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Cannabis use in people with Parkinson's disease and Multiple Sclerosis: A web-based investigation

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ABSTRACT

Objectives: Cannabis has been used for medicinal purpose for thousands of years; however the positive and negative effects of cannabis use in Parkinson's disease (PD) and Multiple Sclerosis (MS) are mostly unknown. Our aim was to assess cannabis use in PD and MS and compare results of self-reported assessments of neurological disability between current cannabis users and non-users.

Methods: An anonymous web-based survey was hosted on the Michael J. Fox Foundation and the National Multiple Sclerosis Society webpages from 15 February to 15 October 2016. The survey collected demographic and cannabis use information, and used standardized questionnaires to assess neurological function, fatigue, balance, and physical activity participation. Analysis of variance and chi-square tests were used for the analysis.

Results: The survey was viewed 801 times, and 595 participants were in the final data set. Seventy-six percent and 24% of the respondents reported PD and MS respectively. Current users reported high efficacy of cannabis, 6.4 (SD 1.8) on a scale from 0 to 7 and 59% reported reducing prescription medication since beginning cannabis use. Current cannabis users were younger and less likely to be classified as obese ($P < 0.035$). Cannabis users reported lower levels of disability, specifically in domains of mood, memory, and fatigue ($P < 0.040$).

Conclusions: Cannabis may have positive impacts on mood, memory, fatigue, and obesity status in people with PD and MS. Further studies using clinically and longitudinally assessed measurements of these domains are needed to establish if these associations are causal and determine the long-term benefits and consequences of cannabis use in people with PD and MS.

1. Introduction

Cannabis sativa has been used for medicinal purposes for several thousand years.[1] Compounds within the cannabis plant interact with what is now known as the endocannabinoid system, which is comprised of a group of receptors and ligands synthesized within the human body. The cannabinoid receptors are found throughout the body, but with higher densities within the central nervous and immune systems. It has been suggested that cannabis may be a natural therapy for combating neuro-inflammatory and neuro-degenerative conditions due to the high density of cannabinoid receptors in the central nervous system.[2] Published reports suggest that people with Parkinson's disease (PD) and multiple sclerosis (MS) may experience relief of some of their symptoms, such as spasticity and pain, when using cannabis.[3–9] Under certain condition cannabis has been shown to have neuroprotective effects.[10] However, negative effects, such as cognitive impairment, are prevalent as well.[11]

Several surveys have looked into cannabis use in Parkinson's disease (PD)[12] and Multiple sclerosis (MS).[13–15] While most studies reported some efficacy of cannabis, none of these studies compared symptoms or disability status between the cannabis users and the non-cannabis users. With the legal status of cannabis use currently in flux, we created an anonymous web based survey to: (1) investigate patterns of cannabis use among people with PD and MS and (2) compare self-reported measures of disability between the cannabis users and non-users.

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2. Materials and methods

2.1. Ethical statement

All procedures and methods were approved by the Colorado State University Institutional Review Board. An acknowledgement of consent was displayed once a prospective participant accessed the survey, and acceptance of this consent was required before an individual could begin the survey.

2.2. Measures

The anonymous survey consisted of the following validated scales: Guy's Neurological Status Scale (GNDS),[16] Nottingham Health Profile (NHP),[17] Fatigue Severity Scale (FSS),[18] Activities of Balance Confidence (ABC),[19] and the International Physical Activities Questionnaire (IPAQ).[20] Demographic (e.g. age, sex, body mass index (BMI)), disease diagnosis, and cannabis use (e.g. past/current use status, times per week, methods of cannabis use) were also assessed. Cannabis use related questions were collapsed into a dichotomous variable (current users vs. non-users). Cannabis efficacy was assessed using an 8 point Likert scale (0: Not helpful − 7: Very Helpful).

Each of the scales were digitized and entered into the on-line survey host Qualtrics. The survey was tested in house by the authors to ensure proper: order, adaptive questioning, and required question enforcement. Adaptive questioning was used to hide questions when previous answers would make subsequent questions irrelevant, e.g. when a participant answered no to current cannabis use no further cannabis use questions were presented. Survey testing was conducted for approximately 3 months, after which an anonymous link was created by the survey host. This link was then posted to the websites of the Michael J. Fox Foundation and the National Multiple Sclerosis Society. These websites are recognized as prominent sources of information about their respective diseases and offer portals to view research opportunities that visitors can partake in. In total, the survey consisted of 185 items, although the length of each survey varied per person depending responses to adaptive questions.

