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Patterns of Medical Cannabis Use Among Older Adults from a Cannabis Dispensary in New York State

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Abstract

Background: Cannabis use has increased among older adults. Few epidemiological studies have examined the medical diseases reported for cannabis use, routes of cannabis administration, and methods of consumption among older adults, and how they differ from younger adults.

Methods: We analyzed invoice data on purchases of cannabis products from a large medical cannabis dispensary in New York State between January 1, 2016 and December 31, 2017. Data came from $n = 11,590$ patients stratified by ages 18–49 ($n = 4,606$), 50–64 ($n = 3,993$), and ≥65 years ($n = 2,991$). We assessed differences in groups by demographic characteristics of patients, qualifying conditions and symptoms for cannabis use, cannabis product dosing of THC and CBD, THC:CBD ratios, and cannabis delivery methods.

Results: Among cannabis patients, 25.8% were aged ≥65 years, and 34.5% were ages 50–64. Across all age groups, severe or chronic pain was the predominant symptom for cannabis use, although older patients were more likely to use cannabis for cancer and Parkinson's disease among other conditions. Older adults were more likely to use sublingual tincture versus other consumption methods, to use products with a lower THC:CBD ratio, and to begin cannabis treatment with a lower THC and higher CBD dose compared with younger age groups. However, all age groups demonstrated a similar increase in THC dosing over time.

Conclusion: Analysis of medical cannabis invoices from a dispensary in New York State showed that although there are similarities in patterns of cannabis use across all groups, there are key characteristics unique to the older adult medical cannabis user.

Keywords: cannabinoid dosing; medical cannabis; older adults

Introduction

With the legalization of cannabis in many states, there is increasing interest in using cannabis to treat a range of medical diseases that are common among older adults. The number of cannabis users age ≥65 years in the U.S population has grown over the past two decades,[1,2] and support for cannabis legalization is also growing among older adults. A recent Pew research study found that in 2019, 63% of the Boomer Generation and 35% of the Silent Generation (born between 1928 and 1945) reported support for marijuana legalization.[3] There is also some evidence that older adults are seeing the potential therapeutic benefits of cannabis as well.[4] However, despite the strong interest in cannabis, the current clinical evidence to support its use, especially among older adults, is lacking. Although many older adults use cannabis to alleviate chronic pain, relieve anxiety, and treat insomnia,[5–7] most of the evidence supporting its use is limited to neuropathic pain, spasticity, and nausea.[8–11] In addition, the risks and harms associated with cannabis use are not well defined for older adults, who may have multiple comorbidities that render them more vulnerable to adverse effects, including blood pressure alterations, tachycardia, palpitations, wheezing, dizziness, confusion, hallucinations, and impairments of short-term cognition,[8,10–13] as well as hypothetical risks of falls and impairments in long-term cognition.[14]

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In addition, patients have a number of choices of medical cannabis products with different doses of cannabinoids, including THC and CBD and a variety of THC to CBD ratios. Cannabis products also have several delivery methods such as tinctures, capsules, or vaporizers. It is not clear what cannabis product may work best for specific medical conditions or symptoms or what products may minimize potential harms for older adults.

In the absence of clinical trial data for medical cannabis use, largely due to cannabis still being a Schedule I substance, epidemiological studies may be helpful in understanding how older adults are currently using medical cannabis. A number of epidemiological studies from national surveys examining patterns of cannabis use in older adults already exist[1,15–18]—studies document a significant increase in cannabis use by older people over the past two decades,[1,17,18] with one study by Han and Palamar showing that among U.S. older adults age 65+ years, there was an increase in the use of cannabis from 2.4% in 2015 to 4.2% in 2018.[1] A number of reasons for these increases have been proposed, including changing attitudes of cannabis among older people, changes in the legal status in individual states, and unique health care needs of patients.[16]

The majority of these epidemiologic studies include self-reported data about use patterns and associated health characteristics, and it may be important to identify patterns of use by using more objective measures of actual products purchased (including their dosing, route of administration), and any changes in products purchased over time. In addition, with recent legalization efforts and the establishment of dispensaries around the country, dispensaries may be a unique setting for establishing safer cannabis use practices as they are highly regulated. There was one previous large survey by Abuhasira et al., conducted at a medical cannabis clinic,[15] but that study did not examine actual products purchased. Therefore, understanding how cannabis is used by older adults in these settings may identify important trends.

