

# Living Systematic Review on Cannabis and Other Plant-Based Treatments for Chronic Pain – Quarterly Progress Report: May 2021

## Overview

This is the third quarterly progress report for an ongoing living systematic review on cannabis and other plant-based treatments for chronic pain. The first progress report was published in January 2021 and the second in March 2021. The draft systematic review was available for public comment from May 19 through June 15, 2021, on the Agency for Healthcare Research and Quality (AHRQ) Effective Health Care website. The systematic review synthesizes evidence on the benefits and harms of plant-based compounds (PBCs), such as cannabinoids and kratom, used to treat chronic pain, addressing concerns about severe adverse effects, abuse, misuse, dependence, and addiction.

The purpose of this progress report is to describe the cumulative literature identified thus far. This report will be periodically updated with new studies as they are published and identified, culminating in an annual systematic review that provides a synthesis of the accumulated evidence.

## Main Points

In patients with chronic (mainly neuropathic) pain with short-term treatment (4 weeks to <6 months):

- Studies of cannabis-related products were grouped based on their tetrahydrocannabinol (THC) to cannabidiol (CBD) ratio using the following categories: high THC to CBD, comparable THC to CBD, and low THC to CBD.
- Comparable THC to CBD ratio oral spray is probably associated with small improvements in pain severity and may be associated with small improvements in function. There was no effect in pain interference or serious adverse events. There may be a large increased risk of dizziness and sedation, and a moderate increased risk of nausea.
- Synthetic THC (high THC to CBD) may be associated with moderate improvement in pain severity and increased risk of sedation, and large increased risk of nausea. Synthetic THC is probably associated with a large increased risk of dizziness.
- Extracted whole-plant high THC to CBD ratio products may be associated with large increases in risk of withdrawal due to adverse events and dizziness.
- Evidence on whole-plant cannabis, low THC to CBD ratio products (topical CBD), other cannabinoids (cannabidivarin), and comparisons with other active interventions was insufficient to draw conclusions.
- Other key adverse event outcomes (psychosis, cannabis use disorder, cognitive deficits) and outcomes on the impact on opioid use were not reported.

- No evidence on other plant-based compounds, such as kratom, met criteria for this review.

## Summary Tables

The Key Questions (KQs) for this review focus on the benefits (KQ1) and harms (KQ2) of cannabinoids for treating chronic pain, as well as the benefits (KQ3) and harms (KQ4) of other PBCs, such as kratom, for treating chronic pain. Tables 1 and 2 summarize benefits and harms of cannabinoids. No evidence was available for other PBCs.

**Table 1. Key Question 1: Benefits of cannabinoids for chronic pain compared with placebo in the short term (4 weeks to <6 months)**

THC to CBD Ratio	Pain Response Effect Size (N Studies) SOE	Pain Severity Effect Size (N Studies) SOE	Pain Interference Effect Size (N Studies) SOE	Function Effect Size (N Studies) SOE
Comparable THC/CBD Oromucosal Spray	Potential effect (4) <sup>a</sup> +	Small effect (7) ++	No effect (2) +	Small effect (2) +
High THC – Synthetic, Oral	Insufficient (1)	Moderate effect (5) +	Insufficient (1)	Insufficient (1)
High THC – Extracted From Whole Plant, Oral	No evidence	Insufficient (2)	No evidence	Insufficient (1)
Low THC – Topical CBD	No evidence	Insufficient (1)	No evidence	No evidence
Other Cannabinoids – CBDV, Oral	Insufficient (1)	Insufficient (1)	No evidence	No evidence
Whole-Plant Cannabis (12% THC) <sup>b</sup>	No evidence	Insufficient (1)	No evidence	No evidence

Abbreviations: CBD = cannabidiol; CBDV = cannabidivarin; SOE = strength of evidence; THC = tetrahydrocannabinol.

<sup>a</sup> Potential effect: SOE of low or higher; findings indicate at least a small magnitude of effect, but not statistically significant.

<sup>b</sup> Comparison was “usual care.”

Effect size: None (i.e., no effect/no statistically significant effect), small, moderate, or large increased benefit; SOE: + = low, ++ = moderate, +++ = high.

**Table 2. Key Question 2: Harms of cannabinoids for chronic pain compared with placebo in the short term (4 weeks to <6 months)**

THC to CBD Ratio	WAE Effect Size (N Studies) SOE	SAE Effect Size (N Studies) SOE	Dizziness Effect Size (N Studies) SOE	Nausea Effect Size (N Studies) SOE	Sedation Effect Size (N Studies) SOE
Comparable THC/CBD Oromucosal Spray	Insufficient (5)	No effect (2) +	Large effect (6) +	Moderate effect (6) +	Large effect (6) +
High THC – Synthetic, Oral	Potential effect <sup>a</sup> (4) +	Insufficient (1)	Large effect (2) ++	Potential effect <sup>a</sup> (2) +	Moderate effect (3) +
High THC – Extracted From Whole Plant, Oral	Large effect (1) +	Insufficient (1)	Large effect (1) +	No evidence	No evidence
Low THC – Topical CBD	No evidence	No evidence	No evidence	No evidence	No evidence
Other Cannabinoids – CBDV, Oral	Insufficient (1)	Insufficient (1)	No evidence	No evidence	No evidence
Whole-Plant Cannabis (12% THC) <sup>b</sup>	Insufficient (2)	Insufficient (2)	Insufficient (2)	Insufficient (2)	Insufficient (2)

Abbreviations: CBD = cannabidiol; CBDV = cannabidivarin; SAE = serious adverse event; SOE = strength of evidence; THC = tetrahydrocannabinol; WAE = withdrawal due to adverse event.

<sup>a</sup> Potential effect: SOE of low or higher; findings indicate at least a small magnitude of effect, but not statistically significant.

<sup>b</sup> Comparison was “usual care.”

Effect size: None (i.e., no effect/no statistically significant effect), small, moderate, or large increased risk; SOE: + = low, ++ = moderate, +++ = high.

## Background

Chronic pain is defined as pain lasting longer than 3 to 6 months or past normal time for tissue healing,<sup>1,2</sup> and it affects approximately 100 million people in the United States.<sup>3</sup> Chronic pain adversely affects physical and mental functioning, productivity, and quality of life, and is often refractory to treatment and associated with substantial costs.<sup>4-6</sup>

While opioids are often prescribed for chronic pain, a recent series of systematic reviews found that opioids,<sup>7</sup> several nonopioid drugs,<sup>8</sup> and some nonpharmacologic treatments<sup>9</sup> have small to moderate effects on pain and function, with some frequent adverse effects and some less frequent but serious ones. The 2016 Centers for Disease Control and Prevention *Guideline for Prescribing Opioids for Chronic Pain* recommends that nonopioid therapy is preferred for treatment of chronic pain.<sup>1,2</sup> The limited efficacy of opioids and the ongoing opioid crisis drive a search for alternative pain treatments, including PBCs such as cannabis and related compounds, as some data suggest they may have analgesic properties.<sup>10</sup>

The term *cannabinoid* refers to a group of closely related compounds that are active in cannabis, with the two main cannabinoid compounds being THC and CBD. THC has demonstrated analgesic properties,<sup>11,12</sup> although its psychoactive effects and abuse potential may limit its suitability as an analgesic. CBD and other cannabinoids may also have some analgesic or anti-inflammatory properties and are not thought to be psychoactive or addictive.<sup>13,14</sup> While not derived from plants, two synthetic THC drug products, dronabinol and nabilone, are approved for use in the United States by the Food and Drug Administration. Their approvals are not for treating pain, but for treating nausea and vomiting associated with chemotherapy and for anorexia associated with HIV. However, because they contain THC, they have also been studied for treating chronic pain. Other PBCs with effects similar to opioids or cannabis, such as kratom, may be explored by patients to treat chronic pain but may also have serious harms, such as dependence, addiction, withdrawal potential, and developmental impacts in adolescents.

Four KQs guide the review:

**KQ1:** In adults with chronic pain, what are the benefits of cannabinoids for treatment of chronic pain?

**KQ2:** In adults with chronic pain, what are the harms of cannabinoids for treatment of chronic pain?

**KQ3:** In adults with chronic pain, what are the benefits of kratom or other plant-based substances for treatment of chronic pain?

**KQ4:** In adults with chronic pain, what are the harms of kratom or other plant-based substances for treatment of chronic pain?

The protocol for the systematic review can be found on the AHRQ website (<https://effectivehealthcare.ahrq.gov/topics/nonopioid-chronic-pain/protocol>) and on the PROSPERO systematic reviews registry (registration number CRD42021229579).

## Methods

This report includes all studies included cumulatively in this living systematic review, including studies from prior quarterly progress reports and the full draft Evidence Report,<sup>15,16</sup> and additional studies identified in our searches for this third quarterly progress report.

In brief, we searched Ovid<sup>®</sup> MEDLINE<sup>®</sup>, PsycINFO<sup>®</sup>, Embase<sup>®</sup>, the Cochrane Library, and SCOPUS<sup>®</sup> databases monthly through April 23, 2021, for studies of patients with chronic pain for at least 4 weeks of treatment or followup. We selected studies of cannabis, kratom, and similar PBCs compared with a placebo, no treatment, each other, or another treatment. Pain is the primary outcome for this review; details on the search strategies are in Appendix A. The full inclusion and exclusion criteria for all primary and secondary outcomes for this report are in Appendix B.

We followed the methods guidance in the AHRQ Methods Guide,<sup>17</sup> and we abstracted key information and conducted risk-of-bias assessments for each included study. Our methods include categorizing the duration of studies as short-, intermediate-, and long-term. Studies that assessed the cannabinoids, THC and/or CBD, were grouped based on their THC to CBD ratios and categorized as high THC to CBD ratio, comparable THC to CBD ratio, and low THC to CBD ratio (Table 3). We also grouped studies by whether the product was a whole-plant product (cannabis), cannabinoids extracted or purified from a whole plant, or synthetic. We conducted meta-analyses using the profile likelihood random effects model and assessed between-study heterogeneity using Cochran's Q statistic chi square and the I<sup>2</sup> test for inconsistency. Magnitude of benefit was categorized into no effect or small, moderate, and large effects. (See Appendix B, Table B-2.)

**Table 3. Organizing principle of cannabis-related studies based on ratios of THC to CBD**

Intervention Category	Definition	Possible Derivatives
High THC	THC to CBD ratio equals $\geq 2:1$ ratio	Synthetic, extracted or purified from whole plant, whole-plant
Low THC	THC to CBD ratio equals $1:\geq 2$ ratio	Extracted or purified from whole plant, whole-plant
Comparable THC to CBD	THC to CBD ratio is between threshold for high THC and low THC categories	Extracted or purified from whole plant, whole-plant
Whole-Plant Cannabis Products	Potentially unknown THC to CBD ratio; categorized based on information provided	Whole-plant, not extracted, purified, or synthetic
Other Cannabinoids	Interventions testing cannabinoids other than THC and/or CBD	Extracted or purified from whole plant

Abbreviations: CBD = cannabidiol; THC = tetrahydrocannabinol.

A more detailed discussion of methods can be found in the protocol and in Appendix B.

## Results to Date

### Results Overview

Across the monthly literature searches, 2,742 citations were screened, from which we included 24 studies,<sup>18-41</sup> one of which is new to this progress report.<sup>41</sup> Appendix C contains a list of all 24 included studies, and a literature flow diagram can be found in Appendix D. Appendix E contains summary tables of individual study data for all included studies and the results of synthesis (i.e., forest plots). Appendix F contains detailed evidence tables of included studies,

and Appendix G contains risk-of-bias assessments. Appendix H contains details on strength-of-evidence ratings. A list of studies excluded after reviewing the full manuscripts can be found in Appendix I along with reasons for their exclusion.

## Description of the Evidence

### Overview

In this progress report, one observational study was added,<sup>41</sup> comparing 37 patients who were treating chronic pain using medical cannabis with 9 usual-care patients.

In total, seven randomized controlled trials (RCTs) evaluated products that contain a combination of THC and CBD (comparable THC to CBD ratio).<sup>19,24-26,29,31,32</sup> Two RCTs evaluated the effects of high THC to CBD ratio, whole-plant derived extracts.<sup>20,40</sup> Nine RCTs evaluated synthetic forms of THC (high THC to CBD ratio).<sup>21,23,27,28,30,33-35,38</sup> One trial assessed the effect of topical CBD (low THC to CBD ratio),<sup>39</sup> and another evaluated the phytocannabinoid cannabidiol (CBDV). The findings are applicable to *short-term* treatment (1 to <6 months) in patients with chronic pain (mainly neuropathic pain) compared with placebo. Change in pain severity was reported across all studies, but other pain-related and functional outcomes were reported sporadically.

Four observational studies were included, two allowing use of any medicinal cannabis product,<sup>36,41</sup> one assessing a whole-plant cannabis product with a known content of 12.5 percent THC (CBD content not reported),<sup>37</sup> and one assessing the synthetic THC product nabilone.<sup>18</sup> The characteristics of the RCTs are listed in Table 4; observational study characteristics are in Table 5.

**Table 4. Characteristics of included randomized controlled trials**

Characteristic	THC/CBD	THC	Synthetic THC	CBD	CBDV
THC to CBD Ratio	Comparable	High	High	Low	NA - other cannabinoids
Source	Plant-extracted	Plant-extracted	Synthetic	Plant-extracted	Plant-extracted
N Studies	7	2	9	1	1
Risk of Bias % High, % Moderate, % Low	29%, 57%, 14%	0%, 50%, 50%	22%, 44%, 33%	100% high	100% moderate
Total Randomized	882	297	534	29	34
Age, Mean Years	53	52	50	68	50
Female, %	66%	89%	61%	38%	3%
% Non-White <sup>a</sup>	1.6% (2)	1% (1)	5.4% (3)	NA	NA
Primary Pain Type (n studies)	NPP (6)	NPP (1)	NPP (6)	NPP (1)	NPP (1)
Baseline Pain Score, Mean (Range) <sup>b</sup>	6.59 (5.3 to 7.3)	8.47 (8.25 to 8.67)	6.46 (4 to 8.1) <sup>c</sup>	5.38 (4.67 to 6.14)	6.28 (6.12 to 6.44)
Study Duration	4 to 15 weeks	8 to 12 weeks	4 to 47 weeks	4 weeks	4 weeks

Abbreviations: CBD = cannabidiol; CBDV = cannabidiol; NA = not applicable; NPP = neuropathic pain; THC = tetrahydrocannabinol.

<sup>a</sup> (n) = number of studies reporting this characteristic at baseline.

<sup>b</sup> Scores were standardized to a 0 to 10 scale.

<sup>c</sup> Weighted mean includes median scores for 1 study (6 vs. 6).

**Table 5. Characteristics of included observational studies**

Characteristic	THC/CBD <sup>a</sup>	THC	Synthetic THC
THC to CBD Ratio	Unclear	High	High
Source	Any medicinal cannabis product	Plant-based	Synthetic
N Studies	2	1	1
ROB % High, % Moderate, % Low	100% high	100% high	100% moderate
N Total	112	431	156
Age, Mean Years	55	49	61
Female, %	46%	57%	59%
Race, % Non-White	NR	NR	NR
Primary Pain Type(s)	Musculoskeletal	Chronic noncancer pain	NPP
Baseline Pain Score, Mean (Range) <sup>b</sup>	NR	6.35 (6.1 to 6.6)	4.98 (4.58 to 5.31)
Study Duration	12 to 21 weeks	52 weeks	26 weeks

Abbreviations: CBD = cannabidiol; NPP = neuropathic pain; NR = not reported; ROB = risk of bias; THC = tetrahydrocannabinol.

<sup>a</sup> Patients could choose any medicinal product they preferred in these studies.

<sup>b</sup> Scores were standardized to a 0 to 10 scale.

## KQs 1 and 2: Benefits and Harms of Cannabis

The findings for intervention effects and the strength of the evidence (SOE) are summarized in Tables 1 and 2. Comparable THC to CBD ratio oromucosal spray is probably associated with small improvements in pain severity (SOE: moderate) and may be associated with small improvements in functioning (SOE: low). Combined THC/CBD may also be associated with a moderate to large increased risk of dizziness, sedation, and nausea (SOE: low). Low SOE of no effect was found for pain interference (the degree to which pain directly interferes with patients' ability to participate in their daily activities) and serious adverse events. There was a small increase in the proportion of patients with at least 30-percent improvement in pain (pain response); while the SOE was low, the finding was not statistically significant due to inadequate sample size (imprecision). For secondary outcomes, sleep quality was improved in the treatment groups, and quality of life was not different between groups.

