Cannabinoids for treatment of chronic non-cancer pain; a systematic review of randomized trials

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Effective therapeutic options for patients living with chronic pain are limited. The pain relieving effect of cannabinoids remains unclear. A systematic review of randomized controlled trials (RCTs) examining cannabinoids in the treatment of chronic non-cancer pain was conducted according to the PRISMA statement update on the QUORUM guidelines for reporting systematic reviews that evaluate health care interventions. Cannabinoids studied included smoked cannabis, oromucosal extracts of cannabis based medicine, nabilone, dronabinol and a novel THC analogue. Chronic non-cancer pain conditions included neuropathic pain, fibromyalgia, rheumatoid arthritis, and mixed chronic pain. Overall the quality of trials was excellent. Fifteen of the eighteen trials that met the inclusion criteria demonstrated a significant analgesic effect of cannabinoid as compared with placebo and several reported significant improvements in sleep. There were no serious adverse effects. Adverse effects most commonly reported were generally well tolerated, mild to moderate in severity and led to withdrawal from the studies in only a few cases. Overall there is evidence that cannabinoids are safe and modestly effective in neuropathic pain with preliminary evidence of efficacy in fibromyalgia and rheumatoid arthritis. The context of the need for additional treatments for chronic pain is reviewed. Further large studies of longer duration examining specific cannabinoids in homogeneous populations are required.

Introduction

Chronic pain is common and debilitating with too few effective therapeutic options. Cannabinoids represent a relatively new pharmacological option as part of a multi-model treatment plan. With increasing knowledge of the endocannabinoid system [1–3] and compelling preclinical work supporting that cannabinoid agonists are analgesic [4, 5] there is increasing attention on their potential role in the management of chronic pain [6–9]. A previous systematic review done a decade ago identified the need for further randomized controlled trials (RCTs) evaluating cannabinoids in the management of chronic pain indicating that there was insufficient evidence to introduce cannabinoids into widespread use for pain at that time [10]. A subsequent review identified a moderate analgesic effect but indicated this may be offset by potentially serious harm [11]. This conclusion of serious harm mentioned in the more recent review is not consistent with our clinical experience. In addition there have been a number of additional RCTs published since this review. We therefore conducted an updated systematic review examining RCTs of cannabinoids in the management of chronic pain.

Methods

We followed the PRISMA update on the QUORUM statement guidelines for reporting systematic reviews that evaluate health care interventions [12].

Systematic search

A literature search was undertaken to retrieve RCTs on the efficacy of cannabinoids in the treatment for chronic pain. The databases searched were: PubMed, Embase, CINAHL (EBSCO), PsycInfo (EBSCO), The Cochrane Library (Wiley), ISI Web of Science, ABI Inform (Proquest), Dissertation Abstracts (Proquest), Academic Search Premier (EBSCO), ClinicalTrials.gov, TrialsCentral.org, individual pharmaceutical company trials sites for Eli Lilly and GlaxoSmithKline,
OAIster (OCLC) and Google Scholar. None of the searches was limited by language or date and were carried out between September 7 and October 7, 2010. The search retrieved all articles assigned the Medical Subject Headings (MeSH) Cannabis, Cannabinoids, Cannabidiol, Marijuana Smoking and Tetrahydrocannabinol as well as those assigned the Substance Name tetrahydrocannabinol-cannabidiol combination. To this set was added those articles containing any of the keywords cannabis, cannabinoi, marijuana, marihuana, dronabinol or tetrahydrocan- nibinol. Members of this set containing the MeSH heading Pain or the title keyword ‘pain’ were passed through the ‘Clinical Queries: therapy/narrow’ filter to arrive at the final results set. For the pain aspect, the phrase ‘Chronic pain’ along with title keyword ‘pain’ was used to retrieve the relevant literature. We contacted authors of original reports to obtain additional information. Bibliographies of included articles were checked for additional references.