The purpose of this study was to use invoice data from a medical cannabis dispensary in New York State to better understand the patterns of medical cannabis use among older adults and changes of its use over time. In this study, we were able to describe condition and symptom indications for cannabis use, methods of cannabis delivery, and dosing of THC and CBD cannabis products among older adults and how they compare with younger and middle-aged medical cannabis users.

Materials and Methods

Data source

With the passing of the Compassionate Care Act in 2014,[19] New York State legalized cannabis for medicinal use. To meet eligibility requirements for obtaining medicinal cannabis, patients are required to have been diagnosed with a debilitating/life-threatening condition, with an associated severe symptom. The conditions qualifying a patient include cancer, HIV/AIDS, amyotrophic lateral sclerosis (ALS), Parkinson's disease, multiple sclerosis, spinal cord nerve injury with spasticity, epilepsy, inflammatory bowel disease (IBD), neuropathy, Huntington's disease, post-traumatic stress disorder, chronic pain, pain that degrades health and functional capability as an alternative to opioid use, or substance use disorder. The eligible accompanying symptoms include cachexia or wasting syndrome, severe or chronic pain, severe nausea, seizures, severe or persistent muscle spasms, or opioid use disorder.

We analyzed de-identified data of cannabis sales invoices from patients of Columbia Care, Inc., one of the largest and most experienced multistate operators in the medical cannabis industry, with licenses in 16 jurisdictions in the United States and European Union. Our analyses focused on New York State. Invoices analyzed included those for patients ≥18 years old who had at least one cannabis invoice between January 1, 2016 and December 31, 2017. Our de-identified data included a masked patient identification number, which allowed us to group multiple invoices together for an individual patient. Of note, the data analyzed in this study were before the inclusion of substance use disorder as a qualifying condition. Columbia Care, Inc. cultivates, manufactures, and dispenses medical cannabis products. Within New York State, Columbia Care, Inc. has four locations, including Manhattan, Riverhead, Rochester, and Brooklyn. All patients pay out-of-pocket for cannabis products, which are legalized by the state for medical use. As this was a secondary data analysis using pre-existing de-identified data, the study was exempt from IRB review.

Measures

Patient characteristics. We obtained information on patient age (in years), gender, residence (New York City counties, Long Island counties, and all others), and qualifying conditions and symptoms for which cannabis use is approved for the patient. A list of qualifying conditions and symptoms is provided earlier.

Cannabis product characteristics. We obtained data on days-supply of cannabis product, cannabis delivery method (including sublingual tincture, vaporization cartridge, tablet, or capsule, all approved by New York state regulations), and labeled ratios of THC to CBD, including high THC:low CBD (20:1 ratio), equal THC:CBD (1:1 ratio), and low THC:high CBD (1:20 and 1:2 ratios). We were also provided with the precise dose in milligrams of THC and CBD of each product sold, with which we were able to compute a THC:CBD continuous ratio based on these exact dosages.

Analysis plan

We categorized patients based on their age at first invoice during the study period. As patients across the age spectrum may differ in their use patterns, product preferences, and reasons for using cannabis, we categorized patients as younger (18–49 years), middle-aged (50–64 years), and older adults (≥65 years old). We first compared demographic and clinical variables (age, gender, residence, qualifying conditions, qualifying symptoms) across the three age groups by using multinomial logistic regression where the age groups served as the outcome and characteristics served as predictors. Specifically, both the 50–64 years and ≥65 years age groups were individually compared with the 18–49 years age group (which served as our "base outcome"). For each characteristic, we conducted multivariate analyses (controlling for all patient characteristic variables), which yielded adjusted odds ratios (AORs).

Next, we completed similar analysis to above for the cannabis product characteristics. As some patients had multiple invoices over our study period, we computed within-person averages for product information. For example, across all of the patients' invoices, we averaged the days' supply, and we summed the number of invoices available. For methods of cannabis delivery and THC:CBD ratio label (i.e., high THC:low CBD, equal, low THC:high CBD), we identified the category most commonly seen among all patients' invoices. For patients with "ties" (e.g., where a subject had two invoices for equal THC:CBD, and two for high THC:low CBD), we chose to select the category with highest "value" (in this case would be equal because we coded high THC:low CBD as 1 and equal THC:CBD as 2). Both bivariate and multivariate analyses (adjusted for all cannabis product variables) were completed for each product categorization. Given the high prevalence of cancer among older cannabis users,[20] we also conducted a sensitivity analysis by which we additionally controlled for cancer.