Synthetic oral THC (high THC to CBD ratio) may be associated with moderate improvement in pain severity (SOE: low). Synthetic THC treatments are probably associated with a large increase in risk of dizziness (SOE: moderate) and may be associated with a large increased risk of nausea and moderate increased risk of sedation (SOE: low). There was a moderate increase in the proportion of patients who withdrew due to adverse events; the SOE was low, but the finding was not statistically significant due to inadequate sample size (imprecision). For secondary outcomes, evidence for treatment with synthetic high THC to CBD ratio products was very limited, with no clear effect on quality of life or depression, inconsistent results for anxiety, and global disease improvement for patients with fibromyalgia.

Extracted whole-plant high THC to CBD ratio products may be associated with large increases in risk of study withdrawal due to adverse events and dizziness (SOE: low). For secondary outcomes, a single study found no difference between groups in depression or anxiety. Combining the evidence for all high THC to CBD ratio products resulted in a moderate improvement in pain severity, with a similarly low SOE.

Evidence on whole-plant cannabis (solely from observational studies), low THC to CBD ratio products (topical CBD), other cannabinoids (CBDV), and comparisons with other active interventions were insufficient to draw conclusions. The new high risk-of-bias observational study added in this progress report did not alter the findings<sup>41</sup> from the draft Evidence Report.

Similarly, evidence for other outcomes reported for comparable THC to CBD and high THC to CBD ratio products was insufficient. See Appendix H for details.

Other key adverse event outcomes (psychosis, cannabis use disorder, cognitive deficits) and outcomes on the impact on prescription opioid use were not reported.

### **KQs 3 and 4: Kratom and Other Plant-Based Compounds**

No evidence was identified.

## **Discussion**

Key limitations of the evidence base relate to the limited ability to provide strong, reliable estimates of effect due to: (1) inadequate sample sizes or numbers of studies; (2) narrowness of enrolled populations (see Tables 4 and 5); (3) lack of evidence or inadequate evidence on high THC to CBD products extracted from whole-plant cannabis, whole-plant cannabis products, low THC to CBD products (e.g., topical CBD), and other plant-based compounds, including kratom; and (4) inconsistent reporting of important outcomes such as pain response, function or disability, effect on opioid use, and longer term adverse events, such as cannabis use disorder, psychosis, and cognitive deficits. These limitations affect both the stability and applicability of the findings.

Only short-term evidence is available for cannabis-related interventions containing THC and/or CBD to treat primarily neuropathic chronic pain. Improvement in pain was small to moderate with THC/CBD oral spray, synthetic oral THC, and products extracted from whole cannabis plants with a high THC to CBD ratio. Compared with placebo, these interventions resulted in greater risk of common adverse events (dizziness, nausea, sedation) and withdrawals from studies due to adverse events. Evidence for other interventions, including kratom, was insufficient or not found. Additional studies are needed to improve confidence in these findings and to provide evidence on longer term followup, other outcomes, and other interventions.

## **Next Reports**

The final version of the systematic review of the evidence is scheduled to be available in August 2021. The next quarterly progress report is scheduled to be available in September 2021.

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# Disclaimers

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None of the investigators have any affiliations or financial involvement that conflicts with the material presented in this report.

The information in this report is intended to help healthcare decision makers—patients and clinicians, health system leaders, and policymakers, among others—make well-informed decisions and thereby improve the quality of health care services. This report is not intended to be a substitute for the application of clinical judgment. Anyone who makes decisions concerning the provision of clinical care should consider this report in the same way as any medical reference and in conjunction with all other pertinent information, i.e., in the context of available resources and circumstances presented by individual patients.

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# Afterword

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of systematic reviews to assist public- and private-sector organizations in their efforts to improve the quality of healthcare in the United States. These reviews provide comprehensive, science-based information on common, costly medical conditions, and new healthcare technologies and strategies.

Systematic reviews are the building blocks underlying evidence-based practice; they focus attention on the strength and limits of evidence from research studies about the effectiveness and safety of a clinical intervention. In the context of developing recommendations for practice, systematic reviews can help clarify whether assertions about the value of the intervention are based on strong evidence from clinical studies. For more information about AHRQ EPC systematic reviews, see <https://effectivehealthcare.ahrq.gov/about/epc/evidence-synthesis>.

These quarterly progress reports will provide up-to-date information about the evidence base to inform health plans, providers, purchasers, government programs, and the healthcare system as a whole on the state of the science. Transparency and stakeholder input are essential to the Effective Health Care Program. Please visit the website ([www.effectivehealthcare.ahrq.gov](http://www.effectivehealthcare.ahrq.gov)) to see draft research questions and reports or to join an email list to learn about new program products and opportunities for input.

If you have comments on this report, they may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 5600 Fishers Lane, Rockville, MD 20857, or by email to [epc@ahrq.hhs.gov](mailto:epc@ahrq.hhs.gov). They will be considered in the next version of the report.

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## Appendix A. Literature Search Strategies

### Database: Ovid MEDLINE(R) ALL 1946 to April 23, 2021

- 1 Chronic Pain/
- 2 exp arthralgia/ or exp back pain/ or exp headache/ or exp musculoskeletal pain/ or neck pain/ or exp neuralgia/ or exp nociceptive pain/ or pain, intractable/ or fibromyalgia/ or myalgia/
- 3 Pain/
- 4 chronic.ti,ab,kw.
- 5 3 and 4
- 6 ((chronic or persistent or intractable or refractory) adj3 pain).ti,ab,kw.
- 7 (((back or spine or spinal or leg or musculoskeletal or neuropathic or nociceptive or radicular) adj1 pain) or headache or arthritis or fibromyalgia or osteoarthritis).ti,ab,kw.
- 8 1 or 2 or 5 or 6 or 7
- 9 Cannabis/
- 10 exp Cannabinoids/
- 11 Medical Marijuana/
- 12 Mitragyna/
- 13 (cannabis or cannabinoid\* or cannabinal or marijuana or cannabidiol or phytocannabinoid\* or tetrahydrocannabinol or dronabinol or nabilone or sativex or "CBD" or "THC" or kratom or khat or qat or psilocybin or hemp or hydroxymitragynine).ti,ab,kf.
- 14 or/9-13
- 15 8 and 14
- 16 limit 15 to english language
- 17 (Animals/ or Models, Animal/ or Disease Models, Animal/) not Humans/
- 18 ((animal or animals or avian or bird or birds or bovine or canine or cow\* or dog or dogs or cat or cats or feline or hamster\* or horse\* or lamb or lamb\* or mouse or mice or monkey or monkeys or murine or pig or piglet\* or pigs or porcine or primate\* or rabbit\* or rat or rats or rodent\* or songbird\* or veterinar\*) not (human\* or patient\*)).ti,kf,jw.
- 19 or/17-18
- 20 16 not 19

### Database: EBM Reviews - Cochrane Central Register of Controlled Trials April, 2021

- 1 Chronic Pain/
- 2 exp arthralgia/ or exp back pain/ or exp headache/ or exp musculoskeletal pain/ or neck pain/ or exp neuralgia/ or exp nociceptive pain/ or pain, intractable/ or fibromyalgia/ or myalgia/
- 3 Pain/
- 4 chronic.ti,ab,kw.
- 5 3 and 4
- 6 ((chronic or persistent or intractable or refractory) adj3 pain).ti,ab,hw.
- 7 (((back or spine or spinal or leg or musculoskeletal or neuropathic or nociceptive or radicular) adj1 pain) or headache or arthritis or fibromyalgia or osteoarthritis).ti,ab,hw.
- 8 1 or 2 or 5 or 6 or 7
- 9 (cannabis or cannabinoid\* or cannabinal or marijuana or cannabidiol or phytocannabinoid\* or tetrahydrocannabinol or dronabinol or nabilone or sativex or "CBD" or "THC" or kratom or khat or qat or psilocybin or hemp or hydroxymitragynine).ti,ab,hw.
- 10 8 and 9
- 11 conference abstract.pt.

- 12 "journal: conference abstract".pt.
- 13 "journal: conference review".pt.
- 14 "http://.www.who.int/trialsearch\*".so.
- 15 "https://clinicaltrials.gov\*".so.
- 16 11 or 12 or 13 or 14 or 15
- 17 10 not 16

**Database: EBM Reviews - Cochrane Database of Systematic Reviews 2005 to April 1, 2021**

- 1 ((chronic or persistent or intractable or refractory) adj3 pain).ti,ab.
- 2 (((back or spine or spinal or leg or musculoskeletal or neuropathic or nociceptive or radicular) adj1 pain) or headache or arthritis or fibromyalgia or osteoarthritis).ti,ab.
- 3 (cannabis or cannabinoid\* or cannabiniol or marijuana or cannabidiol or phytocannabinoid\* or tetrahydrocannabinol or dronabinol or nabilone or sativex or "CBD" or "THC" or kratom or khat or qat or psilocybin or hemp or hydroxymitragynine).ti,ab.
- 4 (1 or 2) and 3

**Database: APA PsycInfo 1806 to April Week 2, 2021**

- 1 Chronic Pain/
- 2 exp arthralgia/ or exp back pain/ or exp headache/ or exp musculoskeletal pain/ or neck pain/ or exp neuralgia/ or exp nociceptive pain/ or pain, intractable/ or fibromyalgia/ or myalgia/
- 3 Pain/
- 4 chronic.ti,ab.
- 5 3 and 4
- 6 ((chronic or persistent or intractable or refractory) adj3 pain).ti,ab.
- 7 (((back or spine or spinal or leg or musculoskeletal or neuropathic or nociceptive or radicular) adj1 pain) or headache or arthritis or fibromyalgia or osteoarthritis).ti,ab.
- 8 1 or 2 or 5 or 6 or 7
- 9 Cannabis/
- 10 exp Cannabinoids/
- 11 (cannabis or cannabinoid\* or cannabiniol or marijuana or cannabidiol or phytocannabinoid\* or tetrahydrocannabinol or dronabinol or nabilone or sativex or "CBD" or "THC" or kratom or khat or qat or psilocybin or hemp or hydroxymitragynine).ti,ab.
- 12 or/9-11
- 13 8 and 12
- 14 limit 13 to english language

**Database: Elsevier Embase to April 26, 2021**

('cannabis'/exp OR cannabis OR cannabinoid\* OR 'cannabiniol'/exp OR cannabiniol OR 'marijuana'/exp OR marijuana OR 'cannabidiol'/exp OR cannabidiol OR phytocannabinoid\* OR 'tetrahydrocannabinol'/exp OR tetrahydrocannabinol OR 'dronabinol'/exp OR dronabinol OR 'nabilone'/exp OR nabilone OR 'sativex'/exp OR sativex OR 'cbd' OR 'thc' OR 'kratom'/exp OR kratom OR 'khat'/exp OR khat OR 'qat'/exp OR qat OR 'psilocybin'/exp OR psilocybin OR 'hemp'/exp OR hemp OR hydroxymitragynine) AND ('chronic pain'/exp OR arthralgia OR 'back pain' OR headache OR 'musculoskeletal pain' OR 'neck pain' OR neuralgia OR 'nociceptive pain' OR 'intractable pain' OR fibromyalgia OR myalgia OR arthritis OR osteoarthritis) AND [embase]/lim NOT ([embase]/lim AND [medline]/lim)

**Database: Elsevier Scopus to April 23, 2021**

( TITLE ( cannabis OR cannabinoid\* OR cannabinal OR marijuana OR cannabidiol OR phytocannabinoid\* OR tetrahydrocannabinol OR dronabinol OR nabilone OR sativex OR "CBD" OR "THC" OR kratom OR khat OR qat OR psilocybin OR hemp OR hydroxymitragynine ) ) AND ( TITLE ( "chronic pain" OR arthralgia OR "back pain" OR headache OR "musculoskeletal pain" OR "neck pain" OR neuralgia OR "nociceptive pain" OR "intractable pain" OR fibromyalgia OR myalgia OR arthritis OR osteoarthritis OR "neuropathic pain" ) )

# Appendix B. Methods

## Inclusion and Exclusion Criteria

Table B-1 outlines the inclusion and exclusion criteria related to populations, interventions, comparators, outcomes, timing, and settings (PICOTS), and study designs of interest for each Key Question (KQ):

**KQ1:** In adults with chronic pain, what are the benefits of cannabinoids for treatment of chronic pain?

**KQ2:** In adults with chronic pain, what are the harms of cannabinoids for treatment of chronic pain?

**KQ3:** In adults with chronic pain, what are the benefits of kratom or other plant-based substances for treatment of chronic pain?

**KQ4:** In adults with chronic pain, what are the harms of kratom or other plant-based substances for treatment of chronic pain?

**Table B-1. PICOTS**

PICOTS Element	Inclusion Criteria	Exclusion Criteria
Population	<b>All KQs:</b> Adults (including pregnant or breastfeeding women) 18 years and older with chronic pain (>12 weeks or pain persisting past the time for normal tissue healing). See categorization of specifically included pain populations below.	<b>All KQs:</b> Children and adolescents <18 years old; adults with acute or subacute pain; patients at end of life or in palliative care (e.g., with late stage cancer-related pain)
Interventions	<b>KQs 1 and 2:</b> Cannabinoids (including synthetics) using different delivery mechanisms such as oral, buccal, inhalational, topical, or other administration routes <b>KQs 3 and 4 :</b> Kratom or other plant-based substances; co-use of kratom or other plant-based substances and opioids <b>All KQs:</b> Co-use of other drugs for pain	<b>All KQs:</b> Non-plant-based interventions, capsaicin, herbal supplements
Comparators	<b>All KQs:</b> Any comparator or usual care	<b>All KQs:</b> No comparison
Outcomes	<b>All KQs:</b> Primary efficacy outcomes (i.e., pain, function, disability, pain interference); harms and adverse effects (e.g., dizziness, nausea, sedation, development of cannabis use disorder); secondary outcomes (i.e., psychological distress including depression and anxiety, quality of life, opioid use, sleep quality, sleep disturbance, health care utilization)	<b>All KQs:</b> Other outcomes
Time of followup	<b>All KQs:</b> short term (4 weeks to <6 months), intermediate term (6 to <12 months), long term (≥1 year)	<b>All KQs:</b> studies with <1-month (4 weeks) of treatment or followup after treatment
Setting	<b>All KQs:</b> Any nonhospital setting or setting of self-directed care	<b>All KQs:</b> Hospital care, hospice care, emergency department care
Study design	<b>All KQs:</b> RCTs; observational studies with a concurrent control group for harms, and to fill gaps in the evidence for benefits	<b>All KQs:</b> Other study designs

Abbreviations: KQ = Key Question; PICOTS = populations, interventions, comparators, outcomes, timing, and settings; RCT = randomized controlled trial.

Important subgroups to consider in evaluating this evidence are:

- Specific types of pain: neuropathic pain (including nociceptive and centralized; patients with multiple sclerosis and painful skin disorders are included in this category), musculoskeletal pain (including low-back pain), visceral pain, fibromyalgia, inflammatory arthritis, headache disorders, sickle cell disease, and cancer pain (non-end of life)
- Degree of nociplasticity/central sensitization
- Patient demographics (e.g., age, race, ethnicity, sex, socioeconomic status)
- Comorbidities, including past or current substance use disorders, mental health disorders, medical comorbidities, and high risk for opioid use disorder
- Plant-based compound characteristics: route of administration, frequency of administration, potency of product, dose or estimated dose, specific compounds (e.g., tetrahydrocannabinol, cannabidiol, terpenes, flavonoids), and specific formulations used
- Co-use of other interventions for pain: opioids, nonopioids (e.g., nonsteroidal anti-inflammatory drugs, acetaminophen, gabapentin, pregabalin)

Below are additional details on the scope of this project:

*Study Design:* For all Key Questions, we included randomized controlled trials (RCTs) of at least 4 weeks duration. Initially, in the base-year of this living systematic review, we included observational studies for both benefits (to address gaps in evidence where RCTs are not available) and harms. Eligible observational studies must have assessed a mean duration of treatment of at least 4 weeks, and have concurrent controls (e.g., cohort and case-control studies). Those controlling for potential confounders were prioritized. As the evidence grows, and more RCTs become available throughout the project, we will reassess the need to include observational studies, specifically to address benefits. A decision to discontinue including them will be made based on the strength of the RCT evidence. When the RCT evidence on a given Key Question and outcome is insufficient, we will include observational studies that meet inclusion criteria. When the strength of evidence is low, moderate, or high based on RCTs, we will update our protocol to exclude observational studies. We do not anticipate excluding observational studies assessing harms. For all Key Questions, we excluded uncontrolled observational studies, case series, and case reports. Systematic reviews were used to supplement searches and identify primary studies.

*Non-English Language Studies:* We restricted to English-language articles, but reviewed English-language abstracts of non-English-language articles to identify studies that would otherwise meet inclusion criteria in order to help assess for the likelihood of language bias.

