USE OF MARIJUANA FOR THE TREATMENT OF MULTIPLE SCLEROSIS

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DISCLOSURES

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Funding
American Brain Foundation (AAN)
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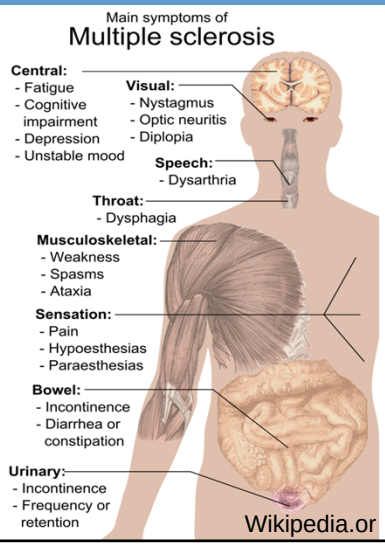
No COI

MULTIPLE SCLEROSIS (MS): A disease affecting many systems



Focus on symptomatic therapy:

- Cognition
- Spasticity
- Pain

Not disease-modifying effects

Use of Marijuana for the Treatment of Multiple Sclerosis

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Current Literature Review

Cannabinoids for treatment of spasticity and other symptoms related to multiple sclerosis (CAMS study): multicentre randomised placebo-controlled trial

Zajicek, Fox, Sanders, Wright, Vickery, Nunn, Thompson, on behalf of UK MS Research Group. *Lancet* 2003.

CAMS Study by Zajicek et al, *Lancet* 2003.

Objective

- To determine the efficacy of cannabinoids in treating spasticity and other MS-related symptoms

CAMS Study by Zajicek et al, *Lancet* 2003.

Methods

- Randomized, placebo-controlled trial
- Enrolled 667 patients (18-64yo) with stable MS and muscle spasticity from 33 UK centres
  - Ashworth score of 2+ in 2+ lower limb muscle groups
- Randomized treatment (N=630)
  - Oral cannabis extract (N=211)
  - Delta-Tetrahydrocannabinol (delta-THC – marinol - N=206)
  - Placebo (N=213) (each treatment had own placebo)
- Duration: 15 weeks
- Outcomes:
  - Primary: Ashworth scale for overall spasticity
  - Secondary: PROs (pain, spasticity, mobility, sleep quality)
- Analysis: Intend-to-treat

CAMS Study by Zajicek et al, *Lancet* 2003.

	Treatment group					
	Cannabis extract (n=211)		Δ⁹-THC (n=206)		Placebo (n=213)	
	Number of patients	Mean (SD)/% of group	Number of patients	Mean (SD)/% of group	Number of patients	Mean (SD)/% of group
Sex						
Male (n=217)	76	..	63	..	78	..
Female (n=413)	135	..	143	..	135	..
Age (years) (n=630)	211	50·5 (7·6)	206	50·2 (8·2)	213	50·9 (7·6)
Height (cm) (n=624)	209	167·5 (9·3)	205	167·9 (9·8)	210	168·0 (10·4)
Weight (kg) (n=630)	211	71·7 (15·9)	206	71·2 (16·5)	213	71·6 (15·9)
Body-mass index (kg/m²) (n=624)	209	25·6 (5·6)	205	25·2 (5·2)	210	25·4 (5·1)
Mean baseline Ashworth						
Upper-body muscles (n=629)	211	5·0 (4·8)	206	5·9 (5·6)	212	5·4 (4·9)
Lower-body muscles (n=630)	211	16·8 (6·0)	206	16·7 (6·6)	213	16·1 (5·8)
All muscle groups (n=630)	211	21·8 (8·7)	206	22·6 (10·1)	213	21·4 (8·5)
Form of multiple sclerosis						
Relapsing/remitting (n=33)	6	3%	14	7%	13	6%
Primary progressive (n=145)	53	25%	43	21%	49	23%
Secondary progressive (n=452)	152	72%	149	72%	151	71%
Ambulatory status						
Able to walk with or without aid (n=303)	103	49%	95	46%	105	49%
Unable to walk (n=327)	108	51%	111	54%	108	51%
EDSS						
0–3·5 (n=3)	0	0%	1	0·5%	2	1%
4–5·5 (n=23)	6	3%	9	4%	8	4%
6–6·5 (n=299)	104	49%	94	46%	101	47%
7–9 (n=299)	99	47%	99	48%	101	47%
Missing (n=6)	2	1%	3	1·5%	1%	1%

