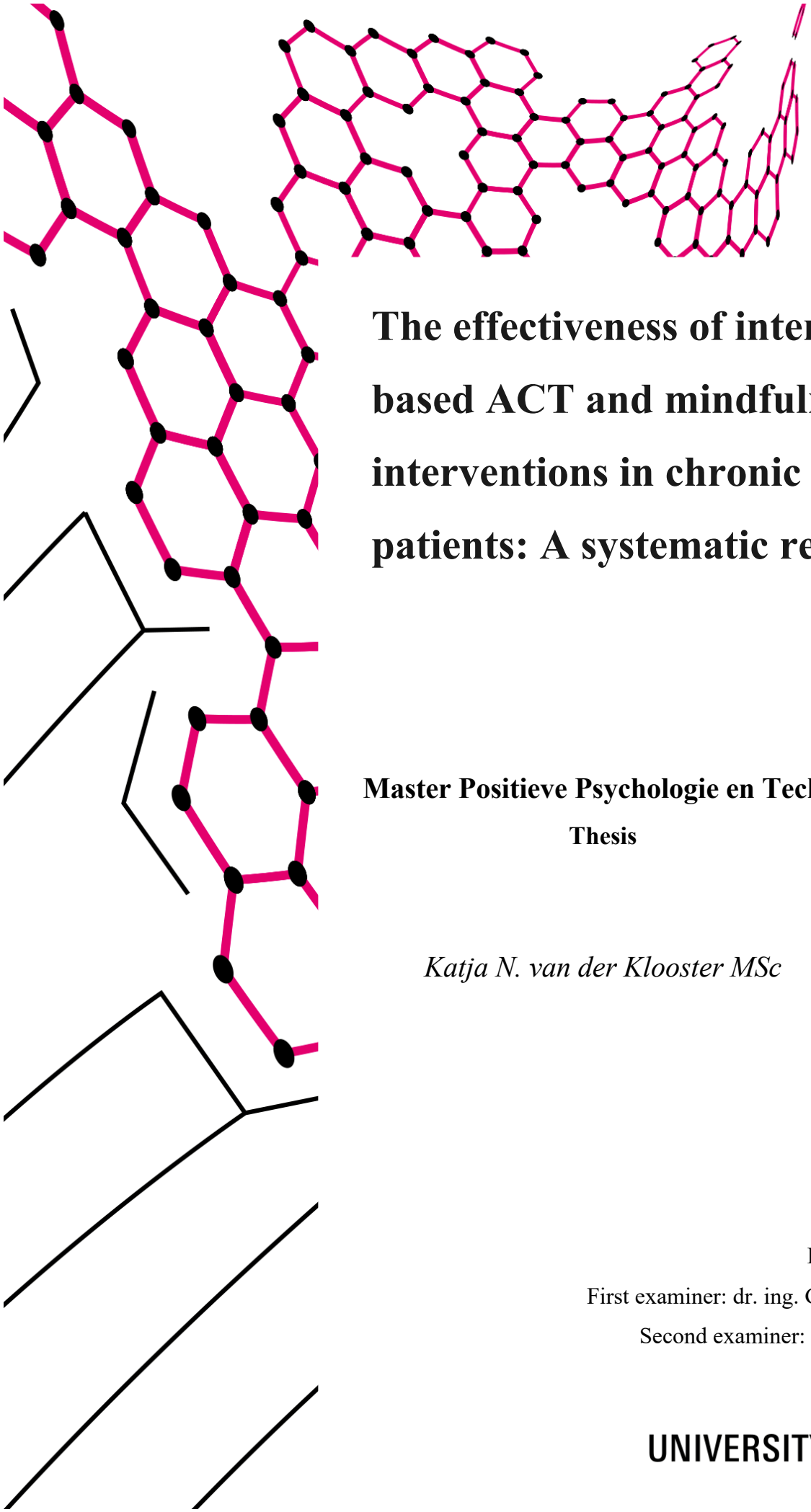

The effectiveness of internet-based ACT and mindfulness interventions in chronic pain patients: A systematic review

Master Positieve Psychologie en Technologie

Thesis

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Abstract

There is a growing body of evidence that shows that third generation Cognitive Behavioral Therapy (CBT; Acceptance and Commitment Therapy (ACT) and mindfulness interventions), can be effective in the management of chronic pain. As a result of increasing internet-use, also third generation CBT interventions are more and more delivered online. However, there are no systematic reviews on the effectiveness of internet-based third generation CBT for chronic pain yet. Therefore, the aim of this thesis is to provide an overview of the existing RCT's on the effectiveness of internet-based ACT and mindfulness interventions in chronic pain patients. Until 2019-01-03, databases (PubMed, PsycINFO, Web of Science, Scopus) were searched for published journal articles. The search strategy combined keywords for ACT and mindfulness with keywords for chronic pain and internet-based. Two reviewers independently assessed the quality of the RCT's using the Cochrane risk of bias tool. Eight RCT's were included in this thesis, with a total study population of 1060 participants with chronic pain. Four RCT's assessed the effectivity of online ACT and four of online mindfulness (mindful socioemotional regulation (MSER), Mindfulness-Based Cognitive Therapy (MBCT), Mindfulness-Based Pain Management (MBPM), Mindfulness-Based Stress Reduction (MBSR)). All ACT interventions were guided, whereas one ACT study used both a guided and an unguided version of ACT. Only one mindfulness intervention was guided (MBCT). With regard to the quality of the included RCT's, most had a low or unclear risk of bias on almost all domains, except on performance bias. Significant effects of online ACT were found on pain reduction, the impact of pain on daily life, pain coping efficacy, the development of psychological flexibility and mindfulness, the acceptance of pain, and psychological health. Significant effects of online mindfulness were found on pain reduction, social activity engagement, pain coping efficacy, the development of mindfulness, the acceptance of pain, psychological health, life satisfaction, perceived social relations, and stress coping efficacy. No conclusions about the difference in effectiveness between ACT and mindfulness, and between guided and unguided interventions could be drawn yet. Findings suggests that online ACT and mindfulness interventions may be a valuable addition in the treatment of chronic pain, for example through delivering them to patients on waiting lists in pain clinics. More RCT's assessing the effectivity of specific forms of ACT and mindfulness in specific pain populations are needed, in order to substantiate the use of online third generation CBT in health care more strongly.

Samenvatting

Er komt steeds meer bewijs voor de effectiviteit van derde generatie Cognitieve Gedragstherapie (CGT; Acceptatie en Commitment Therapie (ACT) en mindfulness-interventies), in de behandeling van chronische pijn. Door het toenemende internetgebruik worden ook derde generatie CGT-interventies in grotere mate online aangeboden. Echter, er zijn nog geen systematische reviews die de effectiviteit van online derde generatie CGT voor chronische pijn beschrijven. Daarom is het doel van deze these om een overzicht te verschaffen van de bestaande RCT's over de effectiviteit van online ACT en mindfulness-interventies bij chronische pijn patiënten. Tot 03-01-2019 werd in databases (PubMed, PsycINFO, Web of Science, Scopus) gezocht naar gepubliceerde journal artikelen. De zoekstrategie combineerde termen voor ACT en mindfulness met termen voor chronische pijn en online. Twee reviewers beoordeelden onafhankelijk van elkaar de kwaliteit van de RCT's met behulp van de Cochrane risk of bias tool. Acht RCT's werden in deze these geïncludeerd, met een totale studiepopulatie van 1060 participanten met chronische pijn. Vier RCT's beoordeelden de effectiviteit van online ACT en vier van online mindfulness (mindful socioemotional regulation (MSER), Mindfulness-Based Cognitive Therapy (MBCT), Mindfulness-Based Pain Management (MBPM), Mindfulness-Based Stress Reduction (MBSR)). Alle ACT-interventies waren begeleid, terwijl één ACT-studie een begeleide én onbegeleide versie van ACT gebruikte. Eén mindfulness interventie was begeleid (MBCT). Met betrekking tot de kwaliteit van de studies, hadden de meesten een laag of onduidelijk risico op bias op bijna alle domeinen, behalve op performance bias. Significante effecten van online ACT werden gevonden voor pijn reductie, de invloed van pijn op het dagelijks leven, de omgang met pijn, de ontwikkeling van psychologische flexibiliteit en mindfulness, de acceptie van pijn en psychologische gezondheid. Significante effecten van online mindfulness werden gevonden voor pijn reductie, de betrokkenheid in sociale activiteiten, de omgang met pijn, het ontwikkelen van mindfulness, de acceptatie van pijn, psychologische gezondheid, levenstevredenheid, de beleving van sociale relaties en het omgaan met stress. Er konden voor alsnog geen conclusies getrokken worden over de verschillen in effectiviteit tussen ACT en mindfulness en tussen begeleide en onbegeleide interventies. De bevindingen suggereren dat online ACT en mindfulness een waardevolle aanvulling kunnen zijn in de behandeling van chronische pijn, door ze onder andere te leveren aan patiënten op wachtlijsten in pijnklinieken. Er zijn meer RCT's nodig die de effectiviteit beoordelen van specifieke vormen van ACT en mindfulness in specifieke pijn populaties, om het gebruik van online derde generatie CBT in de gezondheidszorg sterker te onderbouwen.

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Introduction

Chronic pain, also defined as longstanding pain lasting for more than three months, is a major health problem: one out of five to six people in the Netherlands struggles with chronic pain (Gezondheidsplein, 2018). Chronic pain can cause huge issues, for instance poor general health, disturbed daily functioning, high healthcare use and therefore high health care costs, as well as significant psychological problems, including depression, anxiety disorders and substance abuse disorder (McCracken & Vowles, 2009). Biopsychosocial processes play a crucial role in the suffering and disability of chronic pain patients. Therefore, biomedical models of chronic pain and the corresponding pharmacological, interventional and surgical treatments are not entirely adequate, particularly in the longer term (McCracken & Vowles, 2009).