## Data Extraction

After studies were selected for inclusion, data were abstracted into categories that included but are not limited to: study design, year, setting, country, sample size, eligibility criteria, population and clinical characteristics, intervention characteristics, and results relevant to each Key Question as outlined in the previous inclusion and exclusion criteria section. Information that was abstracted that was relevant for assessing applicability included the number of patients randomized relative to the number of patients enrolled, use of run-in or wash-out periods, and characteristics of the population, intervention, and care settings. All study data were verified for accuracy and completeness by a second team member. On a quarterly basis, any newly identified

studies were abstracted and evidence tables updated. Quarterly reports were published to the Agency for Healthcare Research and Quality (AHRQ) website, and evidence tables will be updated in AHRQ's Systematic Review Data Repository Plus (SRDR+).

## **Risk of Bias Assessment of Individual Studies**

Predefined criteria were used to assess the risk of bias of individual controlled trials, systematic reviews, and observational studies. RCTs were evaluated using criteria and methods developed by the Cochrane Back Review Group,<sup>1</sup> and cohort and case-control studies were evaluated using criteria developed by the U.S. Preventive Services Task Force.<sup>2</sup> These criteria and methods were used in accordance with the approach recommended in the chapter Assessing the Risk of Bias of Individual Studies When Comparing Medical Interventions in the Methods Guide for Effectiveness and Comparative Effectiveness Reviews developed by AHRQ.<sup>3</sup> Studies were given an overall rating of “low,” “medium,” or “high” risk of bias. We used DistillerSR<sup>®</sup> software to conduct these assessments, using dual review by two independent reviewers. Disagreements identified by DistillerSR<sup>®</sup> were resolved through consensus. Assessments and final ratings were converted to evidence tables, and will be uploaded on a quarterly basis to SRDR+.

## **Data Synthesis and Analysis**

We constructed evidence tables showing study characteristics (as discussed above), results, and risk of bias ratings for all included studies, and summary tables to highlight the main findings. Data were qualitatively summarized in tables, using ranges and descriptive analysis and interpretation of the results. Studies identified in prior AHRQ chronic pain reports<sup>4,5</sup> that meet inclusion criteria are included in this review. We evaluated the persistence of benefits or harms by evaluating the three periods identified in prior AHRQ pain reports (3 to 6 months, 6 to 12 months, and  $\geq 12$  months).<sup>4-8</sup>

Meta-analyses were conducted to summarize data and obtain more precise estimates on outcomes for which studies were homogeneous enough to provide a meaningful combined estimate.<sup>9</sup> The decision to conduct quantitative synthesis depends on presence of at least two studies, completeness of reported outcomes and a lack of heterogeneity among the reported results. To determine whether meta-analyses were indicated, we considered the risk of bias of the studies and the heterogeneity among studies in design, patient population, interventions, and outcomes. Meta-analyses were conducted using a random effects model, and statistical heterogeneity was assessed using the  $I^2$  method. Publication bias (small sample size bias) is assessed using funnel plots when there are eight or more studies in meta-analyses. To evaluate subgroup effects, we summarized within-study analyses of subgroup differences and performed study-level analyses on key demographic and clinical factors. Sensitivity analyses were conducted on study risk of bias.

The magnitude of effects for pain and function is classified using the same system used in other recent AHRQ Evidence-based Practice Center (EPC) reviews conducted on chronic pain<sup>4-8</sup> to provide a consistent benchmark for comparing results of pain interventions across reviews. Table B-2 provides thresholds for determining the magnitude of effect. A small effect is defined for pain as a mean between-group difference following treatment of 5 to 10 points on a 0- to 100-point visual analog scale (VAS), 0.5 to 1.0 points on a 0- to 10-point numeric rating scale, or equivalent; for function as a mean difference of 5 to 10 points on the 0- to 100-point Oswestry Disability Index (ODI) or 1 to 2 points on the 0- to 24-point Roland-Morris Disability

Questionnaire (RDQ), or equivalent; and for any outcome as a standardized mean difference (SMD) of 0.2 to 0.5. A moderate effect is defined for pain as a mean difference of 10 to 20 points on a 0- to 100-point VAS, for function as a mean difference of 10 to 20 points on the ODI or 2 to 5 points on the RDQ, and for any outcome as an SMD of 0.5 to 0.8. Large effects are defined as greater than moderate. We apply similar thresholds to other outcomes measures. Small effects using this system may be below published thresholds for clinically meaningful effects; however, there is variability across individual patients regarding what constitutes a clinically meaningful effect, which is influenced by a number of factors such as preferences, duration and type of chronic pain, baseline symptom severity, harms, and costs. For some patients a small improvement in pain or function using a treatment with low cost or no serious harms may be important.

**Table B-2. Definitions of effect sizes**

Effect Size	Definition
Small effect	<ul style="list-style-type: none"> <li>• MD 0.5 to 1.0 points on a 0 to 10-point scale, 5 to 10 points on a 0 to 100-point scale</li> <li>• SMD 0.2 to 0.5</li> <li>• RR/OR 1.2 to 1.4</li> </ul>
Moderate effect	<ul style="list-style-type: none"> <li>• MD &gt;1 to 2 points on a 0 to 10-point scale, &gt;10 to 20 points on a 0 to 100-point scale</li> <li>• SMD &gt;0.5 to 0.8</li> <li>• RR/OR 1.5 to 1.9</li> </ul>
Large effect	<ul style="list-style-type: none"> <li>• MD &gt;2 points on a 0 to 10-point scale, &gt;20 points on a 0 to 100-point scale</li> <li>• SMD &gt;0.8</li> <li>• RR/OR <math>\geq 2.0</math></li> </ul>

Abbreviations: MD = mean difference; OR = odds ratio; RR = relative risk; SMD = standardized mean difference.

Findings that were not statistically significant were interpreted as follows:

- In determining the strength of evidence (SOE), the precision of evidence was downgraded two levels if inadequate sample size (optimal information size) *and* the 95% confidence interval includes both potentially meaningful benefit and harm (e.g., for a relative effect, the lower bound is  $\leq 0.75$  *and* the upper bound is  $\geq 1.25$ ).<sup>10</sup>
- If the magnitude of effect is below the threshold for a small effect, the finding is considered to have “No effect.”<sup>4</sup>
- If the magnitude of effect is small or greater, and SOE is at least Low, the finding is considered to have a “Potential effect, not statistically significant.”
- If the magnitude of effect is small or greater, and SOE is insufficient, the finding is considered to have “failed to demonstrate or exclude a beneficial/detrimental effect.”<sup>11</sup>

## Grading the Strength of the Body of Evidence

We assessed the strength of evidence for all primary comparisons and outcomes listed in Table B-1. Regardless of whether evidence is synthesized quantitatively or qualitatively, the strength of evidence for each Key Question/body of evidence is initially assessed by one researcher for each clinical outcome by using the approach described in the AHRQ Methods Guide.<sup>3</sup> To ensure consistency and validity of the evaluation, the strength of evidence is reviewed by the entire team of investigators prior to assigning a final grade on the following factors:

- Study limitations (low, medium, or high level of study limitations)
- Consistency (consistent, inconsistent, or unknown/not applicable)
- Directness (direct or indirect)

- Precision (precise or imprecise)
- Reporting/publication bias (suspected or undetected)

The strength of evidence was assigned an overall grade of high, moderate, low, or insufficient according to a four-level scale by evaluating and weighing the combined results of the above domains:

- High—We are very confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has few or no deficiencies. We believe that the findings are stable, i.e., another study would not change the conclusions.
- Moderate—We are moderately confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has some deficiencies. We believe that the findings are likely to be stable, but some doubt remains.
- Low—We have limited confidence that the estimate of effect lies close to the true effect for this outcome. The body of evidence has major or numerous deficiencies (or both). We believe that additional evidence is needed before concluding either that the findings are stable or that the estimate of effect is close to the true effect.
- Insufficient—We have no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome. No evidence is available or the body of evidence has unacceptable deficiencies, precluding reaching a conclusion.

Plain-language statements are used in the Main Points and the Results to Date sections to convey the SOE. High SOE is described as "is associated with" or simply "reduces/increases;" moderate SOE is described as "probably;" and low SOE is described as "may be."<sup>12</sup>

## Peer Review and Public Commentary

Peer reviewers are invited to provide written comments on the annual draft report/systematic review based on their clinical, content, or methodological expertise. The EPC considers all peer review comments on the draft report in preparation of the final report. Peer reviewers do not participate in writing or editing of the final report or other products. The final report does not necessarily represent the views of individual reviewers. The EPC will complete a disposition of all peer review comments. The disposition of comments for systematic reviews and technical briefs will be published 3 months after the publication of the evidence report.

Potential Peer Reviewers must disclose any financial conflicts of interest greater than \$5,000 and any other relevant business or professional conflicts of interest. Invited Peer Reviewers may not have any financial conflict of interest greater than \$5,000. Peer reviewers who disclose potential business or professional conflicts of interest may submit comments on draft reports through the public comment mechanism.

## Assessing Applicability

Applicability is assessed in accordance with the AHRQ Methods Guide,<sup>13</sup> which is based on the PICOTS framework. Applicability addresses the extent to which outcomes associated with an intervention are likely to be similar across different patients and settings in clinical practice based on the populations, interventions, comparisons, and outcomes evaluated in the studies. For example, exclusion of chronic pain patients with psychiatric comorbidities reduces applicability to clinical practice since many patients with chronic pain have such comorbidities and may

respond more poorly to treatment. Similarly, trials that use active run-in periods evaluate highly selected populations who tolerated and responded well to the study intervention, rather than the general population of chronic pain patients being considered for the intervention. Factors that may affect applicability which we have identified a priori include eligibility criteria and patient factors (e.g., demographic characteristics, duration or severity of pain, underlying pain condition, presence of medical and psychiatric comorbidities, event rates and symptom severity in treatment and control groups), intervention factors (e.g., dose and duration of therapy, intensity and frequency of monitoring, level of adherence, use of co-interventions), comparisons (e.g., type and dosing of comparison), outcomes (e.g., use of unvalidated or nonstandardized outcomes, measurement of short-term or surrogate outcomes), settings (e.g., primary care vs. specialty setting, country), and study design features (e.g., use of run-in periods) relevant to applicability. We use this information to assess the situations in which the evidence is most relevant and to evaluate applicability to real-world clinical practice in typical U.S. settings, summarizing applicability assessments qualitatively.

## Appendix B References

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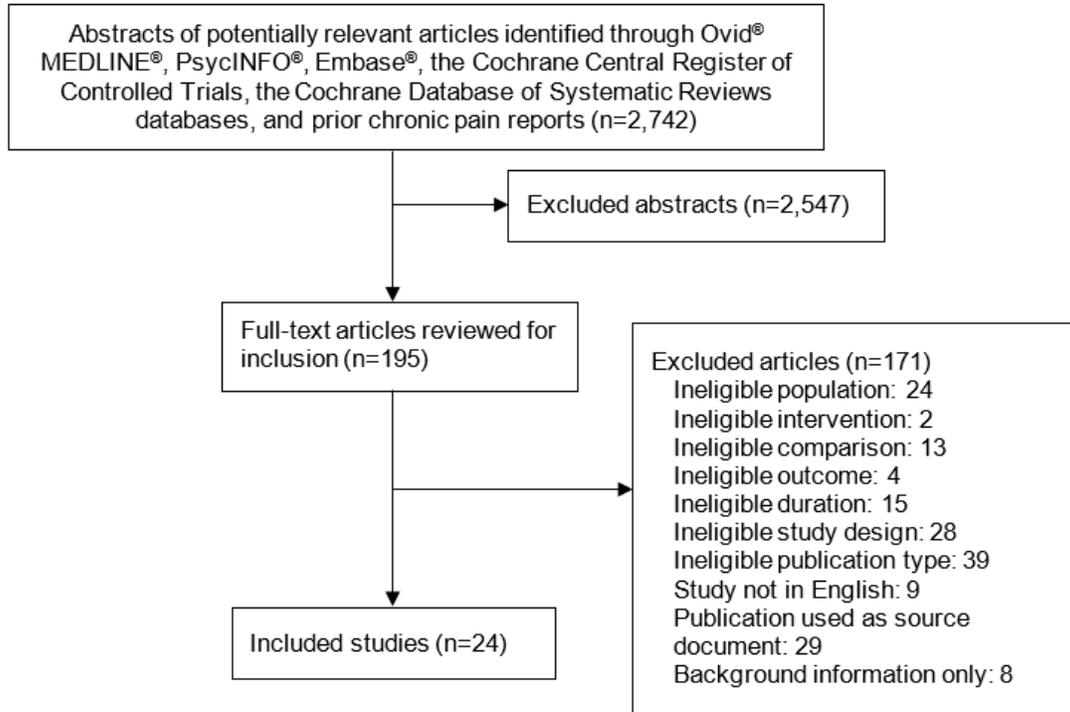
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# Appendix D. Literature Flow Diagram

Figure D-1. Literature flow diagram



# **Appendix E. Results**

## **Individual Study Summary Tables**

Tables E-1 through E-5 present details and results for primary outcomes, serious adverse events, and withdrawals due to adverse events for each included study. Tables E-1 through E-3 provide information for randomized controlled trials and are organized by their respective ratio of tetrahydrocannabinol to cannabidiol. Table E-4 includes details for studies of other cannabinoids, and Table E-5 presents details of observational studies.

**Table E-1. Comparable THC to CBD ratio study primary outcomes**

Author, Year Risk of Bias Study Design Pain Condition	Comparison (n) Followup Duration Derivative	Primary Pain Outcomes (Response, Severity)	Serious Adverse Events and Withdrawals Due to Adverse Events <sup>a</sup>	Other Primary Outcomes (Function/Disability, Pain Interference)
Blake, 2006 Moderate RCT Inflammatory arthritis- rheumatoid arthritis	A: 2.7 mg THC/2.5 mg CBD/100 mcl oromucosal spray, mean dose 5.4 sprays/day (31) B: Placebo (27) 5 weeks Whole plant extracted	Pain severity (mean [SD NR] 0 to 10 NRS scale): 3.1 vs. 4.1, MD -1.04 <sup>b</sup> (95% CI -1.9 to -0.18)	SAE: 0/31 (0%) vs. 2/27 (7.41%) WAE: 0/31 (0%) vs. 3/27 (11.11%)	Function (mean [SD NR] 0 to 10 28-Joint Disease Activity Score scale): 5 vs. 5.9, MD -0.76 <sup>c</sup> (95% CI -1.23 to -0.28)
Langford, 2013 Low RCT Neuropathic pain- multiple sclerosis	A: 2.7 mg THC/2.5 mg CBD/100 mcl oromucosal spray, mean dose 8.8 sprays/day (167) B: Placebo (172) 15 weeks Whole plant extracted	Pain response ≥30% (NRS scale): 83/167 (49.75%) vs. 77/172 (44.77%), RR 1.11 (95% CI 0.89 to 1.39)  Pain severity (mean [SD] 0 to 10 NRS scale): 4.54 (2.24) vs. 4.73 (2.26), MD -0.19 (SE 0.24) (95% CI -0.67 to 0.29)	WAE: 14/167 (8.38%) vs. 9/172 (5.23%)	Pain interference (0 to 10 BPI-SF scale): Treatment difference -0.12, p=0.56  Function (0 to 100 SF-36 Physical Functioning scale): Treatment difference -0.45, p=0.785
Lynch, 2014 High RCT (crossover) Neuropathic pain- chemotherapy induced	A: THC/CBD oromucosal spray (dose NR), mean dose 8 sprays/day (8) B: Placebo (8) 4 weeks Whole plant extracted	Pain severity (mean, 0 to 10 NRS-PI scale): 6 (95% CI 6.98 to 5.02) vs. 6.38 (95% CI 5.67 to 7.09)	SAE: 0/8 (0%) vs. 0/8 (0%) WAE: 0/8 (0%) vs. 0/8 (0%)	Function (mean [SD] 0 to 100 SF-36 Physical Functioning scale): 35.5 (9.19) vs. 46.5 (8.5), MD -11 (4.43) (95% CI -20.49 to -1.51)

