

**The effects of  
acceptance- and mindfulness- based  
interventions on chronic pain:  
A systematic review**

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### **Abstract**

Acceptance- and mindfulness- based interventions as Mindfulness- Based Stress Reduction program (MBSR), Mindfulness- Based Cognitive Therapy (MBCT) and Acceptance and Commitment Therapy (ACT) are new generation of Cognitive- Behavioral Therapies for the treatment of chronic pain. To evaluate the effectiveness of acceptance- and mindfulness- based interventions on patients with chronic pain, a systematic review was conducted. Outcome measures were pain intensity, physical wellbeing and quality of life. Twenty- four randomized controlled trials were included, totaling 1521 patients with chronic pain. Based on the results, it can be concluded that acceptance- and mindfulness- based interventions may have a positive effect on pain intensity, physical wellbeing and quality of life in patients with chronic pain. Additionally, mindfulness- based interventions may have a superior effect than acceptance- based interventions on pain intensity. This review found limited evidence for the effectiveness of acceptance- based interventions on physical wellbeing and quality of life. A following meta- analysis and more high- quality studies are recommended to produce more differentiated and validated findings.

### **Samenvatting**

Acceptatie- en mindfulness- gebaseerde interventies zoals Mindfulness- Based Stress Reduction program (MBSR), Mindfulness- Based Cognitive Therapy (MBCT) en Acceptance and Commitment Therapy (ACT) zijn de nieuwe generatie van de Cognitieve Gedrags Therapie voor de behandeling van chronische pijn. Om de effectiviteit van acceptatie- en mindfulness- gebaseerde therapieën op patiënten met chronische pijn te evalueren, is er een systematische review uitgevoerd. Uitkomstmaten waren pijn intensiteit, fysiek welbevinden en kwaliteit van leven. Vierentwintig gerandomiseerde onderzoeken met controlegroepen zijn geïncludeerd en deze studies bevatten in het geheel 1521 patiënten met verschillende typen van chronische pijn. De resultaten laten zien dat acceptatie- en mindfulness- gebaseerde interventies een positief effect kunnen hebben op pijn intensiteit, fysiek welbevinden en kwaliteit van leven. Verder is aangetoond dat mindfulness- gebaseerde interventies mogelijk een groter effect hebben op pijn intensiteit dan acceptatie- gebaseerde interventies. Er is alleen aangetoond dat acceptatie- gebaseerde interventies een positief effect op fysiek welbevinden en kwaliteit van leven kunnen hebben. Een opvolgend meta- analyse is aanbevolen en er is behoefte aan meer studies met een hoge methodologische kwaliteit.

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## 1 Introduction

Chronic pain is a major health problem worldwide. Approximately 19% of adult Europeans have to deal with chronic pain and its negative effects on their daily lives (Breivik, Collett, Ventafridda, Cohen & Gallacher, 2006). The World Health Organization (WHO) estimates that 20% of individuals worldwide have some degree of chronic pain (Gureje, Von Korff, Simon & Gater, 1998). On average, patients with chronic pain rate their pain intensity as at least 5 on a 10- point Numeric Rating Scale (NRS) during last episode of pain (Breivik et al., 2006). The experience of chronic pain has impact on daily, social and working lives. For example, Breivik et al. (2006) show that many chronic pain patients are less able or unable to do a range of daily activities, 65% were less able or unable to sleep and 48% were less able or unable to attend social activities. Additionally, Breivik et al. (2006) indicate that 61% were less able or unable to work outside the home and 19% lost their job. Chronic pain also has a high comorbidity and various psychological outcomes (Miller & Cano, 2009). Research by Breivik et al. (2006) show that 21% of chronic pain patients have also been diagnosed with major depressive disorder (MDD). Chronic pain does not only affect negatively many aspects of patients' lives but also has negative consequences for both health care system and economy. The US National Research Council (2001) estimates the total cost of chronic pain exceeding US\$ 210 billion annually in the USA. Thus, chronic pain is a major health care problem that affects patients, their social environments and society in several ways.

The most common medical treatments for chronic pain are painkillers, muscle relaxants and anti-depressant drugs (Dahl & Lundgren, 2006). These medical treatments for chronic pain focus on reducing or controlling pain sensations. Over the last decades, several meta- analyses evaluated medical treatments used today. Traditional medical treatments may possibly be effective for the treatment of acute pain but may not be effective for the treatment of chronic pain (Bigos, Bowyer & Braen, 1994; van Tulder, Goossens, Waddell & Nachemson, 2000). They often do not improve physical and emotional functioning and overall health-related quality of life (Martin et al., 2008). In fact, some medical treatments as opioids may even cause additional problems as addiction or tolerance (Morley, Eccleston & Williams, 1999). Current results by Turk, Wilson & Cahana (2011) suggest that none of the most common medical treatments are by themselves sufficient to reduce the pain intensity effectively and to have major effects on physical and emotional functioning. In addition, Van Tulder et al. (2000) even arrive at the radical conclusion that providing no treatment for chronic pain patients would have far better results than any medical treatment used today.

Traditional medical treatments revealed their limitations for the treatment of chronic pain. One possible explanation is that these medical treatments underestimate the role of psychological factors. For example, individual coping styles are essential for pain management and differential responding determines the subjective pain experience (Eccleston, 2001). So, there has been growing interest by clinicians and researchers in new psychological treatments over the last decade. Since Turk, Meichenbaum & Genest (1983) introduced the cognitive behavioral perspective, Cognitive Behavioral Therapy (CBT) developed to

the standard treatment for chronic pain in rehabilitation centers (Veehof, van Oskam, Schreurs & Bohlmeijer, 2011). While the first generation of CBT, Behavior Therapy (Lindsley, Skinner & Solomon, 1953), is based on Pavlov's classical conditioning and Skinner's operant conditioning, the second generation, Cognitive Behavioral Therapy (Beck, Rush, Shaw & Emery, 1979), combines both cognitive and behavioral principles to influence behavior. Research indicate CBT- based interventions to have a positive effect with many disorders as anxiety disorders (Otte, 2011), depression (Driessen & Hollon, 2010), eating disorders (Murphy, Straebler, Cooper & Fairburn, 2010), personality disorders (Matusiewicz, Hopwood, Banducci & Lejuez, 2010) and substance use disorder (Mc Hugh, Hearon & Otto, 2010). But for the treatment of chronic pain, meta- analyses and systematic reviews of CBT- based interventions show only small effect sizes on pain intensity and physical wellbeing (Eccleston, Williams & Morley, 2009) and moderate effect sizes on positive coping and social role functioning (Morley et al., 1999). Moreover, several participants show small or even no effect from CBT- based interventions (Turk, 2005; Vlaeyen & Morley, 2005).

The third generation of CBT, acceptance- and mindfulness- based interventions, try to combine Buddhist psychology with principles from the first and second generation of CBT. The central focus is not so much on controlling the pain as it was the case with traditional CBT but rather on acceptance of pain and the subsequent interferences in physical, psychological and social domains of life (Hayes, Luoma, Bond, Masuda & Lillis, 2006). After Thich Nhat Hanh introduced the concept of mindfulness in Western culture in the 1960s (Hanh, 2006), Jon Kabat- Zinn developed the first mindfulness- based intervention, Mindfulness Based Stress Reduction program (MBSR; Kabat- Zinn, 1982). Kabat- Zinn defines mindfulness as intentional and nonjudgmental present moment awareness (Kabat- Zinn, 1990). Practicing mindfulness may result in a 'reperceived' (Shapiro, Carlson, Astin & Freedman, 2006) or 'decentered' (Safran & Segal, 1990) state of consciousness. In other words, patients may gain the ability to "disidentify from the contents of consciousness (ie, one's thoughts) and view his or her moment-by-moment experience with greater clarity and objectivity" (Shapiro et al., 2006; p. 377).

