 2017; Steele et al., 2019; Zylla et al., 2021). In two large observational studies, patients reported significant symptom improvement in the first 4-6 months after starting cannabis use with low rates of adverse events (Anderson et al., 2019; Bar-Lev Schleider et al., 2018). Generalizing results from cannabis studies is challenging given the myriad of cannabinoid-based products with varying amounts of delta-9-tetrahydrocannabinol (THC): cannabidiol (CBD) and different delivery mechanisms (Anderson et al., 2019; Bar-Lev Schleider et al., 2018; Kim et al., 2019). Furthermore, only 29% of oncologists report having sufficient knowledge of cannabis to provide recommendations to patients on its use (Braun et al., 2018). As a result, patients may create their own cannabis treatment plans, experimenting with different products which can lead to higher overall out-of-pocket costs.

The cost of cannabis is not covered by health insurance. Cancer and its treatments are associated with high costs, some of which patients must cover themselves. Growing cancer costs have given rise to sometimes dramatic financial burdens (“financial toxicity”) incurred by cancer (Sedhom et al., 2021). Costs for medical cannabis programs could further add to these financial burdens. In the highly regulated Minnesota Cannabis Program (MCP), patients with cancer-related symptoms report spending an average of \$236 each month in addition to the yearly \$200 registration fee, and patients using long-term cannabis for chronic, non-cancer pain may spend close to \$4000 per year (MDH, n.d.). States with recreational programs may have lower monthly cannabis costs, but data are lacking (Chino, 2022). The cost of cannabis is listed by both patients and clinicians as a barrier to more widespread cannabis utilization (Olson et al., 2023; Zylla et al., 2018; Zylla et al., 2021) and differential affordability of medical cannabis programs could create new health inequities.

Despite increasing use of cannabis in patients with cancer to manage symptoms, data on the effectiveness of cannabis products for specific cancer symptoms remain sparse. Further, little is known about if and how income is associated with the patterns of use of cannabis products and out-of-pocket costs. We examined how financial

wellness was associated with patterns of cannabis use and self-reported change in cancer symptoms (pain, anorexia, insomnia, stress, digestive issues, fatigue, and neuropathy) among cancer patients registered with the MCP.

METHODS

Study Setting

In Minnesota, legislation was passed in 2014 that allows seriously ill Minnesotans to use medical cannabis to treat certain conditions. Patients with cancer, coupled with a diagnosis of cancer-related pain, nausea or anorexia/cachexia are eligible to enroll in a patient registry maintained by the state. Patients on this registry can get medical cannabis directly from one of fourteen dispensaries set up across the state. In December 2021, just under 1,400 individuals aged 18+ with a cancer-related indication were enrolled in the MCP.

Data Collection

Central IRB approval was obtained from the University of Minnesota (protocol number 2020LS161). Of the approximate 1,400 MCP registrants, 796 made a cannabis purchase in the prior three months and were invited to participate in a one-time survey. The survey was mailed December 2021-January 2022, accompanied by a letter signed by the MCP, and a postage-paid envelope to return the paper survey. Returned surveys were scanned centrally using the TeleForm verification process and using a priori defined rules for data capture including treatment of out-of-range values, missed skip patterns and/or multiple responses. In total, 220 (28%) individuals completed the survey. For this analysis, we excluded participants who had not answered the question of whether they were living comfortably on their income, resulting in a total sample size of 211. The MCP provided a comprehensive report of all cannabis purchases from state-approved dispensaries for any survey respondent that was used to validate patient-reported cannabis use and monthly costs.

Measures and Statistical Analysis

The study survey was developed under the direction of Dr. Zylla in partnership with The HealthPartners Center for Evaluation and Survey Research (CESR) and the study team using survey items with known psychometric properties where available, and with best practices for reducing measurement error and reducing burden when not (Fowler, 1995). The survey was reviewed by content experts and patient advocates for face validity and iteratively modified as indicated. Survey questions focused on a) current and past use of cannabis, b) frequency and duration of use, c) mode of use, d) therapeutic reasons for use, e) perceptions of benefit or risk/harm, f) discussion of use with clinical providers, g) recommendations received from clinical providers and h) costs. The survey questions used for this analysis are displayed in supplemental Figure 1.

