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Age-related Patterns of Medical Cannabis Use: A Survey of Authorized Patients in Canada

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ABSTRACT

Objective: An increasing number of Canadians are registering as authorized users of medical cannabis. Older patients comprise a growing subset of this population; however, relatively little information exists around age-related patterns of medical cannabis use. **Methods:** The Canadian Cannabis Patient Survey (CCPS) is a large cross-sectional survey of authorized medical cannabis patients in Canada. This publication summarizes the results of the CCPS 2021, with a focus on age-related outcomes and the elderly sub-population. **Results:** The survey was completed by 2,697 patients. The mean age of participants was 54.3 years of age and the proportion of female respondents was 49.1%. Among older patients, pain was the most common symptom, while anxiety was the most common symptom reported by younger patients. Older patients exhibited a significant preference for oral administration over inhalation of medical cannabis when compared to younger patients, respectively (p>0.05). Among patients taking prescription opioids, most of whom were older patients, 54% reported a decrease in use concurrent with medical cannabis. **Conclusions:** Older patients comprise a growing subset of medical cannabis patients, which is also reflected in CCPS participants over time. This patient population exhibits different patterns of use compared to their younger counterparts, preferring high CBD orally ingested formulations, which they use primarily to treat pain-related illnesses/symptoms. Overall, study participants reported that cannabis had a high degree of efficacy in alleviating their illness/symptoms, and many reported a reduction in their use of prescription opioids, alcohol, tobacco, and other substances.

Key words: = cannabis; medical cannabis; gender differences; age differences; survey

Medical cannabis was first made legally available in Canada in 2001. As of March 2021, there were approximately 300,000 active client registrations with federal license holders, representing almost 1% of the Canadian population (Health Canada, 2023). However, due to the availability of recreational cannabis in Canada both before and after the legalization of adult recreational use in 2018, a substantial number of patients obtain and use cannabis for medical purposes without federal registration (Hamilton et al., 2017; Statistics Canada, 2019). Thus, these numbers are likely an underestimate

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of the prevalence of medical cannabis use in Canada.

Despite the growing number of medical cannabis users around the globe, there is relatively little data to describe medical patterns of use overall, and among distinct demographic groups defined by gender, age, or medical condition. Importantly, the number of older patients and female patients among medical cannabis users is increasing (Bruce et al., 2020; Han & Palamar, 2020; Vacaflor et al., 2020; Yang et al., 2021) and these populations may exhibit different patterns of use compared to younger or male cohorts. Older consumers are more likely to use cannabis for medicinal purposes rather than recreational purposes, to favour oral formulations, and to use medical cannabis to treat chronic health conditions (Kaufmann et al., 2020; Yang et al., 2021). Understanding age-related differences in medical cannabis use can help inform healthcare decisionmakers about specific therapeutic patterns of use and the associated potential harms and benefits and of medical cannabis among various user populations.

Examinations of real-world medical cannabis use can provide valuable self-reported data about patient health, use of other medications, and the perceived effectiveness of medical cannabis. The Canadian Cannabis Patient Survey (CCPS) is a large cross-sectional survey that was developed to collect data from Canadian authorized medical cannabis patients registered with Tilray, a federally authorized licensed producer with production facilities in British Columbia and Ontario and patients and distribution in all Canadian provinces and territories. The survey has been administered every two years using a similar methodology since 2015, and includes questions on participant demographics, patterns of cannabis use, and self-reported use of prescription drugs and other substances before and after medical cannabis initiation.

Results from previous CCPS have described the conditions for which medical cannabis is used, the preferred formulations and modes of administration, and the preferred ratios of active ingredients cannabidiol (CBD) and tetrahydrocannabinol (THC) (Baron et al., 2018; Lucas et al., 2020). Subsequent publications stemming from latter iterations of CCPS have focused on the relationship between medical cannabis use and reductions in substance use, including prescription medications (opioids and non-opioids), unregulated drugs, alcohol, and tobacco (Lucas et al., 2019; Lucas et al., 2020; Lucas et al., 2021). Earlier versions of CCPS also noted an under-represented but growing female patient population, as well a steady increase in the age of respondents (Lucas et al., 2019; Lucas & Walsh, 2017; Lucas et al., 2021). In regard to gender, 27% of respondents identified as female in 2015, 37% in 2017, and 45% in 2019 (Lucas et al., 2019; Lucas & Walsh, 2017; Lucas et al., 2021). Regarding age, 40 was the mean age of respondents in 2015 and 2017, increasing to 48 in 2019 (Lucas et al., 2019; Lucas & Walsh, 2017; Lucas et al., 2021). The present report summarizes results from CCPS 2021 with a focus on age-related differences in primary illnesses and patterns of medical cannabis use, including primary modes of administration and preferred major cannabinoid profiles (i.e., THC vs. CBD). We hypothesized that the respondent population would continue to trend older than previous iterations of this survey and that medical conditions and patterns of use would differ by age, as would changes in the use of other substances including prescription drugs, alcohol, tobacco, and unregulated drugs.

METHODS

Study Sample

Invitations to participate in the survey were sent by email to medical cannabis patients registered with Tilray, a federally authorized Licensed Producer (LP) in Canada. Recipients were informed that patients who completed the survey would be entered into a draw for 3 prizes of a $1000 credit to their medical account with Tilray. Clicking on the link in the email invitation led to a digital Informed Consent Form. Clicking "yes" to proceed with the survey was interpreted to mean that participants had provided consent to participate; clicking "no" immediately ended the survey.

Inclusion criteria included being age 18 or older, capable of reading and understanding English, and capable of legally consenting to the Informed Consent Form. Authorization to use medical cannabis was also included and confirmed by verifying the patient identification number.