Mindfulness- Based Cognitive Therapy (MBCT) integrated the concept of mindfulness with cognitive therapy and was primarily designed to prevent depressive relapse (Segal, Williams & Teasdale, 2002). In comparison to MBSR, MBCT focuses more on the observation of negative thoughts. In the late 1990s, Steven Hayes and his colleges developed the first acceptance- based intervention built on mindfulness principles, called Acceptance and Commitment Therapy (ACT; Hayes, Strosahl & Wilson, 1999). ACT can be applied to many problems and disorders, including chronic pain. Patients learn to stay in contact with unpleasant sensations, thoughts and emotions. ACT focuses on ineffective control strategies and experiential avoidance (Hayes et al., 2006) and uses mainly two strategies based on Buddhist principles: Acceptance/ mindfulness and values/ committed action. ACT places much less emphasize on formal mindfulness exercises than MBSR and MBCT. The extension of ACT in comparison to the mindfulness- based interventions is that ACT also focuses on value clarification and the ability of patients to commit to those in daily life.

Since the rise of acceptance- and mindfulness- based interventions, a lot of research is conducted to

evaluate their effectiveness. The different types of interventions are precisely evaluated and this field of scientific research is growing immensely. Results of the meta- analysis by Grossmann, Niemann, Schmidt & Walach (2004) suggest that MBSR may help a broad range of individuals to deal with clinical and nonclinical problems. Koch, Nachtigall, Mitte & Strauß (2007) could replicate these results. Further, the positive effects of MBCT on preventing depressive relapses of patients diagnosed with MDD are also reported precisely in meta- analyses (Piet & Hougaard, 2011; Vittengl, Clark, Dunn & Jarrett, 2007). Ruiz (2010) conducted a review of different studies concerning correlational, component and outcome studies using ACT. The results indicate in general that evidence regarding all these types of studies are very coherent and are supporting the ACT model. In the context of chronic pain, Baer (2003) found in her clinical review significant improvements of MBSR- based interventions on pain and depression. Bohlmeijer, Prenger, Taal & Cuijpers (2010) conducted a meta- analysis on the effects of MBSR and found small effects on depression, anxiety and psychological distress in patients with chronic medical diseases including chronic pain. Additionally, Powers, Zum Vörde Sive Vörding & Emmelkamp (2009) conducted a meta- analysis indicating that ACT has similar effects than well- established interventions on several primary and secondary outcome measures (e.g. depression, pain intensity, physical functioning) in mixed patient populations including chronic pain. Hayes et al. (2006) even show in their review that ACT may have superior outcome effects for chronic pain patients in comparison with traditional CBT.

All these meta- analyses report the effects of the different acceptance- and mindfulness- based interventions apart. Veehof et al. (2011) conducted the first comprehensive systematic review and meta- analysis on acceptance- and mindfulness- based interventions for the treatment of chronic pain. They reviewed 22 eligible studies reporting on the effects of a standardized acceptance- or mindfulness- based treatment program in patients with chronic pain or chronic pain- related conditions. Both 14 controlled and 8 noncontrolled studies were included, given the limited number of randomized controlled trials (RCT) and clinical controlled trials (CCT) published until 2009. Moderate and significant effect sizes were found for pain intensity, physical wellbeing and quality of life when pretest and posttest scores of all studies were analyzed. When RCT's and CCT's were analyzed separately, the effect sizes were small and significant for the included RCT's. Subgroup analyses revealed no significant differences between subgroups as type of intervention, methodological quality score, control group or type of pain.

There is a growing field of psychotherapeutic research on acceptance- and mindfulness- based interventions and so systematic reviews should keep updated. For example in 2006, ACT has been evaluated in about 30 RCT's and CCT's for a variety of client problems (Hayes et al., 2006). In 2010, that number has about doubled and new controlled studies are appearing regularly (Ruiz, 2010). Veehof et al. (2011) included eligible studies published until 2009 and by now there is no current systematic review available. This study is an update of the systematic review and meta- analysis by Veehof et al. (2011). The aim of this study is to conduct the first comprehensive systematic review of RCT's reporting on the effects of acceptance- and mindfulness- based interventions in patients with chronic pain or chronic pain related conditions. Based on the Clinical Importance of Treatment Outcomes in Chronic Pain Clinical Trials (IMMPACT)

recommendations (Dworkin et al., 2005), the outcome measures of this review are pain intensity, physical wellbeing and quality of life. The second aim of this study is to compare the effectiveness of different types of acceptance- and mindfulness- based interventions.

## 2 Methods

### 2.1 Search strategy

Two independent reviewers (S.B. and A.O.D.) performed a systematic search in 3 electronic databases: PubMed, PsycInfo and the Cochrane Central Register of Controlled Trials. The search was performed using the following terms for English language studies in the period 01/2009- 10/2013: “mindfulness” or “vipassana” or “meditation” or “mindfulness-based stress reduction” or “MBSR” or “mindfulness-based cognitive therapy” or “MBCT” or “acceptance based” or “acceptance-based” or “acceptance and commitment”, in combination with “chronic pain” or specific chronic pain conditions including “fibromyalgia” or “chronic fatigue syndrome” or “chronic low back pain” or “whiplash associated disorder” or “WAD” or “repetitive strain injury” or “RSI” or “complaints arm neck shoulders” or “CAN” or “dystrophy” or “complex regional pain syndrome” or “CRPS”.

### 2.2 Selection of studies

The search unfolded 931 hits (PubMed: 727 hits, PsycInfo: 144 hits and Cochrane: 60 hits). The selection process can be divided into five steps and is summarized in figure 1. During step 1, the two reviewers formulated basic inclusion and exclusion criteria for the study selection and new criteria were added during the selection process. Studies were included if they reported on the effectiveness of a standardized acceptance- or mindfulness- based treatment program on chronic pain or chronic pain related conditions. Only RCT's were included, based on the principle of best evidence. If it remained unclear that the described treatment program could contain acceptance- or mindfulness- based principles or if the treatment was described as complementary alternative medicine (CAM), the study was included to make sure that no possible study would be ignored. Meta- analyses and systematic reviews were also included to search in the referent lists for further eligible studies. Studies were excluded if they reported explicitly on CBT- based interventions or if the intervention consisted just of a single treatment session. With these inclusion and exclusion criteria in mind, the two reviewers evaluated independently the first 100 hits in the PubMed database on the basis of title and abstract. Disagreements were resolved completely by consensus and further exclusion criteria were formulated. Studies were excluded if they reported on mind- body therapies (e.g. Yoga or Qi Gong) because they do not fulfill the criteria of an acceptance- or mindfulness- based intervention. Further, if randomization or the use of a control group remained unclear on basis of title and abstract, the study was included to make sure that no eligible study would be ignored. Outcome measures



remained often unclear on basis of title and abstract and so they were not taken into consideration during early selection phases.

During step 2 of the selection, the two reviewers evaluated independently the next 200 hits in the PubMed database on the basis of the prescribed criteria. The interrater reliability of this step 2 selection was good (Kappa = 0,80; Cicchetti, 1994). Disagreements were resolved for 100% by consensus. Then during step 3, the remaining hits in the three databases were split and each reviewer evaluated one half of the remaining hits. This was possible because the criteria were precisely formulated and the interrater reliability was good during step 2. At the end of step 3, the two reviewers and their supervisor decided by consensus that books and dissertations were excluded because they were mostly not retrievable for this project. They also decided by consensus that only studies containing adult participants were included. In total, the two reviewers selected 106 potentially eligible studies based on title and abstract.