The primary exposure of interest (taken from the National Cancer Institute’s Health Information National Trends Survey) was whether participants reported ‘living comfortably’ (LC) on their present income versus ‘not living comfortably’ (NLC; e.g., ‘getting by,’ ‘finding it difficult,’ or ‘finding it very difficult’) on their present income (National Cancer Institute, n.d.) . We chose subjective income perception over income dollar ranges because the same objective income may mean different things subjectively depending on one’s circumstances (e.g., dependents, assets, debts, fixed monthly expenses, etc.).

The primary outcomes of interest in this analysis were 1) self-reported changes in symptoms (“How much do you think cannabis has worsened or improved your [pain; loss of appetite; insomnia or difficulty sleeping; stress (including

anxiety or depression); digestive problems (including nausea, vomiting, diarrhea, constipation); fatigue or lack of energy; neuropathy]”, with answers ranging from “Worsened quite a bit” to “Improved quite a bit,” and with one answer option “I do not have this symptom.” Second, we assessed patterns of cannabis use and cost: cannabis use before and since one’s cancer diagnosis, frequency of use, product type, average costs from cannabis use per month, whether cannabis use was stopped or frequency was reduced, and if yes, whether cost was a reason. A full list of these questionnaire items is provided in supplemental Figure 1. We used descriptive statistics (frequencies, and Chi-squared, Fisher, or Wilcoxon rank sum tests as appropriate) to describe the study characteristics.

RESULTS

Of 211 total respondents, 95 (45%) reported LC on their present income, and 116 (55%) reported NLC on their present income. Respondents had diverse cancer diagnoses as seen in Table 1 (breast 25.4%, lung 15.1%, colorectal 9.8%, prostate 8.8%). Approximately 61% were 60 years old or older (with a median age of 62 years), 52% were female, 95% were white, and 40% were retired. Most respondents (57%) had stage IV disease. Some characteristics differed between the LC and the NLC group: Those NLC were less likely to be married or partnered (60% vs. 88%), less likely to be 60 years old or older (53% vs. 71%), less likely to be retired (28% vs. 54%), more likely to be unemployed (7% vs. 0%) or disabled (35% vs. 7%), and to have lower incomes (47% vs. 8% with annual incomes <\$50,000).

Table 1. *Characteristics of the Study Population*

Characteristic	Everyone (N= 211)	Not Living Comfortably (N= 116)	Living Comfortably (N= 95)	P ^b
	N(%)	N(%)	N(%)	
Age group:				0.007
<40 years	13 (6.2)	6 (5.3)	7 (7.4)	
40-49	25 (12)	19 (16.7)	6 (6.3)	
50-59	44 (21.1)	29 (25.4)	15 (15.8)	
60-69	84 (40.2)	45 (39.5)	39 (41.1)	