There is a growing body of evidence that shows that psychological interventions can be effective in the management of chronic pain (Eccleston, Williams & Morley, 2012; Hoffman, Papas, Chatkoff & Kerns, 2007; Koes, Van Tulder & Thomas, 2006; Morley, Eccleston & Williams, 1999; Van Tulder et al., 2000), and are even more effective than medically focused interventions (McCracken & Vowles, 2009). Cognitive Behavioral Therapy (CBT) is to date the most well-known psychological intervention for the treatment of chronic pain (Lim et al., 2018), and addresses emotional functioning, which is a core part of the experience of chronic pain (McCracken & Vowles, 2009). However, only moderate effect sizes were reported (Eccleston, Williams & Morley, 2012; Hoffman, Papas, Chatkoff & Kerns, 2007; Koes, Van Tulder & Thomas, 2006; Morley, Eccleston & Williams, 1999; Van Tulder et al., 2000).

In recent years, there is an increasing interest in the use of ‘third generation CBT’ for the treatment of chronic pain (McCracken & Vowles, 2014). In these interventions, the focus is not so much on controlling or fighting the pain, but on changing the influence of pain on a person’s daily life, by accepting it (Scott & McCracken, 2015). This basic thought is based on the principles of mindfulness. *Mindful* refers to a state of mind in which an individual is in the present, conscious and non-judgmental (Noonan, 2014). One is aware of thoughts, feelings or bodily sensations in the present moment with an open and accepting orientation towards one's experiences (Kabat-Zinn, 1990). Three most well-known intervention programs focusing on these processes of mindfulness and acceptance are: Mindfulness-Based Stress Reduction (MBSR), Mindfulness-Based Cognitive Therapy (MBCT) and Acceptance and Commitment Therapy (ACT).

MBSR was founded by Dr. Jon Kabat-Zinn about forty years ago and developed at the University of Massachusetts Medical School. Through an eight-week course, exercising basic relaxation, breathing techniques, meditation and yoga, individuals learned to appreciate the present (Noonan, 2014). MBCT combines MBSR with the ideas of CBT. Different from CBT, MBCT places little emphasis on changing or altering thought content, but aims at the awareness of the patient's relationship with his or her thoughts and feelings (Sipe & Eisendrath, 2012).

ACT integrates acceptance- and mindfulness-based methods together with activation and behavior change methods (McCracken & Vowles, 2014). The goal of ACT is to reduce the impact of pain on a patient's daily life by increasing the engagement in activities that bring "meaning, vitality and importance" to the life of a patient, through enhancing psychological flexibility (McCracken & Vowles, 2014; Pielech, Vowles & Wicksell, 2017). Psychological flexibility refers to a person's ability to be aware of the present moment, and to persist with or change behavior that is consistent with one's values and goals, even in the presence of interfering private experiences (Fletcher & Hayes, 2005; Hayes, Strosahl & Wilson, 1999; Scott & McCracken, 2015).

There are several systematic reviews and meta-analyses addressing the effectiveness of third generation CBT interventions in chronic pain patients. For example, Veehof, Oskam, Schreurs and Bohlmeijer (2011) found medium effect sizes for pain intensity, depression, anxiety, physical wellbeing and quality of life, when all studies focusing on the change score before and after treatment were included. Instead, Marikar Bawa et al. (2015) found no beneficial effects in clinical outcomes, such as pain intensity and depression, but they did find a moderate effect size on perceived pain control. In another systematic review, Hann and McCracken (2014) found ACT to be effective in chronic pain patients, especially with regard to outcomes of physical and emotional functioning, in comparison to inactive control groups.

Today, along with increasing use of internet and technology, third generation CBT interventions for a variety of problems, including chronic pain, are more and more being offered online (Van Rooijen, 2012). The use of internet-based interventions has a number of advantages over face-to-face interventions, for both patients and health care providers (Andersson & Titov, 2014; Van Gemert-Pijnen, Peters & Ossebaard, 2013; Van Rooijen, 2012; Wright et al., 2005). For patients, online interventions are easily accessible and time efficient, due to the absence of long waiting lists and needed traveling time, and the availability of the materials 24/7. Furthermore, online interventions permit patients to remain anonymous without the need to adopt a patient role. On top of that, internet-based

interventions are cost efficient, because, among other things, they do not necessarily require involvement of an educated therapist (Andersson & Titov, 2014; Van Gemert-Pijnen, Peters & Ossebaard, 2013; Van Rooijen, 2012). For health care providers in general, the use of internet-based interventions reduces treatment time while maintaining efficacy, which allows therapists to treat more patients within the same time and amount of money. This can shorten waiting lists of health care clinics (Van Rooijen, 2012; Wright et al., 2005).

Despite it's advantages, internet-based interventions have a number of disadvantages. The biggest one is the lack of face-to-face contact in online interventions, which may result in higher drop-out rates and non-adherence for people with lower levels of independence and self-discipline. Furthermore, internet-based interventions are not appropriate for all kinds of population groups, for example people suffering from technophobia or people who dislike communicating via a computer or smartphone (Van Rooijen, 2012).

It has been found that internet-based interventions can be as effective (Wright et al., 2005), or even more effective than face-to-face interventions (Wantland et al., 2004). Moreover, Wahbeh, Svalina and Oken (2014) showed in a cross-sectional survey among 500 adults in the United States that many people prefer individual and online formats for mindfulness interventions above group formats.

All in all, internet-based third generation CBT interventions could be an acceptable alternative to face-to-face formats. However, as far as our knowledge goes, there are no systematic reviews about the effectiveness of online third generation CBT for chronic pain patients yet. Therefore, the aim of this thesis is to provide an overview of the existing RCT's on the effectiveness of internet-based ACT and mindfulness interventions in chronic pain patients. The specific objectives are to: (1) identify the intervention characteristics of the various internet-based ACT and mindfulness interventions for chronic pain, (2) examine the quality of the RCT's on internet-based ACT and mindfulness interventions in chronic pain patients, and (3) to determine the effectivity of internet-based ACT and mindfulness interventions in chronic pain patients.

Method

Search strategy

In this thesis the literature search was conducted in the following electronic databases: PubMed, PsycINFO, Web of Science and Scopus. In order to check for missed but relevant (unpublished) studies, an additional search was conducted in the Cochrane Library and EBSCO OpenDissertations. The databases were searched for published journal articles, without restrictions for publishing date. The following search terms were used: ("chronic pain" or "chronic low back pain" or CLBP or "low back pain" or "back pain" or "neck pain" or "pelvic pain" or "facial pain" or "musculoskeletal pain" or migraine or neuropathy or neuralgia or sciatica or fibromyalgia or FM or "whiplash associated disorder" or WAD or "repetitive strain injury" or RSI or dystrophy or headache) and ("acceptance and commitment therapy" or acceptance* or ACT) or (mindfulness* or mindful* or MBSR or MBCT) and (internet-based or "mobile applications" or computers or mobile* or internet* or eHealth or application or app or web-based or website or "web based" or online* or computer*). See the appendix for the full search strategy. In addition, existing reviews on this subject were screened for relevant records. The search was conducted until 2019-01-03.

Selection of studies

First of all, duplicates were removed. After that, the titles of the remaining articles were reviewed, after which the abstracts from the potentially valuable articles were read. Next, the full texts of the remaining articles were screened.

The selection of articles was based on the inclusion criteria (see below) and carried out by one reviewer (K.K.). A second reviewer (S.S.) checked the selection. All this was done under supervision of a third reviewer (G.P).

Inclusion and exclusion criteria in the study selection were based on previous reviews (Macea, Gajos, Calil & Fregni, 2010; Spijkerman, Pots & Bohlmeijer, 2016; Veehof, Oskam, Schreurs & Bohlmeijer, 2011). Inclusion criteria were: (1) RCT's with either an inactive or active control condition, (2) reported effectiveness of ACT or mindfulness interventions for chronic pain patients, (3) internet-based programs or programs received via a computer application or smartphone application, (4) chronic pain as one of the outcome measures, (5) participants with chronic pain for at least three months, regardless of cause and intensity, (6) patients over 18 years, (7) published journal articles, and (8) written in English or Dutch. Exclusion criteria were: (1) no RCT, (2) no ACT or mindfulness as main intervention, (3) ACT or mindfulness combined with another (psychological) intervention, (4) internet-based

programs or programs received via a computer application or smartphone application, combined with a face-to-face program, and (5) only one treatment session.

Data extraction and quality assessment

The data extraction was carried out by K.K. under supervision of G.P. The following data was extracted: characteristics of the study population (i.e. kind of pain/diagnosis, country, the inclusion criteria, percentage of females, mean age and the recruitment procedure), characteristics of the intervention (i.e. kind of intervention, guidance (with or without), delivery mode, number of sections and duration in weeks) and characteristics of the study (i.e. adherence rates, the control groups, co-interventions, the measurements, the outcomes, the trial design, randomization, blinding, data-analysis and the study protocol).

The methodological quality of each study was assessed by two reviewers (K.K and S.S.) independently, using the Cochrane risk of bias tool. This tool assesses the risk of bias on the following six domains: selection bias, performance bias, detection bias, attrition bias, reporting bias and other bias (Higgins & Green, 2011).

Analysis

A meta-analysis was planned if the included studies were sufficiently homogeneous for statistical pooling of the data. However, only eight studies were included that were heterogeneous with regard to the study populations, the intervention protocols, the control groups and the outcome measures, indicating clinical heterogeneity. Therefore, no meta-analysis was conducted.

Results

Selection of studies

In total 102 records were retrieved in the literature search, using earlier mentioned databases and through searching for records in a systematic review and meta-analysis in press (O'Connor, Munnelly, Whelan & McHugh, in press). After checking for duplicates, 65 studies were excluded. The remaining 37 studies were screened on title and 14 on abstract, of which 28 were excluded, because they were not RCT's. After that, nine full texts were screened for eligibility, of which another one was excluded, because it was not an RCT. The remaining eight RCT's were included in the qualitative analysis (Figure 1), with a total study population of 1060 participants.