Table 2: **Baseline characterisics**

CAMS Study by Zajicek et al, *Lancet* 2003.

Results

- 611/630 completed study
- No effect of treatment on primary endpoint
  - Ashworth scale reduction: 0.32 (95% CI: -1.04 to 1.67)

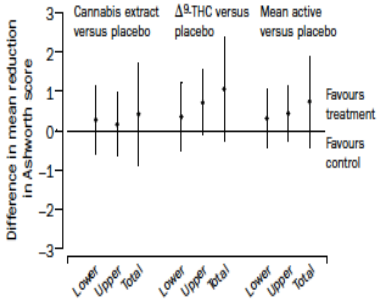

Figure 2: **Changes in Ashworth scores from baseline to 13 weeks' follow-up, adjusted for ambulatory status and centre effects**
Estimates (95% CI) shown for lower-body, upper-body, and total scores

CAMS Study by Zajicek et al, *Lancet* 2003.

Results

- Treatment effect on:
  - Patient-reported spasticity
  - Patient-reported pain
- Mobility
  - (median timed 10m walk)

	Treatment group			p
	Cannabis extract (n=197)	Δ⁹-THC (n=181)	Placebo (n=198)	
Symptom improvement				
Bladder				0·149
Yes	68 (44%)	67 (40%)	51 (33%)	
No	87 (56%)	97 (59%)	102 (67%)	
Pain				0·003
Yes	83 (57%)	64 (50%)	51 (37%)	
No	63 (43%)	64 (50%)	86 (63%)	
Tremor				0·052
Yes	58 (48%)	44 (40%)	43 (33%)	
No	64 (52%)	67 (60%)	89 (67%)	
Spasticity				0·003
Yes	121 (61%)	108 (60%)	91 (46%)	
No	76 (39%)	73 (40%)	107 (54%)	

Data are number (% of particular symptom within group). Not all patients responded to questions, particularly if that symptom was not a major problem for them.

Table 4: **Assessment of treatment benefit at visit 8**

CAMS Study by Zajicek et al, *Lancet* 2003.

Conclusions

- No effect on objective spasticity
- Effect on secondary outcomes
  - (objective walking; reported pain and spasticity)
- Range of unmasking noted among patients in active treatment group

Use of Marijuana for the Treatment of Multiple Sclerosis
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Current Literature Review

Multiple sclerosis and extract of cannabis: results of the MUSEC (MS and Extract of Cannabis) trial

Zajicek, Hobart, Slade, Barnes, Mattison,

Multiple sclerosis and extract of cannabis: results of the MUSEC trial by Zajicek et al, *JNNP* 2012.

Objective

- To assess the effect of OCE on symptomatic relief of muscle stiffness and pain in adult patients with stable MS and ongoing troublesome muscle stiffness.

Multiple sclerosis and extract of cannabis: results of the MUSEC trial by Zajicek et al, *JNNP* 2012.

Methods

- Double blind placebo controlled Phase III trial
- Patients aged 18-64 years
  - MS according to McDonald criteria
  - Stable disease for the previous 6 months
  - Troublesome and ongoing muscle stiffness for at least 3 months before enrollment (as shown by a current disability score of at least 4 on an 11 point category rating scale (CRS)
- Randomized to OCE (N =144) vs. placebo (N = 135)
- Duration: screening, 2 week dose titration, 10 week maintenance
- Outcomes:
  - Primary: CRS measuring muscle stiffness from baseline
  - Secondary: CRS assessing: body pain, spasms, sleep quality

Multiple sclerosis and extract of cannabis: results of the MUSEC trial by Zajicek et al, *JNNP* 2012.