> 70	43 (20.6)	15 (13.2)	28 (29.5)	
Gender:				0.48
Male	100 (47.6)	53 (46.1)	47 (49.5)	
Female	109 (51.9)	62 (53.9)	47 (49.5)	
Other	1 (0.5)	0 (0)	1 (1.1)	
Race:				0.46
White	202 (96.7)	109 (95.6)	93 (97.9)	
Other	7 (3.4)	5 (4.4)	2 (2.1)	
Hispanic ethnicity:				>0.99
No	202 (98.1)	111 (98.2)	91 (97.9)	
Yes	4 (1.9)	2 (1.8)	2 (2.2)	
Education:				
Less than HS	4 (1.9)	3 (2.6)	1 (1.1)	
HS graduate	19 (9.1)	14 (12.3)	5 (5.3)	
Post HS training	23 (11)	11 (9.7)	12 (12.6)	
Some college	57 (27.3)	38 (33.3)	19 (20)	
College graduate	68 (32.5)	34 (29.8)	34 (35.8)	
Postgraduate	38 (18.2)	14 (12.3)	24 (25.3)	
Marital status:				<0.0001
Married or partnered	152 (72.7)	68 (59.7)	84 (88.4)	
Divorced / separated	29 (13.9)	25 (21.9)	4 (4.2)	
Widowed	13 (6.2)	8 (7.0)	5 (5.3)	
Single, never married	15 (7.2)	13 (11.4)	2 (2.1)	
Occupation status:				<0.0001
Employed	61 (29.3)	26 (23)	35 (36.8)	
Unemployed	8 (3.9)	8 (7.1)	0 (0)	
Homemaker	3 (1.4)	2 (1.8)	1 (1.1)	
Student	1 (0.5)	0 (0)	1 (1.1)	
Retired	83 (39.9)	32 (28.3)	51 (53.7)	
Disabled	47 (22.6)	40 (35.4)	7 (7.4)	
Other	5 (2.4)	5 (4.4)	0 (0)	
Annual household income:				<0.0001
<20K	20 (9.9)	20 (17.9)	0 (0)	
20K-35K	21 (10.4)	18 (16.1)	3 (3.3)	
35K-50K	18 (8.9)	14 (12.5)	4 (4.4)	
50K-75K	43 (21.3)	24 (21.4)	19 (21.1)	
75K-100K	35 (17.3)	19 (17)	16 (17.8)	
100K-200K	49 (24.3)	16 (14.3)	33 (36.7)	
>200K	16 (7.9)	1 (0.9)	15 (16.7)	
Health Care coverage:				>0.99
Yes	198 (96.6)	108 (96.4)	90 (96.8)	
No	7 (3.4)	4 (3.6)	3 (3.2)	
Cancer type: ^a				
Breast	52 (25.4)	30 (27)	22 (23.4)	0.55
Prostate	18 (8.8)	9 (8.1)	9 (9.6)	0.71
Lung	31 (15.1)	14 (12.6)	17 (18.1)	0.28

Colon	20 (9.8)	12 (10.8)	8 (8.5)	0.58
Other	115 (56.1)	60 (54.1)	55 (58.5)	0.52
Cancer stage:				0.90 ^c
I	15 (9.1)	8 (8.9)	7 (9.3)	
II	26 (15.8)	13 (14.4)	13 (17.3)	
III	30 (18.2)	18 (20)	12 (16)	
IV	94 (57.0)	51 (56.7)	43 (57.3)	
Don't know	39	23	16	

Note. ^a More than one response may be selected; total *N* does not sum up to total sample size.

^b The *p*-value was derived from the Chi-square or Fisher's exact tests for categorical factors and the non-parametric Wilcoxon rank sum test for ordinal variables. ^c *P* calculated without the "don't know" category.

Cannabis Use Patterns

Approximately 70% of all respondents reported using cannabis at least once prior to cancer diagnosis (Table 2). Nearly all respondents (94%) were currently using cannabis with 75% of those using cannabis reporting daily use. There was no evidence for differences in frequency of use between the LC and NLC groups. Oral products (tablets, oral solutions and/or tinctures) were used more commonly than vaporizers (88% vs. 53%). The NLC group more often ingested cannabis via

foods such as brownies, cookies, cake, or candy (35% vs. 18%, *p* = 0.01) and used vaporizers more often than the LC group (64% vs. 40%, *p* = 0.001). About one third of patients used topical products. Eighty-eight percent of all respondents purchased at least one THC dominant product with NLC group having slightly higher purchase rates of THC-dominant products (92% vs. 82%, *p* = 0.05) and lower rates of using THC:CBD equivalent products (29% vs. 44%, *p* = 0.03). Whole plant/smokeable products were not available in MCP during the period of the survey.

Table 2. Patterns of Cannabis Use

Patterns of cannabis use	Everyone (<i>N</i> = 211)	Not Living Comfortably (<i>N</i> = 116)	Living Comfortably (<i>N</i> = 95)	<i>P</i>
	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)	
Used prior to cancer diagnosis:				0.08
No	63 (30.3)	29 (25.2)	34 (36.6)	
Yes	145 (69.7)	86 (74.8)	59 (63.4)	
Used since cancer diagnosis:				0.63
No	4 (1.9)	3 (2.6)	1 (1.1)	
Yes	204 (98.1)	112 (97.4)	92 (98.9)	
Current user:				>0.99
No	11 (6)	6 (6)	5 (6)	
Yes	172 (94)	94 (94)	78 (94)	
Number of days used in past 30 days:				0.31
1-15	39 (20.7)	20 (19.4)	19 (22.4)	
16-29	45 (23.9)	21 (20.4)	24 (28.2)	
30	104 (55.3)	62 (60.2)	42 (49.4)	
Product type: ^a				0.05
High THC:CBD	149 (87.7)	84 (92.3)	65 (82.3)	