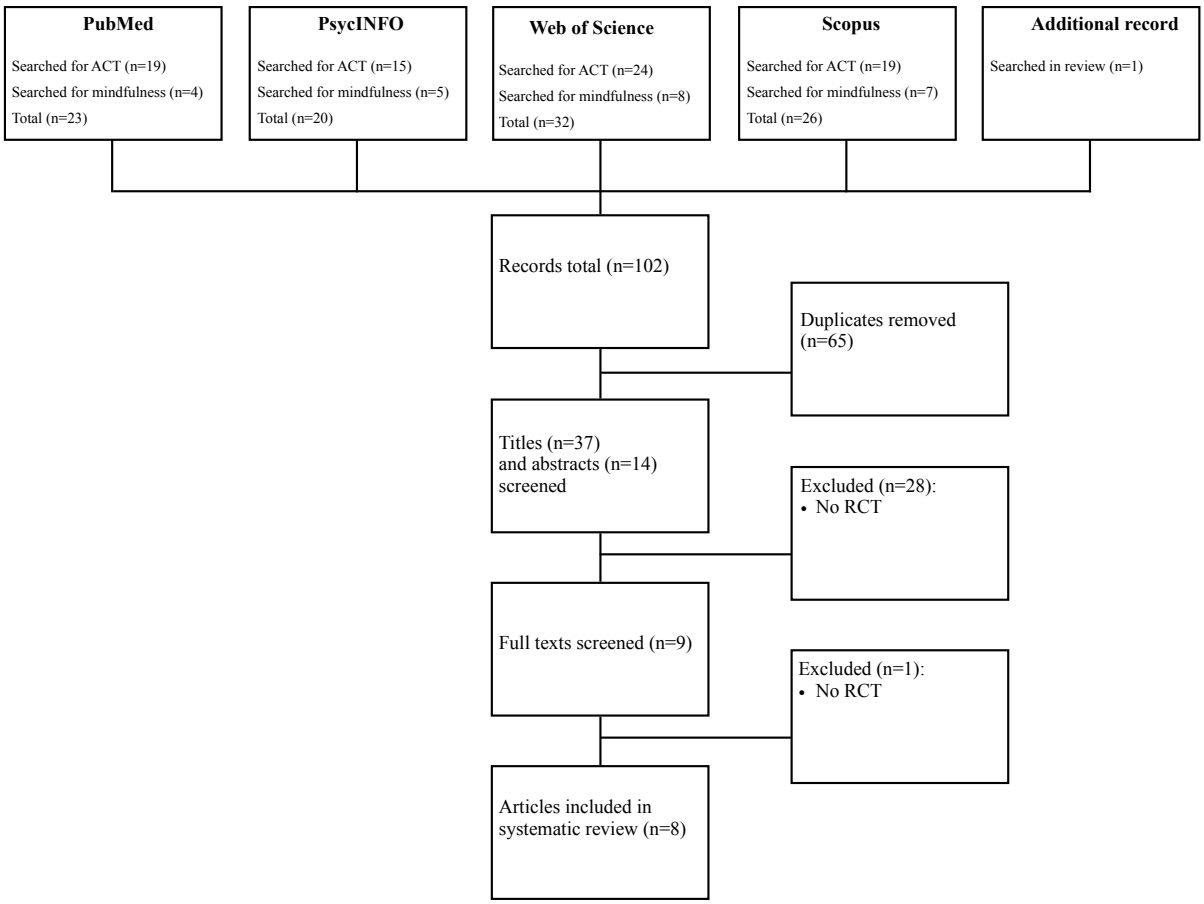

Figure 1. Flowchart of the literature search.

Description of included studies

Characteristics of the included studies with regard to the study population, the interventions, the control conditions and the measurements are presented in Table 1. The outcomes are presented in Table 2 and Table 3.

Population characteristics

Most of the included studies were conducted in de EU (Sweden, Germany, the Netherlands, UK, Ireland) and three outside the EU (Canada, USA). Participants were recruited via advertising involving cooperation with a health insurance provider (Lin et al., 2017), in local newspapers (Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), in waiting rooms at local clinics (Simister et al., 2018), in online patient platforms (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), on Facebook (Davis & Zautra, 2013), on Fibromyalgia (FM) support-group websites (Davis & Zautra, 2013), and through various self-help groups for individuals with FM (Simister et al., 2018), in primary care settings (Henriksson, Wasara & Rönnlund, 2016), in pain clinics (Henriksson, Wasara & Rönnlund, 2016; Simister et al., 2018), in a pain center at a university hospital (Buhrman et al., 2013), in a spinal injuries center (Hearn & Finlay, 2018), in online closed social media groups (Henriksson, Wasara & Rönnlund, 2016), in a research database (Dowd et al., 2015) and "by contacting individuals with FM who expressed an interest in participation in research during recruitment for unrelated research projects" (Davis & Zautra, 2013).

In two RCT's, participants were included with a diagnosis FM (Davis & Zautra, 2013; Simister et al., 2018). One of these two RCT's included only patients with a self-reported pain intensity rating of at least 4 of 10 on the basis of a 0 to 10 rating (Simister et al., 2018). The other one reported no pain intensity criteria (Davis & Zautra, 2013). One other RCT included patients with spinal cord injury (SCI), with reduced sensory and motor function arising from SCI for a period of at least one year (Hearn & Finlay, 2018). The other five RCT's included patients with chronic pain in general, with slightly different inclusion criteria. Three RCT's included patients with a minimal pain duration of six months, of which one RCT included patients with a pain interference level of at least 2 on the von Korff pain scale (Lin et al., 2017). In the other two RCT's patients had to experience pain for at least three days a week and had to have a minimal momentary pain intensity score of 4 on a 11-point Numeric Rating Scale (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), and had to experience chronic pain which was unrelated to cancer (Dowd et al., 2015). Patients with chronic pain for at least three months and a pain intensity level of 4 or higher on a scale from 0 to 10, were included in the seventh RCT (Henriksson, Wasara & Rönnlund, 2016), whereas in the eighth RCT patients had to have undergone medical investigation (within one year) and had to have functional impairment caused by chronic pain (Buhrman et al., 2013).

Intervention characteristics

ACT

Four out of eight studies delivered an ACT intervention via an online platform (Buhrman et al., 2013; Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). All ACT programs consisted of information, assignments, relevant metaphors and mindfulness exercises (Buhrman et al., 2013; Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Furthermore, the programs helped patients to connect to the key components of ACT by providing experiences of other individuals with chronic pain (Buhrman et al., 2013; Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Patients in one of the ACT programs were also encouraged to practice mindfulness daily and were given the opportunity to keep a personal diary (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Contrasting to the ACT intervention of Burhman et al. (2013), a further developed version of the intervention (Lin et al., 2017) provided the materials as integral parts of each module, structured the text in shorter paragraphs or tables, added illustrations, pictures and videos, and introduced three vignettes that were typical examples of persons with chronic pain to accompany the patients throughout the modules.

The content of the online ACT interventions was based on procedures recommended by Hayes, Strosahl and Wilson (1999; Buhrman et al., 2013), by Hayes, Strosahl and Wilson (2012; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), by Dahl, Wilson, Luciano and Hayes (2005) and by McCracken (2005; Simister et al., 2018). One ACT intervention was based on a previously developed self-help program (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) and one other intervention was built on the online ACT intervention of Buhrman et al. (2013; Lin et al., 2017).

Mindfulness

The other four interventions were named ‘mindfulness interventions’, without the ACT part (Davis & Zautra, 2013; Dowd et al., 2015; Hearn & Finlay, 2018; Henriksson, Wasara & Rönnlund, 2016). All were delivered via an online platform. One of the mindfulness interventions was called ‘mindful socioemotional regulation’ (MSER) and was based on an effective mindfulness-based group intervention for emotion regulation. It was designed to address the positive emotional and social engagement deficits, which are evident in FM patients relative to other pain patients. The intervention incorporated mindfulness meditation

and the practice of mindfulness awareness skills. Patients were encouraged to use the learned skills over the next several days and to access the meditation daily (Davis & Zautra, 2013).

The second intervention was based on the online mindfulness intervention of Davis and Zautra (2013). The intervention drew on the principles of MBCT. Each section included a prerecorded presentation designed to build skills associated with mindfulness, instructions on how to cultivate and sustain positive emotional experiences, particularly within social relationships, and an audio recorded meditation that participants were asked to access daily (Dowd et al., 2015).

The third mindfulness intervention was designed in collaboration with a mindfulness center in Sweden, specifically for people with chronic pain and/or illness (also known as Mindfulness-Based Pain Management (MBPM)). The intervention delivered two, 10-minute audio-guided meditations (recorded by trained and accredited mindfulness teachers), on six out of seven days a week. Besides traditional mindfulness exercises, such as breath awareness, body scanning, kindness and activities for embedding mindfulness in daily life, the course also contained 'mindful movement', designed to promote awareness of physical activity (Hearn & Finlay, 2018).

The fourth mindfulness intervention was based on a MBSR program originally developed by Vidyamala Burch and Breathworks. The main components in the intervention were the 10-minute mindfulness exercises that patients had to perform twice a day. Each intervention week had a separate theme: (1) the breathing body, (2) dwelling in the body, (3) mindfulness of moving and living, (4) acceptance and self-compassion, (5) the treasure of pleasure, (6) being whole, (7) turning outwards-compassion for others, and (8) the journey continues-living with choice (Henriksson, Wasara & Rönnlund, 2016).

Guidance

All four ACT interventions were guided. However, one RCT used both a guided and an unguided ACT intervention (Lin et al., 2017). Guidance was delivered through e-mail messages (Buhrman et al., 2013; Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) and structured phone calls (Buhrman et al., 2013). It was given by trained graduate students under supervision of a clinical psychologist (Buhrman et al., 2013), recently graduated students trained and supervised by a cognitive behavioral therapist (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), psychologists under supervision of an experienced psychotherapist (Lin et al., 2017), and a treatment team

including the first author (Simister et al., 2018). One of the four mindfulness interventions was guided, in which guidance was delivered via e-mail reminders (Dowd et al., 2015).

Adherence

Adherence was defined as completing all sections of the intervention and was assessed in six of the eight studies. Adherence rates for ACT were: 39.5% (Buhrman et al., 2013) and 48% (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Adherence rates for mindfulness were: 49% (Davis & Zautra, 2013), 74% (Dowd et al., 2015), 72% (Hearn & Finlay, 2018), and 50% (Henriksson, Wasara & Rönnlund, 2016).