Table 2 Baseline characteristics—full analysis set

Parameter	Cannabis extract (N = 143)	Placebo (N = 134)
Time since first diagnosis of MS		
Mean±SD (years)	14.5±9.5	15.1±8.4
Median (range) (years)	13.0 (0–40)	14.0 (2–34)
Form of MS		
Relapsing–remitting (n (%))	13 (9.1)	8 (6.0)
Primary progressive (n (%))	34 (23.8)	32 (23.9)
Secondary progressive (n (%))	96 (67.1)	94 (70.1)
Ambulatory status at screening		
Non-walking (n (%))	31 (21.7)	32 (23.9)
Walking (n (%))	112 (78.3)	102 (76.1)
Baseline status of body pain		
Low* (n (%))	49 (34.3)	54 (40.3)
High† (n (%))	94 (65.7)	80 (59.7)
Baseline status of muscle spasms		
Low* (n (%))	27 (18.9)	33 (24.6)
High† (n (%))	116 (81.1)	101 (75.4)
Baseline status of quality of sleep		
Low* (n (%))	47 (32.9)	54 (40.3)
High† (n (%))	96 (67.1)	80 (59.7)
Use of spasticity medication		
Yes (n (%))	85 (59.4)	85 (63.4)
No (n (%))	58 (40.6)	49 (36.6)
Use of analgesic medication		
Yes (n (%))	83 (58.0)	76 (56.7)
No (n (%))	60 (42.0)	58 (43.3)

*Categories 0–4 in the rating scale of the amount of the respective symptom at baseline.
†Categories 5–10 in the rating scale of the amount of the respective symptom at baseline.
%, percentage based on N; MS, multiple sclerosis; n, number of patients in specified category; N, number of patients in specified treatment group.

Multiple sclerosis and extract of cannabis: results of the MUSEC trial by Zajicek et al, *JNNP* 2012.

Results

- The rate of relief from muscle stiffness after 12 weeks was almost twice as high with OCE than with placebo
  - (29.4% vs 15.7%; OR 2.26; 95% CI 1.24 to 4.13; p = 0.004, one sided).
- Similar results were found after 4 weeks and 8 weeks, and also for all further CRSs.
- Results from the MS scales supported these findings.

Multiple sclerosis and extract of cannabis: results of the MUSEC trial by Zajicek et al, *JNNP* 2012.

Table 4 Category rating scales for amount of symptoms at weeks 4, 8 and 12

	Week 4		Week 8		Week 12	
Questionnaire	Cannabis extract $\bar{x}\pm SD$	Placebo $\bar{x}\pm SD$	Cannabis extract $\bar{x}\pm SD$	Placebo $\bar{x}\pm SD$	Cannabis extract $\bar{x}\pm SD$	Placebo $\bar{x}\pm SD$
CRS*						
Muscle stiffness	5.3±2.2	6.1±2.3	5.3±2.3	6.2±2.6	5.4±2.6	6.4±2.6
Body pain	3.9±2.6	4.5±3.0	4.1±2.8	4.6±3.2	4.1±2.9	4.7±3.0
Muscle spasms	4.5±2.6	6.1±2.7	4.6±2.5	5.1±2.8	4.7±2.7	5.4±2.8
Sleep quality	3.6±2.6	4.5±3.0	3.8±2.7	4.3±2.9	3.8±2.9	4.3±3.0
MSSS-88†						
Muscle stiffness	30.3±8.3	32.9±9.0	–	–	31.8±9.6	34.2±9.2
Pain/discomfort	21.0±7.0	21.7±7.5	–	–	21.7±7.6	22.5±7.6
Muscle spasms	27.9±10.2	28.8±11.1	–	–	29.1±11.0	30.5±12.1
Daily activities	30.1±9.3	31.0±9.1	–	–	31.4±10.1	31.4±9.4
Ability to walk	31.2±8.4	33.3±6.5	–	–	31.6±7.9	34.2±6.7
Body movement	29.3±9.2	30.1±8.8	–	–	30.0±10.0	31.2±9.0
Feelings	29.4±12.0	29.6±11.9	–	–	30.9±11.9	30.7±12.2
Social functioning	17.0±7.41	17.4±6.8	–	–	18.1±7.6	17.6±7.2
MSIS-29†						
Physical impact	58.1±24.1	59.8±22.7	–	–	58.6±25.7	62.4±22.7
Psychological impact	38.7±25.7	38.5±26.6	–	–	42.0±27.5	40.4±24.4
MSWS-12‡						
Total score	81.9±22.6	87.6±15.5	–	–	78.7±26.2	89.6±14.6