Finally, we completed longitudinal analyses to examine trajectories of THC and CBD dosing and ratio over time by using multilevel models. Specifically, the dosing (both THC and CBD) and ratio (THC:CBD) all served as the outcomes, and time, age group, and time by age group interactions were the predictors. The multilevel models enabled us to account for clustering of invoices within patients and allowed for slopes to vary across time. If multiple invoices were available for the same day (e.g., multiple products purchased at a visit to dispensary), we computed the mean of dosing variables for that day. Time was characterized as the number of days since the first invoice during the study period. For the purposes of interpretation, we transformed this variable by dividing by 7 to represent the average change in dosing/ratio over a 1-week period. All analyses were completed in Stata SE version 15 (StataCorp, College Station, TX).

Results

Demographic and clinical characteristics

Our data included 63,042 invoices from 11,590 patients. Across the entire sample, the average age of patients was 53.5 (standard deviation [SD] = 16.21, range = 18–100) years, 50.5% were female, and the majority lived in Nassau/Suffolk Counties (40.3%) and all other counties (40.8%). The most common qualifying conditions were chronic pain (36.5%), neuropathy (31.3%), and cancer (17.2%), and the most common qualifying symptoms were severe or chronic pain (83.4%) and severe or persistent muscle spasms (24.6%).

Across the entire sample, 39.7% were ages 18–49 years, 34.4% were ages 50–64, and 25.8% were ages ≥65. Compared with those aged 18–49 years, the 50–64 years age group were more likely to have cancer (AOR = 3.10, 95% confidence interval [CI] = 2.56 to 3.75), HIV/AIDS (AOR = 1.80, 95% CI = 1.29 to 2.50), Parkinson's disease (AOR = 5.51, 95% CI = 3.15 to 9.66), spinal cord injury with spasticity (AOR = 1.33, 95% CI = 1.10 to 1.61), neuropathy (AOR = 1.60, 95% CI = 1.39 to 1.85), and cachexia or wasting syndrome (AOR = 1.38, 95% CI = 1.12 to 1.70), and were less likely to have epilepsy (AOR = 0.57, 95% CI = 0.34 to 0.96), IBD (AOR = 0.45, 95% CI = 0.36 to 0.57), post-traumatic stress disorder (AOR = 0.38, 95% CI = 0.17 to 0.82), and severe nausea (AOR = 0.77, 95% CI = 0.65 to 0.91). In

addition, compared with those aged 18–49 years, those older than age 65 were more likely to have cancer (AOR = 3.51, 95% CI = 2.84 to 4.33), ALS (AOR = 2.34, 95% CI = 1.01 to 5.43), Parkinson's disease (AOR = 28.45, 95% CI = 16.79 to 48.22), spinal cord injury with spasticity (AOR = 1.26, 95% CI = 1.01 to 1.58), neuropathy (AOR = 1.59, 95% CI = 1.34 to 1.87), and cachexia or wasting syndrome (AOR = 1.97, 95% CI = 1.59 to 2.45), and less likely to have HIV/AIDS (AOR = 0.26, 95% CI = 0.14 to 0.48), multiple sclerosis (AOR = 0.58, 95% CI = 0.43 to 0.79), epilepsy (AOR = 0.25, 95% CI = 0.12 to 0.53), and IBD (AOR = 0.28, 95% CI = 0.21 to 0.37) (Table 1).

Cannabis product information

In the entire sample, 35.2% of patients had only one invoice. The mean day supply was 16.1 (SD = 7.58) days, and the mean number of invoices was 5.4 (SD = 6.94, range = 1–131). The most common method of cannabis delivery was vaporization cartridge (41.2%) followed by sublingual tincture (36.5%). The most common THC:CBD ratio was high THC:low CBD (40.1%). Compared with those aged 18–49 years, those aged 50–64 years were less likely to have only one invoice (AOR = 0.80, 95% CI = 0.72 to 0.88), and to have a higher mean day supply (AOR = 1.02, 95% CI = 1.01 to 1.02). The 50–64 years age group was less likely to use vaporization cartridge (AOR = 0.60, 95% CI = 0.54 to 0.66) and capsules (AOR = 0.72, 95% CI = 0.64 to 0.82) versus sublingual tincture. They also were less likely to report low THC:high CBD ratios as compared to high THC:low CBD (AOR = 0.89, 95% CI = 0.80 to 0.99). Compared with those aged 18–49 years, those aged ≥ 65 years were less likely to have only one invoice (AOR = 0.68, 95% CI = 0.61 to 0.76), and to have a greater mean day supply (AOR = 1.04, 95% CI = 1.03