Measures

The survey consisted of multiple choice, ranking, Likert-type, and open-ended questions regarding demographic information, health-related information, details on medical cannabis use, and questions around use of other substances such as prescription drugs, unregulated drugs, alcohol, and tobacco.

The survey gathered self-reported demographic data, including gender, age, current relationship status, highest education level completed, annual household income, and Canadian province/ territory of residence. We also assessed the primary symptoms and illness for which participants used medical cannabis by providing a list of common symptoms and illnesses associated with medical cannabis use that included an option of clicking "other," prompting a textual response. For primary illness, respondents could only select a single response, but the question on primary symptoms allowed for multiple responses.

We gathered cannabis use information via multiple choice questions. Primary method of use was assessed by providing a list of common methods of use (i.e., vaporizer/flower, oral oil/drops, oral capsules, oral edibles, oral tincture, joint, pipe, waterpipe/bong, vape pen, concentrates, topical, juicing, and "other") limited to a single response. Those who endorsed flower use were asked about days per week of use, as well as typical amount used per day (on days used) in dry weight, from "0.25 grams or less" to "4 grams or more". Participants were also asked to identify preferred flower types (i.e., high THC/low CBD, high CBD/low THC, 1:1 THC/CBD, or no preference). Those who endorsed oral extract use (i.e., drops or capsules) answered questions specific to these products, including what type of extract they used most (i.e., high THC/ low CBD, high CBD/low THC, and 1:1 THC/CBD). Those who endorsed liquid vape product use (i.e., vape pens or cartridges) answered questions specific to these products, including their preferred vape product (i.e., high THC/ low CBD, high CBD/low THC, and 1:1 THC/CBD, no preference)

The use of prescription medications (opioids and non-opioids to treat a medical condition), alcohol, tobacco, and other substances was assessed by asking participants about lifetime regular use (defined as ≥10 days in a year). Those who endorsed current or past regular use of prescription opioids, non-opioid prescription drugs, and illicit drugs were asked to identify up to five specific drugs within that category that they use(d). For opioids, up to five specific generic types of prescription opioid medications and associated dosages could be selected via drop down menu. We also asked participants to indicate which of the following statements best matched their experience using cannabis and prescribed opioids: (1) "I was surprised to find that my use of opioids changed after I began to use medical cannabis;" (2) "I deliberately used medical cannabis to reduce my use of opioids;" (3) "My MD recommended medical cannabis in order to reduce my use of opioids;" (4) "My MD recommended medical cannabis and then worked with me to develop a specific tapering program to help reduce my use of opioids;" or (5) "None of the above." To understand potential differences in self- vs. clinician-guided use of medical cannabis to reduce prescription opioid use, we pooled the above responses into categories for intentional self-guided management (i.e., response 2), clinician-guided (i.e., responses 3 or 4), and no/non-intentional management of opioids with cannabis (i.e., responses 1 or 5). For prescription non-opioids, up to five drugs could be identified through an autofill list connected to the National Drug Data File (NDDF), a US-based national prescription drug database. This ensured that consistent generic prescription drug names were used across participants to facilitate the analysis. However, a free-text option was also provided. For illicit drugs, up to five drugs could be indicated through a free-text option. For all substance categories (prescription opioids, prescription non-opioids, illicit drugs, alcohol, tobacco), participants were asked about perceived changes in use of that substance over the past-year, with options for increase, decrease, and no change.

Participants were asked to include their unique patient identification number to confirm eligibility and to assign credits to those who won a prize for participation. Accordingly, the survey was not completely anonymous. However, all data was collected and examined at the group level, and patient identifier numbers were de-linked from the specific survey data provided by the patient during analysis. The survey received approval from Advarra (Pro00050772), an independent ethics review service provider. Data

collection was done using REDCap software (Vanderbilt University, Nashville, TN, USA), a HIPAA and PIPEDA compliant, password protected, electronic data capture program. Data will be stored for seven years.

Statistical Analysis

We used descriptive statistics to summarize the socio-demographic characteristics of survey sample. We then stratified the sample by age group (≤40 years, 41-60 years, >60 years) and used Pearson's Chi-square test or Kruskal-Wallis test, as appropriate, to examine age-related differences in primary illnesses and symptoms treated with medical cannabis, perceived effectiveness of cannabis for symptom relief, primary mode of administration, frequency of use, preferred major cannabinoid profiles of currently used formulations, and perceived past-year changes in other substance use. We followed up significant age-related differences with post hoc tests for pairwise comparisons (≤40 vs. 41-60 years; 41-60 years vs. >60 years; ≤40 vs. >60 years). We used the Bonferroni methods to adjust p-values from post hoc tests. All analyses were conducted in R using RStudio.

RESULTS

In total, 27,431 survey invitations were issued by email, and 2,697 respondents met the inclusion criteria and completed the survey. At the time of the survey, Health Canada data indicates there were 272,690 federally registered patients, so those registered with Tilray accounted for approximately 10% of all patients, and therefore survey respondents represent nearly 1% of all federally registered medical cannabis patients in Canada (Health Canada, 2023).

Participant Characteristics

Table 1 highlights participant characteristics. There was an almost even distribution of males (n = 1352, 50.1%) and females (n = 1325, 49.1%), and 10 respondents (0.4%) identified as a third gender. The mean age of study participants was 54.3 years (standard deviation = 14.0), and mean age did not differ significantly between males (54.6 years) and females (54.2 years; p = 0.429). Most were married, and almost half identified as female. The survey provided the option to select multiple ethnicities, and there was an over-representation of White/Caucasian respondents (91.3%) compared to the general Canadian population, and an under-representation of all other ethnic groups. Participants were highly educated, with over 95% (n=2583) having at least a high school degree, and 30.6% (n=827) reporting a university degree. With respect to employment, 44.6% (n = 1202) of patients worked full or part time, 32.9% (n = 887) were retired, and 16% (n = 431) did not work due to disability.