Author, Year Risk of Bias Study Design Pain Condition	Comparison (n) Followup Duration Derivative	Primary Pain Outcomes (Response, Severity)	Serious Adverse Events and Withdrawals Due to Adverse Events <sup>a</sup>	Other Primary Outcomes (Function/Disability, Pain Interference)
Nurmikko, 2007 Moderate RCT Neuropathic pain- mixed	A: 2.7 mg THC/2.5 mg CBD/100 mcl oromucosal spray, mean dose 10.9 sprays/day (63) B: Placebo (62) 5 weeks Whole plant extracted	Pain response $\geq 30\%$ (NRS scale): 16/73 (25.4%) vs. 9/62 (14.52%), RR 1.75 (95% CI 0.84 to 3.66)  Pain severity (mean [SD NR] 0 to 10 NRS scale): 5.82 vs. 6.68, treatment difference -0.96 (95% CI -1.59 to -0.32)	SAE: 1/63 (1.6%) vs. 0/62 (0%) WAE: 11/63 (17.46%) vs. 2/62 (3.23%)	Function (0 to 70 Pain Disability Index scale): MD -5.85 (95% CI -9.62 to -2.09)
Rog, 2005 Moderate RCT Neuropathic pain- multiple sclerosis	A: 2.7 mg THC/2.5 mg CBD/100 mcl oromucosal spray, mean dose 9.6 sprays/day (34) B: Placebo (32) 5 weeks Whole plant extracted	Pain severity (mean [95% CI] 0 to 10 NRS scale): 3.85 (3.13 to 4.58) vs. 4.96 (4.19 to 5.72), treatment difference -1.25 (95% CI -2.11 to -0.39)	SAE: 0/34 (0%) vs. 0/32 (0%) WAE: 2/34 (5.88%) vs. 0/32 (0%)	NR
Selvarajah, 2010 High RCT Neuropathic pain- diabetic neuropathy	A: 2.7 mg THC/2.5 mg CBD/100 mcl oromucosal spray, mean dose 7 sprays/day <sup>d</sup> (15) B: Placebo (14) 12 weeks Whole plant extracted	Pain severity (mean [SD] 0 to 100 NPS scale): 51.6 (21.9) vs. 51.9 (24.1), MD -0.3 (SE 8.54) (95% CI -17.83 to 17.23)	NR	Function (mean [SD] 0 to 100 SF-36 Physical Functioning scale): 30.5 (16.6) vs. 36.5 (27.9), MD 6 (SE 8.5) (95% CI -11.35 to 23.35)
Serpell, 2014 Moderate RCT Neuropathic pain- mixed	A: 2.7 mg THC/2.5 mg CBD/100 mcl oromucosal spray, mean dose 8.9 sprays/day (128) B: Placebo (118) 15 weeks Whole plant extracted	Pain response $\geq 30\%$ (NRS scale): 34/123 (27.64%) vs. 19/117 (16.24%), RR 1.7 (95% CI 1.03 to 2.91)  Pain severity (mean [SE NR] 0 to 10 NRS scale): Mean reduction -0.34 (0.23) (95% CI -0.79 to 0.11)	SAE: 10/128 (7.81%) vs. 6% WAE: 25/128 (19.53%) vs. 25/118 (21.19%)	Pain interference (0 to 10 BPI-SF scale): Treatment difference -0.32 (SE 0.241) (95% CI -0.8 to 0.15)

Abbreviations: BPI-SF = brief pain inventory-short form; CBD = cannabidiol; CI = confidence interval; MD = mean difference; NPS = neuropathic pain scale; NR = not reported; NRS = numeric rating scale; NRS-PI = numeric rating scale for pain intensity; SAE = serious adverse events; SD = standard deviation; SE = standard error; SF-36 = short form-36; THC = tetrahydrocannabinol; RCT = randomized controlled trial; RR = relative risk; WAE = withdrawal due to due adverse events.

<sup>a</sup> Other serious adverse events (i.e., psychosis and cannabis use disorder) not reported in any study.

<sup>b</sup> Difference in median differences.

<sup>c</sup> Difference in mean differences.

<sup>d</sup> Mean sprays calculated by systematic review team.

**Table E-2. High THC to CBD ratio study primary outcomes**

Author, Year Risk of Bias Study Design Pain Condition	Comparison (n) Followup Duration Derivative	Primary Pain Outcomes (Response, Severity)	Serious Adverse Events and Withdrawals Due to Adverse Events <sup>a</sup>	Other Primary Outcomes (Function/Disability, Pain Interference)
Chaves, 2020 Low RCT Fibromyalgia	A: 1.2 mg THC/0.02 mg CBD sublingual drops, mean 3.6 drops/day (8) B: Placebo (9) 8 weeks Whole plant extracted	Pain severity (mean [SD] 0 to 10 FIQ scale): 3.75 (2.49) vs. 7.67 (1.84), MD -3.92 (1.05) (95% CI -6.17 to -1.68)	WAE: 0/8 (0%) vs. 0/9 (0%)	Function (mean [SD] 0 to 10 FIQ scale): 5.83 (2.02) vs. 4.07 (2.25), MD 1.76 (1.04) (95% CI -0.46 to 3.98)
de Vries, 2017 Moderate RCT Visceral pain- chronic pancreatitis and postsurgical abdominal pain	A: THC oral tablet (Dronabinol), range 15 to 24 mg/day (30) B: Placebo (32) 7 weeks Synthetic	Pain severity (mean [SD] 0 to 10 VAS scale): 2.4 (2.28) vs. 3.5 (2.42), MD -1.1 (SE 0.68) (95% CI -2.46 to 0.26)	WAE: 7/30 (23.33%) vs. 2/32 (6.25%)	NR
Frank, 2008 Moderate RCT (crossover) Neuropathic pain	A: THC oral capsule (Nabilone), max dose 2 mg/day (48) B: Dihydrocodeine 30 mg, max dose 240 mg/day (48) 6 weeks Synthetic	Pain severity (mean [SD NR] 0 to 100 VAS scale): Treatment effect 5.7 (95% CI 0.5 to 10.9)	SAE: 0/48 (0%) vs. 0/48 (0%) WAE: 2/48 (4%) vs. 6/48 (12.5%)	Function (mean [SD NR] 0 to 100 SF-36 Physical Functioning scale): Treatment effect 10.8 (95% CI 2.3 to 19.2)

<b>Author, Year Risk of Bias Study Design Pain Condition</b>	<b>Comparison (n) Followup Duration Derivative</b>	<b>Primary Pain Outcomes (Response, Severity)</b>	<b>Serious Adverse Events and Withdrawals Due to Adverse Events<sup>a</sup></b>	<b>Other Primary Outcomes (Function/Disability, Pain Interference)</b>
Pini, 2012 Low RCT (crossover) Headache- medication overuse headache	A: THC 0.5 mg oral capsule (Nabilone) daily (26) B: Ibuprofen 400 mg/day (26) 8 weeks Synthetic	Pain severity (mean [SD] 0 to 10 VAS scale): 5.55 (2.5) vs. 6.75 (2.4), MD -1.2 (0.68) (95% CI -2.57 to 0.17)	WAE: 1/30 (3.33%) vs. 1/30 (3.33%)	NR
Rintala, 2010 High RCT (crossover) Neuropathic pain- spinal cord injury	A: THC 5 mg oral capsule (Dronabinol), max dose 20 mg/day (7) B: Diphenhydramine 25 mg, max dose 75 mg/day (5) 47 weeks Synthetic	Pain severity (mean [SD NR] 0 to 10 BPI scale): 5.8 vs. 5.8	SAE: 1/7 (14.29%) vs. 1/5 (20%) WAE: 1/7 (14.29%) vs. 0/5 (0%)	NR
Schimrigk, 2017 Low RCT Neuropathic pain- multiple sclerosis	A: THC 2.5 mg oral capsule (Dronabinol), mean dose 13 mg/day (124) B: Placebo (116) 16 weeks Synthetic	Pain severity (mean [SD] 0 to 10 NRS scale): 4.48 (2.04) vs. 4.92 (2.04), MD NR, p=0.676	SAE: 12/124 (9.68%) vs. 7/116 (6.03%) WAE: 19/124 (15.32%) vs. 12/116 (10.34%)	NR
Skrabek, 2008 Moderate RCT Fibromyalgia	A: THC 0.5 mg oral capsule (Nabilone), endpoint dose 2 mg/day (15) B: Placebo (18) 4 weeks Synthetic	Pain severity (mean [SD NR] 0 to 10 VAS scale): 4.8 vs. 5.6, MD -1.43, p<0.05	SAE: 0/15 (0%) vs. 0/18 (0%) WAE: 1/20 (5%) vs. 1/20 (5%)	NR
Toth, 2012 Low RCT Neuropathic pain- diabetic neuropathy	A: THC 0.5 mg oral capsule (Nabilone), max dose 4 mg/day (13) B: Placebo (13) 5 weeks Synthetic	Pain response ≥30% (NRS scale): 11/13 (84.62%) vs. 5/13 (38.46%), RR 2.2 (95% CI 1.06 to 4.55)  Pain severity (mean [SD] 0 to 10 NRS scale): 3.5 (1.3) vs. 5.4 (1.7), MD -1.9 (0.59) (95% CI -3.13 to -0.68)	NR	Pain interference (mean [SD] 0 to 10 MBPI scale): 2.5 (1.6) vs. 3.6 (0.9), MD -1.1 (0.51) (95% CI -2.15 to -0.05)

Author, Year Risk of Bias Study Design Pain Condition	Comparison (n) Followup Duration Derivative	Primary Pain Outcomes (Response, Severity)	Serious Adverse Events and Withdrawals Due to Adverse Events <sup>a</sup>	Other Primary Outcomes (Function/Disability, Pain Interference)
Turcotte, 2015 Moderate RCT Neuropathic pain- multiple sclerosis	A: THC 0.5 mg oral capsule (Nabilone), max dose 2 mg/day (8) B: Placebo (7) 9 weeks Synthetic	Pain severity (mean [SD NR] 0 to 100 VAS scale): 35 vs. 57 <sup>b</sup>	SAE: 0/8 (0%) vs. 0/7 (0%) WAE: 1/8 (12.5%) vs. 0/7 (0%)	Pain interference (mean [SD NR] 0 to 100 VAS impact scale): 41 vs. 40 <sup>b</sup>
Wissel, 2006 High RCT (crossover) Neuropathic pain- multiple sclerosis	A: THC 0.5 mg oral capsule (Nabilone), endpoint dose 1 mg/day (13) B: Placebo (13) 4 weeks Synthetic	Pain severity (median [SD NR] 11 Point Box Test): 4 vs. 6, p<0.05	WAE: 2/13 (15.38%) vs. 0/13 (0%)	NR
Zajicek, 2012 Moderate RCT Neuropathic pain- multiple sclerosis	A: THC 2.5 mg capsule, max dose 25 mg/day (143) B: Placebo (134) 12 weeks Whole plant extracted	Pain severity (mean [SD] 0 to 10 CRS scale): 4.1 (2.9) vs. 4.7 (3.0), MD -0.6 (95% CI -1.3 to 0.1)	SAE: 7/143 (4.9%) vs. 3/134 (2.24%) WAE: 30/143 (20.98%) vs. 9/134 (6.72%)	NR

Abbreviations: BPI = brief pain inventory; CBD = cannabidiol; CI = confidence interval; CRS = category rating scale; FIQ = fibromyalgia impact questionnaire; MBPI = modified brief pain inventory; MD = mean difference; NR = not reported; NRS = numeric rating scale; RCT = randomized controlled trial; SAE = serious adverse events; SD = standard deviation; SE = standard error; THC = tetrahydrocannabinol; RR = relative risk; VAS = visual analog scale; WAE = withdrawal due to due adverse events.

<sup>a</sup> Other serious adverse events (i.e., psychosis and cannabis use disorder) not reported in any study.

<sup>b</sup> Estimated from graph.

**Table E-3. Low THC to CBD ratio study primary outcomes**

<b>Author, Year Risk of Bias Study Design Pain Condition</b>	<b>Comparison (n) Followup Duration Derivative</b>	<b>Primary Pain Outcomes (Response, Severity)</b>	<b>Serious Adverse Events and Withdrawals Due to Adverse Events<sup>a</sup></b>	<b>Other Primary Outcomes (Function/Disability, Pain Interference)</b>
Xu, 2020 High RCT (crossover) Neuropathic pain- mixed	A: CBD cream (250 mg/3 oz) up to 4 times daily (15) B: Placebo (14) 4 weeks Whole plant extracted	Pain severity (mean [SD] 0 to 10 NPS scale): 3.33 (2.02) vs. 5.55 (2.81), MD -2.22 (95% CI -4.07 to -0.37)	SAE: 0/15 (0%) vs. 0/14 (0%)	NR

Abbreviations: CBD = cannabidiol; MD = mean difference; NPS = neuropathic pain scale; NR = not reported; RCT = randomized controlled trial; SAE = serious adverse event; SD = standard deviation; THC = tetrahydrocannabinol.

<sup>a</sup> Other serious adverse events (i.e., psychosis and cannabis use disorder) not reported in any study.

**Table E-4. Other cannabinoids study primary outcomes**

<b>Author, Year Risk of Bias Study Design Pain Condition</b>	<b>Comparison (n) Followup Duration Derivative</b>	<b>Primary Pain Outcomes (Response, Severity)</b>	<b>Serious Adverse Events and Withdrawals Due to Adverse Events<sup>a</sup></b>	<b>Other Primary Outcomes (Function/Disability, Pain Interference)</b>
Eibach, 2020 Moderate RCT (crossover) Neuropathic pain- HIV associated	A: CBDV oral solution (50 mg/mL) 400 mg/day (16) B: Placebo (16) 4 weeks Whole plant extracted	Pain response $\geq$ 30% (NRS scale): 6/16 (37.5%) vs. 13/16 (81.25%), RR NR  Pain severity (mean [SD] 0 to 10 NRS scale): 2.74 (1.47) vs. 3.67 (2.62), MD -0.62 (95% CI -0.27 to 1.51)	SAE: 1/16 (6.25%) vs. 0/16 (0%) WAE: 1/16 (6.25%) vs. 0/16 (0%)	Pain interference (0 to 10 BPI-SF scale): MD -0.35 (95% CI -1.36 to 0.43)

Abbreviations: CBDV = cannabidivarin; HIV = human immunodeficiency virus; MD = mean difference; NR = not reported; RCT = randomized controlled trial; RR = relative risk; SAE = serious adverse event; SD = standard deviation.

<sup>a</sup> Other serious adverse events (i.e., psychosis and cannabis use disorder) not reported in any study.

**Table E-5. Observational study primary outcomes**

Author, Year Risk of Bias Study Design Pain Condition	Comparison (n) Followup Duration Derivative	Primary Pain Outcomes (Response, Severity)	Serious Adverse Events and Withdrawals Due to Adverse Events <sup>a</sup>	Other Primary Outcomes (Function/Disability, Pain Interference)
Bestard, 2011 Moderate Prospective cohort Neuropathic pain- mixed	A: THC oral capsule (Nabilone), mean dose 3.05 mg/day (49) B: Gabapentin, mean dose 2,295.5 mg/day (52) C: Gabapentin + THC capsule, mean dose NR + 3.02 mg/day (55) 6 months Synthetic	Pain intensity (mean [SD] 0 to 100 VAS scale): 28.0 (10.5) vs. 33.8 (11.6) vs. 33.1 (20.2), MD -5.8 (95% CI -10.18 to -1.42) for A vs. B, -5.1 (95% CI -11.48 to 1.28) for A vs. C	SAE: 0/49 (0%) vs. 0/52 (0%) vs. 0/55 (0%) WAE: 5/49 (10%) vs. 12/52 (23%) vs. 5/55 (9%)	Pain interference (mean [SD] 0 to 10 BPI scale): 4.5 (2.3) vs. 4.6 (2.2) vs. 4.5 (2.2), MD -0.1 (95% CI -0.99 to 0.79) for A vs. B, 0.00 (95% CI -0.88 to 0.88) for A vs. C  Function (mean [SD] 0 to 100 SF-36 scale <sup>a</sup> ): 48.3 (27.2) vs. 46.5 (25.1) vs. 43.7 (26.4), MD 1.80 (95% CI -8.53 to 12.13) for A vs. B, 4.60 (95% CI -5.83 to 15.03) for A vs. C
Gruber, 2021 High Prospective cohort Mixed (primarily musculoskeletal)	A: THC/CBD: Medicinal cannabis program, mean dose THC 13.3 mg/day, CBD 28.9 mg/day (37) B: Usual care, dose NA (9) 12 weeks Mixed cannabis products	Pain intensity (mean [SD] 0 to 100 VAS scale): 34.07 (22.36) vs. 48.78 (30.42); MD -14.71 (95% CI, -32.71 to 3.29)	NR	A vs. B Function (mean [SD], 0 to 10 PDI scale): 18.13 (12.26) vs. 19.22 (12.73); MD -1.09 (95% CI -10.33 to 8.16)  SF-36 Function (mean [SD], 0 to 100 scale <sup>a</sup> ): 70.00 (22.87) vs. 69.44 (26.98); MD 0.56 (95% CI -17.17 to 18.29)

<b>Author, Year Risk of Bias Study Design Pain Condition</b>	<b>Comparison (n) Followup Duration Derivative</b>	<b>Primary Pain Outcomes (Response, Severity)</b>	<b>Serious Adverse Events and Withdrawals Due to Adverse Events<sup>a</sup></b>	<b>Other Primary Outcomes (Function/Disability, Pain Interference)</b>
Vigil, 2017 High Preliminary historical cohort Mixed musculoskeletal pain	A: THC/CBD: Participation in New Mexico Medical Cannabis Program (37) B: Not participating in medical marijuana program and not using cannabis (29) 21 months Unknown THC concentration	NR	NR	NR <sup>b</sup>
Ware, 2015 High Prospective cohort Chronic non-cancer pain	A: THC 12.5 +/- 1.5% herbal cannabis, median dose 2.5 g/day (215) B: Usual care (216) 13 months Whole plant non- extracted	NR	SAE: 28/215 (13%) vs. 42/216 (19.4%) WAE: 10/215 (4.65%) vs. NR (assumed 0)	NR

Abbreviations: BPI = brief pain inventory; CBD = cannabidiol; CI = confidence interval; MD = mean difference; NA = not applicable; NR = not reported; PDI = Pain Disability Index; SAE = serious adverse events; SD = standard deviation; SF-36= short form-36; THC = tetrahydrocannabinol; VAS = visual analog scale; WAE = withdrawal due to due adverse events.