Table 1. Demographic Characteristics and Qualifying Conditions/Symptoms for Individuals Who Used Medical Cannabis Products During Study Period

Characteristic	All patients (*n* = 11,590), *N* (%)	Ages 18–49 (*n* = 4,606), *N* (%)	Ages 50–64 (*n* = 3,993), *N* (%)	Comparison,[a] 50–64 vs. 18–49, AOR (95% CI)	Ages ≥ 65 (*n* = 2,991), *N* (%)	Comparison,[a] ≥ 65 vs. 18–49, AOR (95% CI)
Age, years						
Mean (SD)	53.5 (16.21)	37.2 (8.13)	57.0 (4.20)	—	73.8 (7.26)	—
Median	54	38	57	—	72	—
Age range (age at date of first invoice)	18–100	18–49	50–64	—	65–100	—
Sex						
Female	5,850 (50.5)	2,192 (47.6)	2,016 (50.5)	Ref.	1,642 (54.9)	Ref.
Male	5,734 (49.5)	2,412 (52.4)	1,975 (49.5)	**0.89 (0.81 to 0.97)**	1,347 (45.0)	**0.75 (0.68 to 0.83)**
Other	6 (0.1)	2 (0.0)	2 (0.1)	1.81 (0.25 to 13.29)	2 (0.1)	2.02 (0.26 to 15.74)
Patient's residence						
New York City Counties	2,196 (19.0)	798 (17.3)	657 (16.5)	Ref.	741 (24.8)	Ref.
Nassau/Suffolk Counties (Long Island)	4,671 (40.3)	1,665 (36.2)	1,728 (43.3)	**1.27 (1.12 to 1.45)**	1,278 (42.7)	**0.79 (0.69 to 0.90)**
All others	4,723 (40.8)	2,143 (46.5)	1,608 (40.3)	0.90 (0.79 to 1.02)	972 (32.5)	**0.47 (0.41 to 0.54)**
Qualifying condition						
Cancer	1,990 (17.2)	416 (9.0)	827 (20.7)	**3.10 (2.56 to 3.75)**	747 (25.0)	**3.51 (2.84 to 4.33)**
HIV/AIDS	194 (1.7)	85 (1.9)	96 (2.4)	**1.80 (1.29 to 2.50)**	13 (0.4)	**0.26 (0.14 to 0.48)**
ALS	37 (0.3)	11 (0.2)	13 (0.3)	1.90 (0.84 to 4.33)	13 (0.4)	**2.34 (1.01 to 5.43)**
Parkinson's disease	291 (2.5)	17 (0.4)	60 (1.5)	**5.51 (3.15 to 9.66)**	214 (7.2)	**28.45 (16.79 to 48.22)**
Multiple sclerosis	605 (5.2)	294 (6.4)	234 (5.9)	1.21 (0.96 to 1.52)	77 (2.6)	**0.58 (0.43 to 0.79)**
Spinal cord injury with spasticity	784 (6.8)	298 (6.5)	301 (7.5)	**1.33 (1.10 to 1.61)**	185 (6.2)	**1.26 (1.01 to 1.58)**
Epilepsy	286 (2.5)	216 (4.7)	55 (1.4)	**0.57 (0.34 to 0.96)**	15 (0.5)	**0.25 (0.12 to 0.53)**
Inflammatory bowel disease	732 (6.3)	512 (11.1)	150 (3.8)	**0.45 (0.36 to 0.57)**	70 (2.3)	**0.28 (0.21 to 0.37)**
Neuropathy	3,629 (31.3)	1,284 (27.9)	1,390 (34.8)	**1.60 (1.39 to 1.85)**	955 (31.9)	**1.59 (1.34 to 1.87)**
Huntington's disease	5 (0.0)	4 (0.1)	0 (0.0)	—	1 (0.0)	0.60 (0.07 to 5.44)
Post-traumatic stress disorder	52 (0.5)	35 (0.8)	8 (0.2)	**0.38 (0.17 to 0.82)**	9 (0.3)	0.52 (0.24 to 1.11)
Chronic pain	4,235 (36.5)	1,862 (40.4)	1,362 (34.1)	1.07 (0.92 to 1.24)	1,011 (33.8)	1.11 (0.94 to 1.32)
Qualifying symptom						
Cachexia or wasting syndrome	897 (7.7)	203 (4.4)	335 (8.4)	**1.38 (1.12 to 1.70)**	359 (12.0)	**1.97 (1.59 to 2.45)**
Severe or chronic pain	9,660 (83.4)	3,829 (83.1)	3,401 (85.2)	1.10 (0.95 to 1.27)	2,430 (81.2)	**0.84 (0.72 to 0.99)**
Severe nausea	1,236 (10.7)	482 (10.5)	446 (11.2)	**0.77 (0.65 to 0.91)**	308 (10.3)	**0.57 (0.47 to 0.69)**
Seizures	344 (3.0)	239 (5.2)	75 (1.9)	0.64 (0.40 to 1.01)	30 (1.0)	**0.43 (0.24 to 0.76)**
Severe or persistent muscle spasms	2,856 (24.6)	1,125 (24.4)	1,036 (26.0)	1.00 (0.89 to 1.12)	695 (23.2)	**0.78 (0.68 to 0.89)**