Table 1. *Characteristics of the Sample (n = 2697) Overall and by Age Group.*

Variable	Overall	Age ≤40	Age 41-60	Age >60
	2697 (100.0)	535 (19.8)	1150 (42.6)	1012 (37.5)
Age				
Mean (SD)	54.3 (14.0)	33.8 (4.7)	51.2 (5.9)	68.6 (5.9)
Median (IQR)	56 (43 - 65)	35 (31-38)	52 (46-57)	67 (64-72)
Range	(20 - 94)	--	--	--
Gender				
Male	1352 (50.1)	269 (50.3)	575 (50.0)	508 (50.2)
Female	1325 (49.1)	250 (46.7)	572 (49.7)	503 (49.7)
Not Indicated	10 (0.4)	8 (1.5)	2 (0.2)	0 (0.0)
Other gender	10 (0.4)	8 (1.5)	1 (0.1)	1 (0.1)
Relationship Status				
Married	1541 (57.1)	209 (39.1)	667 (58.0)	665 (65.7)
Widowed	109 (4.0)	4 (0.7)	21 (1.8)	84 (8.3)
Divorced	262 (9.7)	10 (1.9)	111 (9.7)	141 (13.9)
Separated	86 (3.2)	12 (2.2)	59 (5.1)	15 (1.5)

In a domestic partnership or civil union	262 (9.7)	95 (17.8)	115 (10.0)	52 (5.1)
Single, but cohabiting with a significant other	106 (3.9)	50 (9.3)	35 (3.0)	21 (2.1)
Single, never married	331 (12.3)	155 (29.0)	142 (12.3)	34 (3.4)
Race/Ethnicity[1]				
White	2463 (91.3)	467 (87.3)	1048 (91.1)	948 (93.7)
Hispanic	27 (1.0)	9 (1.7)	11 (1.0)	7 (0.7)
Asian	29 (1.1)	10 (1.9)	16 (1.4)	3 (0.3)
South Asian	37 (1.4)	19 (3.6)	13 (1.1)	5 (0.5)
Black	36 (1.3)	14 (2.6)	13 (1.1)	9 (0.9)
Aboriginal/First Nation	67 (2.5)	21 (3.9)	30 (2.6)	16 (1.6)
Metis	64 (2.4)	12 (2.2)	29 (2.5)	23 (2.3)
Other	70 (2.6)	23 (4.3)	28 (2.4)	19 (1.9)
Highest degree completed				
Less than high school degree	114 (4.2)	49 (4.7)	39 (3.4)	50 (4.9)
High school degree or equivalent	638 (23.7)	115 (21.5)	258 (22.4)	265 (26.2)
Technical and non-university degree	1118 (41.5)	220 (41.1)	527 (45.8)	371 (36.7)
University degree	593 (22.2)	142 (26.5)	240 (20.9)	211 (20.8)
Graduate degree	182 (6.7)	26 (4.9)	68 (5.9)	88 (8.7)
Doctorate or professional degree	52 (1.9)	142 (26.5)	240 (20.9)	211 (20.8)
Employment Status				
Employed, working full-time	952 (35.3)	325 (60.7)	540 (47.0)	87 (8.6)
Employed, working part-time	250 (9.3)	61 (11.4)	125 (10.9)	64 (6.3)
Not employed, looking for work	112 (4.2)	39 (7.3)	54 (4.7)	19 (1.9)
Not employed, not looking for work	65 (2.4)	28 (5.2)	32 (2.8)	5 (0.5)
Retired	887 (32.9)	7 (1.3)	120 (10.4)	760 (75.1)
Disabled, no able to work	431 (16.0)	75 (14.0)	279 (24.3)	77 (7.6)
Annual household income				
Less than $10,000	66 (2.4)	20 (3.7)	34 (3.0)	12 (1.2)
$10,000 - $39,999	541 (20.1)	121 (22.6)	171 (14.9)	249 (24.6)
$40,000 - $69,999	717 (26.6)	130 (24.3)	273 (23.7)	314 (31.0)
$70,000 - $99,999	564 (20.9)	102 (19.1)	248 (21.6)	214 (21.1)
$100,000 - $129,999	387 (14.3)	83 (15.5)	184 (16.0)	120 (11.9)
$130,000 - $159,999	212 (7.9)	43 (8.0)	108 (9.4)	61 (6.0)
Over $160,000	210 (7.8)	36 (6.7)	132 (11.5)	42 (4.2)
Financial assistance for medical cannabis				
Not applicable	2424 (89.9)	494 (92.3)	1028 (89.4)	902 (89.1)
Veterans Affairs Canada	147 (5.5)	17 (3.2)	67 (5.8)	63 (6.2)
Private insurance provider	21 (0.8)	5 (0.9)	7 (0.6)	9 (0.8)
Other	105 (3.9)	19 (3.6)	48 (4.2)	38 (3.8)

Note. [1]Does not sum up to 100% as participants could check off multiple race/ethnicity categories.

Reasons for Medical Cannabis Use

The primary illnesses and symptoms, stratified by age, for which medical cannabis was used are reported in Supplementary Table S1. Chronic pain (27.8%; n = 750) and arthritis (14.9%; n = 402) were the two most common primary illnesses, and pain was the most common primary symptom (66.6%; n = 1796). Anxiety was the third most common primary illness (9%; n = 242) and the second most common primary symptom (35.7%; n = 964). Insomnia/sleep disorder was also a common condition, and this symptom, which is often co-morbid with chronic pain and other illnesses, was reported by 34.6% (n = 933)

Regarding perceived effectiveness, 87.1% of respondents (n = 2348) reported that medical cannabis helped alleviate primary symptoms "often" or "always," ranking the effectiveness of medical cannabis at achieving symptom relief at 75.2 out of 100 (SD 16.4; Table S1). Statistically

significant differences are observed in terms of perceived effectiveness between age groups, with the oldest age groups reporting a worst perceived effectiveness compared to the youngest one.

