

The Efficacy of Acceptance and Commitment Therapy for Chronic Pain

A Systematic Review and Meta-analysis

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Objectives: Previous meta-analyses of a small number of trials showed that acceptance and commitment therapy (ACT) might improve chronic pain. Many new trials have been published afterward, and the factors that may impact the efficacy of ACT are less understood. We, therefore, conducted an updated systematic review with meta-analysis to investigate the efficacy of ACT for people with chronic pain.

Methods: Randomized controlled trials that investigated the efficacy of ACT in clinical or community setting for adult populations with chronic pain were included. The methodological quality of trials was assessed with the Cochrane Risk of Bias tool. Standardized mean differences between ACT and comparison groups in their effects on 6 outcomes (ie, pain acceptance, quality of life, pain-related functioning, pain intensity, anxiety, and depression) were pooled across studies.

Results: Of the 3171 records identified, 21 trials with 1962 participants were included for analysis. The comparison groups included active treatment and waitlist control/usual care. The standardized mean difference was 0.67 (95% CI: 0.48, 0.87) for pain acceptance, 0.43 (95% CI: 0.29, 0.57) for quality of life, -0.88 (95% CI: -1.14, -0.63) for pain-related functioning, -0.45 (95% CI: -0.62, -0.27) for pain intensity, -0.35 (95% CI: -0.54, -0.15) for anxiety, and -0.74 (95% CI, -0.98, -0.50) for depression, all favoring ACT. Subgroup analyses showed that the effects were statistically significant across almost all subgroups and for some outcomes were greater in the trials conducted in people with a specific diagnosis (as compared with those conducted in people with general chronic pain), the trials with waitlist or usual care control, the trials with a greater number of sessions of ACT, and the trials with a longer ACT intervention.

Discussion: ACT is effective and comparable to, if not better than, some other available active treatments for chronic pain.

Key Words: acceptance and commitment therapy, chronic pain, randomized controlled trial, systematic review, meta-analysis

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Chronic pain, defined as pain with a duration longer than 3 months, has recently been highlighted as one of the most prominent causes of disability worldwide.^{1,2} The prevalence of chronic pain in general adult populations ranges from 15% to 35%, with the back, head, and lower extremities being the most common pain sites.^{3,4} Both pharmacological and nonpharmacological interventions are available for the management of chronic pain.^{5–7} Acceptance and Commitment Htherapy (ACT) is a behavioral therapy that aims to increase psychological flexibility and promote behavior change consistent with personal values by enhancing the capacity to connect fully with the present moment.^{8,9} As described by Hayes et al,^{9,10} there are 6 components in the ACT model, namely acceptance, defusion, contact with the present moment, self-as-context, values, and committed action.

In the context of chronic pain, people with higher levels of psychological flexibility are able to accept the painful sensations, feelings, and thoughts, and can typically focus on the opportunities of the current situations rather than on ruminating about the lost past or catastrophizing about the future.¹¹ Similarly, higher levels of psychological flexibility allow a person to experience a distinction between self and the content of the mind, and this in turn can enhance openness to painful sensations and reduce the suffering inherent in struggling with them.⁹ Development of these psychological skills may allow for the clarification of values and would lead to the development of committed actions in line with values such as exercise and social activities with friends and family.

A previous meta-analysis (literature search conducted in November 2015)¹² included 11 studies to evaluate the efficacy of ACT. It showed that ACT was effective in improving pain acceptance, pain-related functioning, anxiety, and depression. The authors evaluated the effects of different formats of ACT (group or therapist-delivered) against control groups separately, but did not examine the difference in effect size between subgroups and thus drew no conclusions about moderators of efficacy. A more recent meta-analysis that exclusively focused on online-based ACT found that online ACT was effective in improving pain acceptance, pain intensity, depression, and anxiety.¹³ However, no subgroup analyses were conducted to examine the moderators of efficacy. Another recent review examined the effects of ACT on depression and quality of life but did not conduct a meta-analysis.¹⁴

The number of trials has increased considerably since 2015, which warrants an update of the summary of evidence. To address the limitations of previous studies, we conducted an updated systematic review with meta-analysis

to evaluate the efficacy of ACT on all of the mentioned outcomes and to investigate whether such factors as patient characteristics (eg, type of chronic pain), study design features (eg, type of control groups), and mode of treatment delivery (eg, face-to-face vs online) would affect treatment efficacy, which was not well addressed in previous meta-analyses.