*Assessed by an 11 point numerical Likert scale (0=no symptom expression, …, 10=extreme symptom expression).
†Possible answers: 1, not at all bothered/limited; 2, a little bothered/limited; 3, moderately bothered/limited; 4, extremely bothered/limited.
‡Possible answers: 1, not at all; 2, a little; 3, moderately; 4, quite a bit; 5, extremely.
CRS, category rating scale; MSIS-29, Multiple Sclerosis Impact Scale; MSSS-88, Multiple Sclerosis Spasticity Scale; MSWS-12, Multiple Sclerosis Walking Scale; N, number of patients in specified group; $\bar{x}$, mean symptom score.

Multiple sclerosis and extract of cannabis: results of the MUSEC trial by Zajicek et al, *JNNP* 2012.

Conclusion

- The study met its primary objective to demonstrate the superiority of CE over placebo in the treatment of muscle stiffness in MS.
- This was supported by results for secondary efficacy variables.
- Adverse events in participants treated with CE were consistent with the known side effects of cannabinoids.
  - These were observed primarily in weeks 1-2, during the rapid uptitration (this is atypical in many contexts)
  - No new safety concerns were observed.
- ? Hospitalizations for relapses

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Current Literature Review

Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders

Report of the Guideline Development Subcommittee of the American Academy of Neurology

Barbara S. Koppel, John C.M. Brust, Terry Fife, Jeff Bronstein, Sarah Youssof, Gary Gronseth, David Gloss, MD.

Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders by Barbara S. Koppel, et al. *Neurology* 2014.

Objective

- To determine the efficacy of medical marijuana in several neurologic conditions.

Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders by Barbara S. Koppel, et al. *Neurology* 2014.

Methods

- Systematic review of medical marijuana
- Medline, EMBASE, PsycINFO, Web of Science, and Scopus (1948–November 2013)
- To address treatment of symptoms of MS, epilepsy, and movement disorders.
- Studies graded according to the AAN classification scheme for therapeutic articles.

Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders by Barbara S. Koppel, et al. *Neurology* 2014.

Results

- Thirty-four studies met inclusion criteria; 8 were rated as Class I.

Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders by Barbara S. Koppel, et al. *Neurology* 2014.