Inclusion and exclusion criteria
Included were RCTs comparing a cannabinoid with a placebo or active control group where the primary outcome was pain in subjects with chronic non-cancer pain. Relevant pain outcomes included any scale measuring pain, for example the numeric rating scale for pain (NRS), visual analogue scale for pain (VAS), the Neuropathy Pain Scale or the McGill Pain Scale. We excluded (i) trials with fewer than 10 participants, (ii) trials reporting on acute or experimental pain or pain caused by cancer, (iii) preclinical studies and (iv) abstracts, letters and posters where the full study was not published.

Data extraction and validity scoring
One author (ML) did the initial screen of abstracts, retrieved reports and excluded articles that clearly did not meet the inclusion criteria. Both authors independently read the included articles and completed an assessment of the methodological validity using the modified seven point, four item Oxford scale [13, 14] (Figure 1). After reading the complete articles it was clear that several additional papers did not meet inclusion criteria and these were excluded. Discrepancies on the quality assessment scale were resolved by discussion. Trials that did not include randomization were not included and a score of 1 on this item of the Oxford scale was required and the maximum score was 7.

Information about the specific diagnosis of pain, agent and doses used, pain outcomes, secondary outcomes (sleep, function, quality of life), summary measures, trial duration and adverse events was collected. Information on adverse events was collected regarding serious adverse events, drug related withdrawals and most frequently reported side effects. A serious adverse event according to Health Canada and ICH1 guidance documents is defined as any event that results in death, is life threatening, requires prolonged hospitalization, results in persistent of significant disability or incapacity or results in congenital anomaly or birth defects [15].

Results

Trial flow
Eighty abstracts were identified of which 58 did not meet inclusion criteria on the initial review of records (Figure 2). Twenty-two RCTs comparing a cannabinoid with either a placebo or active control group where pain was listed as an outcome were found and full text articles were reviewed, four further studies were excluded, two because pain was not the primary outcome (Zajicek [16, 17]), one because there were fewer than 10 participants in the study (Rintala [18]). A further study was excluded because there were two studies reporting on what appeared to be the same group of participants (Salim [19], Karst [20]), in this case we included the first study in which the pain outcomes were reported (Karst). References of the included trials were reviewed for additional trials meeting inclusion criteria. This revealed no further studies. Eighteen trials met the study criteria for inclusion. We did not retrieve any unpublished data. Given the different cannabinoids, regimens, clinical conditions, different follow-up periods, and

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1. International Conference on Harmonization of Technical Requirements for the Registration of Pharmaceuticals for Human Use.
outcome measures used in these trials, pooling of data for meta-analysis was inappropriate. Results were therefore summarized qualitatively.

**Primary outcome – efficacy**

Eighteen trials published between 2003 and 2010 involving a total of 766 completed participants met inclusion criteria (Table 1). The quality of the trials was very good with a mean score of 6.1 on the 7 point modified Oxford scale. The majority (15 trials) demonstrated a significant analgesic effect for the cannabinoid agent being investigated. Several trials also noted significant improvements in sleep [21–24]. Treatment effects were generally modest, mean duration of treatment was 2.8 weeks (range 6 h–6 weeks) and adverse events were mild and well tolerated.

**Cannabis** Four trials examined smoked cannabis as compared with placebo. All examined populations with neuropathic pain and two involved neuropathic pain in HIV neuropathy [21, 25–27]. All four trials found a positive effect with no serious adverse effects. The median treatment duration was 8.5 days treatment (range 6 h–14 days).

**Oromucosal extracts of cannabis based medicine (CBM)** Seven placebo controlled trials examined CBM [22–24, 28–30]. Five examined participants with neuropathic pain, one rheumatoid arthritis and one a mixed group of people with chronic pain, many of whom had neuropathic pain. Six of the seven trials demonstrated a positive analgesic effect. Of note in the one trial examining pain in rheumatoid arthritis, the CBM was associated with a significant decrease in disease activity as measured by the 28 joint disease activity score (DAS28) [23].