Equal THC:CBD	61 (35.9)	26 (28.6)	35 (44.3)	0.03
High CBD:THC	27 (15.9)	12 (13.2)	15 (19.0)	0.3
Product route of admin: ^a				
Oral	173 (87.8)	96 (87.3)	77 (88.5)	0.79
Oral via food	54 (27.4)	38 (34.6)	16 (18.4)	0.01
Oral via drink	10 (5.1)	6 (5.5)	4 (4.6)	>0.99
Oral via pills, tinctures, sublingually	160 (81.2)	85 (77.3)	75 (86.2)	0.11
Vaporizer	105 (53.3)	70 (63.6)	35 (40.2)	0.001
Topical	71 (36.0)	42 (38.2)	29 (33.3)	0.48
Smoking	47 (23.9)	31 (28.2)	16 (18.4)	0.11
Frequency of use during cancer treatment:				0.64
More than once a day	56 (34.6)	34 (39.5)	22 (29)	
Once a day or almost every day	66 (40.7)	33 (38.4)	33 (43.4)	
Few times a week	28 (17.3)	13 (15.1)	15 (19.7)	
Few times a month	9 (5.6)	4 (4.7)	5 (6.6)	
Once a month or less	0 (0)	0 (0)	0 (0)	
Only tried it once or twice	3 (1.9)	2 (2.3)	1 (1.3)	
Average cannabis costs per month:				0.04
<\$50	31 (15.6)	15 (13.5)	16 (18.2)	
\$50-\$99	51 (25.6)	24 (21.6)	27 (30.7)	
\$100-\$199	55 (27.6)	28 (25.2)	27 (30.7)	
≥\$200	62 (31.2)	44 (39.6)	18 (20.5)	
Stopped / used less than you would like:				0.002
No	108 (55.7)	49 (45.8)	59 (67.8)	
Yes	86 (44.3)	58 (54.2)	28 (32.2)	
Cost was a reason for stopping or using less than you would like? ^b				<0.0001
No	26 (30.2)	9 (15.5)	17 (60.7)	
Yes	60 (69.8)	49 (84.5)	11 (39.3)	

Note. ^a More than one answer may be selected. ^b Among those who answered ‘Yes’ to previous question.

The NLC group more often reported stopping cannabis use or using cannabis less frequently than they would like to (54% versus 32%, $p = 0.002$). Among those reporting they had stopped using cannabis or were using it less frequently than they would like to, NLC respondents were more likely than LC respondents to cite costs as a reason (85% versus 39%, $p = <0.001$). The NLC group also reported higher cannabis costs than the LC group (40% versus 21% having \$200 or more in monthly cannabis costs, $p = 0.04$).

Comprehensive cannabis purchase data provided by the MCP linked to survey respondents helped support self-reported data on

cannabis use (results not shown). NLC respondents showed a trend towards longer duration enrolled in the MCP program (12.5 vs. 8.1 months (median), $p = 0.27$), higher total number of cannabis purchases (16 vs 12 total purchases (median), $p = 0.10$), and greater use of high THC products (58% vs. 50% high THC>CBD purchases, $p = 0.035$).

Patient-Reported Symptom Burden

Most respondents gave favorable judgements as to how cannabis impacted their cancer symptoms (Table 3). There was no evidence for significant differences in any of the self-

reported effects on symptom burden between the LC and NLC groups. Patients with pain, insomnia, and stress (anxiety/depression) had the largest benefit from cannabis use, with patient proportions reporting improvements in these symptoms ranging from 83-91%. The proportion of

patients reporting improvements in anorexia and digestive symptoms was 69-80%, and about half of respondents reported improvements in fatigue and neuropathy. Almost no respondents reported that any of these symptoms got worse after cannabis use.