Table 1 Cannabinoid formulations

Generic name	Trade name	Manufacturer	Dosage and components	Study and dosage used of this formulation
Oral administration				
Cannabis extract	Cannador	IKF, Berlin, Germany	Ratio of Δ^9-THC 2.5 mg: CBD 1.25 mg	Mean 0.146 mg/kg/d up to maximum of 1.25 mg/kg/d (Carroll 2004[36]); mean 1.25 mg/kg/d up to maximum of 25 mg/d; maximum varied by weight (Zajicek 2003[7])
Cannabis extract	None	Not stated	Ratio of Δ^9-THC 2.5 mg: CBD 0.9 mg	Mean 0.146 mg/kg/d up to maximum of 0.25 mg/kg/d (Vaney 2004[5])
Cannabis extract	None	NIH, Bethesda, MD	1.00 mg CBD	100–300 mg/d (Cunha 1980[41])
Cannabis extract	None	NIH, Bethesda, MD	1.00 mg CBD	10 mg/kg/d (Consroe 1991,[38] Curtis 2009[31])
Dronabinol	Marinol	Solvay Pharmaceuticals, Marietta, GA	2.5 mg Δ^9-THC	Maximum of 10 mg/d (Svendsen 2004,[25] Müller-Vahl 2003[40]); maximum of 25 mg/d (Freeman 2006,[28] Zajicek 2003[7])
Nabilone	Cesamet	Meda Pharmaceuticals, Somerset, NJ	1.00 mg CBD	1.00 mg (Curtis 2009[31]); 0.03 mg/kg (Fox 2002[29])
Oromucosal spray administration				
Nabiximols	Sativex	GW Pharmaceuticals, PLC, London, UK	Ratio of Δ^9-THC 2.7 mg: CBD 2.5 mg/spray	Mean 7.19 mg/d (Kavia 2010[26])
Nabiximols	Sativex	GW Pharmaceuticals, PLC, London, UK	Ratio of Δ^9-THC 2.7 mg: CBD 2.5 mg/spray	Dosage varied by study; maximum 65 mg/d (Collin 2010[10]); maximum 120 mg/d (Wade 2004[8])
Smoked (inhaled) marijuana				
Marijuana	None	Source not stated	4% THC	4 puffs (hits)/d (Corey-Bloom 2012[14]); 3.5% THC (Abrams 2007[42]); 3.5%–7% (Wilsey 2008[43]); 1%–9% THC (Ellis 2009[44]); 0%–9.4% (Ware 2010[45])

Abbreviations: CBD = cannabidiol, a major less-psychoactive resin extract constituent of the plant *Cannabis sativa L.* (marijuana); THC = Δ-9-tetrahydrocannabinol, the principal psychoactive agent.

Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders by Barbara S. Koppel, et al. *Neurology* 2014.

Conclusions

- The following were studied in patients with MS:
  1. Spasticity: oral cannabis extract (OCE) is effective, and nabiximols and tetrahydrocannabinol (THC) are probably effective, for reducing patient-centered measures; it is possible both OCE and THC are effective for reducing both patient-centered and objective measures at 1 year.
  2. Central pain or painful spasms (including spasticity-related pain, excluding neuropathic pain): OCE is effective; THC and nabiximols are probably effective.
  3. Urinary dysfunction: nabiximols is probably effective for reducing bladder voids/day; THC and OCE are probably ineffective for reducing bladder complaints.
  4. Tremor: THC and OCE are probably ineffective; nabiximols is possibly ineffective.

Systematic review: Efficacy and safety of medical marijuana in selected neurologic disorders by Barbara S. Koppel, et al. *Neurology* 2014.

Conclusions

- Other neurologic conditions: OCE is probably ineffective for treating levodopa-induced dyskinesias in patients with Parkinson disease. Oral cannabinoids are of unknown efficacy in non–chorea-related symptoms of Huntington disease, Tourette syndrome, cervical dystonia, and epilepsy.
- The risks and benefits of medical marijuana should be weighed carefully. Risk of serious adverse psychopathologic effects was nearly 1%.
- Comparative effectiveness of medical marijuana vs. other therapies is unknown for these indications.

Use of Marijuana for the Treatment of Multiple Sclerosis
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Current Literature Review

Effects of Cannabis on Cognition in Patients with MS

A psychometric and MRI study

Bennis Pavisian, Bradley J. MacIntosh, Greg Szilagyi, Richard W. Staines, Paul O'Connor, Anthony Feinstein. *Neurology* 2014.