During step 4, the full- text articles of the selected studies were requested. Each reviewer evaluated half of the full- text articles. The two reviewers focused on different outcome measures (S. B.: Pain intensity, physical well- being, quality of life; A. O. D.: Depression, anxiety, quality of life) and studies were included if they reported on at least one of these outcome measures. To make sure that the interrater reliability remained satisfactory, the reviewers evaluated randomly 10 studies processed by the other reviewer. The agreement with the selection of the other reviewer was 100% for both samples. In total, 22 studies were selected on basis of the full- text. Then during step 5, the 22 selected studies of the meta- analysis by Veehof et al. (2011) were added to the list. Each reviewer selected independently the studies that were relevant for his or her review. For this systematic review, 24 studies were selected. The final inclusion and exclusion criteria for this review are summarized in table 1.

**Table 1**

Final inclusion and exclusion criteria

Type	Criteria
Inclusion	RCT Standardized treatment program Acceptance- or mindfulness- based treatment program Chronic pain or chronic pain related conditions At least one outcome measure (Pain intensity, physical well- being, quality of life) Adult participants
Exclusion	Explicitly CBT- based treatment program Mind- body therapies (e.g. Yoga or Qi Gong) Single treatment session Books and dissertations

RCT, randomized controlled trial; CBT, cognitive behavioral therapy.

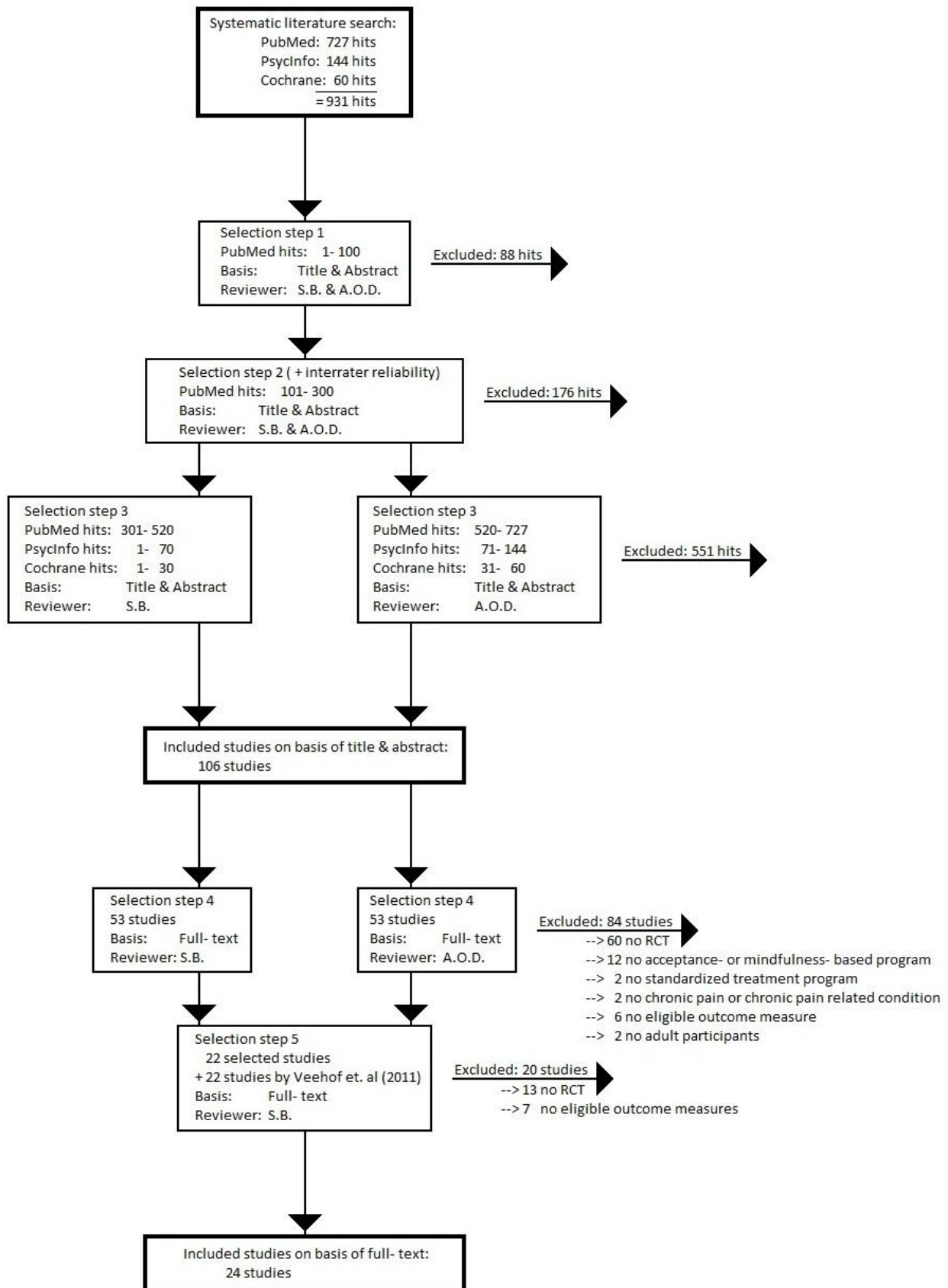


Figure 1: Selection process

### 2.3 Data extraction

Data were extracted using a standardized data abstraction form based on the form by Veehof et al. (2011). The data abstraction form contains information on publication date, characteristics of participants (type of pain, mean age and % male), type of intervention (MBSR-, MBCT-, ACT- or other type of acceptance- or mindfulness- based), control group, attrition rate, outcome measures, intervention effects and effect sizes. Two studies included by Veehof et al. (2011) were coded differently. The study by Surawy, Roberts & Silver (2005) was coded as RCT instead of CCT and the study by Zautra et al. (2008) was coded as Mindfulness Meditation and Emotion Regulation Therapy (MMERT) instead of MBSR. The intervention was considered positive (+) if the authors reported a statistically significant interaction effects (group x time). Further, an intervention was considered positive if the authors reported a statistically significant difference between the intervention group and the control group. Studies were considered negative (0) if there was no significant difference between the two groups or if there was no interaction effect. A statistically significant effect within the treatment group was not sufficient to be considered positive. Positive and negative considerations were extracted for post- intervention and follow- up measurements. The effect sizes between- group effects were extracted and also transformed according to the standards by Cohen (1988). For Cohen's d, an effect size of 0,2 to 0,3 might be a "small" effect, around 0,5 a "medium" effect and 0.8 to infinity, a "large" effect. Concerning Pearson's correlation (r), an effect size of 0,1 might be a "small" effect, 0,3 a "medium" effect and 0,5 to infinity, a "large" effect. Finally for eta- squared ( $\eta^2$ ), an effect size of 0,01 (partial  $\eta^2=0,01$ ) might be a "small" effect, 0,06 (partial  $\eta^2=0,09$ ) a "medium" effect and 0,14 (partial  $\eta^2=0,25$ ) to infinity, a "large" effect.

### 2.4 Quality assessment

The methodological quality assessment was based on the quality criteria by Veehof et al. (2011). These methodological quality criteria can be found in table 2. They used an 8- point scale, based on the criteria by Cochrane Collaboration (Higgins & Altman, 2008) and the validated Jadad scale (Jadad, 1996) tailored for the included studies. When 7 or more criteria were met, the quality of a study was assessed as high, when 4, 5 or 6 criteria were met as medium and when 3 or fewer criteria were met as low (Veehof et al., 2011). Each reviewer assessed the quality of the studies which he or she processed during step 4 of the selection. The methodological quality scores by Veehof et al. (2011) were controlled separately by the reviewers. The methodological quality assessment of these studies revealed the same scores as done by Veehof et al. (2011). Results of the quality assessment can be found in the appendix.