Table 3. *Self-reported changes in symptoms after cannabis use*

Symptom	Everyone (N= 211)	Not Living Comfortably (N= 116)	Living Comfortably (N= 95)	P ^c
	N(%)	N(%)	N(%)	
Pain:				0.44
Worsened	1 (0.5)	1 (1)	0 (0)	
No change	18 (9.8)	8 (7.8)	10 (12.3)	
Improved	165 (89.7)	94 (91.3)	71 (87.7)	
Do not have symptom	13	6	7	
Anorexia:				0.05
Worsened	1 (0.6)	1 (1.1)	0(0)	
No change	41 (26.1)	17 (19.3)	24 (34.8)	
Improved	115 (73.2)	70 (79.5)	45 (65.2)	
Do not have symptom	40	21	19	
Insomnia:				0.44
Worsened	0 (0)	0 (0)	0 (0)	
No change	20 (10.8)	13 (12.3)	7 (8.8)	
Improved	166 (89.2)	93 (87.7)	73 (91.3)	
Do not have symptom	12	4	8	
Stress ^a :				0.93
Worsened	0 (0)	0 (0)	0 (0)	
No change	31 (17.5)	18 (17.3)	13 (17.8)	
Improved	146 (82.5)	86 (82.7)	60 (82.2)	
Do not have symptom	21	6	15	
Digestive ^b :				0.47
Worsened	2 (1.4)	0 (0)	2 (3.4)	
No change	47 (32)	28 (31.5)	19 (32.8)	
Improved	98 (66.7)	61 (68.5)	37 (63.8)	
Do not have symptom	50	20	30	
Fatigue:				0.12
Worsened	7 (4)	5 (5)	2 (2.7)	
No change	91 (52)	45 (45)	46 (61.3)	
Improved	77 (44)	50 (50)	27 (36)	
Do not have symptom	21	9	12	
Neuropathy:				0.72
Worsened	1 (0.7)	1 (1.2)	0 (0)	
No change	65 (46.4)	39 (47)	26 (45.6)	
Improved	74 (52.9)	43 (51.8)	31 (54.4)	
Do not have symptom	58	27	31	

Note.^a Includes anxiety and depression ^b Includes nausea, vomiting, diarrhea and constipation ^c The *p*-value was derived from the Wilcoxon rank sum test excluding those not reporting the respective symptom.

DISCUSSION

In this survey study of patients with cancer registered in a state medical cannabis program, we found that individuals not living comfortably on their present income had higher monthly out-of-pocket costs for cannabis and were more likely to stop using cannabis or use it less than they would like; and this group more often cited cost as a reason for cannabis use disruptions. The overwhelming majority of patients reported improvements across a range of cancer symptoms and over half had used cannabis daily during their cancer treatments. Virtually no respondents reported worsening symptoms from cannabis use.

Our study adds to a growing body of literature suggesting that medical cannabis may be a promising intervention to alleviate cancer symptoms (Abrams, 2018; Anderson et al., 2019; Bar-Lev Schleider et al., 2018; Steele et al., 2019). Our study is one of the first to highlight financial challenges that come along with cannabis use: in our study population, those not living comfortably on their income reported higher costs related to cannabis, more often reported use disruptions (about half of NLC respondents), and more often cited costs as a reason for those disruptions. These findings are even more concerning as we also found that those not living comfortably on their income were younger, more likely to be disabled or unemployed, and less likely to be partnered – i.e., those not living comfortably on their income included some vulnerable patient subgroups. The annual enrollment fee of up to \$200 for the state program may further add to the financial burden. However, while all patients in our survey paid the \$200 annual fee, this fee was discontinued by the MCP in July 2023 when Minnesota passed a recreational cannabis law and shows that costs for cannabis may drop when cannabis becomes recreationally legal.

Together, our findings raise questions around health equity with regards to access to medical cannabis among those with cancer. If cannabis is indeed effective to reduce cancer symptoms, all patient groups, and especially those most vulnerable, should have access to cannabis if they wish to, calling for interventions to make medical cannabis more affordable. For example, uncontrolled pain remains a large challenge for patients with cancer, with many seeking out alternative/integrative therapies suggested in

National Comprehensive Cancer Network guidelines (Nahin et al., 2016; Sedhom et al., 2021). Like cannabis, many of these therapies often lack insurance coverage and lead to more financial toxicity. For instance, acupuncture costs over \$100 per session and requires weekly visits, leading to similar monthly costs for patients using daily cannabis (Fan et al., 2019).