Effects of Cannabis on Cognition in Patients with MS: A psychometric and MRI study by Bennis Pavisian, Bradley J. MacIntosh, et al. *Neurology* 2014.

Objective

- To determine functional and structural neuroimaging correlates of cognitive dysfunction associated with cannabis use in multiple sclerosis (MS).

Effects of Cannabis on Cognition in Patients with MS: A psychometric and MRI study by Bennis Pavisian, Bradley J. MacIntosh, et al. *Neurology* 2014.

Methods

- Cross-sectional
- 20 subjects with MS who smoked cannabis and 19 noncannabis users with MS, matched on demographic and neurologic variables
- Testing:
  - Primary measure: fMRI while the N-Back (test of working memory)
  - Resting-state fMRI and structural MRI data (lesion and normal-appearing brain tissue volumes, diffusion tensor imaging metrics)
  - Psychometric: verbal (Selective Reminding Test Revised) and visual (10/36 Spatial Recall Test) memory, information processing speed (Paced Auditory Serial Addition Test [2- and 3-second versions] and Symbol Digit Modalities Test), and attention (Word List Generation)

Effects of Cannabis on Cognition in Patients with MS: A psychometric and MRI study by Bennis Pavisian, Bradley J. MacIntosh, et al. *Neurology* 2014.

Table 1 Demographic and disease characteristics of MS cannabis and MS noncannabis groups

Sample characteristics	MS cannabis (n = 20)	MS noncannabis (n = 19)	t Test/χ^2	p
Age, y, mean (SD)	41.30 (11.28)	43.89 (9.085)	$t = -7.88$	0.44
Females, n (%)	6 (30.0)	6 (31.6)	$\chi^2 = 0.011$	0.92
Years of education, mean (SD)	14.3 (1.8)	15.2 (2.0)	$t = -1.5$	0.14
EDSS score, mean (SD); median (range)	2.83 (2.2); 3.0 (0–8.0)	2.47 (1.52); 2.0 (0–8.5)	$t = -0.62$	0.54
Currently employed, n (%)	10 (50.0)	10 (52.6)	$\chi^2 = 0.27$	0.87
Disease-modifying drugs, n (%)	7 (35.0)	9 (47.4)	$\chi^2 = 0.62$	0.43
Disease course, n				
RRMS	16	17	$\chi^2 = 0.67$	0.88
PPMS	2	1		
SPMS	2	1		
Disease duration, y, mean (SD)	9.5 (7.24)	9.9 (9.6)	$t = -0.79$	0.44
Urine concentration of cannabis metabolite, μg/L, mean (SD)	246 (90.0)	0	—	—

Abbreviations: EDSS = Expanded Disability Status Scale; MS = multiple sclerosis; PPMS = primary progressive MS; RRMS = relapsing-remitting MS; SPMS = secondary progressive MS.

Effects of Cannabis on Cognition in Patients with MS: A psychometric and MRI study by Bennis Pavisian, Bradley J. MacIntosh, et al. *Neurology* 2014.

Results

- fMRI: Cannabis users had more diffuse cerebral activation across all N-Back trials and made more errors on the 2-Back task (p = 0.006), during which they displayed increased activation relative to nonusers in parietal (p = 0.007) and anterior cingulate (p = 0.001) regions implicated in working memory.
- No group differences in resting-state networks or structural MRI variables were found.
- Psychometric: Cannabis users performed more poorly on the more demanding of the Paced Auditory Serial Addition Test tasks (i.e., 2-second version) (p = 0.02) and the 10/36 Spatial Recall Test (p = 0.03).

Effects of Cannabis on Cognition in Patients with MS: A psychometric and MRI study by Bennis Pavisian, Bradley J. MacIntosh, et al. *Neurology* 2014.