**Table 2**

## Criteria methodological quality

Criteria	Scoring
1. Allocation to conditions was based on randomization according to the text	1/0
2. The randomization scheme was described and appropriate, eg, using a computer, random number table	1/0
3. A dropout analysis was conducted, or there were no dropouts	1
Reasons of attrition were reported, but no analysis was conducted	0
4. Intention to treat analysis was performed, or there were no dropouts	1/0
5. At least 1 of the trainers was experienced or trained in teaching mindfulness or ACT	1
Specific experience or training was not reported	0
6. Patient's pain was diagnosed by a physician or rheumatologist, or patients were referred from a pain clinic where diagnosis is prior to admission	1
Recruitment through media, or diagnosis based on a scale and self-report, or diagnosis not mentioned	0
7. The study had a minimal level of statistical power to find significant effects of the treatment, and included 50 or more persons in the comparison between treatment and control group (this allows the study to find standardized effect sizes of 0.80 and larger, assuming a statistical power of 0.80 and alpha of 0.05)	1
Sample smaller than 50, or the total the sample was bigger than 50, but the results were only reported divided by different studies	0
8. Treatment integrity was checked during the study by supervision of the therapists during treatment, or by recording the treatment sessions, or by systematic screening of protocol adherence by a standardized measurement instrument	1
Treatment integrity was not checked, or integrity was supervised by one of the therapists, or they tried to keep the intervention sound by intensive consultation	0

ACT, acceptance and commitment therapy.

### 3 Results

#### 3.1 Characteristics of included studies

The main characteristics of the included studies are summarized in Table 3. The sample size of the reviewed studies ranged from 11 to 168, with a total of 1521 subjects. The mean age of the participants was between 33 and 76 years, but most of the studies (17 out of 24 studies) reported a mean age between 40 and 60 years. In almost all studies, except 2, the majority of participants were female. In 6 studies, the attrition rate was higher than 25% (range from 0% to 62%). In total, 17 studies measured pain intensity, 11 physical wellbeing and 15 quality of life. All studies reported good psychometric qualities for the used instruments. The studies provided 27 effect sizes for 38 post- intervention measurements. Additionally, the studies provided 10 effect sizes for 27 follow- up measurements. Furthermore, 7 studies reported the effects of a MBSR- based intervention, 2 studies of a MBCT- based intervention, 11 studies of an ACT- based intervention and 4

studies of other acceptance- or mindfulness- based interventions as Mindfulness- Based Pain Management (MBPM; Brown & Jones, 2013; Cusens, Duggan, Thorne & Burch , 2010), Mindfulness- based CBT (Ljótsson et al., 2010), and Mindfulness Meditation and Emotion Regulation Therapy (MMERT; Zautra et al., 2008). These other acceptance- or mindfulness- based interventions were listed separately because they integrated aspects of MBSR, MBCT and ACT in a new treatment protocol. They were just considered for the effects on the outcome measures but not for the comparison between the different types of acceptance- and mindfulness- based interventions because of their heterogeneity and their limited number. Most of the included studies (18 out of 24) reported on interventions consisting of 8 (range: 4- 11) weekly group- based sessions. Additionally, two interventions were composed of an individual internet- based treatment, 2 interventions of an individual self- help manual intervention and 2 interventions of individual treatment sessions. In total, 8 studies used an active control group (2 CBT, 2 education program, 2 online discussion forum, 1 applied relaxation and 1 progressive relaxation) and 8 used treatment as usual (TAU), 6 used a waitlist group and 2 used medical treatment as usual (MTAU) as control condition. Overall, 4 studies scored high on the quality assessment, 17 scored medium and 3 scored low. Each study met at least 2 quality criteria but none of the studies met all criteria. The frequencies of positive effects at post- intervention and follow- up are summarized in table 4.

**Table 4**

Frequencies of significant effects for post- treatment and follow- up

Treatment	Measurement	Pain intensity		Physical wellbeing		Quality of life	
MBSR	Post- intervention	0/1		1/4	(S07)	1/4	(S07)
	Follow- up	1/2	(S14)	1/3	(S14)	1/5	(S14)
MBCT	Post- intervention	1/1	(S01)	0/1		0/0	
	Follow- up	1/1	(S01)	0/1		0/0	
ACT	Post- intervention	0/9		2/5	(S05, S21)	3/7	(S05, S16, S21)
	Follow- up	0/5		2/4	(S05, S21)	2/6	(S05, S21)
Others	Post- intervention	0/3		0/1		1/2	(S15)
	Follow- up	0/0		0/0		0/0	

MBSR, mindfulness- based stress reduction; MBCT, mindfulness- based cognitive therapy; ACT, acceptance and commitment therapy; S, study number.

# The effects of mindfulness- based interventions on chronic pain

**Table 3**  
Characteristics of included studies

Study Number	Author	Publication date	Quality score	Pain	Mean age (SD or range)	Male, %	Intervention	Delivery format	Group size	Sessions (number), duration	Control Group	n	Attrition rate (intervention), %	Outcome measures	Outcome effect Post treatment (+=positive, 0= none)	Follow – Up (duration), Outcome effect (+=positive, 0= none)	Effect sizes, post- intervention (s=small, m=medium, l=large)	Effect sizes, follow- up (s=small, m=medium, l=large)
S01	Parra- Delgado & Latorre-Postigo	10/2013	5	Fibromyalgia	52,7 (10,1)	0	MBCT	Group- based	-	8, 2,5h	TAU	31	12	Pain: FIQ	+	3m, +	$\eta^2=0,35$ (l)	$\eta^2=0,24$ (m)
S02	McCracken et al.	09/2013	6	Chronic pain	58 (12,8)	31	ACT	Group- based	12- 13	4, 4h	TAU	73	27	Physical : SF-36 Pain: NRS	0 0	3m, 0 3m, 0	d=0,17 (s) d=0,44 (m)	d=0,39 (s) d=0,32 (s)
S03	Buhman et al.	06/2013	5	Chronic pain	49,1 (10,3)	40	ACT	Internet- based	Individual	7	CG: Online discussion forum	76	62	QoL: QOLI	0	6m, 0		
S04	Rines & Wingrove	04/2013	5	Chronic fatigue syndrome	I: 41,4 (10,9) C: 45,2 (9,4)	I: 25 C: 10	MBCT	Group- based	-	8, 2,5h	Waitlist	35	11	Physical: PF- 10	0	2m, 0	partial $\eta^2=0,07$ (s)	partial $\eta^2=0,03$ (s)
S05	Wicksell et al.	04/2013	5	Fibromyalgia	45,1 (6,6)	0	ACT	Group- based	6	12, 1,5h	Waitlist	40	13	Physical: PDI QoL: SF- 36 Pain: NRS	+ + 0	3m, + 3m, + 3m, 0	d=0,75 (l) d=0,84 (l) d=0,38 (s)	d=0,73 (l) d=1,06 (l) d=0,82 (l)
S06	Brown et al.	03/2013	3	Chronic musculoskeletal pain	I: 48 (10) C: 45 (12)	I: 20 C: 31	MBPM	Group- based	-	8, 2,5h	TAU	40	10	QoL: SF- 36 Pain: MPQ- SF	0 0		$r^2=0,00$ $r^2=0,38$ (m)	
S07	Fjorback et al.	01/2013	6	Bodily distress syndrome	I: 38 (9,0) C: 40 (8,0)	I: 20 C: 20	MBSR	Group- based	12	8, 3,5h	TAU	119	12	Physical: PCS QoL: SF- 36	+ +	15m, 0 15m, 0		
S08	Mo'tamedi et al.	08/2012	5	Chronic headache	I: 34,2 (7,4) C: 37,9 (8,7)	0	ACT	Group- based	-	8, 1,5h	MTAU	30	27	Pain: MPQ- SF	0		d=0,28 (s)	
S09	Jensen et al.	07/2012	4	Fibromyalgia	45,6 (6,4)	0	ACT	Group- based	6	12, 1,5h	Waitlist	43	24	Pain: VAS	0			
S10	Wong et al.	10/2011	5	Chronic pain	I: 48,7 (7,8) C: 47,1 (7,8)	-	MBSR	Group- based	-	8, 2,5h	TAU	100	24	Pain: NRS QoL: SF- 12	0 0	6m, 0 6m, 0		
S11	Thorsell et al.	10/2011	4	Chronic pain	46,0 (12,3)	36	ACT	Self- help manual	Individual	7	CG: Applied Relaxation	115	37	QoL: SWLS Physical: ÖMPQ Pain: ÖMPQ	0 0 0	12m, 0 12m, 0 12m, 0		
S12	Wetherell et al.	09/2011	7	Chronic pain	54,9 (12,5)	49	ACT	Group- based	4- 6	8, 1,5h	CBT	99	12	QoL: SF- 12	0	6m, 0		
S13	Schmidt et al.	02/2011	7	Fibromyalgia	52,5 (9,6)	0	MBSR	Group- based	12	8, 2,5h	CG: Progressive Relaxation	168	17	QoL: HRQoL (PLC) Pain: PPS		2m, 0 2m, 0		
S14	Esmer et al.	10/2010	4	Failed back surgery syndrome	I: 55,2 (11,2) C: 54,9 (9,5)	I: 47 C: 70	MBSR	Group- based	-	8, 1-5h - 2,5h	TAU	40	21	QoL: CPAQ Pain: VAS Physical: RMDQ		3m, + 3m, + 3m, +		d=1,14 (l) d=1,02 (l) d=1,28 (l)