2.3. Sampling

The anonymous online hyperlink to the web-based survey was posted to the research recruitment pages on the websites of the Michael J. Fox Foundation and the National Multiple Sclerosis Society from 15 Feb 2016 until 15 Oct 2016. The survey was also advertised through the participant databases of the investigators and posted to our laboratory webpages. This was a voluntary open survey allowing anyone with access to these websites to participate. There were no incentives offered for participation. Investigator contact information was also made available to prospective participants. Participants were able to contact the investigators via email or through the websites directly if they had questions about the survey. IP address verification was performed to remove duplicate records from individuals who may have filled out the survey multiple times.

2.4. Statistics

Means and standard deviations were calculated for continuous variables. Individual variables are reported and listwise deletion variables were excluded if information was not provided. No statistical corrections for missing data were performed. Demographic comparisons between PD and MS respondents were performed using Students' T-Tests for continuous data (e.g. Age, BMI) and chi-square tests (e.g sex, obesity status) for categorical data. The effect of cannabis use on self-reported scales (GNDS, NHP, ABC, FSS, IPAQ) was examined using a between-subjects two-way (Current Cannabis Use × Disease Diagnosis) analysis of variance (ANOVA). The main effects of disease are only reported in the tables, as it is expected that people with PD and MS will have varying levels of disability due to their differing disease diagnosis and symptoms. Chi-square values were used to test the associations of cannabis use status with categorical variables (e.g. sex and obesity status). Obesity status was defined as having a BMI ≥ 30 and education status was defined as possessing at least a 4 year degree. All analyses were two-sided with significance set to $\alpha < 0.05$ and performed using IBM SPSS Statistics for Windows, version 24 (IBM Corp, Armonk, N.Y., USA).

3. Results

3.1. Sample demographics

The survey was viewed a total of 801 times. The participation/recruitment rate was 96.1%, with 31 records not providing consent. Forty-one records were removed after IP address verification, and 92 records were removed due to lack of self-reported diagnosis. Two records were removed due to lack of demographic information. Forty records were removed due to a diagnosis other than PD or MS, leaving a total sample of 595 records. The completeness rate was 77.3% with 538 records in the final dataset filling out 100% of the survey.

Demographic information is shown in Table 1. The sample was made up of 76.3% PD and 23.7% MS. The average age of the PD group was greater than the MS group ($T = 15.948$, $P < 0.001$). The MS group had a lower proportion of men ($\chi^2 = 24.606$, $P < 0.01$). Body mass index, obesity status, and education status did not differ between the PD and MS groups (BMI, $T = 0.420$, $P = 0.675$; Obesity Status, $\chi^2 = 0.084$, $P = 0.772$; Education Status, $\chi^2 = 2.338$, $P = 0.126$).

3.2. Cannabis users and non-user demographics

Demographic comparisons between current cannabis users and non-users are shown in Table 2. Non-users are defined as any individual who is not currently using cannabis, and includes individuals who have tried cannabis in the past. The sex and education status of current cannabis users and non-users was similar (sex, $\chi^2 = 0.034$, $P = 0.854$; education status, $\chi^2 = 1.519$, $P = 0.218$), but the current cannabis users were younger, had lower BMI, and were less likely to be classified as obese (age, $F = 4.464$, $P = 0.035$; BMI, $F = 6.070$, $P = 0.014$; obesity status, $\chi^2 = 7.173$, $P = 0.007$).

3.3. Cannabis use characteristics

Cannabis use characteristics are shown in Table 3. Seventy percent of the sample reported having used cannabis at least once within their lifetime, and 44% reported currently using cannabis. Of the current cannabis users, 74% stated their use was for medicinal purposes, but

Table 1
Sample Demographics.

	Total	PD	MS	T-Test/χ^2 results
Age, years [mean(SD)]	57.3(12.4)	61.1 (9.5)	45.1 (12.8)	**
Sex (%)				
Men	52.3	57.9	34.0	**
Women	47.7	42.1	66.0	
BMI [mean(SD)]	26.3 (5.5)	26.4 (5.3)	26.1 (6.1)	ns
Classified as Obese (%)	20.0	20.3	19.1	ns
4-year degree or higher (%)	56.6	58.4	51.1	ns

PD: Parkinson's disease; MS: multiple sclerosis; BMI: body mass index; SD: standard deviation.
*P < 0.05; ** P < 0.01; ns − not significant.