<sup>a</sup> Higher scores indicate better outcomes.

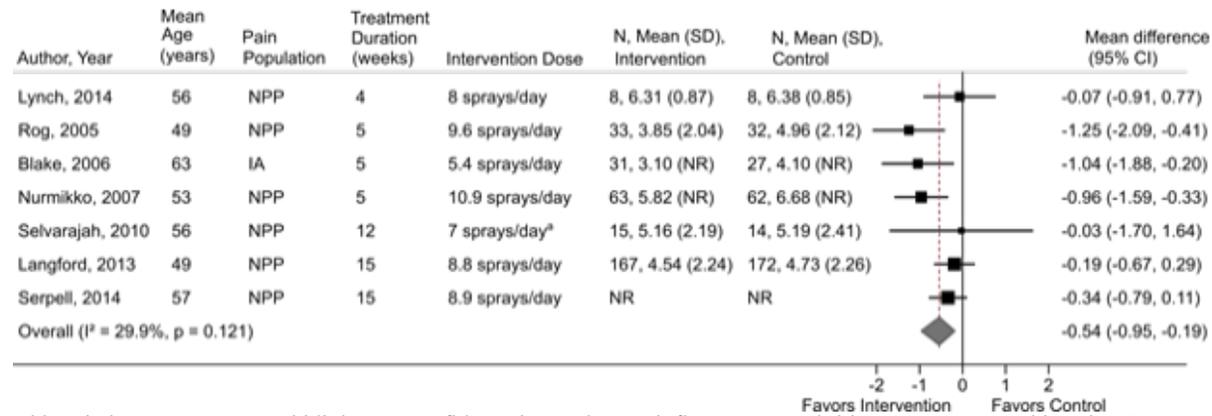
<sup>b</sup> Only included outcome reported was opioid-use.

## **Forest Plots**

### **Comparable THC to CBD Ratio Studies**

Pooled results and the forest plot for the sensitivity analysis conducted for improvement in pain severity (removing high risk of bias studies) is available upon request

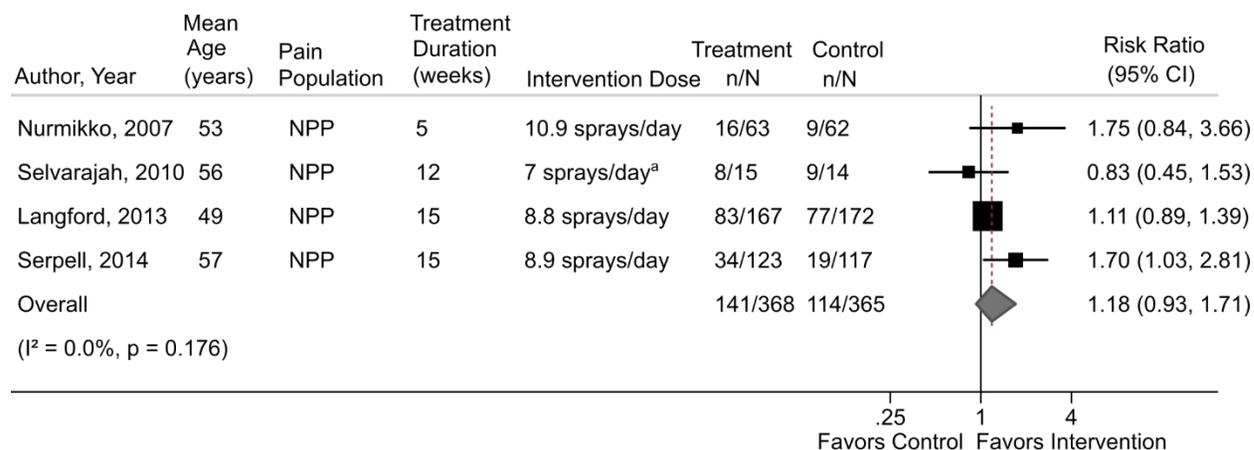
**Figure E-1. Change in pain severity with comparable THC to CBD ratio versus placebo (short-term, 4 weeks to 6 months followup)**



Abbreviations: CBD = cannabidiol; CI = confidence interval; IA = inflammatory arthritis; NPP = neuropathic pain; NR = not reported; SD = standard deviation; THC = tetrahydrocannabinol

<sup>a</sup> Calculated by review team

**Figure E-2. Proportion of patients with pain response ( $\geq 30\%$  improvement) with comparable THC to CBD ratio versus placebo (short-term, 1 to 6 months followup)**



Abbreviations: CI = confidence interval; NPP = neuropathic pain

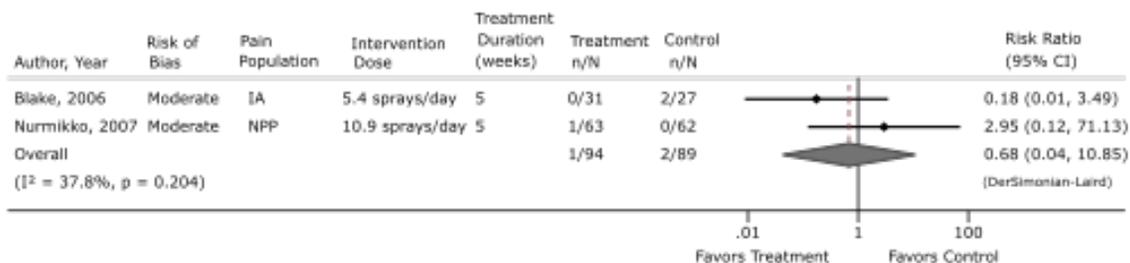
<sup>a</sup>Calculated by review team

**Figure E-3. Adverse events for comparable THC to CBD ratio versus placebo (short-term, 1 to 6 months followup)**



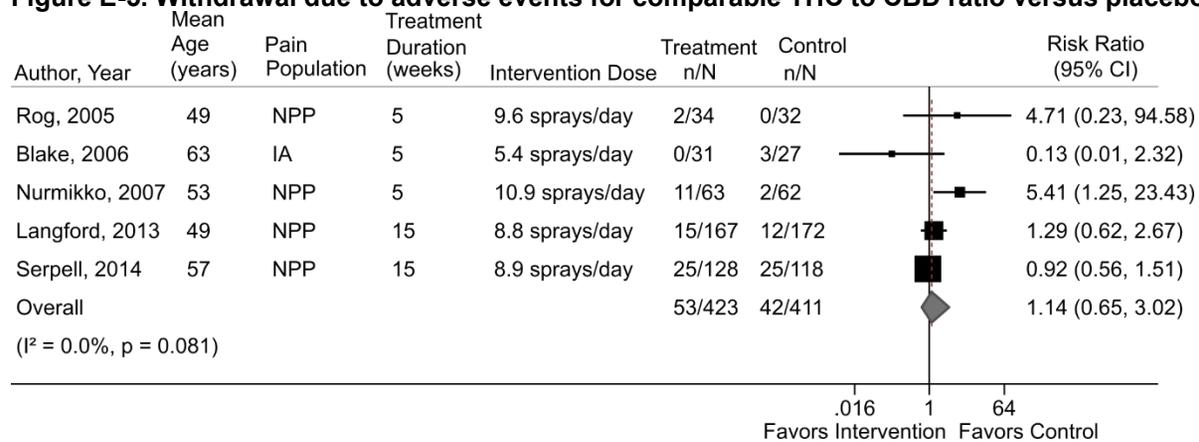
Abbreviations: CI = confidence interval; NPP = neuropathic pain

**Figure E-4. Serious adverse events for comparable THC to CBD ratio versus placebo (short-term, 1 to 6 months followup)**



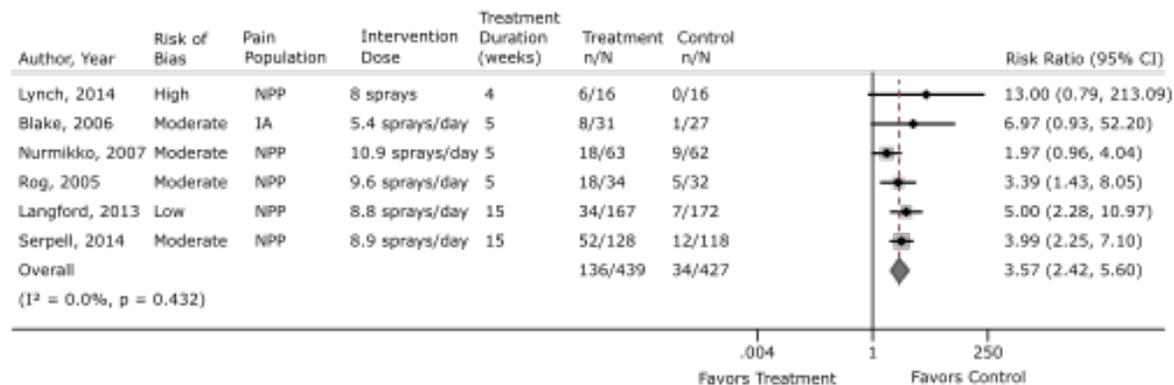
Abbreviations: CI = confidence interval; IA = inflammatory arthritis; NPP = neuropathic pain

**Figure E-5. Withdrawal due to adverse events for comparable THC to CBD ratio versus placebo (short-term, 1 to 6 months followup)**



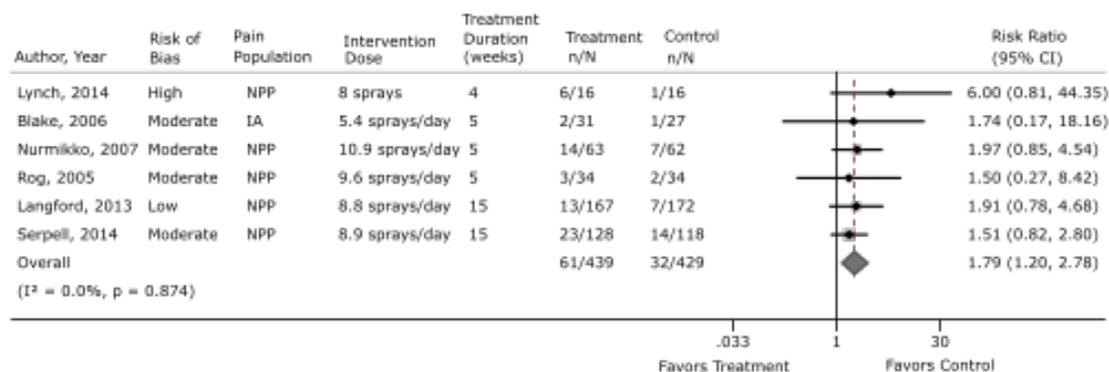
Abbreviations: CI = confidence interval; IA = inflammatory arthritis; NPP = neuropathic pain

**Figure E-6. Dizziness for comparable THC to CBD ratio versus placebo (short-term, 1 to 6 months followup)**



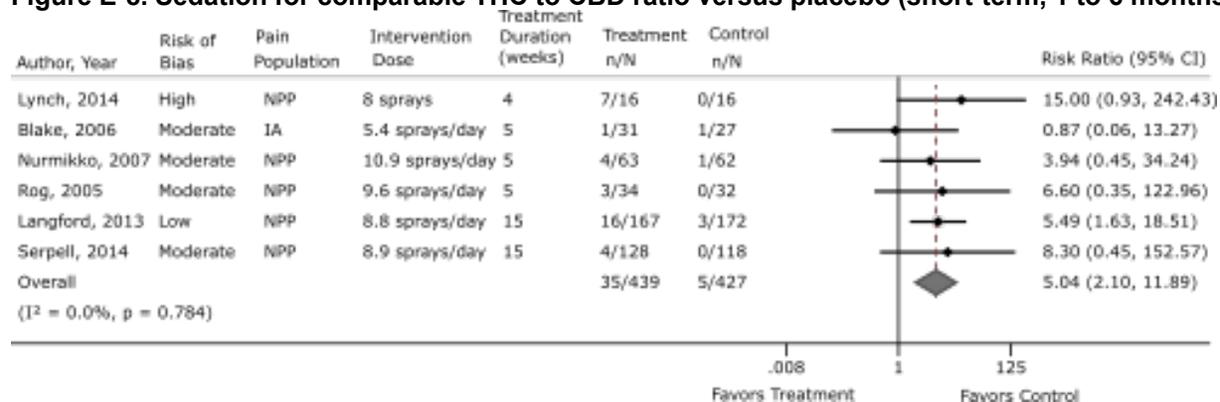
Abbreviations: CI = confidence interval; IA = inflammatory arthritis; NPP = neuropathic pain

**Figure E-7. Nausea for comparable THC to CBD ratio versus placebo (short-term, 1 to 6 months followup)**



Abbreviations: CI = confidence interval; IA = inflammatory arthritis; NPP = neuropathic pain

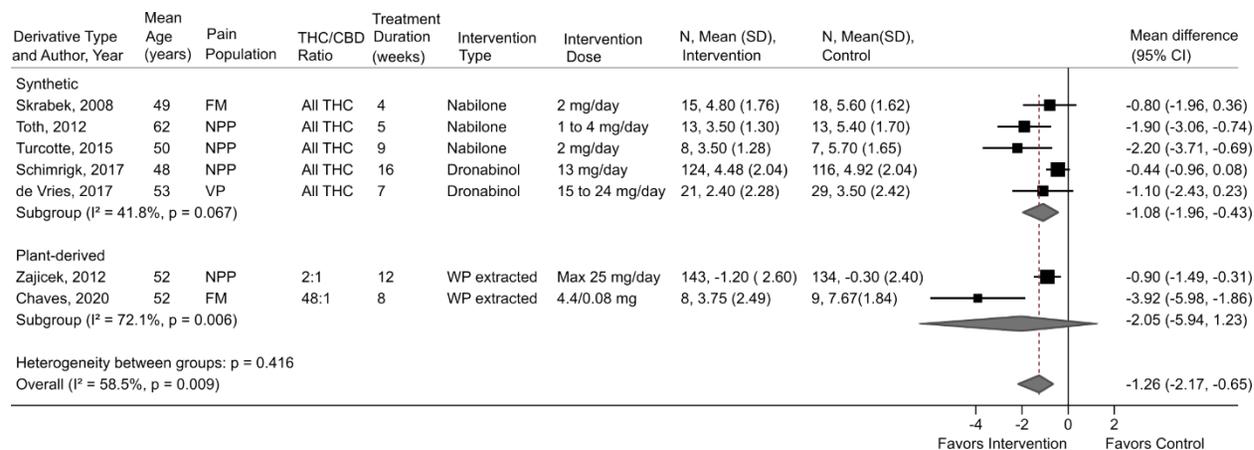
**Figure E-8. Sedation for comparable THC to CBD ratio versus placebo (short-term, 1 to 6 months followup)**



Abbreviations: CI = confidence interval; IA = inflammatory arthritis; NPP = neuropathic pain