Despite nearly 20% of patients with cancer use cannabis (Martell et al., 2018; Pergam et al., 2017), little is known about the type of products purchased and financial implications for patients. State medical programs generally require more regulatory oversight including comprehensive product testing for purity and potency, leading to higher overall costs for patients. THC-dominant products and those administered via a vaporizer typically have higher costs. Research conducted in the MCP and other programs showed a wide variety of products and routes being utilized by patients (Anderson et al., 2019; Bar-Lev Schleider et al., 2018; Pergam et al., 2017; Zylla et al., 2021). Patients in our survey also use various products and routes and generally appear to utilize oral products with a high THC:CBD ratio. Vaporizer administration is faster acting compared to the oral route but has a shorter duration of control (Grotenhermen, 2003). Therefore, given the shorter duration of effect, there is concern there would be less of a sustained benefit for chronic symptom control among patients using an inhalation route of administration. As such, the increased rate of vaporizer use in NLC patients may lead to more frequent use and higher overall monthly costs.

More research and clinical education are needed to show patients, providers, and policymakers how cannabis impacts overall symptom burden. Specific dosing regimens for various symptoms would help patients obtain optimal dosing earlier on and lead to less trial and error. Most patients desire cannabis education and guidance from their cancer care team, yet often end up relying on family, friends, and online sources (Pergam et al., 2017) given great variability in medical cannabis knowledge and training for cannabis dispensary staff workers (Braun et al., 2022). These gaps in professional knowledge may result in patients resorting to a “trial and error” approach that requires purchase of products that are ultimately unnecessary. For example, cannabis monthly costs depend largely

on the total amount of THC purchased and frequency of use. Having safe, cost-effective cannabis dosing guidelines may also entice a larger pool of patients to try cannabis. Lowering the overall cost of medical cannabis through improved insurance coverage or discounted fees/rates for patients with cancer (especially those at lower income levels) could improve accessibility and reduce potential economic barriers that make cannabis unobtainable for many patients.

Our study has limitations. This was a cross-sectional study with a limited sample size that was 95% White in one geographic area and state program; our findings should be replicated in larger studies of diverse samples. This lack of racial diversity makes generalizing results difficult. We were unable to address the added economic challenges and potential legal fears that minorities may face when considering a purchase of cannabis. There is a possibility of selection bias in that cannabis users who were more enthusiastic about the effects of cannabis on their symptoms may have been more likely to participate in the study. Further, continuing controversies around the legal status of medical cannabis may have made some potential respondents hesitant to participate, even though we ensured confidentiality in our consent form. We cannot rule out reverse causality in that it is possible that those who report more use or unmet need for cannabis perceive lower levels of living comfortably as a result. Our survey did not explore decision making on how patients selected products/doses, or how much experimentation they needed to reach a cannabis regimen that worked for them. Respondents had a median time in the state program off over 8 months suggesting that the reported cannabis products and monthly costs likely indicated their final “ideal” regimen. Future studies should attempt to track cannabis use from the time of initial purchase to the most recent purchase to determine how product type, route of administration and total THC/CBD dose evolves over time. As stated earlier, the survey did not address other important social determinants of health that could impact overall financial wellness. As this survey took place during the COVID-19 pandemic, it is possible one’s comfort of living (especially amongst those with a cancer diagnosis) may have been significantly altered

further impacting their interest or ability to purchase cannabis.

Conclusion

Patients with cancer who use cannabis report significant improvements in cancer-related symptoms. Out-of-pocket costs for cannabis can be high and may lead to cannabis use disruption especially among those already struggling financially, raising questions about affordability of and equitable access to this therapy. Conducting pragmatic clinical trials and prospective cohort registries will help to identify cost-effective treatment protocols. If cannabis is to be a broadly available way to alleviate symptom burden in patients with cancer, insurance coverage will ultimately be needed to ensure all patients can access it equally.