Control groups

For RCT's on ACT, used control conditions were waiting list/no additional treatment (Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), online expressive writing (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), and an online discussion forum (Buhrman et al., 2013). For RCT's on mindfulness, used control conditions were an online discussion forum (Henriksson, Wasara & Rönnlund, 2016), an online health tips intervention (Davis & Zautra, 2013), and online psychoeducation (Dowd et al., 2015; Hearn & Finlay, 2018). Patients who received no additional treatment (Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), psychoeducation (Hearn & Finlay, 2018) or participated in a discussion forum (Buhrman et al., 2013; Henriksson, Wasara & Rönnlund, 2016) were given access to the (unguided) ACT/mindfulness interventions after completion of the measurements.

Co-interventions

Two RCT's on ACT (Lin et al., 2017; Simister et al., 2018) and one on mindfulness (Hearn & Finlay, 2018) explicitly reported that patients in all groups had access to treatment as usual during the study period. However, one of the three RCT's made a restriction for ongoing or planned psychological pain interventions (Lin et al., 2017). The other five RCT's did not explicitly specify (dis-)allowance of the use of co-interventions during the study period (Buhrman et al., 2013; Davis & Zautra, 2013; Dowd et al., 2015; Henriksson, Wasara & Rönnlund, 2016; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014).

Outcomes

Outcomes assessed in ACT studies

Pain severity was assessed in one RCT at post-intervention and follow-up using the Multidimensional Pain Inventory (MPI) - Severity Scale (Buhrman et al., 2013). Pain intensity was assessed in two RCT's at post-intervention and follow-up using the Numerical Rating Scale of pain (NRS) - Intensity Scale (Lin et al., 2017; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), and pain experience in one RCT using the McGill Pain Questionnaire-short form (SF-MPQ; Simister et al., 2018).

Pain interference was assessed in three RCT's at post-intervention and follow-up using the MPI - Interference Scale (Buhrman et al., 2013; Lin et al., 2017; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). The impact of FM was assessed in one RCT at post-intervention and follow-up using the Fibromyalgia Impact Questionnaire-Revised (FIQ-R; Simister et al., 2018). Pain disability was assessed in one RCT at post-intervention and follow-up using the Pain Disability Index (PDI; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), and physical functioning using the Brief Pain Inventory (BPI; Lin et al., 2017). Activity engagement was assessed at post-intervention and follow-up in one RCT using the Chronic Pain Acceptance Questionnaire (CPAQ; Buhrman et al., 2013), and subjective sleep quality using the Pittsburgh Sleep Quality Index (PSQI; Simister et al., 2018).

Pain catastrophizing was assessed at post-intervention and follow-up in three RCT's using the Coping Strategies Questionnaire (CSQ; Buhrman et al., 2013) and the Pain Catastrophizing Scale (PCS; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Other coping strategies were assessed in only one RCT at post-intervention and follow-up using the CSQ (Buhrman et al., 2013).

Psychological (in)flexibility was assessed in two RCT's at post-intervention and follow-up using the Acceptance and Action Questionnaire - II (AAQ-II), German version: Fragebogen zu Akzeptanz und Handeln II (FAH-II; Lin et al., 2017) and the Psychological Inflexibility in Pain Scale (PIPS; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Valued living was assessed at post-intervention and follow-up in one RCT using the Valued Living Questionnaire (VLQ; Simister et al., 2018), and engaged living using the Engaged Living Scale (ELS; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014).

Pain willingness was assessed in one RCT at post-intervention and follow-up using the CPAQ (Buhrman et al., 2013). Pain acceptance was assessed in three RCT's at both post-intervention and follow-up using the CPAQ (Buhrman et al., 2013), the CPAQ Revised (CPAQ-R; Simister et al., 2018) and the German version of the CPAQ (CPAQ-D; Lin et al., 2017). Mindfulness was assessed in two RCT's at post-intervention and follow-up using the Five Facet Mindfulness Questionnaire (FFMQ; Simister et al., 2018) and the short form

(FFMQ-SF; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Defusion from thoughts was assessed in only one RCT at post-intervention and follow-up using the Cognitive Fusion Questionnaire (CFQ; Simister et al., 2018).

Affective distress was assessed in one RCT at post-intervention and follow-up using the MPI - Affective Distress Scale (Buhrman et al., 2013). Depression was assessed at post-intervention and follow-up in four RCT's using the Hospital and Anxiety Depression Scale (HADS; Buhrman et al., 2013; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), the Patient Health Questionnaire (PHQ-9; Lin et al., 2017) and the Center for Epidemiological Studies Depression Scale (CES-D; Simister et al., 2018). Anxiety was assessed in three RCT's at post-intervention and follow-up using the HADS (Buhrman et al., 2013; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) and the Generalised Anxiety Disorder Screener (GAD-7; Lin et al., 2017). Fear of movement/(re)injury was assessed in one RCT at post-intervention and follow-up using the Tampa Scale for Kinesiophobia-11 (TSK-11; Simister et al., 2018).

Physical disability was assessed in only one RCT at post-intervention and follow up using the 6-Minute walk test and 1-Minute sit to stand test (Simister et al., 2018).

Physical and mental quality of life were assessed in one RCT at post-intervention and follow-up using the Short Form12 (SF-12; Lin et al., 2017), and life satisfaction using the Quality Of Life Inventory (QOLI; Buhrman et al., 2013). Positive mental health was assessed at post-intervention and follow-up in one RCT using the Mental Health Continuum-Short Form (MHC-SF; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014).

Other psychosocial and behavioral consequences of chronic pain, and beliefs and attitudes to chronic pain, were assessed at post-intervention and follow-up in one RCT using the MPI and the Pain And Impairment Relationship Scale (PAIRS; Buhrman et al., 2013). Patients' satisfaction with the intervention was assessed at post-intervention in two RCT's using the Client Satisfaction Questionnaire (CSQ-8; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), German version: Fragebogen zur Patientenzufriedenheit (ZUF-8; Lin et al., 2017). Patients' global impression of change was assessed at post-intervention and follow-up in only one RCT using the Patient Global Impression of Change scale (PGIC; Lin et al., 2017).

Outcomes assessed in mindfulness studies

Daily pain was assessed in one RCT using daily diaries (Davis & Zautra, 2013). Pain intensity was assessed in three RCT's at post-intervention using the NRS - Intensity Scale and the MPI

- Severity Scale (Henriksson, Wasara & Rönnlund, 2016), and at both post-intervention and follow-up using the NRS - Intensity Scale (Hearn & Finlay, 2018) and the BPI (Dowd et al., 2015). Pain suffering was assessed in one RCT at post-intervention using the NRS - Suffering Scale (Henriksson, Wasara & Rönnlund, 2016), and pain unpleasantness was assessed in one RCT at both post-intervention and follow-up using the NRS - Unpleasantness Scale (Hearn & Finlay, 2018).

Pain interference was assessed in two RCT's at post-intervention using the MPI - Interference Scale (Henriksson, Wasara & Rönnlund, 2016), and at both post-intervention and follow-up using the BPI (Dowd et al., 2015). Social activity engagement was assessed in one RCT using daily diaries (Davis & Zautra, 2013).

Pain coping efficacy was assessed in one RCT using daily diaries (Davis & Zautra, 2013). Pain catastrophizing was assessed at post-intervention and follow-up in two RCT's using the PCS (Dowd et al., 2015; Hearn & Finlay, 2018).

Mindfulness was assessed in three RCT's at post-intervention and follow-up using the Mindful Attention Awareness Scale (MAAS; Dowd et al., 2015) and the FFMQ (Hearn & Finlay, 2018), and only at post-intervention also using the FFMQ (Henriksson, Wasara & Rönnlund, 2016). Pain acceptance was assessed in two RCT's at post-intervention using the CPAQ (Henriksson, Wasara & Rönnlund, 2016), and at both post-intervention and follow-up using the brief version of the CPAQ (CPAQ-8; Dowd et al., 2015).

Positive and negative affect were assessed in one RCT using daily diaries (Davis & Zautra, 2013). Psychological distress was assessed at post-intervention and follow-up in one RCT using the HADS (Dowd et al., 2015), and affective distress was assessed in one RCT at post-intervention using the MPI - Affective Distress Scale (Henriksson, Wasara & Rönnlund, 2016). Depression and anxiety were assessed at post-intervention and follow-up in one RCT using the HADS (Hearn & Finlay, 2018).

Life satisfaction was assessed in two RCT's at post-intervention using the Life Satisfaction Questionnaire (LiSat-I I; Henriksson, Wasara & Rönnlund, 2016), and at both post-intervention and follow-up using the Satisfaction with Life Scale (SWLS; Dowd et al., 2015). Quality of life on physical health, psychological health, social relationships and environment was assessed in one RCT at post-intervention and follow-up using the World Health Organization Quality of Life Brief Scale (WHOQoL-BREF; Hearn & Finlay, 2018).

Loneliness, family stress and family enjoyment were assessed in one RCT using daily diaries (Davis & Zautra, 2013).

Patients' global impression of change on three domains (1. ability to manage emotions; 2. dealing with stressful situations; 3. ability to enjoy pleasant events) was assessed in one RCT at post-intervention and follow up using the PGIC (Dowd et al., 2015). Stress coping efficacy was assessed in one RCT using daily diaries (Davis & Zautra, 2013), and life control was assessed at post-intervention in one RCT using the MPI - Life Control Scale (Henriksson, Wasara & Rönnlund, 2016).

Quality of studies

Risk of bias for each included study is shown in Table 4. All studies met the criteria 'random sequence allocation' and 'complete outcome data'. On the other hand, no study met the criterion 'blinding of personnel', and only one study met the criterion 'blinding of participants'. The criteria 'allocation concealment' and 'blinding of outcome assessment' were met in six studies. Furthermore, risk of bias on 'selective reporting' was low in six studies, and in two studies this remained unclear, because no study protocol could be found. No other sources of bias were found in three studies, whereas in five studies this remained unclear.

Effectiveness of the interventions

Effectiveness of online ACT compared to no treatment

Pain

The RCT of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) on adults with chronic pain showed significant effects of guided online ACT on pain intensity, but only at 3-month follow-up. Furthermore, in the trial of Simister et al. (2018) on adults with FM, significant effects were found of guided online ACT on pain experience. In this trial, all effects were measured over time (i.e. pre-, post- and 3-month follow-up assessments).