S15	Ljótsson et al.	06/2010	7	Irritable bowel syndrome	I: 36,4 (10,1) C: 32,8 (8,6)	I: 17 C: 14	Minfulness- based CBT	Internet- based	Individual	10, 2,5h	CG: Online discussion forum	85	10	QoL: IBS- QoL	+	d=0,93 (l)
S16	Johnston et al.	06/2010	4	Chronic pain	(20- 84)	38	ACT	Self- help manual	Individual	6	Waitlist	25	50	Pain: SF- MPQ QoL: QoLI	0 +	d=0,67 (m) d=0,97 (l)
S17	Cusens et al.	02/2010	2	Chronic pain	I: 46,7 (11,5) C: 48,4 (12,3)	I: 7 C: 45	MBPM	Group- based	-	8- 10, 2,5h	TAU	53	3	Pain: NRS Physical: SF- 36	0 0	d=0,00 d=0,07 (s)
S18	Wong	10/2009	4	Chronic pain	(18- 65)	-	MBSR	Group- based	-	10	CG: Education Program	100	-	QoL: SF- 12	0	6m, 0
S19	Vowles et al. (Study 2)	02/2009	4	Chronic pain	50,4 (17,8)	82	ACT	Group- based	2- 3	4, 1,5h	CBT	11	0	Pain: MPQ- SF Physical: PDI	0 0	
S20	Morone et al.	2008	5	Chronic low Back pain	I: 74,1 (6,1) C: 75,6 (5,0)	I: 47 C: 39	MBSR	Group- based	-	8, 1,5h	Waitlist	37	32	Pain: SF- MPQ Physical: SF-36 QoL: SF-36	0 0 0	d=0,32 (s) d=0,46 (m) d=0,21 (s)
S21	Wicksell et al.	2008	5	Wiplash- associated disorder	I: 48,2 (7,8) C: 55,1 (11,2)	38,5	ACT	Individual	Individual	10, 1h	TAU	20	0	Pain: VAS Physical: PDI QoL: SWLS	0 + +	3m, 0 3m, + 3m, + partial $\eta^2=0,44$ (l) partial $\eta^2=0,40$ (l)
S22	Zautra et al.	2008	7	Rheumatoid Arthritis	I: 57,3 (15,3) C: 52,4 (13,0)	31,9	MMERT	Group- based	6- 10	8	CG: Education	144	2	Pain: NRS	0	
S23	Surawy et al. (Study 1)	2005	2	Chronic fatigue syndrome	(18- 65)	44	MBSR	Group- based	9	8	Waitlist	18	0	Physical: SF- 36	0	
S24	Dahl et al.	2004	4	Chronic pain	I: 36,7 (12,5) C: 44,4 (13,6)	10,5	ACT	Individual	Individual	4, 1h	MTAU	19	0	Pain: NRS QoL: LSQ	0 0	6m, 0 6m, 0

I, intervention group; C, control group; TAU, treatment as usual; MBCT, mindfulness- based cognitive therapy; ACT, acceptance and commitment therapy; MBPM, mindfulness- based pain management; CBT, cognitive behavioral therapy; MBSR, mindfulness- based stress reduction; MTAU, medical treatment as usual; MMERT, mindfulness meditation and emotion regulation therapy; CG, control group; FIQ, fibromyalgia impact questionnaire; SF- 36, 36- item short- form health survey; NRS, numerical rating scale; QOLI, quality of life inventory; PF- 10, 10- item physical functioning; PDI, pain disability index; MPQ- SF, McGill pain questionnaire short- form; PCS, physical component summary; VAS, visual analogue scale; SF- 12, 12- item short- form health survey; SWLS, satisfaction with life scale; ÖMPQ, örebro musculoskeletal pain questionnaire; HRQoL, health- related quality of life; PLC, quality of life profile for the chronically III; PPS, pain perception scale; CPAQ, chronic pain assessment questionnaire; RMDQ, roland- morris disability questionnaire; IBS- QoL, irritable bowel syndrome quality of life instrument; QoL, quality of life profile for the chronically III; LSQ, life satisfaction questionnaire; d, Cohen's;  $\eta^2$ , eta- squared

### 3.2 Pain intensity

#### 3.2.1 Post- intervention effects

In total, 17 RCT's reported the effects on pain intensity ratings and 14 provided data of post- intervention effects. One of these 14 studies demonstrated a significant decrease in pain intensity ratings compared to the control condition. This positive study described a MBCT- based intervention for patients with fibromyalgia (S01). There were 3 studies with no significant difference compared to an active control condition. They described the effects of an ACT- based self- help manual for chronic pain compared with an applied relaxation group (S11), an ACT- based intervention for chronic pain compared with a CBT group (S19) and a MMERT intervention for rheumatoid arthritis compared with an education group (S22). The remaining 13 negative studies used TAU, MTAU or waitlist groups as control condition. There was 1 study with a high methodological quality score (S22) and most of the other studies had a medium methodological quality score. The methodological quality scores of the two MBPM programs were low (S17: 2; S06: 3).