Figure 1 Within-group activation maps for the cannabis and noncannabis groups

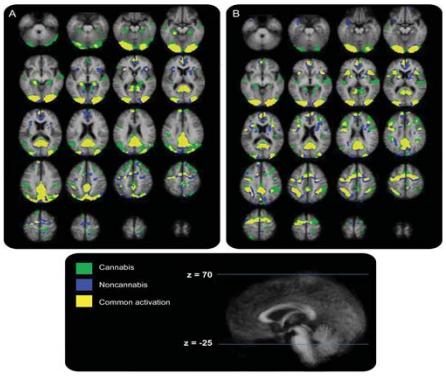
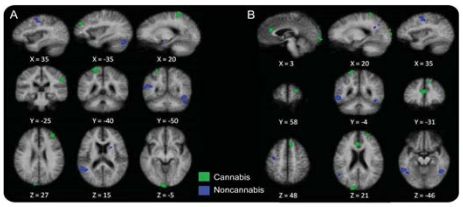


Figure 2 Between-group activation maps for the cannabis and noncannabis groups



Effects of Cannabis on Cognition in Patients with MS: A psychometric and MRI study by Bennis Pavisian, Bradley J. MacIntosh, et al. *Neurology* 2014.

Conclusions

- Patients with MS who smoke cannabis are more cognitively impaired than nonusers.
- Cannabis further compromises cerebral compensatory mechanisms, already faulty in MS.
- These imaging data boost the construct validity of the neuropsychological findings and act as a cautionary note to cannabis users and prescribers.

SUMMARY

- Symptomatic therapy for MS:
  - Spasticity and pain in more advanced MS
  - Side effects: cognition
- MS is a chronic disease. At different stages, different risks and benefits
- Comparative effectiveness and side effects relative to other symptomatic therapies: unknown
- No data on disease modifying effects

Faculty and Planner Disclosures

The following CME faculty and program planners have indicated their financial interests and/or relationships with commercial manufacturer(s) (and/or those of their spouse/partner) below. The Department of Continuing Education and Certification (DCEC) of the Massachusetts Medical Society has reviewed the appropriate documentation provided by the individuals who are in a position to control the content of this educational activity. The DCEC has determined that any potential relevant conflict of interest has been resolved. For more information, contact the DCEC at continuingeducation@mms.org.

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Use of Marijuana for the Treatment of Multiple Sclerosis
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Current Literature Review

Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade

Tibor M. Brunt, Marianne van Genugten, Kathrin Ho¨ner-Snoeken, Marco J. van de Velde, and Raymond J.M. Niesink. *J Clin Psychopharmacol* 2014.

Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade by Tibor M. Brunt, et al. *J Clin Psychopharmacol* 2014.

Objective

- The aims of this study are to assess the therapeutic satisfaction within a group of patients using prescribed pharmaceutical-grade cannabis and to compare the subjective effects among the available strains with special focus on their delta-9-THC and cannabidiol content.

Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade by Tibor M. Brunt, et al. *J Clin Psychopharmacol* 2014.

Methods

- In a cross-sectional and natural design, users of pharmaceutical-grade cannabis were investigated with questionnaires.
- Medical background of the patients was asked as well as experienced therapeutic effects and characteristics of cannabis use.
- Subjective effects were measured with psychometric scales and used to compare among the strains of cannabis used across this group of patients.
- One hundred two patients were included; their average age was 53 years and 76% used it for more than a year preceding this study.

Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade by Tibor M. Brunt, et al. *J Clin Psychopharmacol* 2014.

Results

- Chronic pain (53%; n = 54) was the most common medical indication for using cannabis followed by MS (23%; n = 23), and 86% (n = 88) of patients (almost) always experienced therapeutic satisfaction when using pharmaceutical cannabis.
- Dejection, anxiety, and appetite stimulation were found to differ among the 3 strains of cannabis.
- Patients reported therapeutic satisfaction with pharmaceutical cannabis, mainly pain alleviation.

Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade by Tibor M. Brunt, et al. *J Clin Psychopharmacol* 2014.