To assess age-related patterns of use, patients were divided into three age categories: 40 years and under (n = 535; 19.8%), 41 to 60 years (n = 1150; 42.6%), and over 60 years (n = 1012; 37.5%). Table 2 displays the top five reported primary illnesses and symptoms treated with medical cannabis, stratified by age group. Reasons for medical cannabis use stratified by gender are presented in Supplementary Table S2.

Table 2. *Reasons for Medical Cannabis Use by Age Group.*

	Age group, *n* (%)			
	≤40	41-60	>60	*p*-value[2]
	535 (19.8)	1150 (42.6)	1012 (37.5)	
Primary illness currently treated with medical cannabis				
Chronic pain	120 (22.4)	349 (30.3)	281 (27.8)	.003[a]
Arthritis	20 (3.7)	115 (10.0)	267 (26.4)	<.00[a,b,c]
Anxiety	105 (19.6)	100 (8.7)	37 (3.7)	<.00[a,b,c]
Insomnia/sleep disorder	51 (9.5)	93 (8.1)	94 (9.3)	.501
Fibromyalgia	25 (4.7)	87 (7.6)	60 (5.9)	.059
Primary symptoms currently treated with medical cannabis[1]				
Pain	267 (49.9)	782 (68.0)	747 (73.8)	<.00[a,b,c]
Anxiety	324 (60.6)	439 (38.2)	201 (19.9)	<.00[a,b,c]
Insomnia/sleep disorder	237 (44.3)	428 (37.2)	268 (26.5)	<.00[a,b,c]
Stress	225 (42.1)	309 (26.9)	112 (11.1)	<.00[a,b,c]
Depression/low mood	213 (39.8)	254 (22.1)	135 (13.3)	<.00[a,b,c]
Cannabis perceived to help with primary symptom relief (how often)[3]				
≤ Sometimes	45 (8.4)	139 (12.1)	165 (16.3)	<.001[b,c]
≥ Often	490 (91.6)	1011 (87.9)	847 (83.7)	
Perceived level of cannabis effectiveness for symptom relief (0-100% effective)				
Median (IQR)	80 (73-90)	78 (70-87)	75 (60-84)	<.001[a,b,c]

Note. [1]Patients could indicate >1 primary symptom

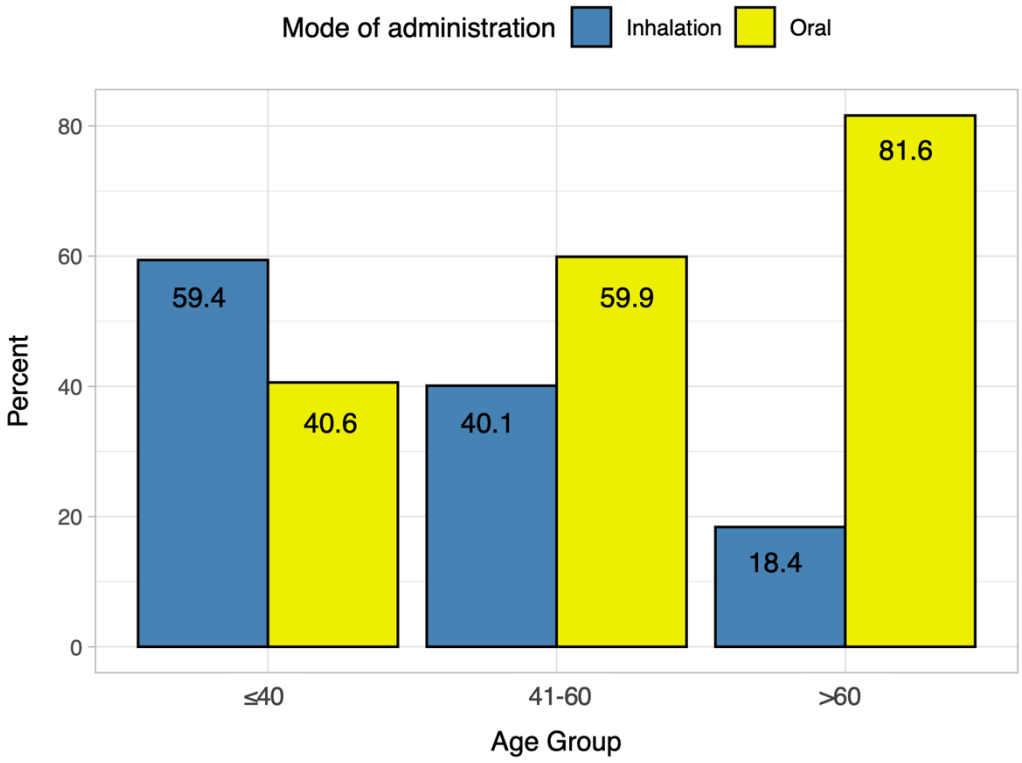
[2]Displayed p-value is from omnibus Pearson chi-square test (categorical variables) or Kruskal-Wallis test (numeric variables); Bonferroni-adjusted p-values for post hoc pairwise tests between age groups indicated by superscript letters: [a]adj. p<.05 for ≤40 vs. 41-60 years; [b]adj. p<.05 for 41-60 vs. >60 years; [c]adj. p<.05 for ≤40 vs. >60 years.