METHODS

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines for interventional studies.¹⁵ The protocol was registered at PROSPERO (www.crd.york.ac.uk/prospéro, registration number: CRD42020207420).

Data Source and Searches

A systematic search on 8 electronic databases, that is, MEDLINE, PsychINFO, EMBASE, PubMed, Web of Science, Google Scholar, CINAHL Plus, and Social Science Index from January 2000 to 18 July 2022, was conducted. The reason that only the studies published from 2000 onwards were searched is that the treatment content and procedure of ACT were not established until 1999.⁹

The search terms included “acceptance and commitment therapy”/“acceptance-based”/“ACT” in combination with “chronic pain” or specific chronic pain conditions such as “fibromyalgia”, “chronic low back pain”, “musculoskeletal pain”, “whiplash associated disorder”, “WAD”, “repetitive strain injury”, “RSI”, “dystrophy”, “complaints arm neck shoulder”, “complex regional pain syndrome”, “CRPS”, “osteoarthritis”, and “rheumatoid arthritis”. The search strategy was detailed in Supplementary Material 1 (Supplemental Digital Content 1, <http://links.lww.com/CJP/A922>). In addition, the initial 200 records identified in Google Scholar were also included as recommended by Bramer et al.¹⁶ To see if there were other eligible studies, the reference lists of all eligible studies and previous review studies were manually checked.

Study Inclusion and Exclusion Criteria

Randomized controlled trials that investigated the efficacy of ACT in adult populations with chronic pain for more than 3 months and reported at least 1 of the following 6 outcomes, that is, (1) pain acceptance, (2) quality of life, (3) pain-related functioning, (4) pain intensity, (5) anxiety, and (6) depression, were included. To be eligible, the ACT