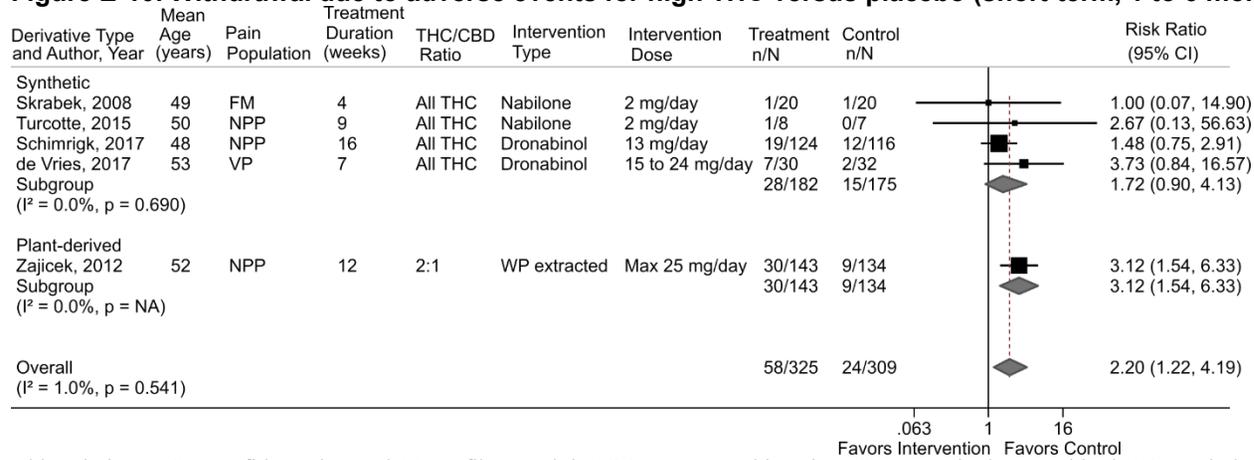
## High THC to CBD Ratio Studies

**Figure E-9. Change in pain severity with high THC ratio versus placebo (short-term, 4 weeks to 6 months followup)**



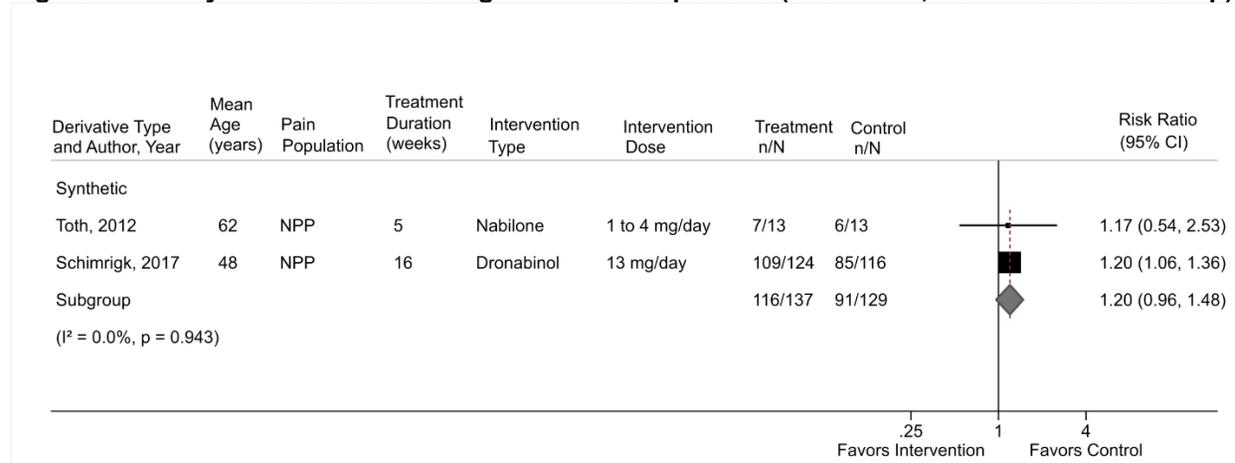
Abbreviations: CBD = cannabidiol; CI = confidence interval; FM = fibromyalgia; NPP = neuropathic pain; SD = standard deviation; THC = tetrahydrocannabinol; VP = visceral pain; WP = whole plant

**Figure E-10. Withdrawal due to adverse events for high THC versus placebo (short-term, 1 to 6 months followup)**



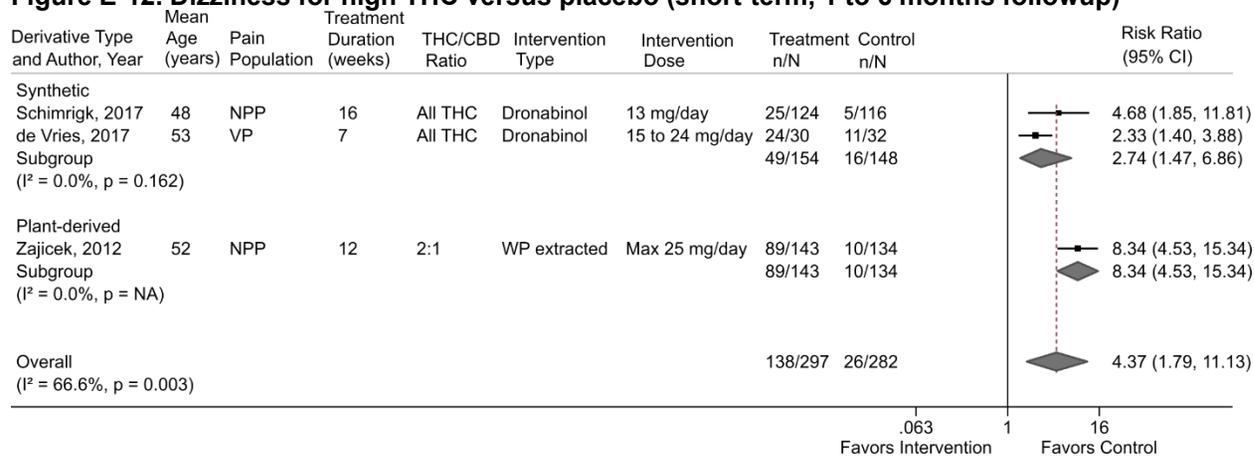
Abbreviations: CI = confidence interval; FM = fibromyalgia; NPP = neuropathic pain; THC = tetrahydrocannabinol; WP = whole plant

**Figure E-11. Any adverse event for high THC versus placebo (short-term, 1 to 6 months followup)**



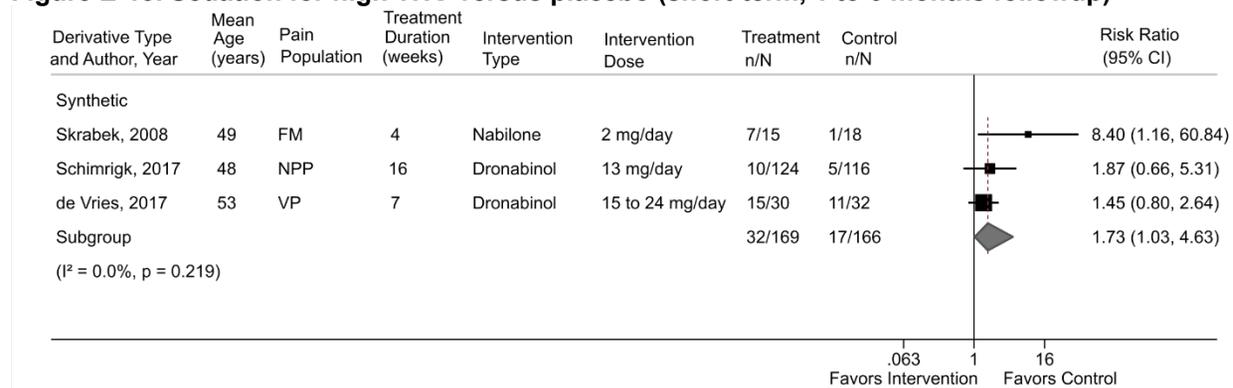
Abbreviations: CI = confidence interval; NPP = neuropathic pain; THC = tetrahydrocannabinol

**Figure E-12. Dizziness for high THC versus placebo (short-term, 1 to 6 months followup)**



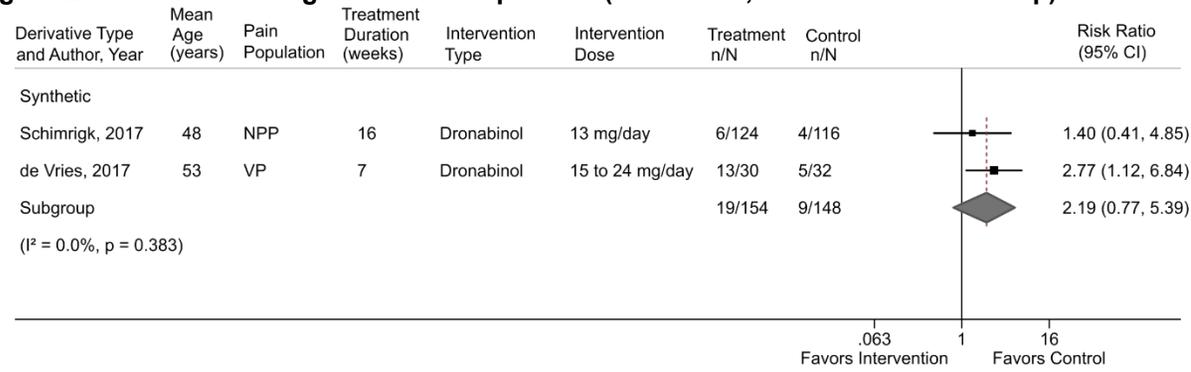
Abbreviations: CI = confidence interval; NPP = neuropathic pain; THC = tetrahydrocannabinol; VP = visceral pain; WP = whole plant

**Figure E-13. Sedation for high THC versus placebo (short-term, 1 to 6 months followup)**



Abbreviations: CI = confidence interval; FM = fibromyalgia; NPP = neuropathic pain; VP = visceral pain

**Figure E-14. Nausea for high THC versus placebo (short-term, 1 to 6 months followup)**



Abbreviations: CI = confidence interval; NPP = neuropathic pain; VP = visceral pain

# **Appendix F. Evidence Tables**

Shown in associated Excel files.

# **Appendix G. Risk of Bias Assessment**

Shown in associated Excel files.

## Appendix H. Details on Strength of Evidence

**Table H-1. KQ1 and 2: Cannabinoids to treat chronic pain – comparable THC to CBD ratio**

Comparison	Outcome	Number of Studies (N) and Total Participants	Study Limitations	Directness	Consistency	Precision	Publication Bias	Main Findings Effect Size (95% CI)	SOE Grade
<b>Comparable THC to CBD ratio vs. Placebo</b>	Pain response (≥30% improvement from baseline)	4 RCTs (N=733) <sup>1-4</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Potential small effect, not statistically significant, with THC:CBD 38% versus 31%, RR 1.18 (0.93 to 1.71); I <sup>2</sup> =0%	Low
<b>Comparable THC to CBD ratio vs. Placebo</b>	Pain severity (change)	7 RCTs (N=878) <sup>1-7</sup>	Moderate	Direct	Consistent	Precise	Unknown	Small benefit with THC:CBD 0 to 10 scale, MD -0.54 (-0.95 to -0.19; I <sup>2</sup> =30%) Subgroup analysis removing high risk of bias studies: Moderate benefit MD -0.64 (-1.15 to -0.24)	Moderate
<b>Comparable THC to CBD ratio vs. Placebo</b>	Pain interference	2 RCTs (N=585) <sup>1,4</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	No effect BPI-SF scale (0 to 10) MD -0.12 (p=0.56) MD -0.32 (-0.8 to 0.15)	Low
<b>Comparable THC to CBD ratio vs. Placebo</b>	Function or Disability	2 RCTs (N=183) <sup>2,5</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Small benefit with THC:CBD MD -5.85 (-0.62 to -2.09) (0 to 70 scale) 28-joint Disease Activity Score (0 to 10 scale, MD -0.76, 95% CI -1.23 to -0.28)	Low

Comparison	Outcome	Number of Studies (N) and Total Participants	Study Limitations	Directness	Consistency	Precision	Publication Bias	Main Findings Effect Size (95% CI)	SOE Grade
Comparable THC to CBD ratio vs. Placebo	WAEs	5 RCTs (N=834) <sup>1,2,4,5,7</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect 13% vs. 10%, RR 1.14 (0.65 to 3.02); I <sup>2</sup> =0%	Insufficient
Comparable THC to CBD ratio vs. Placebo	SAEs	2 RCTs (N= 183) <sup>2,5</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	No effect 1.1% vs. 2.2%, RR 0.68 (0.04 to 10.85; I <sup>2</sup> =38%)	Low
Comparable THC to CBD ratio vs. Placebo	Dizziness	6 RCTs (N=866) <sup>1,2,4-7</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Large effect with THC:CBD 30% vs. 8%, RR 3.57 (2.42 to 5.60; I <sup>2</sup> =0%)	Low
Comparable THC to CBD ratio vs. Placebo	Nausea	6 RCTs (N=866) <sup>1,2,4-7</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Moderate effect with THC:CBD 14% vs. 7.5% RR 1.79 (1.20 to 2.78; I <sup>2</sup> =0%)	Low
Comparable THC to CBD ratio vs. Placebo	Sedation	6 RCTs (N=866) <sup>1,2,4-7</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Large effect with THC:CBD RR 5.04 (2.10 to 11.89; I <sup>2</sup> =0%)	Low

Abbreviations: BPI-SF = Brief Pain Inventory (Short Form); CBD = cannabidiol; CI = confidence interval; KQ = Key Question; MD = mean difference; RCT = randomized controlled trial; RR = relative risk; SAE = serious adverse event; SOE = strength of evidence; THC = tetrahydrocannabinol; WAE = withdrawal due to adverse event

**Table H-2. KQ1 and 2: Cannabinoids to treat chronic pain – high THC to CBD ratio, synthetic THC**

Comparison	Outcome	Number of Studies and Total Participants (N)	Study Limitations	Directness	Consistency	Precision	Publication Bias	Main Findings Effect Size (95% CI)	Strength of Evidence Grade
<b>Synthetic THC vs. Placebo</b>	Pain response (≥30% improvement from baseline)	1 RCT (N=26) <sup>8</sup>	Low	Direct	Unknown	Imprecise	Unknown	Large effect with nabilone 85% vs. 38%, RR 2.20 (CI 1.06 to 4.55)	Insufficient
	Pain severity	5 RCTs (N=364) <sup>8-12</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Moderate effect with synthetic THC 0 to 10 scale, MD -1.08 (-1.96 to -0.43; I <sup>2</sup> =42%)	Low
	Pain interference	2 RCTs (N=40) <sup>8,12</sup>	Moderate	Direct	Inconsistent	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect	Insufficient
	Function/disability	1 RCT (N=13) <sup>13</sup>	High	Direct	Unknown	Imprecise	Unknown	No effect. No change in either group	Insufficient
	WAEs	4 RCTs (N=357) <sup>9-12</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Potential Moderate effect, not statistically significant 13% vs. 9%, RR 1.72 (0.90 to 4.13; I <sup>2</sup> =0%)	Low
	SAEs	1 RCT (N=240) <sup>10</sup>	Low	Direct	Unknown	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect 10% vs. 6%, RR 1.60 (0.65 to 3.93)	Insufficient
	Dizziness	2 RCTs (N=302) <sup>9,10</sup>	Low	Direct	Consistent	Imprecise	Unknown	Large effect with dronabinol 32% vs. 11%, RR 2.74 (1.47 to 6.86; I <sup>2</sup> =0%)	Moderate

Nausea	2 RCTs (N=302) <sup>9,10</sup>	Low	Direct	Consistent	Imprecise	Unknown	Potential large effect with dronabinol, not statistically significant 12% vs. 6%, RR 2.19 (0.77 to 5.39; I <sup>2</sup> =0%)	Low
Sedation	3 RCTs (N=335) <sup>9-11</sup>	Moderate	Direct	Consistent	Imprecise	Unknown	Moderate effect with dronabinol 19% vs. 10%, RR 1.73 (1.03 to 4.63; I <sup>2</sup> =0%)	Low

Abbreviations: CBD = cannabidiol; CI = confidence interval; KQ = Key Question; MD = mean difference; RCT = randomized controlled trial; RR = relative risk; SAE = serious adverse event; SOE = strength of evidence; THC = tetrahydrocannabinol; WAE = withdrawal due to adverse event

**Table H-3. KQ1 and 2: Cannabinoids to treat chronic pain – high THC to CBD ratio, extracted from whole plant**

Comparison	Outcome	Number of Studies and Total Participants (N)	Study Limitations	Directness	Consistency	Precision	Publication Bias	Main Findings Effect Size (95% CI)	Strength of Evidence Grade
<b>Extracted THC vs. Placebo</b>	Pain severity	2 RCTs (N=297) <sup>14,15</sup>	Moderate	Direct	Inconsistent	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect MD -2.05 (-5.94 to 1.26; I <sup>2</sup> =72%)	Insufficient
	Function/disability	1 RCT (N=18) <sup>15</sup>	High	Direct	Unknown	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect MD 1.75 (-0.46 to 3.98)	Insufficient
	WAEs	1 RCT (N=277) <sup>14</sup>	Moderate	Direct	Unknown	Imprecise	Unknown	Large increased risk 13.9% vs. 5.7%, RR 3.12 (1.54 to 6.33)	Low
	SAEs	1 RCT (N=277) <sup>14</sup>	Moderate	Direct	Unknown	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect 4.9% vs. 2.2%, RR 2.19 (0.58 to 8.28)	Insufficient
	Dizziness	1 RCT (N=277) <sup>14</sup>	Moderate	Direct	Unknown	Imprecise	Unknown	Large effect 62.2% vs. 7.5%, RR 8.34 (4.53 to 15.34)	Low

Abbreviations: CBD = cannabidiol; CI = confidence interval; KQ = Key Question; MD = mean difference; RCT = randomized controlled trial; RR = relative risk; SAE = serious adverse event; SOE = strength of evidence; THC = tetrahydrocannabinol; WAE = withdrawal due to adverse event

**Table H-4. KQ1 and 2: Cannabinoids to treat chronic pain – high THC to CBD ratio, combined synthetic and whole-plant extracted studies**