[3]Respondents selected from categories "Never", "Rarely", "Sometimes" (pooled into ≤Sometimes) and "Often", "Always" (pooled into ≥Often)

Preferred Formulations and Modes of Use

Tilray produces a wide range of cannabis-based products, including flower/bud, which can be smoked or vaporized, oil-based vaporizer cartridges, and extracts and capsules which can be taken orally. Participants identified the formulation/mode of administration they use most often for medical purposes, and results are summarized in Supplementary Table S3. The majority (n = 1468; 54.4%) used extracts/drops via oral administration. The second most common primary formulation/mode of administration combination reported by substantially fewer respondents (n = 334; 12.4%) was dried flower via vaporizer. Altogether, the primary mode of administration was oral for most respondents (n = 1722; 63.3%), but a substantial number (n = 939; 34.8%) reported inhalation (Supplementary Table S3). Figures 1 shows primary mode of administration (oral, inhalation) by age group. As shown, oral administration increased significantly with age (Figure 1).

Figure 1. *Inhalation and Oral Modes of Administration by Age Group.*



Proportion of respondents in each age group who reported using cannabis through inhalation and oral modes of administration. Inhalation modes of administration includes concentrates (dabs, shatter, etc.), joints, pipes, plant vaporizer, oil vaporizer, and bong; oral modes of administration include juicing, capsules, edibles, oils/drops, and tinctures. Distribution of mode of administration differed significantly by age (X^2=269.99, p<.001), with significant differences for pairwise age group comparison (Bonferroni-adjusted p<.001).

As shown in Table 3, a substantial majority (n = 2218; 82.2%) used medical cannabis at least once per day, with significantly higher prevalence recorded for the oldest age group: 86.0% vs. 81.0% in the 41-60 group and 77.8% in the ≤40 group. However, the youngest age group was more likely to report using more than one form of cannabis (flower, oral product, vape product).

Of respondents who used dried flower (n = 1399), most (n = 752; 54.2%) used <1g per day. There was a significant age-related difference in the distribution of daily amount of flower used, with <1 g/day more often reported in the oldest group (60.1%) relative to the youngest group (49.3%), but we note that this pairwise difference was just shy of surviving Bonferroni correction (p = 0.052).

Table 3. *Cannabis Use Patterns and Preferences by Age Group.*

Variable	*N*(%)	Age group			*p*-value
		≤ 40	41-60	>60	
Overall (n = 2697)					
Frequency of use					
< Daily	479 (17.8)	119 (22.2)	218 (19.0)	142 (14.0)	<.001[b,c]
≥ Daily	2218 (82.2)	416 (77.8)	932 (81.0)	870 (86.0)	
Form(s) of cannabis consumed					

Flower	1399 (51.9)	424 (79.3)	669 (58.2)	306 (30.2)	<.001[a,b,c]
Oral preparation	2298 (85.2)	398 (74.4)	977 (85.0)	923 (91.2)	<.001[a,b,c]
Vape pen / cartridge	709 (26.3)	226 (42.2)	335 (29.1)	148 (14.6)	<.001[a,b,c]
> 1 form	1271 (47.1)	372 (69.5)	616 (53.6)	283 (28.0)	<.001[a,b,c]
Flower products (n = 1399)					
Average daily dose per use (dried weight)					
<1 gram	758 (54.2)	210 (49.3)	364 (54.4)	184 (60.1)	.021[d]
1-2 grams	422 (30.2)	149 (35.1)	190 (28.4)	83 (27.1)	
≥ 3 grams	219 (15.7)	65 (15.3)	115 (17.2)	39 (12.7)	
Cannabinoid constituents of preferred flower					
High THC, Low CBD	821 (58.7)	227 (53.5)	386 (57.7)	208 (68.0)	.003[c]
1:1 Ratio (THC:CBD)	257 (18.4)	98 (23.1)	119 (17.8)	40 (13.1)	
Low THC, High CBD	134 (9.6)	44 (10.4)	68 (10.2)	23 (7.5)	
No preference	186 (13.3)	55 (13.0)	96 (14.3)	35 (11.4)	
Oral products (n = 2298)					
Cannabinoid constituents of most used oral product					
High THC, Low CBD	532 (23.2)	84 (21.1)	255 (26.1)	193 (20.9)	.010[b]
1:1 Ratio (THC:CBD)	434 (18.9)	80 (20.1)	194 (19.9)	160 (17.3)	
Low THC, High CBD	1332 (58.0)	234 (58.8)	528 (54.0)	570 (61.8)	
Vape products (n = 709)					
Preferred vape product cannabinoid constituents					
High THC, Low CBD	373 (52.6)	109 (48.2)	168 (50.1)	96 (64.9)	.011[b,c]
1:1 Ratio (THC:CBD)	176 (24.8)	66 (29.2)	88 (26.2)	22 (14.9)	
Low THC, High CBD	70 (9.9)	18 (8.0)	36 (10.7)	16 (10.8)	
No preference	90 (12.7)	33 (14.6)	43 (12.8)	14 (9.5)	

Note. [1]Sample is reduced by $n = 20$ for gender
[a]Bonferroni-adjusted p-value <.05 for <40 vs. 41-60 years
[b]Bonferroni-adjusted p-value <.05 for 41-60 vs. >60 years
[c]Bonferroni-adjusted p-value <.05 for <40 vs. >60 years
[d]≤40 vs. >60 no longer significant after Bonferroni correction ($p = .052$)

The majority of those who used flower (n = 821; 58.7%) preferred high THC/low CBD cannabinoid profiles. Significantly fewer people in the youngest group preferred high THC flower relative to the oldest group, (Table 3). The youngest group favored dried flower with a similar ratio of THC to CBD relative to the older group. Similar age-related preferences for high THC/low CBD (oldest group) and equal amounts THC to CBD (youngest group) were recorded for vape products (Table 3). In contrast to preferred flower and vape product major cannabinoid ratios, the most used oral products had high CBD/low THC cannabinoid profiles, reported by 58.0% of eligible respondents ($n = 2298$). Here, preference for high CBD/low THC products was lowest in the middle age group (54.0%) and highest in the oldest group (61.8%). Cannabis use patterns and preferences by gender are presented in Supplementary Table S4.