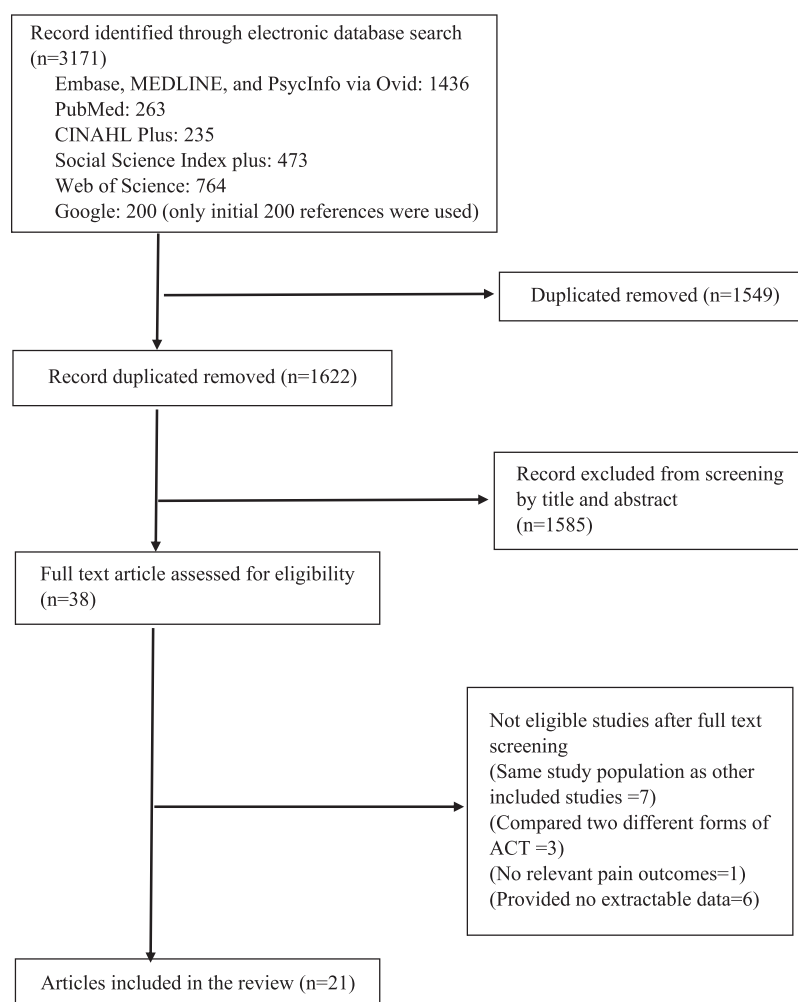


FIGURE 1. Flow chart of the selection procedure.

TABLE 1. Characteristics of Included Studies

Author	Participants and setting	Mean (SD) of age (y)	Female (%)	Intervention and format	Duration and frequency	No. sessions	Total length of intervention (min)	Comparator	Outcome measures	Time points for outcome measurement
Alonso-Fernández et al ³⁸	Adults with age 65 y old or older (n = 101) 5 nursing homes in the region of Madrid, Spain	82.26 (10.00)	78.6	ACT-SOC (face-to-face)	120 min weekly	9	1080	Minimal support group	1. CPAQ; 2. BPI-M; 3. BPI-WA; 4. BPI-S; 5. PASS; 6. GDS	Pretreatment, posttreatment
Bendelin et al ³⁹	Adults with all types of chronic pain (n = 103) Pain and Rehabilitation Centre, University hospital, Linköping, Sweden	36.13 (9.68)	85.4	ACT (Online)	15 min each day for 1 mo	Nil	450	TAU	1. CPAQ; 2. Nil; 3. Nil; 4. MPI; 5. Nil; 6. Nil	Pretreatment, posttreatment, and at follow-up (12 mo)
Buhrman et al ⁴⁰	Adults with all types of chronic pain (n = 76) Pain Center at the Uppsala University hospital in Sweden	49.10 (10.34)	100	ACT (Online)	1 section per week	7	Nil	WLC	1. CPAQ; 2. QOLI; 3. PAIRS; 4. MPI; 5. HADS; 6. HADS	Pretreatment, posttreatment, and at follow-up (6 mo)
Cederberg et al ⁴¹	Adults with all types of chronic pain (n = 115) Pain Center at Uppsala University Hospital	46.00 (12.30)	64	ACT (Telephone)	30 min weekly	7	210	Applied relaxation	1. CPAQ; 2. SWLS; 3. OMPQ; 4. NRS (scale from 0 to 10); 5. HADS; 6. HADS	Baseline, end of treatment, and at follow-up (6 mo, 12 mo)
Dahl et al ⁴²	Working-age Swedish population (n = 19) Public health service employees	40.00 (13.20)	89.5	ACT+TAU (Face-to-face)	1 h weekly	4	240	TAU	1. Nil; 2. LSQ; 3. Nil; 4. NRS (scale from 0 to 10); 5. Nil; 6. Nil	Pretreatment, posttreatment, and at follow-up (6 mo)