Table 2
Demographic comparisons between cannabis users and non-users.

	Total		PD		MS		ANOVA/ χ^2 results
	Non	Use	Non	Use	Non	Use	
Age [mean (SD)]	59.7 (11.1)	54.3 13.2)	61.7 (9.5)	60.0 (9.2)	47.0 (11.8)	44.3 (12.3)	*
Sex							
Men (%)	52.0	52.7	56.3	60.6	25.5	38.7	
Women (%)	48.0	47.3	43.7	39.4	74.5	61.3	
BMI [mean (SD)]	26.8 (5.5)	25.7 (5.4)	26.7 (5.4)	25.8 (5.2)	27.3 (6.4)	25.6 (5.9)	*
Classified as Obese (%)	24.0	15.1	23.4	15.2	27.7	15.1	**
4-year degree or higher (%)	58.6	53.5	57.7	58.8	63.8	44.1	ns

Main effect of Cannabis Use Status was identified for Age and BMI. No interactions were detected between Cannabis Use Status and Diagnosis (P > 0.457).
PD: Parkinson's disease; MS: multiple sclerosis; BMI: body mass index; SD: standard deviation.
*P < 0.05; ** P < 0.01; ns − not significant.

Table 3
Cannabis Use Characteristics by disease diagnosis.

	Total	PD	MS	T-Test/χ^2 results
Past Use (%)	70.3	66.3	83.0	**
Current Use (%)	43.7	36.6	66.4	**
Medicinal Use (%)	73.7	72.3	76.1	ns
Possess Medical Card (%)	42.1	38.4	48.4	ns
Reduced Rx since started cannabis (%)	59.1	47.8	78.5	**
Smoke Only (%)	38.1	40.9	33.3	ns
Edibles Only (%)	6.3	6.3	6.5	ns
Smoked + Edibles (%)	19.4	19.5	19.4	ns
Using longer than 12 months (%)	75.0	69.8	83.9	*
Days/Week [mean(SD)]	5.0 (2.3)	4.6 (2.4)	5.6 (2.1)	**
Effectiveness [mean(SD)]	6.4 (1.8)	6.2 (1.8)	6.9 (1.6)	**

Past and current use is reported as a percentage of the total sample. All other variables are reported as a percentage of the current users.
PD: Parkinson's disease; MS: multiple sclerosis; BMI: body mass index; SD: standard deviation; Rx: Prescription.
*P < 0.05; **P < 0.01; ns − not significant.

only 42% reported possessing a medical cannabis card. Respondents with MS were more likely to have used cannabis previously and be current cannabis users (Past, $\chi^2 = 14.322$, $P < 0.001$; Current, $\chi^2 = 38.683$, $P < 0.001$). Usage purposes, possession of a medical card, and method of cannabis usage were not different between the PD and MS respondents (Purpose, $\chi^2 = 0.282$, $P = 0.595$; Card, $\chi^2 = 2.491$, $P = 0.120$, Method, $\chi^2 = 0.373$, $P = 0.830$). However, MS respondents were more likely to report the reduction of prescription medications with cannabis use ($\chi^2 = 22.878$, $P < 0.001$), were more likely to report using cannabis for at least 1 year ($\chi^2 = 6.186$, $P = 0.013$), are using cannabis on more days per week (T = 3.332, $P = 0.001$), and reported cannabis being more effective at relieving their symptoms (T = 3.121, $P = 0.002$) than the respondents with PD. When non-users were asked if they would consider using cannabis if scientifically shown to be beneficial, 97.9% responded "yes".

3.4. Self-reported scales

No interactions between Cannabis Use × Disease Diagnosis were detected for any of the GNDS, NHP, FSS, ABC, or IPAQ values ($P > 0.05$), signifying that differences between the cannabis users and non-users were not due to a specific disease diagnosis.

Table 4 contains the average values for the aggregate GNDS score, GNDS subscales, NHP scales, FSS, ABC, and the IPAQ. Current cannabis users had lower scores, signifying less disability, on the GNDS (F = 7.481, $P = 0.006$), and specifically within the Memory (F = 4.717, $P = 0.030$), Mood (F = 9.328, $P = 0.002$), and Fatigue (F = 6.870, $P = 0.009$) subscales. No differences were detected in any of the NHP domains (F < 1.637, P > 0.201). Current cannabis users also reported a lower impact of fatigue, as shown by lower FSS scores (F = 4.219, $P = 0.040$). No differences were detected between the current cannabis users and non-users in time spent (min/week) in: moderate to vigorous physical activities (F = 0.520, $P = 0.471$), walking (F = 1.036, $P = 0.309$), sitting (F = 0.001, $P = 0.987$) or balance confidence (ABC, F = 0.049, $P = 0.825$). Although not reaching significance (F = 3.702, $P = 0.055$) there may be an interaction between cannabis use status and balance in the MS group, resulting in people with MS using cannabis reporting lower balance confidence.