**Nabilone** Four trials studied nabilone [31–34]. Three of these trials were placebo controlled and found a significant analgesic effect in spinal pain [34], fibromyalgia [32] and spasticity related pain [33]. The fourth compared a daily dose of nabilone 2 mg with dihydrocodeine 240 mg in neuropathic pain. Mean baseline pain was 69.6 mm on
<table>
<thead>
<tr>
<th>Author and date</th>
<th>Agent (control group)</th>
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<th>Core outcomes</th>
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<th>Oxford scale score</th>
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<th>AEs</th>
<th>Outcome summary</th>
</tr>
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<tbody>
<tr>
<td>Ware et al. [21]</td>
<td>Cannabis smoked 0%, 2.5%, 6%, 9.4% (placebo)</td>
<td>Neuropathic pain 21/23 crossover</td>
<td></td>
<td>NRS Pain, Leeds Sleep POMS</td>
<td>Difference in means</td>
<td>14 day treatment periods</td>
<td>Significantly lower average daily pain intensity on 9.4% THC (5.4) than 0% (6.1). Improved sleep. No change in mood.</td>
<td>No serious AEs</td>
<td>Headache</td>
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<tr>
<td>Ellis et al. [26]</td>
<td>Cannabis smoked 1–8% (Placebo)</td>
<td>HIV neuropathy 28/34 crossover</td>
<td></td>
<td>DDS pain, McGill VAS pain, POMS</td>
<td>Median difference in pain change</td>
<td>5 day treatment periods</td>
<td>Pain reduction significantly greater with cannabis than placebo median difference in pain reduction = 3.3 DDS points, effect size = 0.60. Also proportion achieving &gt;30% reduction greater for active 0.46 vs. placebo 0.18</td>
<td>No serious AEs</td>
<td>Two participants experienced treatment limiting side effects</td>
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<tr>
<td>Frank et al. [31]</td>
<td>Nabilone 2 mg (dihydrocodeine) 240 mg</td>
<td>Chronic neuropathic pain 96 crossover</td>
<td></td>
<td>VAS pain, Hamilton depression, SF-36</td>
<td>Difference in means</td>
<td>6 weeks</td>
<td>Both agents resulted in approximately a 10 mm reduction in a 0–100 mm VAS pain. Baseline 69.6 mm Nabilone 59.6 mm Dihydrocodeine 58.6 mm with dihydrocodeine providing marginally better pain relief</td>
<td>No serious AEs</td>
<td>Tiredness</td>
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<tr>
<td>Narang et al. [36]</td>
<td>Dronabinol 10, 20 mg (placebo)</td>
<td>Chronic pain on opioids 29/30 crossover</td>
<td></td>
<td>NRS pain intensity and pain relief</td>
<td>Difference in average pain intensity and total pain relief</td>
<td>1 day each treatment RCT 4 week open extension</td>
<td>Dronabinol at both doses significantly less pain and greater relief than placebo SDR −6.4 placebo, 10 mg (−17.4, P &lt; 0.01), 20 mg (−19.7, P &lt; 0.01) TOTPAR placebo (31.1), 10 mg (39.7, P &lt; 0.5) 20 mg (41.7, P &lt; 0.01 in both the RCT and the extension</td>
<td>No serious AEs</td>
<td>Drowsiness</td>
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<tr>
<td>Wilsey et al. [27]</td>
<td>Cannabis smoked 7.7%, 3.5% (placebo)</td>
<td>Neuropathic pain 38/44 crossover</td>
<td></td>
<td>VAS pain intensity, Pain relief PGIC</td>
<td>Difference in mean pain</td>
<td>6 h sessions</td>
<td>Cannabis both doses significantly less pain and pain unpleasantness (combined 3.5 and 7% cannabis vs. placebo differences per minute −0.0035, 95% P = 0.016)</td>
<td>No serious AEs or withdrawals</td>
<td>Feeling high</td>
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<tr>
<td>Skrabek et al. [34]</td>
<td>Dronabinol 0.5–1 mg twice daily (placebo)</td>
<td>Fibromyalgia 40 parallel group</td>
<td></td>
<td>VAS pain, FIQ</td>
<td>Difference in means</td>
<td>4 weeks treatment</td>
<td>Significant decrease in 10 cm VAS pain (∼−2.04, P &lt; 0.03), total FIQ (∼−12.0, P &lt; 0.02) and 10 point FIQ anxiety (∼−1.67, P &lt; 0.02) with nabilone vs. placebo</td>
<td>Three withdrew due to side effects</td>
<td>Dizziness</td>
</tr>
<tr>
<td>Abrams et al. [23]</td>
<td>Cannabis smoked 3.56% (placebo)</td>
<td>HIV sensory neuropathy 50/55 parallel group</td>
<td></td>
<td>VAS pain</td>
<td>Difference in Median daily pain ratings</td>
<td>7 day inpatient 7 day outpatient</td>