Godfrey et al ⁴³	Adults with chronic low back pain (n = 248) Physical therapy clinics in 4 UK public hospitals	47.90 (14.30)	59	Physical therapy informed by ACT (face-to-face)	60 min and 2 wk apart	2	120	Physical therapy	1. CPAQ; 2. LSQ; 3. PSFS; 4. NRS (scale from 0 to 10); 5. GAD-7; 6. PHQ-9	Baseline and at follow-up (3 mo, 12 mo)
Johnston et al ⁴⁴	Adults with all types of chronic pain (n = 24) Waikato Hospital Pain Clinic	Age median (range): 43 (20-84)	62.5	ACT (self-help book)	6 wk period	Nil	Nil	WLC	1. CPAQ; 2. QOLI; 3. Nil; 4. SFMPQ; 5. BAI; 6. CMDI	Pretreatment, posttreatment
Kanzler et al ⁴⁵	Adults with all types of chronic pain (n = 26) Primary care clinic affiliated with The University of Texas Health Science Center at San Antonio	Age median (range): 52 (26-79)	53.8	ACT (face-to-face)	1 h weekly	3	180	TAU	1. CPAQ; 2. Nil; 3. ODI; 4. Nil; 5. Nil; 6. Nil	Pretreatment, posttreatment, and follow-up (6 mo)
Kemani et al ⁴⁶	Adults with all types of chronic pain (n = 60) Primary and tertiary care units in Sweden	40.30 (11.40)	73.3	ACT (face-to-face)	90 min weekly	12	1080	Applied Relaxation	1. CPAQ; 2. SF-12; 3. PDI; 4. Single item from 0 to 6; 5. HADS; 6. HADS	Pretreatment, posttreatment, and at follow-up (3 and 6 mo)
Lin et al ⁴⁷	Adults with all types of chronic pain (n = 302) Recruited through sex broad-based online and offline advertisement	51.70 (13.10)	84.1	1: guided ACT 2: unguided ACT (online)	60 min each	7	420	WLC	1. CPAQ; 2. SF-12; 3. BPI; 4. NRS (scale from 0 to 10); 5. GAD-7; 6. PHQ-9	Pretreatment, posttreatment, and follow-up (6 mo)
Luciano et al ⁴⁸	Fibromyalgia adults (n = 101) Primary health care centers in Zaragoza, Spain	Intervention: 48.88 (5.94) Control: 48.28 (5.71)	Intervention: 96.1 Control: 94.3	ACT (face-to-face)	2.5 h weekly	8	1200	WLC	1. CPAQ; 2. EQ-5D; 3. FIQ; 4. PVAS; 5. HADS; 6. HADS	Baseline, end of treatment, and at follow-up (6 mo)
McCracken et al ⁴⁹	Adults with all types of chronic pain (n = 73)	58.00 (12.80)	68.5	ACT+TAU (face-to-face)	4 hr each	4	960	TAU	1. CPAQ; 2. SF-12; 3. RMDQ; 4. NRS (scale	Baseline, end of treatment, and at follow-up (3 mo)