4. Discussion

To our knowledge this is the first study which investigated the patterns of cannabis use amongst people with PD and MS and compared measures of disability between cannabis users and non-users. Our data suggests that a large proportion (44%) of respondents with PD and MS are currently using cannabis. Our results also show that current cannabis users self-report lower levels of disability compared to non-users. Specifically we observed this in scales representing memory, mood, and fatigue. It is also important to note that current cannabis users did not report higher/worsened symptoms in any scale or measure, although there was a borderline significant interaction between balance confidence, cannabis use status, and an MS diagnosis. This interaction suggests that cannabis use may negatively affect balance in people with MS.

4.1. Effectiveness of cannabis

The current cannabis users in our sample reported that cannabis was quite effective. Eighty-five percent reported cannabis' effectiveness as moderate or above in relieving their symptoms, 4 or greater on a 0–7 Likert scale. Unfortunately, one of the limitations of our study is that it was not possible to identify the exact symptoms our respondents were treating with cannabis. An interesting finding from our data is that people with MS reported a greater effectiveness of cannabis compared to the PD group. This may also be supported by the finding that respondents with MS using cannabis were more likely to report reducing the use of prescription medications since beginning cannabis use, and may be contributing to a greater perceived effectiveness by people with MS. This finding is in-line with an examination of prescription drug use by Bradford and Bradford.[21] In their investigation, they reported significant reductions in daily doses filled for prescription drugs per physician in states with medical cannabis laws, especially in the realm of pain medications.

4.2. Possible effects of cannabis

Acute cannabis intoxication is known to negatively affect cognitive processing but these impairments often resolve themselves after a period of abstinence.[22] Due to these known effects it was interesting to see that the current cannabis users in our sample reported better scores within the memory and mood subscales of the GNDS. It is known that cannabis can impair working memory[23,24] and is linked to depressive symptoms, although the link between cannabis use and depression may be weaker than previously thought.[25] Individuals who have cognitive dysfunctions and mood disorders may refrain from cannabis use in fear

Table 4
Self-reported levels of neurological disability.