One study reported the effects of a MBSR- based intervention on pain intensity ratings and this study could not demonstrate significant differences compared to a waitlist group. There was one study reporting on the effects of a MBCT- based intervention on pain intensity ratings and this study could demonstrate significant differences compared to a TAU condition. Nine studies reported on the effects of an ACT- based intervention on pain intensity ratings and none of these could show significant differences compared to the control condition. Two of these studies showed no significant difference to an active control condition (S11: Applied relaxation; S19: CBT). The other negative studies used a TAU, MTAU or waitlist group as control condition. Finally, there were 3 studies reporting on other acceptance- or mindfulness- based programs on pain intensity ratings and none of these could demonstrate significant differences compared to the control condition. One of these studies reporting on a MMERT program showed no significant difference to an active control condition (S22: Education group). The other two negative studies used TAU as control condition.

#### 3.2.2 Follow- up effects

Most of the follow- up's were 3 months after the intervention, but there was also a 12 month follow- up. Overall, 8 studies provided data of follow- up effects and 2 of them demonstrated a significant decrease in pain intensity ratings compared to a control condition. The positive studies described a MBSR- based intervention for patients with failed back surgery syndrome (S14) and a MBCT- based intervention for patients with fibromyalgia (S01). There were 2 negative studies using an active control condition (S11: Applied relaxation; S13: Progressive relaxation) and the remaining 4 negative studies used a TAU, MTAU or waitlist group as control condition. There was 1 study with a high methodological quality score (S13: 7) and



the remaining scores were medium ranging from 4 to 6.

Two studies reported the effects of a MBSR- based intervention on pain intensity ratings and 1 study could demonstrate significant differences compared to a TAU condition (S14). The negative study reporting on a MBSR- based intervention used an active control condition (S13: Progressive relaxation). There was 1 study reporting on the effects of a MBCT- based intervention on pain intensity ratings and this study could show significant differences compared to a TAU condition (S01). There were 5 studies reporting on the effects of an ACT- based intervention on pain intensity ratings and none of these could show significant differences compared to the control condition. One of these negative studies used an active control condition (S11: Applied relaxation). The other negative studies used a TAU, MTAU or waitlist group as control condition. There was no study reporting follow- up effects of other acceptance- or mindfulness- based interventions.

### 3.3 Physical wellbeing

#### 3.3.1 Post- intervention effects

In total, 11 RCT's reported the effects on physical wellbeing ratings and all provided data of post-intervention effects. Three of these studies demonstrated a significant increase in physical wellbeing ratings compared to the control condition. The positive studies described an ACT- based intervention for patients with fibromyalgia (S05), a MBSR- based intervention for patients with bodily distress syndrome (S07) and an ACT- based intervention for patients with whiplash- associated disorder (S21). There were two negative studies using an active control condition. They described the effects of an ACT- based self- help manual for chronic pain compared with an applied relaxation group (S11) and an ACT- based intervention for chronic pain compared with a CBT group (S19). The remaining 6 negative studies used TAU or waitlist groups as control condition. There was no study with a high methodological quality score and most of the studies had a medium methodological quality score. There were two studies with a low methodological quality score of 2 describing a MBPM program for patients with chronic pain (S17) and a MBSR- based intervention for patients with chronic fatigue syndrome (S23).

Four studies reported the effects of a MBSR- based intervention on physical wellbeing ratings and one study could demonstrate a significant difference compared to TAU group. The negative studies used a TAU or waitlist group as control condition. There was 1 study reporting on the effects of a MBCT- based intervention on physical wellbeing ratings and this study could not demonstrate significant differences compared to a waitlist condition. Five studies reported on the effects of an ACT- based intervention on physical wellbeing ratings and two of these could show significant differences compared to a TAU or waitlist condition. Two negative studies used an active control condition (S11: Applied relaxation; S19: CBT). The last negative study used TAU as control condition. Finally, there was 1 study reporting on other acceptance- or mindfulness- based interventions on physical wellbeing ratings and this study could not demonstrate

significant differences compared to TAU condition.

### 3.3.2 Follow- up effects

Most of the follow- up's were 3 months after the intervention, but there was also a 12- and a 15- month follow- up. Overall, 8 studies provided data of follow- up effects and 3 of them demonstrated a significant increase in physical wellbeing ratings compared to a control condition. The positive studies described an ACT- based intervention for patients with fibromyalgia (S05), a MBSR- based intervention for patients with failed back surgery syndrome (S14) and a ACT- based intervention for patients with whiplash- associated disorder (S21). One negative study used an active control condition (S11: Applied relaxation) and the remaining 4 negative studies used a TAU or waitlist group as control condition. All positive and negative studies had a medium methodological quality score ranging from 4 to 6.

Three studies reported the effects of a MBSR- based intervention on physical wellbeing ratings and one study could demonstrate significant differences compared to a TAU condition (S14). The two negative studies used TAU as control condition. There was 1 study reporting on the effects of a MBCT- based intervention on physical wellbeing ratings and this study could show significant differences compared to a waitlist condition. There were 4 studies reporting on the effects of an ACT- based intervention on physical wellbeing ratings and two of these could show significant differences compared to a TAU or waitlist condition. One negative study used an active control group (S11: Applied relaxation). The other negative study used TAU as control condition. There was no study reporting follow- up effects of other acceptance- or mindfulness- based interventions.

## 3.4 Quality of life

### 3.4.1 Post- intervention effects

In total, 15 RCT's reported the effects on quality of life ratings and 13 provided data of post- intervention effects. Five of these 13 studies demonstrated a significant increase in quality of life ratings compared to a control condition. These positive studies described an ACT- based intervention for patients with fibromyalgia (S05), a MBSR- based intervention for patients with bodily distress syndrome (S07), a mindfulness- based CBT program for patients with irritable bowel syndrome (S15), an ACT- based self- help manual for patients with chronic pain (S16) and an ACT- based intervention for patients with whiplash- associated disorder (S21). There were 4 negative studies using an active control condition. They described the effects of an ACT- based intervention for chronic pain compared with an online discussion forum (S03), an ACT- based self- help manual for patients with chronic pain compared with an applied relaxation group (S11), an ACT- based intervention for patients with chronic pain compared with a CBT group (S12) and a MBSR- based

intervention for patients with chronic pain compared with an education group (S18). The remaining 4 negative studies used a TAU, MTAU or waitlist group as control condition. There were 2 studies with a high methodological quality score (S12: 7; S15: 7) and most of the other studies had a medium methodological quality score ranging from 4 to 6. The methodological quality score of one study reporting on a MBPM programs was low (S06: 3).

Four studies reported on the effects of a MBSR- based intervention on quality of life ratings and 1 of these studies could demonstrate significant differences compared to a TAU condition (S07). There was 1 negative study using an active control condition (S18: Education group) and the other 2 negative studies used a TAU or waitlist group as control condition. There was no study reporting on the effects of a MBCT- based intervention on quality of life ratings. Seven studies reported on the effects of an ACT- based intervention on quality of life ratings and 3 of these could show significant differences compared to the control condition. Three negative studies used an active control condition (S03: Online discussion forum; S11: Applied relaxation; S12: CBT). The remaining negative study used MTAU as control condition. Finally, there was 1 study reporting on other acceptance- or mindfulness- based programs on quality of life ratings. This study could not show a significant difference compared to a TAU group.

#### 3.4.2 Follow- up effects

Most of the follow- up's were 3 or 6 months after the intervention, but there was also a 12- and a 15- month follow- up. Overall, 11 studies provided data of follow- up effects and 3 of them demonstrated a significant increase in quality of life ratings compared to a control condition. The positive studies described an ACT- based intervention for patients with fibromyalgia (S05), a MBSR- based intervention for patients with bodily, a MBSR- based intervention for patients with failed back surgery syndrome (S14) and an ACT- based intervention for patients with whiplash- associated disorder (S21). Five negative studies used an active control condition (S03: Online discussion forum; S11: Applied relaxation group; S12: CBT; S13: Progressive relaxation; S18: Education group) and the remaining three negative studies used TAU or MTAU as control condition. There were 2 studies with a high methodological quality score (S12: 7; S13: 7) and all other studies had a medium methodological quality score ranging from 4 to 6.