<td>Significant reduction in pain with cannabis vs. placebo. Median reduction in pain was 34% (17% placebo) &gt;30% relief 52% (vs. 24%) NNT = 3.6</td>
<td>All side effects were mild and included</td>
<td>Anxiety</td>
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<tr>
<td>Study</td>
<td>Intervention</td>
<td>Neuropathic pain with allodynia</td>
<td>NRS pain</td>
<td>Mean change VAS pain</td>
<td>Weeks</td>
<td>Concurrent option</td>
<td></td>
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<td>Numikko et al. [30]</td>
<td>Cannabis based medicine THC/CBD (placebo)</td>
<td>Neuropathic pain with allodynia</td>
<td>NRS pain</td>
<td>PGIC, PI</td>
<td>7 weeks plus open label extension option</td>
<td>Significantly less pain with Sativex vs. placebo Mean change of −1.48 Sativex vs. −0.52 P = 0.006</td>
<td>18% withdrew on Sativex vs. 3% on placebo No serious AEs by definition below Most described as mild Dizziness Nausea Fatigue Dry mouth But seven in Sativex group and five in placebo group graded them as 'severe' Paranoid thinking was reported in one patient while on Sativex</td>
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<td>Wisse et al. [33]</td>
<td>Nabilone 1 mg day (^{-1}) (placebo)</td>
<td>Spasticity related pain in UMNS 11/13 crossover</td>
<td>NRS pain</td>
<td>PI / HQ-12</td>
<td>11-point box test</td>
<td>Significant decrease in spasticity related pain with reduction of median 2 points with nabilone vs. placebo but no significant change in spasticity according to Ashworth scale or motor or ADL Two patients withdrew one due to a relapse felt not to be related to the nabilone, the other due to leg weakness, rest described as mild Drowsiness (2) Slight weakness legs (1)</td>
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<tr>
<td>Pinger et al. [34]</td>
<td>Nabilone 0.25-1 mg day (^{-1}) (placebo)</td>
<td>Chronic pain (spinal) 30 crossover</td>
<td>VAS pain intensity Cohen QOL</td>
<td>PI</td>
<td>3 weeks</td>
<td>Significant decrease in pain intensity (0.6) (0.0) P = 0.006 on nabilone vs placebo</td>
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<td>Bog et al. [22]</td>
<td>Cannabis based medicine THC/CBD (placebo)</td>
<td>Central pain in MS 64/66 parallel group</td>
<td>NRS pain and sleep HADS PGIC</td>
<td>PI</td>
<td>7 weeks</td>
<td>Significant reductions in pain (NRS, NPS) and sleep disturbance (NRS) with CBM 3.85 vs. placebo 4.96 NNT = 3.7 NNI = 13 No significant changes in blood pressure, weight, haematology, blood chemistry</td>
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<tr>
<td>Blake et al. [23]</td>
<td>Cannabis based medicine mean dose 5.4 sprays/day (placebo)</td>
<td>Rheumatoid arthritis 58 parallel group</td>
<td>NRS pain, sleep SF-MPQ DAS28</td>
<td>PI</td>
<td>4 weeks</td>
<td>Significant improvements in pain on movement (difference mean/intensity median = 0.95, P = 0.04 at rest, 1.04, P = 0.01, quality of sleep 1.17, P = 0.02, DAS28 0.76, P = 0.002, and SF-MPQ, 3.00, P = 0.30 with CBM vs placebo) No serious AEs No treatment related withdrawals All mild to moderate Dizziness Somnolence Dissociation Dry mouth Nausea Weakness</td>
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<td>Berman et al. [24]</td>
<td>Cannabis based medicine THC/CBD, THC 8 sprays day (^{-1}) (placebo)</td>
<td>Neuropathic pain brachial plexus avulsion 48 crossover</td>
<td>NRS pain</td>
<td>SF-MPQ</td>
<td>7 weeks</td>
<td>Statistically significant reductions in pain (NRS) and sleep disturbance (NRS) but not to the full 2 point reduction (i.e. reduction of 0.58, P = 0.005 and 0.64, P = 0.002)</td>
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<tr>
<td>Svendsen et al. [35]</td>
<td>Dronabinol 10 mg (placebo)</td>
<td>Central pain in MS 24 crossover</td>
<td>NRS pain Pain relief SF-36</td>
<td>PI</td>
<td>7 weeks</td>
<td>Significant reductions in pain (NRS) modest reductions 1 point on a 0–10 point scale NNI for 50% relief=3.45 Dizziness Headache Tiredness Myalgia Muscle weakness Dose reduction resolved the AEs in the four who experienced 'intolerable level' of the AE Four experienced aggravation of MS, one during drug treatment, two during placebo and one during washout</td>
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Table 1