Prescription Drug Use

Among all patients who reported past-year prescribed opioid use ($n = 452$), the most common opioid was oxycodone (42.9%). More than half of these patients ($n = 270$; 59.7%) reported attempting to use cannabis to reduce prescription opioid use, either self-guided (45.1%) or under the guidance of their healthcare provider (14.6%), with no age-related differences (data not shown). Overall, 53.8% ($n = 243$) reported a decrease in prescription opioid use over the past year. Self-reported changes in prescription opioid use (increase, decrease, stable) over the past year did not differ by age group (Table 4).

Among all patients who reported past-year prescribed non-opioid pharmaceutical use ($n = 1182$), the most common drugs were naproxen (7.2%), acetaminophen (7.0%) and gabapentin (6.9%). Overall, 32.4% ($n = 383$) reported decreasing their use over the last 12 months, 5.8%

(*n* = 69) reported an increase in use, and 61.8% (*n* = 730) reported no change in use. Self-reported changes in prescription non-opioid use (increase, decrease, stable) over the past year did not differ by age group (Table 4). Past-year change in prescription opioids and non-opioids by gender are presented in Supplementary Table S5.

Table 4. *Past-year Change in Prescription Opioids and Non-opioids by Age Group.*

Past-year perceived change in use	*N*(%)	Age group			*p*-value
		≤ 40	41-60	>60	
Opioids[1] (n = 452)					
Increased	27 (6.0)	7 (9.7)	11 (4.8)	9 (6.0)	.563
Decreased	243 (53.8)	40 (55.5)	123 (53.5)	80 (53.3)	
No change	182 (40.3)	25 (34.7)	96 (41.7)	61 (40.7)	
Non-opioids[2] (n =1182)					
Increased	69 (5.8)	16 (8.1)	30 (5.9)	23 (4.9)	.323
Decreased	383 (32.4)	69 (34.8)	169 (33.1)	145 (30.7)	
No change	730 (61.8)	113 (57.1)	312 (61.1)	305 (64.5)	
Illicit substances[3] (n = 110)					
Increased	6 (5.5)	2 (4.7)	3 (6.4)	1 (5.0)	.896[4]
Decreased	54 (49.1)	23 (53.5)	23 (48.9)	8 (40.0)	
No change	50 (45.5)	18 (41.9)	21 (44.7)	11 (55.0)	
Alcohol (n = 1451)					
Increased	132 (9.1)	26 (9.5)	67 (11.0)	39 (6.9)	<.001[a,b,c]
Decreased	551 (38.0)	135 (49.1)	234 (38.3)	182 (32.2)	
No change	768 (52.9)	114 (41.5)	310 (50.7)	344 (60.9)	
Tobacco (n = 850)					
Increased	36 (4.2)	6 (4.2)	22 (5.6)	8 (2.6)	<.001[a,c]
Decreased	202 (23.8)	52 (36.1)	93 (23.7)	57 (18.2)	
No change	612 (72.0)	86 (59.7)	278 (70.7)	248 (79.2)	

Note. [1]Most common prescribed opioids: (1) Oxycodone, *n* = 194 (42.9%), (2) Hydromorphone, *n* = 114 (25.2%), (3) Tramadol, *n* = 94 (20.8%), (4) Codeine, *n* = 85 (18.4%), (5) Morphine, *n* = 44 (9.7%)
[2]Most common prescribed non-opioids: (1) Naproxen/Naproxen-containing, *n* = 85 (7.2%), (2) Acetaminophen/Acetaminophen-containing, *n* = 83 (7.0%), (3) Gabapentin, *n* = 81 (6.9%), (4) Ibuprofen/Ibuprofen-containing, *n* = 63 (5.3%), (5) Pregabalin, *n* = 56 (4.7 %)
[3]Most common illicit substances: (1) Psilocybin, *n* = 57 (51.8%), (2) Cocaine/Crack, *n* = 53 (48.2%), (3) LSD, *n* = 31 (28.2%), (4) MDMA, *n* = 23 (20.9%), (5) Amphetamines, *n* = 12 (10.9%)

Alcohol, Tobacco, and Unregulated Substances

Alcohol use was prevalent in this population, with 53.8% (*n* = 1451) respondents reporting lifetime use of alcohol. Of these, 38% (*n* = 551) reported a reduction in alcohol use in the past year, 9.1% (*n* = 132) reported increased use, and 52.9% (*n* = 768) reported no change. The proportion of respondents reporting a reduction in alcohol use decreased significantly with age (≤40: 49.1%; 41-60: 38.3%; >60: 32.2%; Table 4). Additionally, 31.5% (*n* = 850) respondents reported lifetime use of tobacco or nicotine, with 23.8% (*n* = 202) reporting a decrease in use in the past year. Similar to alcohol, the proportion of respondents reporting a reduction in use decreased significantly with age (≤40: 36.1%; 41-60: 23.7%; >60: 18.2%). Only 4.1% (*n* = 110) respondents reported lifetime use of unregulated substances, of whom 49% (*n* = 54) reported a reduction in use over the past year. No age-related differences in past-year changes in unregulated substance use were apparent.