<b>Comparison</b>	<b>Outcome</b>	<b>Number of Studies and Total Participants (N)</b>	<b>Study Limitations</b>	<b>Directness</b>	<b>Consistency</b>	<b>Precision</b>	<b>Publication Bias</b>	<b>Main Findings Effect Size (95% CI)</b>	<b>Strength of Evidence Grade</b>
<b>Combined High THC Ratio Studies (synthetic and Whole-plant extracted)</b>	Pain Severity improvement	7 RCTs (N=658) <sup>8-12,14,15</sup>	Moderate	Direct	Consistent	Precise	Unknown	Moderate effect MD -1.26 (-2.17 to -0.65; I <sup>2</sup> =59%)	Moderate

Abbreviations: CBD = cannabidiol; CI = confidence interval; KQ = Key Question; MD = mean difference; RCT = randomized controlled trial; SOE = strength of evidence; THC = tetrahydrocannabinol

**Table H-5. KQ1 and 2: Cannabinoids to treat chronic pain – whole plant cannabis**

Comparison	Outcome	Number of Studies and Total Participants (N)	Study Limitations	Directness	Consistency	Precision	Publication Bias	Main Findings Effect Size (95% CI)	Strength of Evidence Grade
<b>Whole plant cannabis (standardized to 12% THC) vs. Usual Care</b>	Pain Severity change	1 (N=431, 302 contribute to pain outcome) <sup>16</sup>	High	Direct	Unknown	Imprecise	Unknown	Moderate effect 0 to 10 scale, Adjusted MD at 12 months: -1.10 (-1.56 to -0.72)	Insufficient
	WAE	1 (N=431) <sup>16</sup>	High	Direct	Unknown	Imprecise	Unknown	Large effect with cannabis 4.7% vs. 0%, RR 21.10 (1.24 to 357.80)	Insufficient
	SAE	1 (N=431) <sup>16</sup>	High	Direct	Unknown	Imprecise	Unknown	No effect 13% vs. 19%, OR 0.64 (0.38 to 1.04)	Insufficient
	Dizziness	1 (N=431) <sup>16</sup>	High	Direct	Unknown	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect 12.6% vs. 9.7%, RR 1.29 (0.75 to 2.21)	Insufficient
	Nausea	1 (N=431) <sup>16</sup>	High	Direct	Unknown	Imprecise	Unknown	Moderate effect 16.7% vs. 9.7%, RR 1.72 (1.04 to 2.85)	Insufficient
	Sedation	1 (N=431) <sup>16</sup>	High	Direct	Unknown	Imprecise	Unknown	Large effect 13.5% vs. 4.63%, RR 2.91 (1.46 to 5.83)	Insufficient
	Cognitive Disorder	1 (N=431) <sup>16</sup>	High	Direct	Unknown	Imprecise	Unknown	Large effect 13.9% vs. 5.7%, RR 3.12 (1.54 to 6.33)	Insufficient

Abbreviations: CI = confidence interval; KQ = Key Question; MD = mean difference; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SAE = serious adverse event; SOE = strength of evidence; THC = tetrahydrocannabinol; WAE = withdrawal due to adverse event;

**Table H-6. KQ1: Cannabinoids to treat chronic pain – low THC to CBD ratio**

Comparison	Outcome	Number of Studies (N) and Total Participants	Study Limitations	Directness	Consistency	Precision	Publication Bias	Main Findings Effect Size (95% CI)	Strength of Evidence Grade
<b>Topical CBD vs. Placebo</b>	Pain severity (change)	1 RCT (N=29) <sup>17</sup>	High	Direct	Unknown	Imprecise	Unknown	Small effect with CBD cream MD -0.75, P=0.009 by ANCOVA (0 to 10 scale)	Insufficient

Abbreviations: ANCOVA = analysis of covariance; CBD = cannabidiol; CI = confidence interval; KQ = Key Question; MD = mean difference; RCT = randomized controlled trial; SOE = strength of evidence; THC = tetrahydrocannabinol

**Table H-7. KQ1 and 2: Cannabinoids to treat chronic pain – low THC to CBD ratio**

Comparison	Outcome	Number of Studies (N) and Total Participants	Study Limitations	Directness	Consistency	Precision	Publication Bias	Main Findings Effect Size (95% CI)	Strength of Evidence Grade
<b>CBDV vs. Placebo</b>	Pain Response (≥30% improvement from baseline)	1 RCT (N=31) <sup>18</sup>	Moderate	Direct	Unknown	Imprecise	Unknown	Large effect, favors placebo 38% vs. 81%, RR 0.46 (95% CI 0.24 to 0.91)	Insufficient
<b>CBDV vs. Placebo</b>	Pain severity (change)	1 RCT (N=31) <sup>18</sup>	Moderate	Direct	Unknown	Imprecise	Unknown	Failed to demonstrate or exclude a detrimental effect MD 0.62 (-0.05 to 1.32)	Insufficient

Abbreviations: CBDV = cannabidivarin; CI = confidence interval; KQ = Key Question; MD = mean difference; RCT = randomized controlled trial; RR = relative risk; SOE = strength of evidence

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10. Schimrigk S, Marziniak M, Neubauer C, et al. Dronabinol Is a Safe Long-Term Treatment Option for Neuropathic Pain Patients. *Eur Neurol*. 2017;78(5-6):320-9. doi: 10.1159/000481089. PMID: 29073592.
11. Skrabek RQ, Galimova L, Ethans K, et al. Nabilone for the treatment of pain in fibromyalgia. *J Pain*. 2008 Feb;9(2):164-73. PMID: 17974490.
12. Turcotte D, Doupe M, Torabi M, et al. Nabilone as an adjunctive to gabapentin for multiple sclerosis-induced neuropathic pain: a randomized controlled trial. *Pain Med*. 2015 Jan;16(1):149-59. doi: <https://dx.doi.org/10.1111/pme.12569>. PMID: 25288189.
13. Wissel J, Haydn T, Muller J, et al. Low dose treatment with the synthetic cannabinoid Nabilone significantly reduces spasticity-related pain : a double-blind placebo-controlled cross-over trial. *J Neurol*. 2006 Oct;253(10):1337-41. PMID: 16988792.
14. Zajicek JP, Hobart JC, Slade A, et al. Multiple sclerosis and extract of cannabis: results of the MUSEC trial. *J Neurol Neurosurg Psychiatry*. 2012 Nov;83(11):1125-32. doi: <https://dx.doi.org/10.1136/jnnp-2012-302468>. PMID: 22791906.
15. Chaves C, Bittencourt PCT, Pelegrini A. Ingestion of a THC-Rich Cannabis Oil in People with Fibromyalgia: A Randomized, Double-Blind, Placebo-Controlled Clinical Trial. *Pain Med*. 2020;21(10):2212-8. doi: <https://dx.doi.org/10.1093/pm/pnaa303>. PMID: 33118602.
16. Ware MA, Wang T, Shapiro S, et al. Cannabis for the Management of Pain: Assessment of Safety Study (COMPASS). *J Pain*. 2015 Dec;16(12):1233-42. doi: <https://dx.doi.org/10.1016/j.jpain.2015.07.014>. PMID: 26385201.
17. Xu DH, Cullen BD, Tang M, et al. The Effectiveness of Topical Cannabidiol Oil in Symptomatic Relief of Peripheral Neuropathy of the Lower Extremities. *Curr Pharm Biotechnol*. 2020;21(5):390-402. doi: <https://dx.doi.org/10.2174/1389201020666191202111534>. PMID: 31793418.
18. Eibach L, Scheffel S, Cardebring M, et al. Cannabidivarin for HIV-Associated Neuropathic Pain: A Randomized, Blinded, Controlled Clinical Trial. *Clin Pharmacol Ther*. 2020 Aug 08;08:08. doi: <https://dx.doi.org/10.1002/cpt.2016>. PMID: 32770831.

## Appendix I. Excluded Studies List

1. Abo Ziad R, Grynbaum MB, Peleg R, et al. The Attitudes and Beliefs of Family Physicians Regarding the Use of Medical Cannabis, Knowledge of Side Effects, and Barriers to Use: A Comparison Between Residents and Specialists. *Am J Ther*. 2020; Publish Ahead of Print. doi: <https://dx.doi.org/10.1097/MJT.0000000000001236>. PMID: 33416237. **Exclusion reason:** Ineligible study design
2. Aboud T, Schuster NM. Pain Management in Multiple Sclerosis: a Review of Available Treatment Options. *Curr Treat Options Neurol*. 2019 Nov 27;21(12):62. doi: <https://dx.doi.org/10.1007/s11940-019-0601-2>. PMID: 31773455. **Exclusion reason:** Used as source document
3. Abrams DI, Couey P, Dixit N, et al. Effect of Inhaled Cannabis for Pain in Adults With Sickle Cell Disease: A Randomized Clinical Trial. *JAMA netw*. 2020 Jul 01;3(7):e2010874. doi: <https://dx.doi.org/10.1001/jamanetworkopen.2020.10874>. PMID: 32678452. **Exclusion reason:** Inadequate duration
4. Abrams DI, Jay CA, Shade SB, et al. Cannabis in painful HIV-associated sensory neuropathy: a randomized placebo-controlled trial. *Neurology*. 2007 Feb 13;68(7):515-21. PMID: 17296917. **Exclusion reason:** Inadequate duration
5. Abuhasira R, Ron A, Sikorin I, et al. Medical Cannabis for Older Patients—Treatment Protocol and Initial Results. *J Clin Med*. 2019 Nov 01;8(11):01. doi: <https://dx.doi.org/10.3390/jcm8111819>. PMID: 31683817. **Exclusion reason:** Ineligible population
6. Abuhasira R, Ron A, Sikorin I, et al. Medical cannabis for older patients—treatment protocol and initial results. *J Clin Med*. 2019;8(11)doi: 10.3390/jcm8111819. **Exclusion reason:** Ineligible population
7. Akgün K, Essner U, Seydel C, et al. Daily Practice Managing Resistant Multiple Sclerosis Spasticity With Delta-9-Tetrahydrocannabinol: Cannabidiol Oromucosal Spray: A Systematic Review of Observational Studies. *J Cent Nerv Syst Dis*. 2019;11doi: 10.1177/1179573519831997. PMID: 30886530. **Exclusion reason:** Used as source document
8. Allan GM, Finley CR, Ton J, et al. Systematic review of systematic reviews for medical cannabinoids: Pain, nausea and vomiting, spasticity, and harms. *Can Fam Physician*. 2018 02;64(2):e78-e94. PMID: 29449262. **Exclusion reason:** Ineligible publication type
9. Almog S, Aharon-Peretz J, Vulfsons S, et al. The pharmacokinetics, efficacy, and safety of a novel selective-dose cannabis inhaler in patients with chronic pain: A randomized, double-blinded, placebo-controlled trial. *Eur J Pain*. 2020 May 23;23:23. doi: <https://dx.doi.org/10.1002/ejp.1605>. PMID: 32445190. **Exclusion reason:** Inadequate duration
10. Amato L, Minozzi S, Mitrova Z, et al. Systematic review of safety and therapeutic efficacy of cannabis in patients with multiple sclerosis, neuropathic pain, and in oncological patients treated with chemotherapy. *Epidemiol Prev*. 2017;41(5-6)doi: 10.19191/EP17.5-6.AD01.069. PMID: 29119763. **Exclusion reason:** Ineligible publication type
11. Andreae MH, Carter GM, Shaparin N, et al. Inhaled Cannabis for Chronic Neuropathic Pain: A Meta-analysis of Individual Patient Data. *J Pain*. 2015 Dec;16(12):1221-32. doi: <https://dx.doi.org/10.1016/j.jpain.2015.07.009>. PMID: 26362106. **Exclusion reason:** Inadequate duration
12. Aviram J, Pud D, Gershoni T, et al. Medical Cannabis Treatment for Chronic Pain: Outcomes and Prediction of Response. *Eur J Pain*. 2020 Oct 16;16:16. doi: <https://dx.doi.org/10.1002/ejp.1675>. PMID: 33065768. **Exclusion reason:** Ineligible comparator

13. Aviram J, Samuelly-Leichtag G. Efficacy of Cannabis-Based Medicines for Pain Management: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Pain physician*. 2017 09;20(6):E755-E96. PMID: 28934780. **Exclusion reason:** Used as source document
14. Ball S, Vickery J, Hobart J, et al. The Cannabinoid Use in Progressive Inflammatory brain Disease (CUPID) trial: a randomised double-blind placebo-controlled parallel-group multicentre trial and economic evaluation of cannabinoids to slow progression in multiple sclerosis. *Health technology assessment*. 2015;19(12):1-187. PMID: 25676540. **Exclusion reason:** Ineligible outcome
15. Barnes MP. Sativex: clinical efficacy and tolerability in the treatment of symptoms of multiple sclerosis and neuropathic pain. *Expert Opin Pharmacother*. 2006 Apr;7(5):607-15. PMID: 16553576. **Exclusion reason:** Ineligible publication type
16. Bellnier T, Brown GW, Ortega TR. Preliminary evaluation of the efficacy, safety, and costs associated with the treatment of chronic pain with medical cannabis. *Ment*. 2018 May;8(3):110-5. doi: <https://dx.doi.org/10.9740/mhc.2018.05.110>. PMID: 29955555. **Exclusion reason:** Ineligible comparator
17. Berger AA, Keefe J, Winnick A, et al. Cannabis and cannabidiol (CBD) for the treatment of fibromyalgia. *Best Practice and Research: Clinical Anaesthesiology*. 2020doi: 10.1016/j.bpa.2020.08.010. **Exclusion reason:** Ineligible publication type
18. Berman JS, Symonds C, Birch R. Efficacy of two cannabis based medicinal extracts for relief of central neuropathic pain from brachial plexus avulsion: results of a randomised controlled trial. *Pain*. 2004 Dec;112(3):299-306. PMID: 15561385. **Exclusion reason:** Inadequate duration
19. Blake A, Wan BA, Malek L, et al. A selective review of medical cannabis in cancer pain management. *Ann*. 2017 Dec;6(Suppl 2):S215-S22. doi: <https://dx.doi.org/10.21037/apm.2017.08.05>. PMID: 28866904. **Exclusion reason:** Ineligible population
20. Boehnke KF, Gagnier JJ, Matallana L, et al. Cannabidiol Use for Fibromyalgia: Prevalence of Use and Perceptions of Effectiveness in a Large Online Survey. *The journal of pain*. 2021doi: <https://dx.doi.org/10.1016/j.jpain.2020.12.001>. **Exclusion reason:** Ineligible study design
21. Boehnke KF, Scott JR, Litinas E, et al. High-Frequency Medical Cannabis Use Is Associated With Worse Pain Among Individuals With Chronic Pain. *J Pain*. 2020 May - Jun;21(5-6):570-81. doi: <https://dx.doi.org/10.1016/j.jpain.2019.09.006>. PMID: 31560957. **Exclusion reason:** Ineligible comparator
22. Boychuk DG, Goddard G, Mauro G, et al. The effectiveness of cannabinoids in the management of chronic nonmalignant neuropathic pain: a systematic review. *J Oral Facial Pain Headache*. 2015;29(1):7-14. doi: <https://dx.doi.org/10.11607/ofph.1274>. PMID: 25635955. **Exclusion reason:** Ineligible publication type
23. Busse JW, Wang L, Kamaleldin M, et al. Opioids for Chronic Noncancer Pain: A Systematic Review and Meta-analysis. *Jama*. 2018 12 18;320(23):2448-60. doi: <https://dx.doi.org/10.1001/jama.2018.18472>. PMID: 30561481. **Exclusion reason:** Used as source document
24. Campbell G, Hall WD, Peacock A, et al. Effect of cannabis use in people with chronic non-cancer pain prescribed opioids: findings from a 4-year prospective cohort study. *Lancet Public Health*. 2018 Jul;3(7):e341-e50. doi: 10.1016/s2468-2667(18)30110-5. PMID: 29976328. **Exclusion reason:** Ineligible comparator
25. Chan CJ. Efficacy of plant based cannabis in reducing pain in patients with chronic pain: A meta analysis. *Dissertation Abstracts International: Section B: The Sciences and Engineering*. 2020;81(10-B):No Pagination Specified. PMID: 2020-31777-030. **Exclusion reason:** Ineligible publication type
26. Christ MM. Pain medicine: Cannabis is effective in neuropathic pain. *Arzneimitteltherapie*. 2019;37(6):242-3. **Exclusion reason:** Not in English