The impact of pain on daily life

One RCT on adults with chronic pain found significant effects of guided online ACT on pain interference, at both post-intervention and 4-month follow-up (Lin et al., 2017). Furthermore, the trial of Simister et al. (2018) found significant effects on the impact of FM.

Pain coping

The trial of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) found significant effects on pain catastrophizing, at both post-intervention and follow-up.

Outcomes specific for ACT

The RCT of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) found significant effects on psychological flexibility, at both post-intervention and follow-up.

Acceptance- and mindfulness-based outcomes

Significant effects on pain acceptance were found in the trial of Lin et al. (2017) at post-intervention and follow-up, and in the trial of Simister et al. (2018; measured over time). The RCT of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) reported significant effects on mindfulness, but only at follow-up.

Psychological health

The trial of Lin et al. (2017) found significant effects of unguided online ACT on depression. Furthermore, the trials of Simister et al. (2018) and Trompetter, Bohlmeijer, Veehof and Schreurs (2014) found significant effects of guided online ACT on depression. But, the trials of Lin et al. (2017) and Trompetter, Bohlmeijer, Veehof and Schreurs (2014) did only find significant effects at follow-up. The trial of Simister et al. (2018) also reported significant effects on fear of movement/(re)injury.

Physical health

No effects were found on physical health outcomes.

Quality of life and well-being

No effects were found on outcomes related to quality of life and well-being.

Other

The trial of Lin et al. (2017) reported higher overall improvement for the online ACT-groups compared to no treatment on patients' global impression of change, at both post-intervention and follow-up. However, it was not mentioned whether the difference was significant or not.

Effectiveness of online ACT compared to an active control group

Pain

The RCT of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) on adults with chronic pain found significant differences between guided online ACT and expressive writing on pain intensity, at post-intervention and 3-month follow-up.

The impact of pain on daily life

The trial of Buhrman et al. (2013) on adults with chronic pain found significant differences between guided online ACT and an online discussion forum on pain interference. At 6-month follow-up, further significant improvements on pain interference were found in the online ACT-group. Furthermore, the RCT found significant effects on activity engagement, but only at post-intervention. The RCT of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) also

found significant effects on pain interference, at post-intervention and follow-up. Furthermore, the trial found significant effects on pain disability, but only at follow-up.

Pain coping

Significant effects on pain catastrophizing were found in both trials, but the trial of Buhrman et al. (2013) reported effects at post-intervention whereas the trial of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) reported effects at follow-up. Furthermore, the trial of Buhrman et al. (2013) found significant effects on praying and hoping, at post-intervention.

Outcomes specific for ACT

The trial of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) found significant effects on psychological flexibility, at both post-intervention and follow-up.

Acceptance- and mindfulness-based outcomes

The trial of Buhrman et al. (2013) found significant effects on pain willingness and pain acceptance, at post-intervention.

Psychological health

Both trials found significant effects on depression, but the trial of Buhrman et al. (2013) reported effects at post-intervention whereas the trial of Trompetter, Bohlmeijer, Veehof and Schreurs (2014) reported effects at follow-up. Furthermore, the trial of Buhrman et al. (2013) found significant effects on anxiety and affective distress, both at post-intervention.

Quality of life and well-being

No effects were found on outcomes related to quality of life and well-being.

Other

In the RCT of Trompetter, Bohlmeijer, Veehof and Schreurs (2014), patients who participated in the ACT intervention evaluated the intervention significantly higher than patients in the Expressive Writing group.

Difference in effectiveness between guided and unguided online ACT

One RCT on adults with chronic pain assessed the difference between guided and unguided online ACT. The trial did not find any significant differences between the two groups (Lin et al., 2017).

Effectiveness of online mindfulness compared to an active control group

Pain

The trial of Henriksson, Wasara and Rönnlund (2016) on adults with chronic pain found significant differences between unguided online MBSR and an online discussion forum on

pain intensity/severity and pain suffering, at post-intervention. The trial of Hearn and Finlay (2018) on adults with SCI found significant differences between unguided online MBPM and online psychoeducation on pain unpleasantness, also at post-intervention.

The impact of pain on daily life

The RCT of Davis and Zautra (2013) on adults with FM found significant differences between unguided online MSER and an online health tips intervention on social activity engagement. The differences were based on daily measurements during the intervention period of six weeks.

Pain coping

The trial of Davis and Zautra (2013) found significant effects on pain coping efficacy. The trial of Hearn and Finlay (2018) found significant effects on pain catastrophizing, at post-intervention and 3-month follow-up.

Acceptance- and mindfulness-based outcomes

The trial of Hearn and Finlay (2018) found significant effects on mindfulness, but only at post-intervention. The RCT of Henriksson, Wasara and Rönnlund (2016) also found significant effects on mindfulness, as well as on pain acceptance, both at post-intervention.

Psychological health

Henriksson, Wasara and Rönnlund (2016) found significant effects on affective distress, at post-intervention. The trial of Hearn and Finlay (2018) found significant effects on depression and anxiety, at both post-intervention and follow-up. The trial of Davis and Zautra (2013) found significant effects on positive affect.

Quality of life

In an RCT on adults with chronic pain significant differences were found between guided online MBCT and online psychoeducation on life satisfaction, at post-intervention (Dowd et al., 2015). Also, the trial of Henriksson, Wasara and Rönnlund (2016) found significant effects on life satisfaction, at post-intervention.

Perceived social relations

The trial of Davis and Zautra (2013) found significant effects on loneliness and family enjoyment.

Other

The RCT of Davis and Zautra (2013) found significant effects on stress coping efficacy. Furthermore, the trial of Dowd et al. (2015) found significant effects on patients' global impression of change, on three domains: the ability to enjoy pleasant events (at post-

intervention), and the ability to manage emotions and to deal with stressful situations (both at post-intervention and 6-month follow-up).

Table 1

Description of included studies

Article	Population, country	Inclusion criteria	Percentage female	Mean age (SD/range)	Recruitment	Intervention (n)	Guidance: with/without (kind of guidance)	Sections, duration in weeks	Control group (n)	Measurements
Buhrman et al. (2013)	Adults with chronic pain, Sweden	Medically investigated within 1 year, functional impairment	59.2%	49.1 (10.34/27-69)	Pain center	ACT (38)	With (e-mail, phone calls)	7 sections, 7 weeks	Discussion forum (38)	Pre, post, 6-month follow-up*
Lin et al. (2017)	Adults with chronic pain, Germany	CP > 6 months, pain interference > score 2	84.1%	51.7 (13.1)	Health care insurance provider	Guided ACT (100) Unguided ACT (101)	With (e-mail) Without	7 sections, 7 weeks	Waiting list (101)	Pre, post, 4-month follow-up
Simister et al. (2018)	Adults with Fibromyalgia, Canada	Diagnosis FM, pain intensity > score 4 of 10	95.0%	39.7 (9.36/18-64)	Local newspapers, waiting rooms at local clinics, FM self-help groups, pain clinics	ACT (33)	With (e-mail)	7 sections, 8 weeks	TAU (34)	Pre, post, 3-month follow-up
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Adults with chronic pain, the Netherlands	CP > 6 months, 3 days a week, pain intensity > score 4 of 11	76.0%	52.8 (20-84)	Local newspapers, online patient platforms	ACT (82)	With (e-mail)	9 sections, 9-12 weeks	Expressive writing (79) Waiting list (77)	Pre, post, 3-month follow-up
Davis & Zautra (2013)	Adults with Fibromyalgia, USA	Diagnosis FM	98.0%	46.14 (22-81)	Facebook, FM support groups, unrelated research projects	MSER (39)	Without	12 sections, 6 weeks	Health tips (40)	Pre, daily measures
Dowd et al. (2015)	Adults with chronic pain, Ireland, UK, North America, other countries	CP > 6 months, unrelated to cancer	90.3%	44.53 (12.25, 19-76)	Research database based at National University of Ireland, Galway	MBCT (62)	With (e-mail)	12 sections, 6 weeks	Psychoeducation (62)	Pre, post, 6-month follow-up
Hearn & Finlay (2018)	Adults with spinal cord injury, UK	SCI, reduced sensory and motor function > 1 year	54.0%	44.4 (10.4)	Spinal injuries center	MBPM (36)	Without	8 sections, 8 weeks	Psychoeducation (31)	Pre, post, 3-month follow-up
Henriksson, Wasara & Rönnlund (2016)	Adults with chronic pain, Sweden	CP > 3 months, pain intensity > score 4 of 10	93.5%	51.0 (9.2)	Primary care settings, pain clinics, social media groups	MBSR (55)	Without	8 sections, 8 weeks	Discussion forum (52)	Pre, post

Abbreviations: ACT - Acceptance and Commitment Therapy; CP - chronic pain; FM - Fibromyalgia; MBCT - Mindfulness-Based Cognitive Therapy; MBPM - Mindfulness-Based Pain Management; MBSR - Mindfulness-Based Stress Reduction; MSER - Mindful Socioemotional Regulation; SCI - spinal cord injury; TAU - treatment as usual.

*Follow-up data was only obtained for the intervention group.