REFERENCES

- Abrams, D. (2018). The therapeutic effects of cannabis and cannabinoids: An update from the National Academies of Sciences, Engineering and Medicine report. - PubMed - NCBI. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC625791/>
- Anderson, S. P., Zylla, D. M., McGriff, D. M., & Arneson, T. J. (2019). Impact of medical cannabis on patient-reported symptoms for patients with cancer enrolled in minnesota's medical cannabis program. *JCO Oncology Practice*, *15*(4), e338-e345. <https://doi.org/10.1200/jop.18.00562>
- Bar-Lev Schleider, L., Mechoulam, R., Lederman, V., Hilou, M., Lencovsky, O., Betzalel, O., Shbiro, L., & Novack, V. (2018). Prospective analysis of safety and efficacy of medical cannabis in large unselected population of patients with cancer. *European Journal of Internal Medicine*, *49*, 37-43. <https://doi.org/10.1016/j.ejim.2018.01.023>
- Braun, I. M., Nayak, M. M., Roberts, J. E., Chai, P. R., Tulskey, J. A., Abrams, D. I., & Pirl, W. (2022). Backgrounds and trainings in cannabis therapeutics of dispensary Personnel. *JCO Oncology Practice*, *18*(11), e1787-e1795. <https://doi.org/10.1200/OP.22.00129>

- Braun, I. M., Wright, A., Peteet, J., Meyer, F. L., Yuppa, D. P., Bolcic-Jankovic, D., LeBlanc, J., Chang, Y., Yu, L., Nayak, M. M., Tulsy, J. A., Suzuki, J., Nabati, L., & Campbell, E. G. (2018). Medical oncologists' beliefs, practices, and knowledge regarding marijuana used therapeutically: A nationally representative survey study. *Journal of Clinical Oncology*, *36*(19), 1957-1962. <https://doi.org/10.1200/jco.2017.76.1221>
- Chino, F. M. A., Mao J, Raghunathan, N, Jinna S, Brens, S, Hernandez, M, Korenstein, D, Salz, T. (2022). Out-of-pocket costs from cannabis use in patients during cancer treatment at a major U.S. cancer center. *Journal of Clinical Oncology*, *40*, no. *28_suppl*, 24-24. https://doi.org/10.1200/JCO.2022.40.28_suppl.024
- Fallon, M. T., Albert Lux, E., McQuade, R., Rossetti, S., Sanchez, R., Sun, W., Wright, S., Lichtman, A. H., & Kornyeveva, E. (2017). Sativex oromucosal spray as adjunctive therapy in advanced cancer patients with chronic pain unalleviated by optimized opioid therapy: two double-blind, randomized, placebo-controlled phase 3 studies. *British Journal of Pain*, *11*(3), 119-133. <https://doi.org/10.1177/2049463717710042>
- Fan, A. Y., Wang, D. D., Ouyang, H., Tian, H., Wei, H., He, D., Gong, C., Wen, J., Jin, M., He, C., Alemi, S. F., & Rahimi, S. (2019). Acupuncture price in forty-one metropolitan regions in the United States: An out-of-pocket cost analysis based on OkCopro.com. *Journal of Integrative Medicine*, *17*(5), 315-320. <https://doi.org/10.1016/j.joim.2019.06.003>
- Fowler, F. (1995). Improving survey questions design and rvaluation. *Applied Social Research Methods*, *38*.
- Good, P. D., Greer, R. M., Huggett, G. E., & Hardy, J. R. (2019). An open-label pilot study testing the feasibility of assessing total symptom burden in trials of cannabinoid medications in palliative care. *Journal of Palliative Medicine*. <https://doi.org/10.1089/jpm.2019.0540>
- Grotenhermen, F. (2003). Pharmacokinetics and pharmacodynamics of cannabinoids. *Clinical Pharmacokinetics*, *42*(4), 327-360. <https://doi.org/10.2165/00003088-200342040-00003>
- Kim, A., Kaufmann, C. N., Ko, R., Li, Z., & Han, B. H. (2019). Patterns of medical cannabis use among cancer patients from a medical cannabis dispensary in New York state. *Journal of Palliative Medicine*, *22*(10), 1196-1201. <https://doi.org/10.1089/jpm.2018.0529>
- Lichtman, A. H., Lux, E. A., McQuade, R., Rossetti, S., Sanchez, R., Sun, W., Wright, S., Kornyeveva, E., & Fallon, M. T. (2017). Results of a double-blind, randomized, placebo-controlled study of nabiximols oromucosal spray as adjunctive therapy in advanced cancer patients with chronic uncontrolled pain. *Journal of Pain and Symptom Management*. <https://doi.org/10.1016/j.jpainsymman.2017.09.001>
- Martell, K., Fairchild, A., LeGerrier, B., Sinha, R., Baker, S., Liu, H., Ghose, A., Olivotto, I. A., & Kerba, M. (2018). Rates of cannabis use in patients with cancer. *Current Oncology*, *25*(3), 219-225. <https://doi.org/10.3747/co.25.3983>
- MDH. (n.d.). *Report on Medical Cannabis Price Study*. <https://www.health.state.mn.us/people/cannabis/docs/rulemaking/pricereport.pdf>
- Nahin, R. L., Barnes, P. M., & Stussman, B. J. (2016). Insurance coverage for complementary health approaches among adult users: United States, 2002 and 2012. *NCHS Data Brief*(235), 1-8.
- National Cancer Institute. (n.d.). *Health Information National Trends Survey*. Retrieved May 2, 2023, from <https://hints.cancer.gov/>
- National Conference of State Legislature (NCSL). (2024). *State Medical Cannabis Laws*. <https://www.ncsl.org/health/state-medical-cannabis-laws>
- Olson, R. E., Smith, A., Good, P., Dudley, M., Gurgenci, T., & Hardy, J. (2023). 'What price do you put on your health?': Medical cannabis, financial toxicity and patient perspectives on medication access in advanced cancer. *Health Expectations: An International Journal of Public Participation in Health Care and Health Policy*, *26*(1), 160-171. <https://doi.org/10.1111/hex.13642>
- Pergam, S.A., Woodfield, M. C., Lee, C. M., Cheng, G. S., Baker, K. K., Marquis, S. R., & Fann, J. R. (2017). Cannabis use among patients at a comprehensive cancer center in a state with legalized medicinal and recreational use.