<table>
<thead>
<tr>
<th>Author and date</th>
<th>Agent (control group)</th>
<th>Population (n completed/randomized design)</th>
<th>Core outcomes*</th>
<th>Summary measures used</th>
<th>Oxford scale score</th>
<th>Duration of RCT</th>
<th>Results (brief comments)</th>
<th>AEs†</th>
<th>Outcome summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wade et al. [28]</td>
<td>Cannabis based medicines THC/CBD (placebo)</td>
<td>MS 160 where 37 had pain as target symptom parallel group</td>
<td>VAS pain spasticity, spasms, bladder problems, tremor</td>
<td>Difference in means</td>
<td>6</td>
<td>6 weeks</td>
<td>No significant difference in pain scores (VAS) between CBM and placebo all decreased. There was a significant reduction in spasticity (VAS) scores.</td>
<td>Dizziness</td>
<td>–</td>
</tr>
<tr>
<td>Karst et al. [37]</td>
<td>Synthetic analogue of THC 11-oic acid (placebo)</td>
<td>Neuropathic pain with hyperalgesia or allodynia 190:1 crossover</td>
<td>VAS pain, Pain relief</td>
<td>Differences in means</td>
<td>7</td>
<td>1 week treatment periods</td>
<td>Significant improvement in pain intensity 3 h after study drug (±11.54 or 9.86, P = 0.02) difference between CT:3 and placebo by 8 h. No significant change pain relief.</td>
<td>No serious AEs</td>
<td>+</td>
</tr>
<tr>
<td>Notcutt et al. [57]</td>
<td>Cannabis based medicine THC CBD THC:CBD (placebo)</td>
<td>Chronic pain 24 of 34 N of 1° 2 week openRCT 1 week Rx periods x 2 for each CBME crossover</td>
<td>VAS pain for Two worst pain symptoms BDI GHQ Sleep</td>
<td>Difference in medians</td>
<td>4</td>
<td>Two 1 week treatment periods or each agent</td>
<td>Significant reduction in pain (VAS) for THC and THC:CBD Cumulative VAS (median, interquartile range for worst pain Placebo 5.9 (2.8–7.3) CBD 5.45 (3.6–7.4) THC 4.63 (1.74–6.06) THC:CBD 4.4 (2.6–5.8) P = 0.001) 9/24 had a reduction of &gt;50% with THC or THC: CBD</td>
<td>No serious AEs</td>
<td>+</td>
</tr>
<tr>
<td>Wade et al. [29]</td>
<td>Cannabis based medicine THC CBD THC:CBD (placebo)</td>
<td>Neurogenic symptoms in MS/sympathetic plexus injury/brain injury/defect</td>
<td>VAS pain Intoxication Alariness Appetite Happiness etc</td>
<td>Difference in means</td>
<td>7</td>
<td>2 week study periods</td>
<td>Difference in mean VAS pain between CBM and placebo = 10.3 for CBD, 10.1 for THC, P = 0.05 Significant reductions in pain CBD and THC but not the combination.</td>
<td>Three withdrawals</td>
<td>+</td>
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</table>