TABLE 1 Patient Characteristics (n = 102)

Characteristic	n	%
Age	52.8*	(24-81)*
Sex		
Male	50	(49.0)
Female	52	(51.0)
Strain pharmaceutical cannabis		
Bedrocan (THC high)	48	(47.1)
Bedrobinol (THC medium)	29	(28.4)
Bediol (THC low)	25	(24.5)
Medical indication		
MS	23	(22.5)
Chronic pain	54	(52.9)
Nausea	6	(5.9)
Cancer	11	(10.8)
Psychologic problems	8	(7.8)
Therapeutic effect†		
Pain alleviation	89	(87.3)
Sleep improvement	47	(46.1)
Spasm alleviation	43	(42.2)
Mood improvement	15	(14.7)
Stress alleviation	10	(9.8)

*Age is given in average and range, respectively.
†Two answer categories were required.

TABLE 2 Therapeutic Satisfaction of Pharmaceutical Cannabis Reported by the Patients

	Frequency of Therapeutic Effect			
Fulfillment of Therapeutic Effect	Always	Usually	Sometimes	Never
Always	27	11	—	—
Usually	30	20	2	—
Sometimes	4	3	1	—
Never	2	2	2	—

Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade by Tibor M. Brunt, et al. *J Clin Psychopharmacol* 2014.

FIGURE 1. Average dose of the 3 strains of pharmaceutical cannabis used per occasion and throughout the day

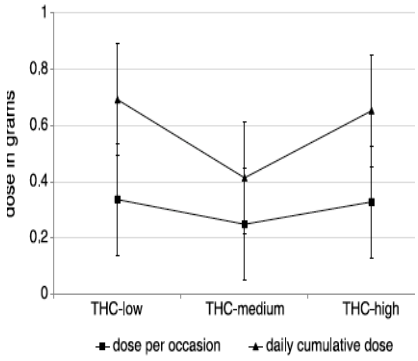
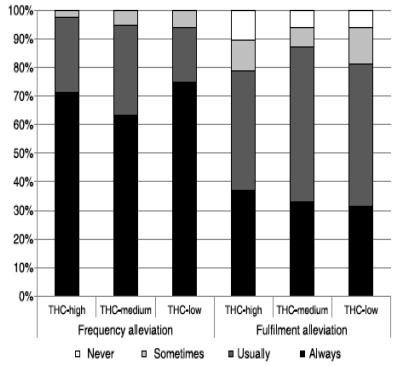
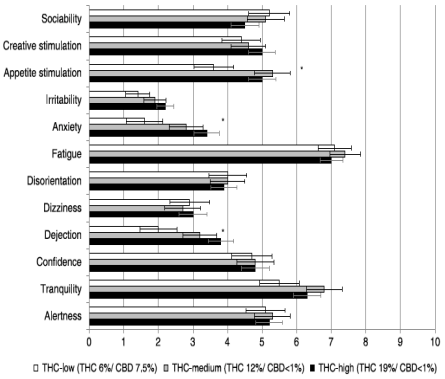


FIGURE 2. Frequency and fulfillment of alleviation of symptoms (therapeutic satisfaction) as reported by the study population, expressed per pharmaceutical strain of cannabis.



Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade by Tibor M. Brunt, et al. *J Clin Psychopharmacol* 2014.

FIGURE 3. Mean VAS scores for 12 subjective effects of medicinal cannabis across the 3 cannabis strains. *Significant differences among the variants as determined with post hoc Bonferroni multiple comparisons.



Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade by Tibor M. Brunt, et al. *J Clin Psychopharmacol* 2014.

Conclusion

- Some subjective effects were found to differ among the available strains of cannabis, which is discussed in relation to their different tetrahydrocannabinol/cannabidiol content.
- These results may aid in further research and critical appraisal for medicinally prescribed cannabis products.
- It also contributes to a growing insight into the various effects of cannabinoids in general.