Table 2
Outcomes ACT

Article	Outcome measures	Results* a = at post-treatment b = at follow-up
	Pain	
Buhrman et al. (2013)	Pain severity (MPI - Severity Scale)	NS
Lin et al. (2017)	Pain intensity (NRS - Intensity Scale)	NS
Simister et al. (2018)	Pain experience (SF-MPQ)	ACT > CG a.b. p = 0.01
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Pain intensity (NRS - Intensity Scale)	ACT > CG (1)** a. p = 0.04 b. p = 0.01 ACT > CG (2)*** a. NS b. p = 0.04
	The impact of pain on daily life	
Buhrman et al. (2013)	Pain interference (MPI - Interference Scale)	ACT > CG a. p = 0.00 b. Further improvement for ACT (p = 0.00)****
	Activity engagement (CPAQ)	ACT > CG a. p = 0.04 b. No improvements/deterioration
Lin et al. (2017)	Pain interference (MPI - Interference Scale)	Guided ACT > CG a. p = 0.01 b. p = 0.01
	Physical functioning (BPI)	NS
Simister et al. (2018)	Impact of FM (FIQ-R)	ACT > CG a.b. p = 0.00
	Subjective sleep quality (PSQI)	NS
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Pain interference (MPI - Interference Scale)	ACT > CG (1) a. p = 0.01 b. p = 0.00
	Pain disability (PDI)	ACT > CG (1) a. NS b. p = 0.01
	Pain coping	
Buhrman et al. (2013)	Pain catastrophizing (CSQ)	ACT > CG a. p = 0.01 b. No improvements/deterioration
	Praying and hoping (CSQ)	ACT > CG a. p = 0.00 b. No improvements/deterioration
	Diverting attention, reinterpret pain sensations, coping self-statements, ignore pain sensations, increasing activity level and pain behaviors (CSQ)	NS
Simister et al. (2018)	Pain catastrophizing (PCS)	NS
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Pain catastrophizing (PCS)	ACT > CG (1) a. NS b. p = 0.01 ACT > CG (2) a. p = 0.01 b. p = 0.02
	Outcomes specific for ACT	
Lin et al. (2017)	Psychological flexibility (AAQ/FAH-II)	NS
Simister et al. (2018)	Valued living (VLQ)	ACT < CG a.b. p = 0.03
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Psychological inflexibility (PIPS)	ACT > CG (1) a. p = 0.01 b. p = 0.00 ACT > CG (2) a. p = 0.00 b. p = 0.00
	Engaged living (ELS)	NS

	Acceptance- and mindfulness-based outcomes	
Buhrman et al. (2013)	Pain willingness (CPAQ)	ACT > CG a. p = 0.01 b. No improvements/deterioration
	Pain acceptance (CPAQ)	ACT > CG a. p = 0.02 b. No improvements/deterioration
Lin et al. (2017)	Pain acceptance (CPAQ-D)	Guided ACT > CG a. p = 0.01 b. p < 0.01
Simister et al. (2018)	Pain acceptance (CPAQ-R)	ACT > CG a.b. p = 0.01
	Mindfulness (FFMQ)	NS
	Defusion from thoughts (CFQ)	ACT < CG a.b. p = 0.01
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Mindfulness (FFMQ-SF)	ACT > CG (2) a. NS b. p = 0.03
	Psychological health	
Buhrman et al. (2013)	Depression (HADS)	ACT > CG a. p = 0.01 b. No improvements/deterioration
	Anxiety (HADS)	ACT > CG a. p = 0.02 b. No improvements/deterioration
	Affective distress (MPI - Affective D Scale)	ACT > CG a. p = 0.03 b. No improvements/deterioration
Lin et al. (2017)	Depression (PHQ-9)	Unguided ACT > CG a. NS b. p = 0.02
	Anxiety (GAD-7)	NS
Simister et al. (2018)	Depression (CES-D)	ACT > CG a.b. p = 0.02
	Fear of movement/(re)injury (TSK-11)	ACT > CG a.b. p = 0.00
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Depression (HADS)	ACT > CG (1) a. NS b. p = 0.01 ACT > CG (2) a. NS b. p = 0.01
	Anxiety (HADS)	NS
	Physical health	
Simister et al. (2018)	Physical disability (6-Minute walk test; 1-Minute sit to stand test)	NS
	Quality of life and well-being	
Buhrman et al. (2013)	Life satisfaction (QOLI)	NS
Lin et al. (2017)	Physical and mental quality of life (SF-12)	NS
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Positive mental health (MHC-SF)	NS
	Other	
Buhrman et al. (2013)	Life control, support, punishing responses, solicitous responses and distracting responses (MPI)	NS
	Beliefs and attitudes to chronic pain (PAIRS)	NS
Lin et al. (2017)	Patients' satisfaction (CSQ-8/ ZUF-8)	NS
	Patients' global impression of change (PGIC)	Guided ACT > CG a. p = Not reported b. p = Not reported Unguided ACT > CG a. p = Not reported b. p = Not reported

Trompetter, Bohlmeijer, Veehof & Schreurs (2014)	Patients' satisfaction (CSQ-8)	ACT > CG (1) a. p = 0.00

Abbreviations: AAQ-II - Acceptance and Action Questionnaire - II, German version: Fragebogen zu Akzeptanz und Handeln II (FAH-II); BPI - Brief Pain Inventory; CES-D - Center for Epidemiological Studies Depression Scale; CFQ - Cognitive Fusion Questionnaire; CG - control group; CPAQ - Chronic Pain Acceptance Questionnaire; CPAQ-D - Chronic Pain Acceptance Questionnaire, German version; CPAQ-R - Chronic Pain Acceptance Questionnaire-Revised; CSQ - Coping Strategies Questionnaire; CSQ-8 - Client Satisfaction Questionnaire, German version: Fragebogen zur Patientenzufriedenheit (ZUF-8); ELS - Engaged Living Scale; FFMQ - Five Facet Mindfulness Questionnaire; FFMQ-SF - Five Facet Mindfulness Questionnaire-Short Form; FIQ-R - Fibromyalgia Impact Questionnaire-Revised; GAD-7 - Generalised Anxiety Disorder Screener; HADS - Hospital and Anxiety Depression Scale; MHC-SF - Mental Health Continuum-Short Form; MPI - Multidimensional Pain Inventory; NRS - Numerical Rating Scale; NS - not significant; PAIRS - Pain And Impairment Relationship Scale; PCS - Pain Catastrophizing Scale; PDI - Pain Disability Index; PGIC - Patient Global Impression of Change scale; PHQ-9 - Patient Health Questionnaire; PIPS - Psychological Inflexibility in Pain Scale; PSQI - Pittsburgh Sleep Quality Index; QOLI - Quality Of Life Inventory; SF-12 - Short Form12; SF-MPQ - McGill Pain Questionnaire-short form; TSK-11 - Tampa Scale for Kinesiophobia-11; VLQ - Valued Living Questionnaire.
* > indicates "significantly better than"
** Expressive writing
*** Waiting list
**** Only assessed in the intervention group.

Table 3
Outcomes mindfulness

Article	**Outcome measures**	**Results* a = at post-treatment b = at follow-up**
	Pain	
Davis & Zautra (2013)	Pain (daily diaries; one item)	NS
Dowd et al. (2015)	Pain intensity (BPI)	NS
Hearn & Finlay (2018)	Pain intensity (NRS - Intensity Scale)	NS
	Pain unpleasantness (NRS - Unpleasantness Scale)	MBPM > CG a. p = 0.01 b. NS
Henriksson, Wasara & Rönnlund (2016)	Pain intensity/severity (NRS - Intensity Scale; MPI - Severity Scale)	MBSR > CG a. p = 0.04 (NRS) a. p = 0.05 (MPI)
	Pain suffering (NRS - Suffering Scale)	MBSR > CG a. p = 0.02
	The impact of pain on daily life	
Davis & Zautra (2013)	Social activity engagement (daily diaries; one item drawn from the SF-36 Social Functioning subscale)	MSER > CG p < 0.05
Dowd et al. (2015)	Pain interference (BPI)	NS
Henriksson, Wasara & Rönnlund (2016)	Pain interference (MPI - Interference Scale)	NS
	Pain coping	
Davis & Zautra (2013)	Pain coping efficacy (daily diaries; two items)	MSER > CG p < 0.01
Dowd et al. (2015)	Pain catastrophizing (PCS)	NS
Hearn & Finlay (2018)	Pain catastrophizing (PCS)	MBPM > CG a. p = 0.02 b. p = 0.00
	Acceptance- and mindfulness-based outcomes	
Dowd et al. (2015)	Mindfulness (MAAS)	NS
	Pain acceptance (CPAQ-8)	NS
Hearn & Finlay (2018)	Mindfulness (FFMQ)	MBPM > CG a. p = 0.00 b. NS
Henriksson, Wasara & Rönnlund (2016)	Mindfulness (FFMQ)	MBSR > CG a. p = 0.00
	Pain acceptance (CPAQ)	MBSR > CG a. p = Not reported
	Psychological health	
Davis & Zautra (2013)	Positive affect (daily diaries; Positive and Negative Affect Schedule)	MSER > CG p < 0.05

	Negative affect (daily diaries; Positive and Negative Affect Schedule)	NS
Dowd et al. (2015)	Psychological distress (HADS)	NS
Hearn & Finlay (2018)	Depression (HADS)	MBPM > CG a. p = 0.00 b. p = 0.00
	Anxiety (HADS)	MBPM > CG a. p = 0.01 b. p = 0.02
Henriksson, Wasara & Rönnlund (2016)	Affective distress (MPI - Affective D Scale)	MBSR > CG a. p = 0.02
	Quality of life	
Dowd et al. (2015)	Life satisfaction (SWLC)	MBCT > CG a. p < 0.05 b. NS
Hearn & Finlay (2018)	Quality of life *Physical health* (WHOQoL-BREF)	NS
	Quality of life (WHOQoL-BREF) *Psychological health*	NS
	Quality of life (WHOQoL-BREF) *Social relationships*	NS
	Quality of life (WHOQoL-BREF) *Environment*	NS
Henriksson, Wasara & Rönnlund (2016)	Life satisfaction (LiSat-I I)	MBSR > CG a. p = 0.02
	Perceived social relations	
Davis & Zautra (2013)	Loneliness (daily diaries; one item)	MSER > CG p < 0.05
	Family stress (daily diaries; one item)	NS
	Family enjoyment (daily diaries; one item)	MSER > CG p < 0.05
	Other	
Davis & Zautra (2013)	Stress coping efficacy (daily diaries; two items)	MSER > CG p < 0.01
Dowd et al. (2015)	Patients' global impression of change (PGIC) *Ability to manage emotions*	MBCT > CG a. p = 0.01 b. p = 0.04
	Patients' global impression of change (PGIC) *Dealing with stressful situations*	MBCT > CG a. p = 0.00 b. p = 0.04
	Patients' global impression of change (PGIC) *Ability to enjoy pleasant events*	MBCT > CG a. p = 0.03 b. NS
Henriksson, Wasara & Rönnlund (2016)	Life control (MPI - Life Control Scale)	NS

Abbreviations: BPI - Brief Pain Inventory; CG - control group; CPAQ - Chronic Pain Acceptance Questionnaire; CPAQ-8 - Chronic Pain Acceptance Questionnaire, brief version; FFMQ - Five Facet Mindfulness Questionnaire; HADS - Hospital and Anxiety Depression Scale; LiSat-I I - Life Satisfaction Questionnaire; MAAS - Mindful Attention Awareness Scale; MPI - Multidimensional Pain Inventory; NRS - Numerical Rating Scale; NS - not significant; PCS - Pain Catastrophizing Scale; PGIC - Patient Global Impression of Change scale; SF-36 - 36-Item Short Form Survey; SWLS - Satisfaction With Life Scale; WHOQoL-BREF - World Health Organization Quality of Life Brief Scale.