Five studies reported on the effects of a MBSR- based intervention on quality of life ratings and one study could demonstrate significant differences compared to a TAU condition (S14). Two negative studies used an active control condition (S13: Progressive relaxation; S18: Education group) and the other 2 negative studies used TAU as control condition. There was no study reporting on the effects of a MBCT- based intervention on quality of life ratings. There were 6 studies reporting on the effects of an ACT- based intervention on quality of life ratings and two of these could show significant differences compared to a TAU or waitlist condition (S15; S21). Three negative studies used an active control group (S03: Online discussion forum; S11: Applied relaxation; S12: CBT). The last negative study used TAU as control condition. There was no study reporting follow- up effects of other acceptance- or mindfulness- based interventions.

## 4 Discussion

### 4.1 Main findings

The main purpose of this study was to evaluate systematically and comprehensively the effectiveness of acceptance- and mindfulness- based interventions on pain intensity, physical wellbeing and quality of life for patients with chronic pain. The second aim of this study was to analyze the effects on the selected outcome measures separately for MBSR, MBCT and ACT. A systematic search was conducted in three databases of peer- reviewed articles to find possible eligible studies. This study reviewed 24 studies describing various acceptance- and mindfulness- based interventions for different types of chronic pain.

In total, the systematic search unfolded 17 eligible studies reporting the effects on pain intensity. Fourteen studies provided post- intervention data and 1 of these studies demonstrated a significant effect on pain intensity compared to the control condition. But there were also 3 studies with no significant difference compared to an active control condition (Applied relaxation, CBT and Education group). Showing no significant differences compared to these control conditions indicates that the described acceptance- and mindfulness- based interventions were as effective as the compared treatments. The study using the education group as control condition had a high methodological quality score, emphasizing its empirical relevance. Eight studies provided follow- up data and 2 of these studies showed a significant effect on pain intensity compared to the control condition. But there were also 2 studies with no significant difference compared to an active control condition (Applied relaxation and Progressive relaxation). The study using progressive relaxation as control intervention had a high methodological quality score. Based on these results, this study found limited evidence for the effectiveness of acceptance- and mindfulness- based interventions on pain intensity at post- intervention and follow- up. Not even the half of the selected studies could show a significant effect compared to a TAU condition or no significant difference to a well- established treatment. But in general, it is questionable if pain intensity is the most appropriate outcome measure for acceptance- and mindfulness- based interventions in patients with chronic pain, even though it is in accordance with the IMMPACT recommendations. Pain reduction is not the primary focus of acceptance- and mindfulness- based interventions. Patients learn the negative impact of pain control strategies on their daily life and they learn to accept pain and its interferences. Thus larger effect sizes should not be expected and future research should also focus more on pain measures as interference of pain with daily life as recommended by Veehof et al. (2011).

There were considerable differences between the types of interventions. One study reported on a MBSR- based intervention and they could not show significant differences on pain intensity compared to a control condition at post- intervention. One of two studies reported significant differences at follow- up and the negative study used an education group as control condition. The findings of the systematic review by Baer (2003) that MBSR- based interventions produce statistically significant improvements in pain ratings

could not be replicated. One study reported on a MBCT- based intervention and this study could show significant differences on pain intensity compared to a control condition at post- intervention and follow- up. So, MBSR- and MBCT- based interventions can possibly have a positive effect on pain intensity but definitely more studies are needed to validate these findings. Further, there were 9 studies reporting on an ACT- based intervention and none of these studies could show a significant difference compared to the control conditions at post- intervention. Further, none of the 5 studies reporting follow- up data could show a significant difference compared to the control conditions. Even though there were studies using an active control group (Applied relaxation and CBT), the number of negative studies reporting on the effects of ACT- based interventions on pain intensity was high. So, it can be concluded that acceptance- based interventions may have a smaller effect on pain intensity than mindfulness- based interventions. One possible explanation is that acceptance- based interventions focus more on acceptance of pain and for this reason less on reduction of pain than mindfulness- based interventions. Veehof et al. (2010) found similar effects for acceptance- based interventions and mindfulness- based interventions on chronic pain. The different findings can possibly be explained by the fact that they just included 2 RCT's reporting on an ACT- based intervention.

Overall, the systematic search unfolded 11 eligible studies reporting the effects on physical wellbeing. All studies provided post- intervention data and 3 of these studies demonstrated a significant effect on physical wellbeing compared to the control condition. But there were also 2 studies with no significant difference compared to an active control condition (Applied relaxation and CBT). Showing no significant differences compared to these control conditions indicates that the described acceptance- and mindfulness- based interventions were as effective as the compared interventions. There was no study with a high methodological quality score. Eight studies provided follow- up data and 3 of these studies showed a significant effect on physical wellbeing compared to the control condition. But there were also 1 study with no significant difference compared to an active control condition (Applied relaxation). Even though just half of the studies reported significant effects on physical wellbeing compared to a control condition, there were some negative studies reporting small or medium effect sizes. This can be possibly related to small sample sizes of the included studies. Chiesa & Serretti (2011) also found in their systematic review small but not significant effect sizes of mindfulness- based interventions on physical wellbeing in patients with chronic pain. Therefore, they argued for more replications with larger sample sizes. So, this review found limited evidence for the effectiveness of acceptance- and mindfulness- based interventions on physical wellbeing at post- intervention and follow- up. Again, not even the half of the selected studies could show a significant effect compared to a TAU condition or no significant difference to a well- established treatment.

Again, there were considerable differences between the types of intervention. Four MBSR- based interventions provided post- intervention data and 3 provided follow- up data. One MBSR- based interventions showed significant differences on physical wellbeing compared to a control condition at post- intervention and follow- up. One MBCT- based intervention could not show a significant effect compared to a control condition at post- intervention and follow- up. Given the limited number of mindfulness- based interventions, no validated conclusions are possible. Five studies provided post- intervention data and 4

studies provided follow- up data of an ACT- based intervention. Two studies could demonstrate a significant difference compared to a control condition at post- intervention and follow- up. Additionally, 2 studies used an active control condition at post- intervention (Applied relaxation and CBT) and 1 study used an active control condition at follow- up (Applied relaxation). Based on these findings, it can be concluded that acceptance- based interventions may have a positive effect on physical wellbeing in patients with chronic pain. The findings of the review by Hayes et al. (2006) that ACT- based interventions may have superior outcome effects in comparison with traditional CBT could not be replicated. But the results of the meta- analysis by Powers et al. (2009) that ACT- based interventions have similar effects than well- established interventions on physical wellbeing in mixed patient populations including chronic pain were replicated.

In total, the systematic search unfolded 15 eligible studies reporting the effects on quality of life. Thirteen studies provided post- intervention data and 5 of these studies demonstrated a significant effect on quality of life compared to the control condition. But there were also 4 studies without a significant difference to an active control condition. Showing no significant differences compared to these control conditions indicates that the described acceptance- and mindfulness- based interventions were as effective as the compared treatments (Online discussion forum, Applied relaxation, CBT and Education group). There were two studies with a high methodological quality score. One of these studies compared an ACT- based intervention with a CBT intervention and they could not find a significant difference between the two interventions. Eleven studies provided follow- up data and 3 of these studies showed a significant effect on quality of life compared to the control condition. The studies using an active control condition at post- intervention showed the same results at follow- up. Again, there were some more negative studies reporting small or medium effect sizes without reporting a statistical significance. This can be related to small sample sizes of included studies. As Chiesa & Serretti (2011) recommend, more replications with larger sample sizes are needed. Based on the findings of this review, it can be concluded that acceptance- and mindfulness- based interventions may have a positive effect on quality of life in patients with chronic pain. This time, more than the half of the selected studies could show a significant effect compared to a TAU condition or no significant difference to a well- established treatment.