(Continued)

TABLE 1. (continued)

Author	Participants and setting	Mean (SD) of age (y)	Female (%)	Intervention and format	Duration and frequency	No. sessions	Total length of intervention (min)	Comparator	Outcome measures	Time points for outcome measurement
Plumb-Vilardaga et al ⁵⁰	United Kingdom primary care setting Adults with all types of chronic pain (n = 28) Single pain management specialty clinic	52.29 (12.99)	75	ACT (face-to-face)	2 h weekly	6	120	WLC	from 1 to 7); 5. Nil; 6. PHQ-9 1. Nil; 2. QOLS; 3. PDI; 4. NRS (scale from 0 to 10); 5. DASS; 6. DASS	Baseline, mid of treatment, posttreatment
Scott et al ⁵¹	Adults with all types of chronic pain (n = 63) Pain Management Centre at St. Thomas' Hospital in London	Intervention: 47.26 (14.00) Control: 43.84 (13.97)	Intervention: 67.7 Control: 59.4	ACT+TAU (online)	8-27 min each	8	~200	TAU	1. CPAQ; 2. Nil; 3. WSAS; 4. (NRS scale from 0 to 10); 5. Nil; 6. PHQ-9	Baseline and at follow-up (3 mo, 9 mo)
Scott et al ⁵²	Adults with HIV and painful peripheral neuropathy (n = 38) HIV clinics at Guy's and St Thomas' Hospital in London	Intervention: 55.80 (5.65) Control: 56.00 (6.22)	Intervention: 20 Control: 30.8	ACT (Online)	45-60 min each	12	~720	WLC	1. CPAQ; 2. Nil; 3. WSAS; 4. BPI-S; 5. Nil; 6. PHQ-9	Baseline and at follow-up (2 mo, 5 mo)
Simister et al ⁵³	Fibromyalgia adults (n = 67) Local clinics in Canada	39.70 (9.36)	95	ACT+TAU (Online)	8 wk period	7	Nil	TAU	1. CPAQ; 2. PSQ; 3. FIQ; 4. Nil; 5. Nil; 6. CES-D	Pretreatment, posttreatment, and at follow-up (6 mo)
Taheri et al ⁵⁴	Patients with diabetic neuropathy (n = 50) Psychiatric Clinic of Farabi Hospital, Kermanshah, Iran	Intervention: 58.60 (9.32) Control: 56.03 (9.70)	Intervention: 25 Control: 40	ACT+TAU (face-to-face)	Nil	8	Nil	TAU	1. CPAQ; 2. Nil; 3. Nil; 4. Nil; 5. Nil; 6. Nil	Pretreatment, and posttreatment
Trompetter et al ⁵⁵	Adults with all types of chronic pain (n = 238) General Dutch population	52.80 (12.37)	76	ACT (online)	~3 h per week	9	1620	1: Expressive Writing 2: WLC	1. Nil; 2. MHC-SF; 3. PDI; 4. PVAS from 0-10; 5. HADS; 6. HADS	Baseline and at follow-up (3 mo, 6 mo)
Wetherell et al ¹⁹	Adults with all types of chronic pain (n = 114) General San Diego (USA) population	54.90 (12.50)	50.9	ACT (face-to-face)	90 min weekly sessions	8	720	CBT	1. CPAQ; 2. SF-12; 3. MPI; 4. Nil; 5. PASS; 6. BDI-II	Baseline, pretreatment, posttreatment, and follow-up (6 mo)
Wicksell et al ⁵⁶	Whiplash-associated disorders adults (n = 21) Swedish Association of Survivors of Traffic Accidents and Polio	Intervention: 48.20 (7.80) Control: 55.10 (11.20)	Intervention: 81.8 Control: 70	ACT (face-to-face)	~90 min weekly	10	900	WLC	1. Nil; 2. SWLS; 3. PDI; 4. PVAS (from 0-10); 5. HADS; 6. HADS	Baseline, posttreatment, and follow-up (4 mo after posttreatment)
Wicksell et al ⁵⁷	Fibromyalgia female adults age 18-55 (n = 40) Karolinska University Hospital, Stockholm, Sweden	45.10 (6.60)	100	ACT (face-to-face)	90-min weekly	12	1080	WLC	1. Nil; 2. SF-36; 3. FIQ; 4. NRS (scale from 0 to 10); 5. STAI-S; 6. BDI	Pretreatment, posttreatment, and follow-up (3-4 mo after posttreatment)

1 = pain acceptance; 2 = quality of life; 3 = pain-related functioning; 4 = pain intensity; 5 = anxiety; 6 = depression.

ACT indicates acceptance and commitment therapy; BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; BPI-M, Brief Pain Inventory short form (mood subscale); BPI-S Brief pain inventory short form (pain severity subscale); BPI-WA, Brief pain inventory short form (waking ability subscale); CBT, Cognitive behavioural therapy; CES-D, Center for Epidemiological Studies Depression scale; CMDI, Chicago Multiscale Depression Inventory; CPAQ, Chronic Pain Acceptance Questionnaire; DASS, Depression Anxiety and Stress Scale; EQ-5D, European Quality of Life-5 Dimensions; FIQ, Fibromyalgia Impact Questionnaire; GAD-7, Generalized Anxiety Disorder 7; GDS, Geriatric Depression Scale; HADS, Hospital Anxiety and Depression Scale; HIV, Human Immunodeficiency Virus; LSQ, Life Satisfaction Questionnaire; MHC-SF, Mental Health Continuum-Short form; MPI, Multidimensional Pain Inventory; NRS, Numeric Rating Scale; ODI Oswestry Disability Index; OMPQ, Orebro Musculoskeletal Pain Questionnaire; PAIRS, Pain and Impairment Relationship Scale; PASS, Pain Anxiety Symptoms Short form; PDI, Pain Disability Index; PHQ-9, Patient Health Questionnaire 9; PSFS, Patient-Specific Functional Scale; PSQI, Pittsburgh Sleep Quality Index; PVAS, Pain Visual Analog Scale; QOLI, Quality of Life Inventory; QOLS, Quality of Life Scale; RMDQ, Roland and Morris Disability Questionnaire; SF, Short Form Health Survey; SFMPQ, Short-Form McGill Pain Questionnaire; STAI-S, Spielberger Trait-State Anxiety Inventory; SWLS, Satisfaction with Life Scale; TAU, treatment as usual; WLC, waitlist control; WSAS, Work and Social Adjustment Scale.

interventions had to be exclusively focused on the 6 components described by Hayes.^{9,10} Therefore, acceptance-based or mindfulness-based interventions that did not include all the essential components of ACT were excluded. Headache and malignancy-related pain were also excluded, according to the recommendations of a leading Cochrane review.¹⁷ No other restrictions were applied.