*Examples:
- Pain: NRS, VAS other scale
  - At least 50% pain reduction
  - At least 30% pain reduction
  - Patient global impression
  - Other key measures, sleep, side effects were for the whole group.

†Adverse events

Note serious adverse events defined by:
- results in death
- is life threatening
- requires or prolongs inpatient hospitalization
- results in persistent or significant disability or incapacity
- results in congenital anomaly or birth defects

Clinical Research in Canada; Edition: January 1, 2006, Book 11, Section title, Guidance for Industry, Clinical Safety Data Management: Definitions and Standards for Expedited Reporting (ICH-E2A); definition is on page 3 of this section, under the heading of ‘Serious Adverse Event or Adverse Drug Reaction’.

DOS descriptor differential scale, ratio scale 24 words describe pain 0–20, PGIC, patient global impression of change; POMS, profile of mood states; PDI, Pain Disability Index, HADS, Hospital anxiety and depression scale; SF-36, McGill Pain Questionnaire, short form; DAS24, 28 joint disease activity score; UNNS, Upper Motor Neuron Syndrome; TOTPAR, total pain relief; SDI, sum pain intensity difference; BDI, Beck Depression Inventory; GHQ, General Health Questionnaire. 

*means fractured.
the 100 mm VAS and dropped to 59.93 mm for participants taking nabilone and 58.58 mm for those taking dihydrocodeine [31].

**Dronabinol** Two trials involved dronabinol. The earlier trial found that dronabinol 10 mg day\(^{-1}\) led to significant reduction in central pain in multiple sclerosis [35], a subsequent trial found that dronabinol at both 10 and 20 mg day\(^{-1}\) led to significantly greater analgesia and better relief than placebo as adjuvant treatment for a group of participants with mixed diagnoses of chronic pain on opioid therapy [36].

**THC-11-oic acid analogue (CT-3 or ajulemic acid)** Two studies reported on various aspects of this trial examining ajulemic acid in a group of participants with neuropathic pain with hyperalgesia or allodynia [37, 38]. Nineteen of 21 completed the trial. It was found that ajulemic acid led to significant improvement in pain intensity at 3 h but no difference at 8 h as compared with placebo.

**Secondary outcome – level of function**
Several trials included secondary outcome measures relating to level of function. Two trials examining cannabis based medicines included the Pain Disability Index (PDI) [24, 30]. Numikko found that six of seven functional areas assessed by the PDI demonstrated significant improvement on CBM (−5.61) as compared with placebo (0.24) (estimated mean difference −5.85, \(P = 0.003\)) in 125 participants with neuropathic pain while Berman [24] noted no significant difference from placebo in 48 participants with central pain from brachial plexus avulsion. Two studies included the Barthel index for activities of daily living (ADL) [28, 33] and noted no significant improvement in ADLs with nabilone for spasticity related pain [33] or with CBMs for multiple sclerosis [28]. In one trial examining nabilone for the treatment of fibromyalgia the FIQ [39] demonstrated significant improvement as compared with placebo. This measure includes a number of questions regarding function in several areas including shopping, meal preparation, ability to do laundry, vacuum, climb stairs and ability to work. The FIQ also includes questions relating to pain, fatigue, stiffness and mood. The total scores presented in this study were not presented separately so the reader cannot be certain. However given that the majority of questions relate to function it is likely that there were some improvements in function.