Multivariate analysis controls for all variables in table. Reference for ORs for qualifying conditions and symptoms are all other patients without respective condition/symptom. Bolded ORs significant at $p < 0.05$.

[a]Ages 18–49 patients as reference.

ALS, amyotrophic lateral sclerosis; AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio; SD, standard deviation.

Table 2. Medical Marijuana Product Characteristics for Individuals Who Used Medical Cannabis Products During Study Period

Characteristic	All Patients ($n=11,590$), *N* (%)	Ages 18–49 ($n=4,606$), *N* (%)	Ages 50–64 ($n=3,993$), *N* (%)	Comparison,[a] 50–64 vs. 18–49, AOR (95% CI)	Ages ≥65 ($n=2,991$), *N* (%)	Comparison,[a] ≥65 vs. 18–49, AOR (95% CI)
Patients with only one invoice	4,084 (35.2)	1,773 (38.5)	1,340 (33.6)	**0.80 (0.72 to 0.88)**	971 (32.5)	**0.68 (0.61 to 0.76)**
Mean day supply (SD)	16.1 (7.58)	15.4 (7.53)	16.2 (7.62)	**1.02 (1.01 to 1.02)**	16.9 (7.52)	**1.04 (1.03 to 1.04)**
Mean number of invoices (SD)	5.4 (6.94)	5.5 (7.24)	5.6 (7.02)	1.00 (0.99 to 1.00)	5.2 (6.34)	**0.99 (0.98 to 0.99)**
Method of cannabis delivery most common						
Sublingual tincture	4,227 (36.5)	1,321 (28.7)	1,499 (37.5)	Ref.	1,407 (47.0)	Ref.
Vaporization cartridge	4,770 (41.2)	2,385 (51.8)	1,740 (43.6)	**0.60 (0.54 to 0.66)**	645 (21.6)	**0.24 (0.21 to 0.27)**
Capsules	2,593 (22.4)	900 (19.5)	754 (18.9)	**0.72 (0.64 to 0.82)**	939 (31.4)	0.96 (0.85 to 1.08)
Cannabis formulation most common, ratios of THC to CBD						
High THC:low CBD	4,643 (40.1)	1,998 (43.4)	1,737 (43.5)	Ref.	908 (30.4)	Ref.
Equal	3,549 (30.6)	1,345 (29.2)	1,158 (29.0)	0.93 (0.84 to 1.03)	1,046 (35.0)	**1.41 (1.25 to 1.59)**
Low THC:high CBD	3,398 (29.3)	1,263 (27.4)	1,098 (27.5)	**0.89 (0.80 to 0.99)**	1,037 (34.7)	**1.24 (1.10 to 1.40)**

Multivariate analysis controls for all variables in table. Bolded ORs significant at $p<0.05$.
[a]Ages 18–49 patients as reference.

to 1.04). They were less likely to use vaporization cartridge (AOR = 0.24, 95% CI = 0.21 to 0.27) versus sublingual tincture, and more likely to use products with equal (AOR = 1.41, 95% CI = 1.25 to 1.59) or low THC:high CBD ratios (AOR = 1.24, 95% CI = 1.10 to 1.40) versus high THC:low CBD (Table 2). In sensitivity analyses, after additionally controlling for cancer, results were, for the most part, similar.