* > indicates "significantly better than"

Table 4

Quality assessment

Article	Selection bias *Random sequence allocation*	Selection bias *Allocation concealment*	Performance bias *Blinding of participants*	Performance bias *Blinding of personnel*	Detection bias *Blinding of outcome assessment*	Attrition bias *Incomplete outcome data*	Reporting bias *Selective reporting*	Other bias *Other sources of bias*
Buhrman et al. (2013)								
Davis & Zautra (2013)								
Dowd et al. (2015)								
Hearn & Finlay (2018)								
Henriksson, Wasara & Rönnlund (2016)								
Lin et al. (2017)								
Simister et al. (2018)								
Trompetter, Bohlmeijer, Veehof & Schreurs (2014)								

Low risk of bias
Unclear risk of bias
High risk of bias

Discussion

Main findings

The aim of this thesis was to provide an overview of the existing RCT's on the effectiveness of internet-based ACT and mindfulness interventions in chronic pain patients. Eight RCT's were found assessing the effectiveness of online ACT and mindfulness for chronic pain up to 2019-01-03. Of these eight RCT's, four assessed the effectivity of online ACT (Buhrman et al., 2013; Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) and four of online mindfulness (Davis & Zautra, 2013; Dowd et al., 2015; Hearn & Finlay, 2018; Henriksson, Wasara & Rönnlund, 2016). All were delivered via an online platform. All ACT interventions were guided. However, one ACT study examined the effectiveness of both a guided and an unguided version (Lin et al., 2017). The mindfulness studies used four different kinds of interventions, including: MSER (Davis & Zautra, 2013), MBCT (Dowd et al., 2015), MBPM (Hearn & Finlay, 2018) and MBSR (Henriksson, Wasara & Rönnlund, 2016), of which only the MBCT intervention was guided. Guidance was delivered through e-mail messages (Buhrman et al., 2013; Lin et al., 2017; Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), e-mail reminders (Dowd et al., 2015) and structured phone calls (Buhrman et al., 2013). The duration of the ACT interventions ranged from seven (Buhrman et al., 2013; Lin et al., 2017) to twelve weeks (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). It was intended that patients completed one section in about one week. The duration of the mindfulness interventions varied from eight (Hearn & Finlay, 2018; Henriksson, Wasara & Rönnlund, 2016) to twelve weeks (Davis & Zautra, 2013; Dowd et al., 2015). It was intended that patients completed one section (Hearn & Finlay, 2018; Henriksson, Wasara & Rönnlund, 2016) or completed two shorter sections (Davis & Zautra, 2013; Dowd et al., 2015) in about one week. Two interventions were based on an earlier developed intervention assessed in two included studies in this thesis: the ACT intervention of Lin et al. (2017) was based on the intervention of Buhrman et al. (2013) and the mindfulness intervention of Dowd et al. (2015) was based on the intervention of Davis and Zautra (2013).

With regard to the quality of the included studies, all studies had a low or unclear risk of selection bias, attrition bias, reporting bias and other bias. Only one study (Hearn & Finlay, 2018) had a high risk of detection bias. Furthermore, almost each study had a high or unclear risk of performance bias. However, only the study of Hearn and Finlay (2018) had a low risk of bias on blinding of participants. The overall high risk of performance bias is not surprising, since blinding of participants and personnel is always difficult when assessing the

effectiveness of psychological interventions in an RCT. For that reason, it sometimes happens that reviews exclude this domain from their risk of bias assessment (Hann & McCracken, 2014) or use a different kind of tool (Gilpin et al., 2017; Spijkerman, Pots & Bohlmeijer, 2016; Veehof, Oskam, Schreurs & Bohlmeijer, 2011). Therefore, no overall quality of the studies was determined in this thesis.

For guided online ACT compared to no treatment, single studies reported significant effects on the intensity (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) and the experience of pain (Simister et al., 2018), the interference of pain with daily life (Lin et al., 2017; Simister et al., 2018) and the ability to cope with pain (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Furthermore, single studies reported significant effects on psychological health outcomes, including depression (Simister et al., 2018; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) and the fear of movement/to get injured again (Simister et al., 2018). With regard to outcomes specific for ACT, significant effects were reported on psychological flexibility (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Also, significant effects were found on the acceptance of pain (Lin et al., 2017; Simister et al., 2018) and on mindfulness (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Finally, positive, but non-significant, effects were reported on patients' global impression of change (Lin et al., 2017).

For unguided online ACT compared to no treatment, significant effects were only reported on depression. Positive, but non-significant, effects were reported on patients' global impression of change (Lin et al., 2017).

For guided online ACT compared to an active control group, single studies reported significant effects on the intensity of pain (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), pain coping (Buhrman et al., 2013; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), and the interference of pain with daily life and the degree to which pain disables a patient to get engaged in daily activities (Buhrman et al., 2013; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014). Furthermore, significant effects were reported on psychological flexibility (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), and the acceptance of pain and the willingness to abandon the struggle against pain (Buhrman et al., 2013). With regard to psychological health, significant effects were reported on depression (Buhrman et al., 2013; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), affective distress and anxiety (Buhrman et al., 2013). Finally, significant effects were reported on patients' satisfaction with the intervention (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014).

For unguided online mindfulness compared to an active control group, single studies reported significant effects on the intensity and severity of pain, the suffering from pain

(Henriksson, Wasara & Rönnlund, 2016), pain unpleasantness (Hearn & Finlay, 2018), the interference of pain in normal social activities (Davis & Zautra, 2013) and on pain coping (Davis & Zautra, 2013; Hearn & Finlay, 2018). Furthermore, significant effects were reported on mindfulness (Hearn & Finlay, 2018; Henriksson, Wasara & Rönnlund, 2016) and the acceptance of pain (Henriksson, Wasara & Rönnlund, 2016), and on psychological health outcomes, including affective distress (Henriksson, Wasara & Rönnlund, 2016), depression, anxiety (Hearn & Finlay, 2018) and positive affect (Davis & Zautra, 2013). With regard to social relations, significant effects were reported on loneliness and family enjoyment (Davis & Zautra, 2013). Finally, significant effects were found on the ability to deal with stressful situations (Davis & Zautra, 2013) and on the degree to which patients are satisfied with life (Henriksson, Wasara & Rönnlund, 2016).

For guided online mindfulness compared to an active control group, significant effects were reported on life satisfaction, as well as on the ability to deal with stressful situations, to manage emotions and to enjoy pleasant events (Dowd et al., 2015).

No effects were found for online ACT on physical health. Moreover, in the mindfulness studies, physical health outcomes were not even assessed. An explanation for this could be that the purpose of ACT and mindfulness-based interventions is not so much to increase the physical health of chronic pain patients, but to teach them to live a mindful, engaged and valued-based life, despite their pain (Noonan, 2014; Scott & McCracken, 2015).

All in all, online ACT can be effective in the management of chronic pain, with regard to pain reduction, the impact of pain on daily life, pain coping efficacy, the development of psychological flexibility and mindfulness, the acceptance of pain, and psychological health. Online mindfulness can be effective in the management of chronic pain, with regard to pain reduction, social activity engagement, pain coping efficacy, the development of mindfulness, the acceptance of pain, psychological health, life satisfaction, perceived social relations, and stress coping efficacy.

The overall findings of online ACT are partly in line with findings in a previous systematic review on face-to-face ACT for chronic pain (Hann & McCracken, 2014). This review reported significant effects of ACT on pain disability, the impact of FM, affective distress, depression, anxiety, psychological flexibility and pain acceptance. Just one included study showed a significant effect on life satisfaction. In this thesis, we did not find a significant effect on life satisfaction. However, in the review of Hann and McCracken (2014), apart from one study, most studies reported no effects of ACT on life satisfaction. The overall findings of online mindfulness were in line with the findings in a systematic review on face-

to-face MBSR for chronic pain (Cramer, Haller, Lauche & Dobos, 2012), which reported significant effects of MSBR on pain intensity, activity engagement and pain acceptance. The review also reported significant effects on physical functioning/pain disability, sleep quality and emotional role functioning. However, these outcomes were not assessed in the included RCT's in this thesis. Another review and meta-analysis on face-to-face mindfulness-based interventions reported no beneficial effects on pain related and psychological outcomes, such as pain intensity or depression, but they did find a positive effect on perceived pain control (Marikar Bawa et al., 2015). However, also this outcome was not assessed in the included RCT's in this thesis. A systematic review and meta-analysis on internet-based CBT for chronic pain (Macea, Gajos, Calil & Fregni, 2010) reported similar results on assessed outcomes as this thesis: positive effects were reported on the intensity of pain, the impact of pain on daily life, pain coping and psychological health.

When taking a closer look at the reported findings of the single included studies, it was remarkable to find significant effects of online ACT on pain intensity, pain disability, pain catastrophizing, mindfulness (Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) and depression (Lin et al., 2017; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014), at follow-up only. A possible explanation for these delayed effects of online ACT, could be the influence of mindfulness on the intervention outcomes. In a study of Carmody and Baer (2007), time spend in mindfulness practice was correlated to the degree of change in mindfulness and various measures of symptoms and well-being. Furthermore, Carmody and Baer (2007) found that increases in mindfulness mediated the relation between practice and improvement in psychological distress and perceived stress. Since Trompetter and colleagues (2014) reported that 77% of the participants had incorporated mindfulness exercises into their daily life at 3-month follow-up, and mindfulness is an incorporated part of the process of psychological flexibility (Pielech, Vowles & Wicksell, 2017), which was a mediator of change in both the studies of Lin et al. (2017) and Trompetter, Bohlmeijer, Veehof and Schreurs (2014; Lin, Klatt, McCracken & Baumeister, 2018; Trompetter, Bohlmeijer, Fox & Schreurs, 2015), it could be that the more time patients spent on practicing ACT and mindfulness exercises, the more their level of mindfulness increased, and the more they improved in other treatment outcomes. However, this hypothesis could not be tested within the scope of this thesis.