	Total [Mean(SD)]		PD [Mean(SD)]		MS [Mean(SD)]		ANOVA/χ2 results
	Non	Use	Non	Use	Non	Use	
GNDS Total	24.4 (6.1)	23.1 (6.4)	24.2 (6.0)	22.7 (6.4)	25.7 (6.5)	23.8 (6.2)	*
GNDS Memory	1.3 (1.0)	1.2 (1.1)	1.3 (1.0)	1.1 (1.0)	1.7 (0.9)	1.4 (1.1)	* $
GNDS Mood	1.5 (1.5)	1.3 (1.4)	1.5 (1.4)	1.2 (1.3)	2.1 (1.5)	1.5 (1.6)	* $
GNDS Vision	1.2 (1.3)	1.2 (1.3)	1.2 (1.2)	1.0 (1.3)	1.4 (1.5)	1.3 (1.3)	ns
GNDS Speech	0.8 (0.9)	0.7 (0.9)	0.9 (0.9)	0.9 (0.9)	0.6 (0.8)	0.4 (0.7)	ns
GNDS Swallow	0.8 (1.0)	0.7 (0.9)	0.8 (1.0)	0.7 (1.0)	0.7 (1.0)	0.6 (0.9)	ns
GNDS Arm/Hand	10.0 (1.2)	9.8 (1.1)	9.9 (1.2)	9.8 (1.1)	10.1 (1.1)	9.9 (1.0)	ns
GNDS Mobility	2.2 (1.3)	2.1 (1.4)	2.2 (1.3)	2.1 (1.4)	1.8 (1.4)	2.0 (1.3)	ns
GNDS Bladder	1.5 (1.4)	1.4 (1.4)	1.4 (1.4)	1.2 (1.4)	1.6 (1.4)	1.7 (1.3)	$
GNDS Bowel	1.2 (1.2)	0.9 (1.2)	1.2 (1.2)	1.1 (1.3)	0.9 (1.1)	0.6 (1.0)	ns
GNDS Fatigue	2.5 (1.5)	2.4 (1.7)	2.4 (1.5)	2.2 (1.5)	3.4 (1.1)	2.7 (1.8)	* $
GNDS Sex	1.4 (0.5)	1.5 (0.5)	1.4 (0.5)	1.5 (0.5)	1.5 (0.5)	1.6 (0.5)	ns
NHP EL	46.8 (39.5)	45.2 (39.1)	44.6 (39.3)	37.8 (36.6)	60.9 (38.3)	57.9 (40.1)	$
NHP P	30.1 (32.1)	31.8 (35.9)	29.5 (31.3)	27.9 (34.3)	33.5 (37.2)	38.4 (37.9)	$
NHP ER	27.4 (29.2)	23.9 (27.6)	26.9 (28.8)	20.7 (26.1)	30.8 (31.3)	29.3 (29.2)	$
NHP S	39.9 (31.7)	37.0 (30.5)	39.5 (31.6)	36.4 (30.5)	42.4 (32.7)	38.0 (30.6)	ns
NHP SI	25.6 (29.7)	23.7 (29.3)	25.1 (29.1)	20.0 (26.7)	29.2 (33.9)	30.3 (32.6)	$
NHP PA	28.7 (23.1)	25.5 (22.5)	28.6 (22.7)	22.4 (20.1)	29.3 (26.0)	31.0 (25.5)	ns
FSS	4.8 (1.7)	4.7 (1.8)	4.7 (1.7)	4.4 (1.7)	5.7 (1.1)	5.3 (1.7)	*
ABC	7.4 (2.7)	7.5 (2.7)	7.4 (2.7)	7.9 (2.5)	7.5 (2.8)	6.8 (3.1)	ns
MVPA (min/week)	730 (1056)	808 (1140)	744 (1068)	894 (1142)	639 (981)	659 (1128)	ns
Walking (min/week)	326 (468)	374 (585)	332 (460)	392 (534)	286 (519)	344 (662)	ns
Sitting (min/week)	1848 (788)	1858 (825)	1831 (782)	1764 (792)	1957 (827)	2027 (860)	ns

Data reported as mean (SD). Guy's Neurological Disability Scale (GNDS) is scored from 0 to 34, and the Nottingham Health Profile (NHP) is scored from 0 to 100, higher values represent greater disability. EL = energy level, P = pain, ER = emotional reaction, S = Sleep, SI = social isolation, PA = physical abilities. FSS = Fatigue Severity Scale range is 0–9 with higher values representing a greater impact of fatigue, ABC = Activities of Balance Confidence range is 0–10 with lower scores representing less confidence in maintaining balance, MVPA = moderate and vigorous physical activities

No interactions between Current Cannabis Use Status x Diagnosis were identified.

* $P < 0.05$ main effect of Current Cannabis Use Status.

$ $P < 0.05$ main effect of Diagnosis.

of exacerbating these symptoms, and this may have led to our results. The placebo effect can also not be ruled out, as people may expect their mood to improve with cannabis use. Further research is needed to determine the effects of cannabis on these parameters in individuals with PD and MS and these domains should have increased priority of monitoring if a person begins using cannabis.

Weight gain is often thought to occur with cannabis use, and is one of the reasons its use is often suggested. In our discussions with people interested in the effects of cannabis this negative effect is often brought up. Cannabis use can lead to increased caloric intake.[26] It has been shown that cannabis consumption can contribute to obesity when initiated during adolescence,[27] but in a large study of adults in the United States, Le Strat and Le Foll[28] reported a lower prevalence of obesity in cannabis users compared to non-users. Combined with our results, it does not appear that significant weight gain should be of concern for patients contemplating cannabis use. Whether cannabis use is protective of obesity in PD and MS cannot be determined from our sample, and long term monitoring of obesity and metabolic syndrome parameters should be monitored in patients using cannabis as cannabis is known to affect the metabolism of several tissues.[29,30]

Our results show that the current cannabis users and non-users are spending the same amount of time performing Moderate-to-vigorous physical activity, walking, and time spent sitting. Acute cannabis use is shown to induce a transient amotivational state in non-users, but regular cannabis use may prevent this from occurring.[31] Cannabis has also been shown to negatively affect motor performance,[32] which could lead to lower physical activity levels. These negative effects do not seem to be manifested within our sample; although effects of acute intoxication from cannabis products cannot be ignored. While this data on physical activity is interesting, it needs to be further explored utilizing objective measures to determine the interactions of cannabis and physical activity participation in the PD and MS populations.