Longitudinal analyses of THC and CBD dosing and ratio

For THC daily dose, the intercept (e.g., average dosing in mg at first invoice) was 14.01 (95% CI = 13.38 to 14.65). Patients aged ≥65 years had a lower overall THC dose versus the 18–49 age group ($B=-3.56$, 95% CI = −4.56 to −2.55), and there were no differences for the 50–64 years age group. There was a statistically significant increase in THC dosing over time ($B=0.20$, 95% CI = 0.16 to 0.23), and there were no differences in these trends by age group. For CBD daily dosing, the intercept was 7.43 (95% CI = 7.08 to 7.77), with the ≥65 years age group having a higher dosage ($B=1.79$, 95% CI = 1.24 to 2.33) than those aged 18–49 years. There were no significant changes in CBD dose over time and no difference in this time trend across age groups. For the THC:CBD daily ratio, the intercept was 7.42 (95% CI = 7.19 to 7.66). Those aged ≥65 years had a lower ratio ($B=-1.97$, 95% CI = −2.34 to −1.60) than those aged 18–49 years. We saw a statistically significant increase in THC:CBD ratio over time ($B=0.12$, 95% CI = 0.11 to 0.13), with no differences in this time trend across age groups (Table 3).

Discussion

In this study, we examined patterns of cannabis use among older adults who purchased products from a medical cannabis dispensary in New York State, and we showed some key differences as compared to younger and middle-aged adults. More than a quarter of patients were aged ≥65 years, and more than a third were aged 50–64. These large proportions of middle-aged and older adults are likely a result of recent trends seen

Table 3. Fixed Effects for Multilevel Models of Time Trends for THC and CBD Daily Dose and THC:CBD Daily Ratio

Characteristic	THC daily dose beta coefficient (95% CI)	CBD daily dose beta coefficient (95% CI)	THC:CBD daily ratio beta coefficient (95% CI)
Intercept	**14.01 (13.38 to 14.65)**	**7.43 (7.08 to 7.77)**	**7.42 (7.19 to 7.66)**
Age group, years			
18–49	Ref.	Ref.	Ref.
50–64	0.01 (−0.92 to 0.93)	0.41 (−0.09 to 0.92)	0.11 (−0.23 to 0.45)
≥65	**−3.56 (−4.56 to −2.55)**	**1.79 (1.24 to 2.33)**	**−1.97 (−2.34 to −1.60)**
Time (per week)	**0.20 (0.16 to 0.23)**	−0.01 (−0.03 to 0.01)	**0.12 (0.11 to 0.13)**
Age (50–64 years) × time interaction	0.01 (−0.05 to 0.06)	−0.01 (−0.05 to 0.02)	−0.00 (−0.02 to 0.02)
Age (65+ years) × time interaction	−0.02 (−0.08 to 0.04)	0.02 (−0.01 to 0.06)	0.01 (−0.01 to 0.03)

Multilevel models account for clustering of observations within subjects and random effects for slopes of time. Time corresponds to a change in dose/ratio across an average 1 week period from date of first invoice. Interaction corresponds to difference in dose/ratio change across time comparing age groups. Bolded beta coefficients significant at $p<0.05$.

over the past decade of increases in the use of cannabis by older age groups,[18] and this suggests that these increases seen nationally may be even more pronounced in states with legislation for cannabis use such as in New York State.

The most common symptoms for cannabis certification across all age groups were severe or chronic pain and muscle spasms, but there were distinctions between the age groups in other characteristics. Our analysis showed that older adults were more likely to be patients with more than one invoice. The reason for this is unclear—as cannabis purchases are generally out-of-pocket, older adults may be more likely to afford purchases over a shorter period. It is also possible that younger people have other sources for cannabis, which allows them to supplement purchases from the dispensary. It is interesting to note that the qualifying conditions of older adults (e.g., cancer and Parkinson's disease) are all chronic conditions for which cannabis may render palliative benefits.[8] The larger proportion of middle-aged adults using medical cannabis suggests that we may see an even higher proportion of older adults using cannabis in the future. Research to understand the unique factors of middle-aged cannabis users may be useful in planning for potential changes in use patterns in future older adult populations.