When comparing online ACT and mindfulness with regard to the effectiveness in chronic pain patients, no major differences could be found. This is not surprising, since mindfulness is an incorporated part of ACT (McCracken & Vowles, 2014). However, only little evidence is provided for guided online ACT interventions to be more effective on the

interference of pain with daily life and for guided or unguided online mindfulness interventions to be more effective on satisfaction with life. Nevertheless, the number of RCT's on which this statement is based is too small to draw any conclusions about the preference for online ACT versus mindfulness for chronic pain yet.

When comparing the guided interventions with the unguided interventions, a number of contradictions can be pointed out. First of all, the only guided online mindfulness intervention (Dowd et al., 2015) did not seem to be more effective, or even less effective, than the unguided online mindfulness interventions (Davis & Zautra, 2013; Hearn & Finlay, 2018; Henriksson, Wasara & Rönnlund, 2016). Furthermore, only one study (Lin et al., 2017) examined the difference between guided and unguided online ACT. The study showed no differences between the guided and unguided ACT groups. However, only the efficacy of the guided, not the unguided, ACT intervention could be confirmed (Lin et al., 2017). Also, the patients participating in the guided ACT intervention completed more modules than patients in the unguided version (Lin et al., 2017). Therefore, it could be supposed that treatment adherence is important for positive treatment outcomes (Donkin et al, 2011). This statement is supported by the trial of Trompetter, Bohlmeijer, Veehof and Schreurs (2014), in which adherers showed to benefit more from the ACT intervention than non-adherers. In order to improve treatment adherence, treatment support or guidance seems to be a positively influencing factor (Spijkerman, Pots & Bohlmeijer, 2016; Van Rooijen, 2012), as was also seen in the study of Lin et al. (2017). However, the reported adherence rates of the included guided interventions (Buhrman et al., 2013; Dowd et al., 2015; Trompetter, Bohlmeijer, Veehof & Schreurs, 2014) compared to the unguided interventions (Davis & Zautra, 2013; Hearn & Finlay, 2018; Henriksson, Wasara & Rönnlund, 2016) in this thesis, do not confirm greater adherence rates for the interventions with guidance. Also, the type of guidance (e.g. reminders, personal contact, positive feedback) and the frequency of interaction with a counselor seemed not to be related to the adherence rates. Therefore, other characteristics of the intervention, like the user-friendliness of the intervention, could explain this contradiction, since bad design, difficult navigation structures, poor readability and little adaption to the needs of the users can predict non-adherence in interventions (Nijland, Van Gemert-Pijnen, Boer, Steehouder & Seydel, 2008). Unfortunately, this hypothesis could not be tested in this thesis.

Limitations and directions for future research

This thesis has some limitations. First of all, as with all reviews, some studies may have been missed. Furthermore, this thesis included ACT and other mindfulness-based interventions, of which MSER, MBCT, MBPM and MBSR. These interventions use slightly different approaches, for example ACT and MBCT using elements from CBT, whereas MSER, MBPM and MBSR do not. This thesis also included different chronic pain populations, among which general chronic pain, FM and SCI. FM patients, for example, have somewhat different needs than general chronic pain patients, given that FM patients in comparison to chronic pain patients have higher levels of perceived pain disability (Payne-Murphy, 2016), and show greater social and emotional dysregulation (Davis & Zautra, 2013; Simister et al., 2018). Due to the small amount of studies, it was not possible to conduct separate analyses for these specific third generation CBT interventions and chronic pain populations. Another limitation of this thesis is the study population, consisting of only adult chronic pain patients from Western countries. Chronic pain is neither a ubiquitous nor a universal occurrence (Free, 2002) and pain behavior is influenced by social and cultural factors (Peacock & Patel, 2008). For example, Turkish pain patients are usually given a mono-causal biomedical explanation for their chronic pain complaints, while the complaints in Dutch rehabilitation centers are explained multi-causally, via the biopsychosocial model. Therefore, Turkish chronic pain patients seem to search in their pain experience and behavior for a biomedical diagnosis and treatment (Popma, 2012), which may make ACT and mindfulness less suitable for this specific population. Also, no studies were included on children or adolescents which chronic pain, nor were they found. A final limitation of this thesis is the inclusion of only RCT's, which reduces risk of bias in the findings, but excludes other important research topics, such as mediators and moderators of the interventions and the perspective of the chronic pain patients themselves. For example, Currie, Philip and Roberts (2015) found that older adults have a broad acceptance of the use of eHealth technologies in managing their chronic pain, but only when delivered alongside in-person visits from health and social care professionals.

Therefore, future research should investigate the appropriateness of internet-based ACT and specific forms of mindfulness interventions in specific pain populations. Furthermore, future research should address the suitability of online ACT and mindfulness in non-Western countries. Also, research should examine the effectiveness of online ACT and mindfulness for children and adolescents with chronic pain. In the Netherlands, about one out of fifty to hundred children suffer from chronic pain. However, up to date no RCT's on online ACT and mindfulness for this population seem to have been published and little is known

about the diagnosis and treatment of chronic pain in children and adolescents (Radboudumc, 2018). Finally, future reviews should include, besides RCT's, qualitative data on the perspectives of health care providers and patients, as well as literature on the moderators and mediators of online ACT and mindfulness treatment, in order to build a broader scientific framework around the effectiveness of internet-based ACT and mindfulness interventions in chronic pain patients.

Conclusion and implications

This is the first systematic review assessing the effectiveness of internet-based ACT and mindfulness interventions in chronic pain patients. Since internet-use increases in all population segments (Van Rooijen, 2012), it seems important to consider providing online treatment in order to, among other things, reduce waiting lists in clinics and help more people to manage their pain (Andersson & Titov, 2014; Van Gemert-Pijnen, Peters & Ossebaard, 2013; Van Rooijen, 2012). After a comprehensive search on RCT's, this thesis shows the first promising findings for the use of online ACT and mindfulness interventions for the treatment of chronic pain.

Up to date, four RCT's assessed the effectivity of online ACT and four of online mindfulness (of which MSER, MBCT, MBPM and MBSR) in chronic pain patients. With regard to the quality of the included studies, most studies had a low or unclear risk of bias on almost all domains, except on performance bias. Both internet-based ACT and mindfulness interventions showed to be effective in the reduction of pain, the impact of pain on a patient's daily life, as well as on psychological health. Effects were found in comparison to both waiting list and active control groups. This suggests that online ACT and mindfulness interventions may be a valuable addition in the treatment of chronic pain, by delivering them to patients on waiting lists to receive face-to-face treatment, as well as to patients who are for some reason not be capable of providing face-to-face treatment in health care clinics.

However, this conclusion is based on a small scientific sample in an expanding area of research. Therefore, caution is recommended in interpreting and generalizing the results.
In order to further develop the scientific framework to support the use of this kind of interventions, future research should focus on the effectivity of specific ACT and mindfulness interventions in specific chronic pain populations, on the effectiveness of online ACT and mindfulness in non-Western pain populations and children and adolescents, and on moderators, mediators and the views of patients and health care providers on online treatments.

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Appendix: Full search strings

PubMed

#1 ("chronic pain"[Title] OR "chronic low back pain"[Title] OR CLBP[Title] OR "low back pain"[Title] OR "back pain"[Title] OR "neck pain"[Title] OR "pelvic pain"[Title] OR "facial pain"[Title] OR "musculoskeletal pain"[Title] OR migraine[Title] OR neuropathy[Title] OR neuralgia[Title] OR sciatica[Title] OR fibromyalgia[Title] OR FM[Title] OR “whiplash associated disorder”[Title] OR WAD[Title] OR “repetitive strain injury”[Title] OR RSI[Title] OR dystrophy[Title] OR headache[Title])

#2 ("acceptance and commitment therapy"[Title] OR acceptance*[Title] OR ACT[Title])

#3 (mindfulness*[Title] OR mindful*[Title] OR MBSR[Title] OR MBCT[Title])

#4 (internet-based[Title] OR "mobile applications"[Title] OR computers[Title] OR mobile*[Title] OR internet*[Title] OR eHealth[Title] OR application[Title] OR app[Title] OR web-based[Title] OR website[Title] OR "web based"[Title] OR online*[Title] OR computer*[Title])

#1 AND #2 AND #4
#1 AND #3 AND #4

PsycINFO

#1 TI ("chronic pain" OR “chronic low back pain” OR CLBP OR “low back pain” OR “back pain” OR “neck pain” OR “pelvic pain” OR “facial pain” OR “musculoskeletal pain“ OR migraine OR neuropathy OR neuralgia OR sciatica OR fibromyalgia OR FM OR “whiplash associated disorder” OR WAD OR “repetitive strain injury” OR RSI OR dystrophy OR headache)

#2 TI (“acceptance and commitment therapy” OR acceptance* OR ACT)

#3 TI (mindfulness* OR mindful* OR MBSR OR MBCT)

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Web of Science

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Scopus

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Cochrane Library

"chronic pain" OR “chronic low back pain” OR CLBP OR “low back pain” OR “back pain” OR “neck pain” OR “pelvic pain” OR “facial pain” OR “musculoskeletal pain“ OR migraine OR neuropathy OR neuralgia OR sciatica OR fibromyalgia OR FM OR “whiplash associated disorder” OR WAD OR “repetitive strain injury” OR RSI OR dystrophy OR headache in Record Title AND “acceptance and commitment therapy” OR acceptance* OR ACT in Record Title AND internet-based OR “mobile applications” OR computers OR mobile* OR internet* OR eHealth OR application OR app OR web-based OR website OR “web based” OR online* OR computer* in Record Title - (Word variations have been searched)'

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EBSCO OpenDissertations

#1 “chronic pain" or fibromyalgia
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#1 AND #2 AND #4
#1 AND #3 AND #4