- Cancer*, 123(22), 4488-4497.
<https://doi.org/10.1002/cncr.30879>
- Saaddeh, C. E., & Rustem, D. R. (2018). Medical marijuana use in a community cancer center. *JCO Oncology Practice*, 14(9), e566-e578.
<https://doi.org/10.1200/jop.18.00057>
- Sedhom, R., Gupta, A., Wang, L., Paller, C., & Bao, T. (2021). Payer coverage of integrative medicine interventions for symptom control in patients with cancer. *JCO Oncology Practice*, 17(10), 587-590.
<https://doi.org/10.1200/OP.21.00361>
- Steele, G., Arneson, T., & Zylla, D. (2019). A comprehensive review of cannabis in patients with cancer: Availability in the USA, general efficacy, and safety. *Current Oncology Reports*, 21(1), 10.
<https://doi.org/10.1007/s11912-019-0757-7>
- Zylla, D., Jax, S., Schmiechen, K, Jelle, K, Gilmore, G. (2022). A novel cannabis education clinic for patients with cancer: Patient characteristics from initial visit. *Journal of Clinical Oncology* 40, no. 28_suppl (October 01, 2022) 298-298.
- Zylla, D., Steele, G., Eklund, J., Mettner, J., & Arneson, T. (2018). Oncology clinicians and the minnesota medical cannabis program: A survey on medical cannabis Practice Patterns, Barriers to Enrollment, and Educational Needs. *Cannabis and Cannabinoid Research*, 3(1), 195-202.
<https://doi.org/10.1089/can.2018.0029>
- Zylla, D. M., Eklund, J., Gilmore, G., Gavenda, A., Guggisberg, J., VazquezBenitez, G., Pawloski, P. A., Arneson, T., Richter, S., Birnbaum, A. K., Dahmer, S., Tracy, M., & Dudek, A. (2021). A randomized trial of medical cannabis in patients with stage IV cancers to assess feasibility, dose requirements, impact on pain and opioid use, safety, and overall patient satisfaction. *Supportive Care in Cancer*, 29(12), 7471-7478.
<https://doi.org/10.1007/s00520-021-06301-x>

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