Our study also showed interesting trends in cannabis products purchased. Compared with younger adults, middle-aged and older adults were more likely to use tinctures than other cannabis delivery methods, which may be attributable to this consumption method being less stigmatized than others such as vaporization cartridges. Another possibility is that these products may have been recommended by the dispensary or the patient's provider. In addition, older adults or those with chronic medical conditions that specifically limit function (i.e., Parkinson's) may find it more difficult to use the vaporization cartridges and therefore opt for other methods. Given the growing prevalence of older cannabis users, it may be important to explore the safety and effectiveness of cannabis delivery methods for specific conditions and symptoms in older adults. For example, sublingual tinctures administered by buccal route may result in a more rapid onset of action than oral capsules; all of which may impact how cannabis influences an older adult's functioning.[21]

The two key cannabinoids in medical cannabis are THC and CBD, and both have different risk and benefit profiles for older adults. THC has intoxicating properties whereas CBD does not.[21] Older adults may be more sensitive to the intoxicating effects of THC, which may explain why in our study older adults were more likely to use and start with products of equal or low THC:high CBD ratios, indicating lower THC concentrations than younger age groups. However, over time, older adults increased their THC dosing at a similar rate as other age groups, suggesting that as older adults become more comfortable with cannabis they may be more willing to use cannabis products with higher THC doses, or develop a tolerance to THC necessitating increased doses over time. In the years to come, we may see increased uptake and dose escalation of THC products used by older adults.

With the passing of the Farm Bill in 2018, which had a provision that effectively legalized use of hemp-derived CBD products (with $<0.3\%$ THC) across all U.S. states, patients may have increased access to CBD-based treatments.[22] The benefits and risks for both THC and CBD for specific chronic diseases and symptoms remains unclear,[8,21] especially for older adults with possible comorbidities, and future research is urgently needed to better understand safe dosing and titration of cannabinoids for older adults to decrease risks of harm.[11–13] Cannabinoids are extensively metabolized by CYP enzymes, with CBD known to be the most potent inhibitor,[23] and further research is needed to study potential drug interactions that can especially impact older patients with polypharmacy. It may also be important for research to examine the factors that lead older adults to begin consuming cannabis for medical purposes, and identify the discussions that health care providers need to have with older patients about cannabis use to improve the course of clinical care.

This study had a number of limitations that should be noted. First, our study data were derived from invoices, and purchases of cannabis products may not correspond to use. Relatedly, it is also possible that products were purchased for someone else such as friends or family members. Second, invoice data do not demonstrate efficacy, so purchase patterns do not inform on clinical utility. However, it should be noted that older age groups were more likely to be "repeat patients," which may indicate that the products were helpful enough to repurchase. Third, it is possible that some patients receive cannabis products from multiple dispensaries, and these purchases would not be available in the data we analyzed. This may be problematic in our longitudinal analyses, as we would not know whether there were invoices between purchases or purchases occurring after the last invoice observed

in our data. Fourth, medical cannabis purchases are out-of-pocket and not covered under insurance, including Medicare; therefore, our sample excludes patients who cannot afford medical cannabis. Data on socioeconomic and demographic information of patients were not collected, but it would be important for future research into health disparities about access to cannabis. Fifth, our findings only apply to New York State and cannot be generalized to other geographic locations. Policies and regulations pertaining to recreational and medical sales of cannabis vary from state-to-state. Finally, our data did not include purchases of cannabis from the illicit market. More studies are needed to determine the sources for obtaining cannabis among all older adults.

Conclusions

Our study showed that across the medical cannabis dispensaries operated by Columbia Care, Inc. in New York State, there is a high percentage of older adults who use medical cannabis and have unique use patterns that differentiate them from younger adults. Given our findings, more research is needed to better understand the benefits and harms of cannabis use in older populations. With the overall growth in the population of older adults, there is an urgent need for more research that elucidates the ways cannabis use could enhance the health of older adults.

Author Disclosure Statement

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Abbreviations Used

ALS = amyotrophic lateral sclerosis
AOR = adjusted odds ratio
CBD = cannabidiol
CI = confidence interval
IBD = inflammatory bowel disease
OR = odds ratio
SD = standard deviation
THC = tetrahydrocannabinol