DISCUSSION

The present report summarizes results of the 2021 CCPS, which is the fourth such survey since 2015. Compared to previous CCPS years, we report a higher proportion of female respondents, reflecting a trend of increasing female

participation in this biannual survey, from 27% in 2015 (Lucas & Walsh, 2017), 37% in 2017 (Baron et al., 2018), and 45% in 2019 (data not published) to 49% in the present report. Nevertheless, males still comprised a slight majority of respondents, despite a slight majority of females in the overall Canadian population (Statistics Canada, 2022). Health Canada does not publish data on gender distribution in the federal medical cannabis program, so we were not able to compare the representation of female participants in CCPS since 2015 to representation in the federal program, but we have found that under-representation of women among cannabis survey participants is consistent with other published study publications examining a similar cohort, including a 2020 survey of patients from another Canadian licensed producer (42% females) (Cahill et al., 2021), a 2014 survey of patients in Ontario (43.8% females) (Hamilton et al., 2017), and a 2016 survey of cannabis users in the US, UK, and Canada (45.4% females) (Sexton et al., 2016).

The observed trend of increasing age of CCPS survey respondents since 2015 is consistent with other studies of medical cannabis populations in Canada and other jurisdictions in the published literature. For example, in a 2013-2016 survey of 1,429 subjects in the US, UK, and Canada who had used cannabis within the last 90 days, the average age was 36.3 years (Sexton et al., 2016), while in a more recent survey of 214 Canadian authorized patients registered with a licensed producer, the average age was 50.7 years (Cahill et al., 2021). We would expect this aging trend in medical cannabis patients in Canada and around the world to continue as the stigma around medical cannabis diminishes and its therapeutic use is increasingly normalized.

In the present study, chronic pain, arthritis, and anxiety were the top three primary illnesses for which medical cannabis was sought, consistent with previous studies (Kaufmann et al., 2020; Kosiba et al., 2019; Yang et al., 2021). Chronic pain is associated with sleep disturbances (Ostovar-Kermani et al., 2020) and mood disorders (Meints & Edwards, 2018), and pain, anxiety, and insomnia were the top three symptoms for which medical cannabis was used. Thus, our findings are consistent with an older population of medical cannabis users who are primarily dealing with pain-related illnesses. This is further supported by age-related analyses. Compared to other age categories, more patients aged 41 to 60 reported using medical cannabis to treat chronic pain, and more patients aged over 60 reported using medical cannabis to treat arthritis. On the other hand, more patients aged 40 and under reported using medical cannabis to treat anxiety as a primary illness, and insomnia, stress, and depression/low mood as primary symptoms. Older age groups reported a lower perceived effectiveness of medical cannabis. The observed difference may be attributed to variations in the primary illness and symptoms treated or their severity status. For example, among patient-reported primary illnesses, medical cannabis use for arthritis showed a significant increase with age, whereas usage for anxiety notably decreased. Moreover, there was a significant difference in the primary symptoms treated with medical cannabis among all age groups: pain emerged as the most frequently treated symptom among the oldest age group, while anxiety, insomnia/sleep disorders, stress, and depression/mood disorders were the most commonly treated symptoms among the youngest age group.

Preferred routes of administration for medical cannabis also reflected additional age-related patterns of use. For example, 81.6% of patients over 60 years preferred oral formulations compared to 40.6% of patients 40 years and under. Interestingly, the preferred ratio of active ingredients THC and CBD showed clear distinctions between oral versus inhalational routes of administration that were independent of age. Patients using oral formulations tended to prefer high CBD and low THC concentrations for these formulations, while those using inhalational formulations (flower and vape products) tended to prefer low CBD and high THC concentrations for these products. Inhalation causes a more rapid onset of effects and shorter duration time, while orally ingested cannabis products cause a slower onset of effects, but these effects last much longer than inhalation (Huestis, 2007). Patients favouring an inhaled high THC product may be seeking a faster onset and offset of action—perhaps for acute conditions needing rapid relief like an anxiety attack, insomnia, or flare-up of symptoms associated with their primary illness (e.g., pain, inflammation, muscle spasms)—while those preferring oral CBD-dominant products may want a longer symptom relief, as is the case

with many chronic pain treatments and the respective age group prevalence.

The increased preference for oral methods of administration and, by extension, high CBD formulations among older patients reflects a pattern observed in the general population of cannabis-consuming Canadians (Statistics Canada, 2019) and may be due to several factors. Older individuals are more likely to suffer from health conditions for which CBD has received increased attention as a potential therapeutic agent that does not cause the impairing effects of THC (Bhaskar et al., 2021; Yang et al., 2021). This may be particularly attractive to older individuals that have traditionally reported a higher risk perception of cannabis compared to younger consumers (Pacek et al., 2015).

Another interesting finding is that older patients had the highest preference in high THC / low CBD products for flower and vape. Some possible reasons may be related to the type of illness being treated or more severe symptoms that require a higher dose of THC, when the inhalation route if chosen. Also, since the oldest age group is least likely to use inhalation products and those that use oral products don't seem to prefer high THC more than the other age groups, this might actually indicate that there is an unmeasured difference between older adults who do choose to use inhalation products and other older adults that comprise the rest of the sample. It's possible that the use of inhalation products despite their older age indicates a higher risk population that may require particular attention.

Among respondents who reported using prescription opioids (most of whom were older patients), a majority reported an intention on their part to reduce opioid use, which is consistent with previous CCPS results (Baron et al., 2018; Lucas & Walsh, 2017). Shi et al. found evidence for reduced use of Schedule III prescription opioids following legalization of recreational cannabis in a number of US states, suggesting the possibility that increased access to legal cannabis facilitates uptake of cannabis in favor of prescription opioids (Shi et al., 2019). Using medical cannabis as a substitute for opioids has been documented previously in survey-based research. For example, in a 2013-2014 cross-sectional survey of 244 medical cannabis patients who patronized a dispensary in Michigan, Boehnke et al. reported a 64% decrease in opioid use (Boehnke et al., 2016).