There were considerable differences between the types of intervention. Four MBSR- based interventions provided post- intervention data and 5 provided follow- up data. One MBSR- based interventions showed significant differences on physical wellbeing compared to a control condition at post- intervention and two studies at follow- up. Additionally, there was 1 study showing no significant difference to an active control condition at post- intervention (Education group) and 2 studies at follow- up (Progressive relaxation and Education group). There was no study reporting on the effects of a MBCT- based intervention on quality of life. Given the limited number of mindfulness- based interventions, no validated conclusions are possible and especially further research on MBCT- based interventions should include quality of life as outcome measure. Seven studies provided post- intervention data and 6 studies provided follow- up data of an ACT- based intervention. Three studies could demonstrate a significant difference compared to a control condition at post- intervention and 2 studies at follow- up. Additionally, 3 studies used an active control

condition (Online discussion forum, Applied relaxation and CBT) at post- intervention and follow- up. Based on these results, it can be concluded that acceptance- based interventions may have a positive effect on quality of life in patients with chronic pain. The findings of the review by Hayes et al. (2006) that ACT- based interventions may have superior outcome effects in comparison with traditional CBT could not be replicated.

#### 4.2 Limitations

The most important limitation of this study is that this review is pure descriptive. This review indicated that there may be a positive effect of acceptance- and mindfulness- based intervention on pain intensity, physical wellbeing and quality of life for patients with chronic pain. But there were found 11 small or medium effect sizes without statistical significance at post- intervention and 4 small, medium and large effect sizes without significance at follow- up. This can possibly related to the small sample sizes. Pooled standardized mean differences (SMD's) to test group heterogeneities and to perform subgroup analyses can possibly produce more differentiated and validated findings. So, a comprehensive meta- analysis with pooled SMD's is strongly recommended.

As described earlier, the selection of outcome measures biased the outcomes. Pain intensity does not seem to be the most appropriate outcome measure for acceptance- and mindfulness- based interventions. Further, MBCT- based interventions could have possibly shown greater results if depression would have been included as outcome measure. MBCT was primarily designed to prevent depressive relapse (Segal, Williams et al., 2002). In a multicenter trial for patients with a recurrent depression, MBCT was found to effectively reduce relapse rates with 44% compared to a TAU condition (Teasdale et al., 2000). Further, these positive effects of MBCT on preventing depressive relapse are also precisely reported in meta- analyses (Piet & Hougaard, 2011; Vittengl et al., 2007). If this study would have included depression as outcome measure, there would possibly have been more eligible MBCT- based studies and possibly a positive effect reported. The choice of outcome measures was done by both reviewers. The other reviewer will use depression, anxiety and quality of life as outcome measures for her systematic review. Thus, the next consequential step would be to compare these two systematic reviews and connect them in a meta- analysis.

The selection of studies was also biased to a certain degree, because books and dissertations were excluded. This decision was based on the given time for this project but this made a publication bias possible. It can be possible that more eligible books and unpublished studies exist in the used databases. The recommended meta- analysis should also include books and dissertations to decrease the possibility of a publication bias.

Another limitation of this study is that this review only found 4 high quality studies and no study met all quality criteria. This is possibly an underestimation because, when a criterion was not reported, it was coded as negative. Some authors may not mention these criteria because of the lack of space and so they may have been more high quality studies. But clearly, authors should keep quality criteria more in mind because

more high quality studies are needed to draw validated conclusions.

The last limitation is the lack of time given for this project. With more time, more variables could have been taken into account. For example, the heterogeneity of samples, the attrition rates and delivery formats were not considered in this review. Further, the selection process and the data extraction was made by two researchers and only this cooperation made the project possible within the given time. But splitting these processes increases the possibility of errors, even though a lot of steps were decided by consensus and a satisfactory interrater- reliability was calculated for step 2 of the selection process. So, the selection process and the data extraction of the recommended meta- analysis should be done completely by two reviewers. Then the interrater- reliability should be calculated. This would support the validity of the findings.

#### 4.3 Conclusions and implications

Despite the limitations, this systematic review shows limited evidence that acceptance- and mindfulness- based interventions may have positive effects on pain intensity, physical wellbeing and quality of life for patients with chronic pain. The strongest evidence was found for the effects on quality of life. While mindfulness- based interventions may have a superior effect than acceptance- based interventions on pain intensity, this review could only indicate acceptance- based interventions to have a positive effect on physical wellbeing and quality of life. Veehof et al. (2011) also found positive effects of acceptance- and mindfulness- based interventions on pain intensity, physical wellbeing and quality of life in patients with chronic pain and so this review could update and replicate these findings with more recent RCT's. A following meta- analysis is strongly recommended to produce more differentiated and validated findings. As this systematic review contained 19 additional RCT's compared to the systematic review and meta- analysis by Veehof et al. (2011), the field psychotherapeutic research on acceptance- and mindfulness- based interventions is growing immensely. Overall, the effects of acceptance- and mindfulness- based interventions are promising, but more high- quality studies and replications with larger sample sizes are needed.



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## 6 Appendix

### 6.1 Methodological quality assessment

**Tabel 4**

Methodological quality assesment

Author (Publication date)	Rando- mization	Random- ization described	Reasons of attrition reported	Intention to treat analysis (ITT)	Trained profes- sionals	Pain diagnosis by profes- sional	Minimal statistical power	Treat- ment integrity checked
Parra- Delgado & Latorre-Postigo (2013)	1	1	0	0	1	1	1	0
McCracken et al. (2013)	1	1	1	1	1	0	1	0
Buhrman et al. (2013)	1	1	0	1	0	1	1	0
Rines & Wingrove (2013)	1	1	1	0	1	1	0	0
Wicksell et al. (2013)	1	1	0	0	1	1	1	1
Brown et al. (2013)	1	0	1	0	0	0	1	0
Fjorback et al. (2013)	1	1	1	1	1	1	1	0
Mo'tamedi et al. (2012)	1	0	1	1	0	1	1	0
Jensen et al. (2012)	1	0	0	0	1	1	1	0
Wong et al. (2011)	1	1	0	1	1	1	1	0
Thorsell et al. (2011)	1	0	0	0	1	1	1	0
Wetherell et al. (2011)	1	1	1	1	1	1	1	1
Schmidt et al. (2011)	1	1	1	1	1	1	1	0
Esmer et al. (2010)	1	0	1	0	1	0	1	0
Ljotsson et al. (2010)	1	1	1	1	1	0	1	1
Johnston et al. (2010)	0	0	0	1	0	1	1	1



Cusens et al. (2010)	0	0	1	0	0	0	1	0
Wong et al. (2009)	1	0	0	0	1	1	0	1
Vowles et al. (Study 2; 2009)	0	0	1	0	1	1	1	0
Morone et al. (2008)	1	1	1	1	1	0	0	0
Wicksell et al. (2008)	1	0	0	1	1	1	1	0
Zautra et al. (2008)	1	1	0	0	1	1	0	1
Surawy et al. (Study 1; 2005)	1	0	0	0	0	1	0	0
Dahl et al. (2004)	1	0	0	0	1	1	0	1