27. Clermont-Gnamien S, Atlani S, Attal N, et al. The therapeutic use of  $\Delta^9$ -tetrahydrocannabinol (dronabinol) in refractory neuropathic pain. *Presse Medicale*. 2002;31(39 I):1840-5. **Exclusion reason:** Not in English
28. Cooper ZD, Abrams DI. Considering abuse liability and neurocognitive effects of cannabis and cannabis-derived products when assessing analgesic efficacy: a comprehensive review of randomized-controlled studies. *Am J Drug Alcohol Abuse*. 2019;45(6):580-95. doi: <https://dx.doi.org/10.1080/00952990.2019.1669628>. PMID: 31687845. **Exclusion reason:** Used as source document
29. Corey-Bloom J, Wolfson T, Gamst A, et al. Smoked cannabis for spasticity in multiple sclerosis: a randomized, placebo-controlled trial. *Cmaj*. 2012 Jul 10;184(10):1143-50. doi: <https://dx.doi.org/10.1503/cmaj.110837>. PMID: 22586334. **Exclusion reason:** Inadequate duration
30. Costales B, van Boemmel-Wegmann S, Winterstein A, et al. Clinical Conditions and Prescription Drug Utilization among Early Medical Marijuana Registrants in Florida. *J Psychoactive Drugs*. 2021:1-10. doi: <https://dx.doi.org/10.1080/02791072.2020.1864069>. **Exclusion reason:** Ineligible study design
31. Coughlin LN, Ilgen MA, Jannausch M, et al. Progression of cannabis withdrawal symptoms in people using medical cannabis for chronic pain. *Addiction (Abingdon, England)*. 2021doi: <https://dx.doi.org/10.1111/add.15370>. **Exclusion reason:** Ineligible study design
32. Crestani F. Medical Cannabis for the Treatment of Fibromyalgia. *J*. 2018 Aug;24(5):281. doi: <https://dx.doi.org/10.1097/RHU.00000000000000823>. PMID: 29757806. **Exclusion reason:** Ineligible study design
33. Cumenal M, Selvy M, Kerckhove N, et al. The safety of medications used to treat peripheral neuropathic pain, part 2 (opioids, cannabinoids and other drugs): review of double-blind, placebo-controlled, randomized clinical trials. Expert opinion on drug safety. 2020doi: <https://dx.doi.org/10.1080/14740338.2021.1842871>. **Exclusion reason:** Used as source document
34. Cunetti L, Manzo L, Peyraube R, et al. Chronic Pain Treatment With Cannabidiol in Kidney Transplant Patients in Uruguay. *Transplant Proc*. 2018 Mar;50(2):461-4. doi: <https://dx.doi.org/10.1016/j.transproceed.2017.12.042>. PMID: 29579828. **Exclusion reason:** Ineligible comparator
35. Cunningham CO, Starrels JL, Zhang C, et al. Medical Marijuana and Opioids (MEMO) Study: protocol of a longitudinal cohort study to examine if medical cannabis reduces opioid use among adults with chronic pain. *BMJ Open*. 2020;10(12):e043400. doi: <https://dx.doi.org/10.1136/bmjopen-2020-043400>. **Exclusion reason:** Ineligible study design
36. Curtis SA, Brandow AM, Deveaux M, et al. Daily Cannabis Users with Sickle Cell Disease Show Fewer Admissions than Others with Similar Pain Complaints. *Cannabis Cannabinoid Res*. 2020;5(3):255-62. doi: 10.1089/can.2019.0036. **Exclusion reason:** Ineligible study design
37. Darnall BD, Humphreys KN. An experimental method for assessing whether marijuana use reduces opioid use in patients with chronic pain. *Addiction*. 2018 08;113(8):1552-3. doi: <https://dx.doi.org/10.1111/add.14239>. PMID: 29882256. **Exclusion reason:** Ineligible study design
38. Degenhardt L, Lintzeris N, Campbell G, et al. Experience of adjunctive cannabis use for chronic non-cancer pain: findings from the Pain and Opioids IN Treatment (POINT) study. *Drug Alcohol Depend*. 2015 Feb 01;147:144-50. doi: <https://dx.doi.org/10.1016/j.drugalcdep.2014.11.031>. PMID: 25533893. **Exclusion reason:** Ineligible study design

39. Denduluri SK, Woolson ST, Indelli PF, et al. Cannabinoid and Opioid Use Among Total Joint Arthroplasty Patients: A 6-Year, Single-Institution Study. *Orthopedics*. 2020 Oct 01;1-6. doi: <https://dx.doi.org/10.3928/01477447-20200928-02>. PMID: 33002174. **Exclusion reason:** Ineligible outcome
40. Deshpande A, Mailis-Gagnon A, Zoheiry N, et al. Efficacy and adverse effects of medical marijuana for chronic noncancer pain: Systematic review of randomized controlled trials. *Can Fam Physician*. 2015 Aug;61(8):e372-81. PMID: 26505059. **Exclusion reason:** Ineligible publication type
41. Durán M, Capellà D. Cannabis and cannabinoids in the treatment of neuropathic pain. *DOLOR*. 2005;20(4):213-6. **Exclusion reason:** Not in English
42. Eadie L, Lo LA, Christiansen A, et al. Duration of Neurocognitive Impairment With Medical Cannabis Use: A Scoping Review. *Frontiers in Psychiatry*. 2021;12doi: 10.3389/fpsy.2021.638962. **Exclusion reason:** Used as source document
43. Ellis RJ, Toperoff W, Vaida F, et al. Smoked medicinal cannabis for neuropathic pain in HIV: a randomized, crossover clinical trial. *Neuropsychopharmacology*. 2009 Feb;34(3):672-80. doi: <https://dx.doi.org/10.1038/npp.2008.120>. PMID: 18688212. **Exclusion reason:** Inadequate duration
44. Fallon MT, Albert Lux E, McQuade R, et al. Sativex oromucosal spray as adjunctive therapy in advanced cancer patients with chronic pain unalleviated by optimized opioid therapy: two double-blind, randomized, placebo-controlled phase 3 studies. *Br*. 2017 Aug;11(3):119-33. doi: <https://dx.doi.org/10.1177/2049463717710042>. PMID: 28785408. **Exclusion reason:** Ineligible population
45. Feingold D, Brill S, Goor-Aryeh I, et al. Depression and anxiety among chronic pain patients receiving prescription opioids and medical marijuana. *J Affect Disord*. 2017 08 15;218:1-7. doi: <https://dx.doi.org/10.1016/j.jad.2017.04.026>. PMID: 28453948. **Exclusion reason:** Ineligible study design
46. Fiani B, Sarhadi KJ, Soula M, et al. Current application of cannabidiol (CBD) in the management and treatment of neurological disorders. *Neurol Sci*. 2020 Jun 16;16:16. doi: <https://dx.doi.org/10.1007/s10072-020-04514-2>. PMID: 32556748. **Exclusion reason:** Background only
47. First L, Douglas W, Habibi B, et al. Cannabis Use and Low-Back Pain: A Systematic Review. *Cannabis Cannabinoid Res*. 2020;5(4):283-9. doi: 10.1089/can.2019.0077. **Exclusion reason:** Used as source document
48. Fishbain DA, Cutler RB, Rosomoff HL, et al. Validity of self-reported drug use in chronic pain patients. *Clin J Pain*. 1999 Sep;15(3):184-91. PMID: 10524471. **Exclusion reason:** Background only
49. Fitzcharles MA, Baerwald C, Ablin J, et al. Efficacy, tolerability and safety of cannabinoids in chronic pain associated with rheumatic diseases (fibromyalgia syndrome, back pain, osteoarthritis, rheumatoid arthritis): A systematic review of randomized controlled trials. *Schmerz*. 2016 Feb;30(1):47-61. doi: <https://dx.doi.org/10.1007/s00482-015-0084-3>. PMID: 26767993. **Exclusion reason:** Ineligible publication type
50. Fitzcharles MA, Ste-Marie PA, Hauser W, et al. Efficacy, Tolerability, and Safety of Cannabinoid Treatments in the Rheumatic Diseases: A Systematic Review of Randomized Controlled Trials. *Arthritis care & research*. 2016 05;68(5):681-8. doi: <https://dx.doi.org/10.1002/acr.22727>. PMID: 26548380. **Exclusion reason:** Ineligible publication type
51. Flachenecker P, Henze T, Zettl UK. Nabiximols (THC/CBD oromucosal spray, Sativex®) in clinical practice--results of a multicenter, non-interventional study (MOVE 2) in patients with multiple sclerosis spasticity. *Eur Neurol*. 2014;71(5-6):271-9. doi: 10.1159/000357427. PMID: 24525548. **Exclusion reason:** Ineligible comparator

52. Flachenecker P, Henze T, Zettl UK. Long-term effectiveness and safety of nabiximols (tetrahydrocannabinol/cannabidiol oromucosal spray) in clinical practice. *Eur Neurol.* 2014;72(1-2):95-102. doi: 10.1159/000360285. PMID: 24943098. **Exclusion reason:** Ineligible comparator
53. Gado F, Mohamed KA, Meini S, et al. Variously substituted 2-oxopyridine derivatives: Extending the structure-activity relationships for allosteric modulation of the cannabinoid CB2 receptor. *Eur J Med Chem.* 2020;211:113116. doi: <https://dx.doi.org/10.1016/j.ejmech.2020.113116>. **Exclusion reason:** Ineligible study design
54. Gambino A, Cabras M, Panagiotakos E, et al. Evaluating the Suitability and Potential Efficiency of Cannabis sativa Oil for Patients with Primary Burning Mouth Syndrome: A Prospective, Open-Label, Single-Arm Pilot Study. *Pain Med.* 2020doi: <https://dx.doi.org/10.1093/pm/pnaa318>. **Exclusion reason:** Ineligible comparator
55. Grotenhermen F. Treatment of severe chronic pain with cannabis preparations. *Arztliche Praxis Neurologie Psychiatrie.* 2002(5):28-30. **Exclusion reason:** Not in English
56. Guillooard M, Authier N, Pereira B, et al. Cannabis use assessment and its impact on pain in rheumatologic diseases: a systematic review and meta-analysis. *Rheumatology (Oxford, England).* 2020doi: <https://dx.doi.org/10.1093/rheumatology/kea534>. **Exclusion reason:** Used as source document
57. Gutierrez T, Hohmann AG. Cannabinoids for the treatment of neuropathic pain: Are they safe and effective? *Future Neurology.* 2011;6(2):129-33. doi: 10.2217/fnl.11.6. **Exclusion reason:** Ineligible publication type
58. Haleem R, Wright R. A Scoping Review on Clinical Trials of Pain Reduction With Cannabis Administration in Adults. *J Clin Med Res.* 2020 Jun;12(6):344-51. doi: <https://dx.doi.org/10.14740/jocmr4210>. PMID: 32587650. **Exclusion reason:** Ineligible population
59. Hassan S, Zheng Q, Rizzolo E, et al. Does Integrative Medicine Reduce Prescribed Opioid Use for Chronic Pain? A Systematic Literature Review. *Pain Med.* 2020 04 01;21(4):836-59. doi: <https://dx.doi.org/10.1093/pm/pnz291>. PMID: 31755962. **Exclusion reason:** Ineligible intervention
60. Haungs A, Elizondo J. Does smoking cannabis help with chronic neuropathic pain? *Evidence-Based Practice.* 2018;21(2):E7-E8. **Exclusion reason:** Ineligible publication type
61. Hauser W, Fitzcharles M-A, Radbruch L, et al. Cannabinoids in pain management and palliative medicine: an overview of systematic reviews and prospective observational studies. *Dtsch.* 2017 Sep;114(38):627-34. PMID: 2017-48103-001. **Exclusion reason:** Used as source document
62. Hauser W, Fitzcharles MA, Radbruch L, et al. Cannabinoids in Pain Management and Palliative Medicine. *Dtsch.* 2017 Sep 22;114(38):627-34. doi: <https://dx.doi.org/10.3238/arztbl.2017.0627>. PMID: 29017688. **Exclusion reason:** Ineligible population
63. Hayes C, Martin JH. Lack of efficacy of cannabidiol for relieving back pain: time to re-set expectations? *Med J Aust.* 2021doi: 10.5694/mja2.51025. **Exclusion reason:** Ineligible publication type
64. Hendricks O, Andersen TE, Christiansen AA, et al. Efficacy and safety of cannabidiol followed by an open label add-on of tetrahydrocannabinol for the treatment of chronic pain in patients with rheumatoid arthritis or ankylosing spondylitis: protocol for a multicentre, randomised, placebo-controlled study. *BMJ Open.* 2019 06 04;9(6):e028197. doi: <https://dx.doi.org/10.1136/bmjopen-2018-028197>. PMID: 31167870. **Exclusion reason:** Ineligible study design
65. Hesselink JM, Kopsky DJ. Enhancing acupuncture by low dose naltrexone. *Acupunct Med.* 2011 Jun;29(2):127-30. doi: <https://dx.doi.org/10.1136/aim.2010.003566>. PMID: 21415049. **Exclusion reason:** Ineligible publication type

66. Hill KP, Hurley-Welljams-Dorof WM. Low to moderate quality evidence demonstrates the potential benefits and adverse events of cannabinoids for certain medical indications. *Evid Based Med*. 2016 Feb;21(1):17. doi: <https://dx.doi.org/10.1136/ebmed-2015-110264>. PMID: 26490847. **Exclusion reason:** Ineligible publication type
67. Hill KP, Palastro MD, Johnson B, et al. Cannabis and Pain: A Clinical Review. *Cannabis Cannabinoid Res*. 2017;2(1):96-104. doi: 10.1089/can.2017.0017. **Exclusion reason:** Used as source document
68. Hoggart B, Ratcliffe S, Ehler E, et al. A multicentre, open-label, follow-on study to assess the long-term maintenance of effect, tolerance and safety of THC/CBD oromucosal spray in the management of neuropathic pain. *J Neurol*. 2015 Jan;262(1):27-40. doi: <https://dx.doi.org/10.1007/s00415-014-7502-9>. PMID: 25270679. **Exclusion reason:** Ineligible study design
69. Hojsted J, Ekholm O, Kurita GP, et al. Addictive behaviors related to opioid use for chronic pain: a population-based study. *Pain*. 2013;154(12):2677-83. PMID: CN-01122248. **Exclusion reason:** Ineligible intervention
70. Holdcroft A, Smith M, Jacklin A, et al. Pain relief with oral cannabinoids in familial Mediterranean fever. *Anaesthesia*. 1997 May;52(5):483-6. PMID: 9165969. **Exclusion reason:** Ineligible study design
71. Huang IC, Alberts NM, Buckley MG, et al. Change in Pain Status and Subsequent Opioid and Marijuana Use Among Long-Term Adult Survivors of Childhood Cancer. *JNCI cancer spectrum*. 2020;4(6):pkaa070. doi: <https://dx.doi.org/10.1093/jncics/pkaa070>. **Exclusion reason:** Ineligible study design
72. Hwang JK, Clarke H. Cannabis and pain: A review. *Journal of Pain Management*. 2016;9(4):395-413. **Exclusion reason:** Ineligible publication type
73. Iskedjian M, Bereza B, Gordon A, et al. Meta-analysis of cannabis based treatments for neuropathic and multiple sclerosis-related pain. *Curr Med Res Opin*. 2007 Jan;23(1):17-24. PMID: 17257464. **Exclusion reason:** Ineligible publication type
74. Jawahar R, Oh U, Yang S, et al. A systematic review of pharmacological pain management in multiple sclerosis. *Drugs*. 2013 Oct;73(15):1711-22. doi: <https://dx.doi.org/10.1007/s40265-013-0125-0>. PMID: 24085618. **Exclusion reason:** Used as source document
75. Jensen TS, Madsen CS, Finnerup NB. Pharmacology and treatment of neuropathic pains. *Curr Opin Neurol*. 2009 Oct;22(5):467-74. doi: <https://dx.doi.org/10.1097/WCO.0b013e3283311e13>. PMID: 19741531. **Exclusion reason:** Ineligible publication type
76. Johal H, Devji T, Chang Y, et al. Cannabinoids in Chronic Non-Cancer Pain: A Systematic Review and Meta-Analysis. *Clin Med Insights Arthritis Musculoskelet Disord*. 2020;13:1179544120906461. doi: <https://dx.doi.org/10.1177/1179544120906461>. PMID: 32127750. **Exclusion reason:** Used as source document
77. Julia SG, Marta VR, Lourdes GR, et al. Off-label use of cannabinoids efficacy and safety. *European Journal of Clinical Pharmacy*. 2017;19(3):158-63. **Exclusion reason:** Ineligible study design
78. Kafil TS, Nguyen TM, MacDonald JK, et al. Cannabis for the treatment of ulcerative colitis. *Cochrane Database Syst Rev*. 2018 Nov 08;11:CD012954. doi: <https://dx.doi.org/10.1002/14651858.CD012954.pub2>. PMID: 30406638. **Exclusion reason:** Ineligible population
79. Karst M, Salim K, Burstein S, et al. Analgesic effect of the synthetic cannabinoid CT-3 on chronic neuropathic pain: a randomized controlled trial. *Jama*. 2003 Oct 01;290(13):1757-62. PMID: 14519710. **Exclusion reason:** Inadequate duration

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