Because most evidence for reductions in opioid use with cannabis use comes from observational studies and surveys, evidence of a causal association is lacking. Nevertheless, findings of reductions in opioid overdose fatalities (Livingston et al., 2017) and dispensing of pharmaceuticals (Liang et al., 2018) associated with increased access to regulated cannabis has generated a promising signal of possible public health impacts of medical cannabis legalization on opioid use, possibly influencing healthcare providers seeking alternatives to opioids in the treatment of pain-causing conditions. Indeed, about 15% of respondents reported that their healthcare provider had recommended and/or supported tapering prescription opioids with medical cannabis.

Previous studies have reported reductions in the use of prescription non-opioid pain medications (Baron et al., 2018; Lucas & Walsh, 2017), unregulated drugs (Socías et al., 2017), alcohol (Lucas et al., 2019), and tobacco (Lucas et al., 2021) concurrent with cannabis use. In the present study, 32.4% of patients taking prescription non-opioid pain medications reported a decrease in use of these medications concurrent with medical cannabis use, and age-related patterns were similar to those for prescription opioids.

In regards to non-pharmaceutical substance use, over half of respondents reported using alcohol concurrent with medical cannabis, and 38% of these reported a decrease in alcohol consumption, which is consistent with the results of CCPS 2019, in which 44% (n=419) of those that identified past alcohol use saw a reduction following medical cannabis initiation (Lucas et al., 2020). Approximately one-third of patients reported using tobacco and/or nicotine, and 24% of those saw decreases in use, while 72% of these reported no change in their use. In contrast, Lucas et al. found that 49% of medical cannabis patients who used tobacco and/or nicotine reported reductions in use concurrent with medical cannabis use (Lucas et al., 2021). It is notable that decreases in both alcohol and tobacco/nicotine use were significantly more prominent in the youngest group of patients, which may have resulted from reduced opportunities to socialize in person due to COVID-19, a phenomenon that

would likely have the highest impact on younger respondents. Given the significant rates of morbidity and mortality associated with both alcohol and/or tobacco/nicotine use in Canada and around the globe, the 38% of respondents that reported declines in alcohol use and the nearly one-quarter of patients using tobacco/nicotine that reported a reduction in use in the present study may represent a significant public health impact.

Only a small percentage of survey participants reported using unregulated substances; however, among these patients almost half reported a reduction in the use of unregulated substances post medical cannabis initiation, while another 48% reported no change, and only 3% reported an increase in use. With so few patients reporting increases or initiation of use, our data suggests that transitions towards higher risk substance use patterns are unlikely to be exacerbated by the use of medical cannabis. Overall, our results highlight that older patients represent an increasingly important subset of the medical cannabis population whose unique needs and patterns of use warrant further investigation.

Limitations of this study include restricting the population to patients registered with Tilray as their provider of medical cannabis. While this was a national sample, it may have yielded data not representative of the broader population of medical cannabis patients in Canada. However, Tilray is a national Licensed Producer, and the geographic distribution of survey respondents closely corresponds with Health Canada's national medical cannabis patient database for the same period (Health Canada, 2023; *Data on Cannabis for Medical Purposes - Canada.Ca*, n.d.). Since this sample was drawn from patients registered with a medical cannabis company, participants may be more likely to report positive effects related to the medical use of cannabis. Additionally, all health information and substance use data was self-reported, and did not benefit from biological confirmation of medical conditions, symptoms, or substance use or abstinence, this data is vulnerable to recall bias, socially desirable responding, and other biases associated with self-report retrospective surveys. Social policy changes and the COVID-19 pandemic may have also impacted patient patterns of use as well as some of the outcomes of this study. Since the non-medical adult use of cannabis was legalized in Canada prior to this survey, and as there are many regulated and unregulated sources of cannabis available to Canadian patients, it is possible that some participants used sources of cannabis other than those accounted for in this study. Finally, the study was not completely anonymous, as the voluntary provision of a patient number at the end of the survey was needed for respondents wishing to be entered into a draw. However, this information was collected separately from the actual survey responses, and never associated with other survey data, and was therefore not expected to compromise confidentiality/anonymity, bias recruitment, or impact the results of the study. These limitations are counterbalanced by the large sample size and confirmation that respondents were federally authorized cannabis patients using under the guidance and/or oversight of a health care practitioner.

Conclusion

In conclusion, the results of this cross-sectional survey of Canadian authorized medical cannabis patients indicate that older patients represent a growing subset of this population, with patterns of use that differ from those of younger patients. Older patients were more likely to use medical cannabis to treat conditions related to chronic pain, while younger patients were more likely to use it to treat mood disorders and symptoms such as anxiety and depression. Older patients preferred oral routes of administration with high CBD and low THC concentrations, while younger patients preferred inhalational formulations with high THC and low CBD concentrations. Use of medical cannabis was associated with symptom improvement and meaningful reductions in the use of prescription opioids and non-opioids, unregulated drugs, alcohol, and tobacco. As cannabis becomes more normalized as a treatment option, it will be important to track changes in primary patient characteristics and associated patterns of use. The present findings may help inform potential treatment decisions by patients and health care providers in regards to medical cannabis use, and suggest that patient characteristics such as gender and age may impact patterns of use, and associated treatment adherence and outcomes. In

light of our findings and other observational studies suggesting that older patients are increasingly using cannabis for therapeutic purposes, further research is warranted to assess the therapeutic potential of various cannabis-based treatments in participants of varying age and gender, including more robust experimental and clinical studies focused on conditions that specifically impact patients of a specific age and/or gender.

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