4.3. Differences in use between PD and MS

In our sample a greater proportion of people with MS report using cannabis. Most cannabis laws specifically state pain and muscle spasms related to MS are appropriate conditions in which to allow cannabis use. Respondents with MS tended to be younger and more likely to have used cannabis in the past. This may contribute to the increased prevalence of cannabis use and the greater usage of cannabis throughout the week in the respondents with MS. Future studies should begin to identify specific symptoms that people with PD and MS are using cannabis for and which symptoms, other than pain and spasticity, are most effectively treated using cannabis.

4.4. Limitations of the study

One of the major limitations of our study, and most others, is how we define cannabis. It is well-known that cannabis products can have a wide range of concentrations in regards to the two most studied cannabinoids: Δ^9-tetrahydrocannabinol (THC) and cannabidiol (CBD). The current body of literature on the negative effects of cannabis is mostly focused on the psychoactive ingredient THC. Several investigations have shown that CBD can ameliorate the negative aspects of THC,[24,33,34] as well as having beneficial effects in its own right.[35,36] The current lack of detailed knowledge, i.e. external validity, about the products individuals are using, as well as which products medical professionals should recommend, creates a quagmire for both medical professionals and patients alike.

As with most surveys, biases in: selection, self-report, recall, social-desirability, and generalizability of the sample are all prominent limitations. Our data was captured in the form of an open web-based survey and allowed anyone with access to the internet to participate. While acceptance of cannabis use is rising we cannot discount the fact that because the title of the survey included "cannabis" many

individuals may not have participated due to an inherent aversion to anything dealing with this topic. This may have led to the increased proportion of current cannabis users in survey compared to others.[12–14,37] Although, a recent report shows that the proportion of older adults using cannabis is increasing at a much higher rate than previously expected.[38] It is possible that our convenience sample more closely reflects this trend than the previous studies referenced, but caution must be advised in the generalizability of our results. We also found that current users believe cannabis to be highly effective, which may be influenced by selection and self-report biases of the sample. For example, it is unlikely that individuals who believe cannabis provided no benefit would continue using it. While these limitations exist, measures to counter-balance them have been taken. These measures include a relatively large sample size and following guidelines established for reporting web-based surveys.[39]

It is also important to note that this sample is largely limited to people who access the internet and are somewhat familiar with the use of online tools. This may reflect that our sample has a higher cognitive ability than the PD and MS populations as a whole. While our data add significantly to our current knowledge of cannabis' effects, results from this survey should be used to inform controlled research, rather than reach definitive conclusions about cannabis' efficacy. Randomized control trials with high external validity are needed for medical professionals and patients to make informed decisions about cannabis use.

4.5. Important gaps in knowledge

Neuroimaging modalities including, magnetic resonance imaging and positron emission tomography are an integral part of disease diagnosis and monitoring. Yet, it is largely unknown how cannabis use alters human brain connectivity, function, and structure. To date there is no conclusive neuroimaging evidence showing that cannabis alters brain structure in healthy adults,[40] although several studies have shown functional differences between cannabis users and non-users.[41,42] Romero et al.[43] reported that in people with MS brain volume reductions were associated with cognitive impairment, and in people with MS using cannabis the association between volume loss and cognition was stronger. Due to the a cross-sectional nature of Romero et al.[43] the authors are unable to determine whether cannabis use caused a greater reduction in brain volume, but it is important to note that current cognitive dysfunction may be a contraindication of cannabis use as it may exacerbate cognitive impairments. How/if cannabis affects brain structure in neurological conditions remains unknown, and longitudinal cause/effect neuroimaging studies are needed to determine these associations.

4.6. Conclusions

In spite of the limitations of this study, we observe that a large proportion of individuals with PD and MS are currently using cannabis as a medical treatment. Our results show cannabis users are reporting lower levels of disability, most notably in domains of memory, mood, and fatigue. It also appears that a large proportion of users are self-medicating with cannabis, as indicated by the fact that only 42% of the current cannabis users reported possessing a medical cannabis card.

As our survey shows, a significant number of people with PD and MS are already using cannabis in the absence of empirical data for or against cannabis use. In addition, given the fact that the removal of legal barriers may lead to a significantly increased number of cannabis users, the challenge faced by the medical profession in the coming years is to play catch-up and help patients make an informed decision on whether to use cannabis.

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