**Drug related adverse effects**
There were no serious adverse events according to the Health Canada definition described above and in Table 1. The most common adverse events consisted of sedation, dizziness, dry mouth, nausea and disturbances in concentration. Other adverse events included poor co-ordination, ataxia, headache, paranoid thinking, agitation, dissociation, euphoria and dysphoria. Adverse effects were generally described as well tolerated, transient or mild to moderate and not leading to withdrawal from the study. This is a significant difference from the withdrawal rates seen in studies of other analgesics such as opioids where the rates of abandoning treatment are in the range of 33% [40]. Except where specifically noted in Table 1 there was no specific mention of whether adverse effects caused limitations in function. The most severe treatment related event in the entire sample was a fractured leg related to a fall that was thought to be related to dizziness [34]. Details regarding specific trials are presented in Table 1.

**Discussion**

**Efficacy and harm**
All of the trials included in this review were conducted since 2003. No trials prior to this date satisfied our inclusion criteria. This review has identified 18 trials that taken together have demonstrated a modest analgesic effect in chronic non-cancer pain, 15 of these were in neuropathic pain with five in other types of pain, one in fibromyalgia, one in rheumatoid arthritis, one as an adjunct to opioids in patients with mixed chronic pain and two in mixed chronic pain. Several trials reported significant improvements in sleep. There were no serious adverse events. Drug related adverse effects were generally described as well tolerated, transient or mild to moderate and most commonly consisted of sedation, dizziness, dry mouth, nausea and disturbances in concentration.

**Limitations**
The main limitations to our findings are short trial duration, small sample sizes and modest effect sizes. Thus there is a need for larger trials of longer duration so that efficacy and safety, including potential for abuse, can be examined over the long term in a greater number of patients. It is also important to recognize that cannabinoids may only reduce pain intensity to a modest degree. It remains for the patients to decide whether this is clinically meaningful.

**The context of chronic pain**
Pain is poorly managed throughout the world. Eighty percent of the world population has no or insufficient access to treatment for moderate to severe pain [41]. Chronic pain affects approximately one in five people in the developed world [42–46] and two in five in less well resourced countries [47]. Children are not spared [48, 49] and the prevalence increases with age [43, 50]. The magnitude of the problem is increasing. Many people with diseases such as cancer, HIV and cardiovascular disease are now surviving their acute illness with resultant increase in quantity of life, but in many cases, poor quality of life due to persistent pain caused either by the ongoing illness or nerve damage caused by the disease after resolution or cure of the disease. In many cases the pain is also caused by
the treatments such as surgery, chemotherapy or radiotherapy needed to treat the disease [51–53].

Chronic pain is associated with the worst quality of life as compared with other chronic diseases such as chronic heart, lung or kidney disease [50]. Chronic pain is associated with double the risk of suicide as compared with those living with no chronic pain [54].

In this context, patients living with chronic pain require improved access to care and additional therapeutic options. Given that this systematic review has identified 18 RCTs demonstrating a modest analgesic effect of cannabinoids in chronic pain that are safe, we conclude that it is reasonable to consider cannabinoids as a treatment option in the management of chronic neuropathic pain with evidence of efficacy in other types of chronic pain such as fibromyalgia and rheumatoid arthritis as well. Of special importance is the fact that two of the trials examining smoked cannabis [25, 26] demonstrated a significant reduction in disease activity was also noted, which is consistent with pre-clinical work demonstrating that cannabinoids are anti-inflammatory [55, 56].

**Conclusion**

In conclusion this systematic review of 18 recent good quality randomized trials demonstrates that cannabinoids are a modestly effective and safe treatment option for chronic non-cancer (predominantly neuropathic) pain. Given the prevalence of chronic pain, its impact on function and the paucity of effective therapeutic interventions, additional treatment options are urgently needed. More large scale trials of longer duration reporting on pain and level of function are required.

**Competing Interests**

The authors have no competing interests.

**REFERENCES**


5 Guindon J, Hohmann AG. The endocannabinoid system and pain. CNS Neurol Dis Drug Targets 2009; 8: 403–21.