Study Selection, Data Extraction, and Quality Assessment

The titles and abstracts of the retrieved records were screened to see whether they seemed to meet the inclusion criteria by 2 independent reviewers (T.W.M. and A.S.K.Y.). Then the full-text papers of seemingly eligible studies were scrutinized by the 2 reviewers to determine whether they were truly eligible. A third experienced reviewer (Z.Y.) resolved the disagreement between the 2 reviewers until consensus was achieved. Data extraction was completed by one author (T.W.M.) and checked for completeness and accuracy by another (Z.Y.). Disagreements were resolved by discussions. The methodological quality of included randomized controlled trials was assessed with the Cochrane Risk of Bias tool,¹⁸ which contains 6 major domains, that is, (1) random sequence generation, (2) random allocation concealment, (3) blinding of participants and personnel, (4) incomplete outcome data, (5) blinding of outcome assessment, and (6) selective outcome reporting. Each domain was rated as low, unclear, or high risk of bias following the guidelines.¹⁸

Data Analyses

As the tools adopted to measure the same outcomes varied across the included studies, we had to use the standardized mean difference (SMD) instead of the mean difference to measure the effect size. According to the Cochrane Handbook for Systematic Reviews of Interventions,¹⁸ the SD of within-group change from baseline was calculated based on the SDs of baseline and final measurements as well as the coefficient of correlation between them. All of the included trials provided the SDs of baseline and final measurements. For the correlation coefficient, a large study¹⁹ that reported all SDs (including that for within-group change from baseline) was used as a reference. Based on the within-group change from baseline, its SD and the sample size of each group, meta-analyses were performed with Review Manager 5.3 to obtain the overall SMD and its 95% CI. Statistical heterogeneity among studies was assessed using I^2 statistics and the Cochran Q test.²⁰ A P value ≤ 0.10 for the Q test or an $I^2 \geq 50\%$ was indicative of significant heterogeneity. If heterogeneity was low, the fixed-effects model was used for meta-analysis, otherwise, the random-effects model was used instead.

Subgroup analyses were conducted to examine the impact of the following factors on the efficacy of ACT and explore the potential source of heterogeneity: (1) type of control group (active treatment vs waitlist control (WLC)/usual care); (2) format of delivery (face-to-face vs online); (3) number of sessions (≤ 7 vs > 7 sessions); (4) total length of intervention (< 810 vs > 810 minutes); (5) type of chronic pain (general chronic pain vs specific diagnosis). The categorizations for the number of sessions and total length of intervention were made based on the median value of those reported by the included studies. The outcome data collected at the longest follow-up were used in the main analyses. In sensitivity analyses, data collected immediately after treatment (referred to as “post-treatment” hereafter) were used instead. Funnel plots were used to evaluate potential publication bias. An asymmetric funnel

plot would indicate the presence of publication bias. However, caution should be taken in interpreting the result when there is substantial heterogeneity among trials in the meta-analyses because the asymmetry could be caused by other reasons than publication bias, such as the true difference between small trials and large ones.¹⁸

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
Alonso-Fernández et al 38	+	?	-	?	?	?
Bendelin et al 39	+	+	-	+	-	+
Buhrman et al 40	+	?	-	+	+	?
Cederberg et al 41	+	?	-	?	?	?
Dahl et al 42	?	?	-	+	?	?
Godfrey et al 43	+	+	-	+	+	+
Johnston et al 44	-	-	-	?	?	?
Kanzler et al 45	+	+	-	+	+	+
Kemani et al 46	+	?	-	+	?	?
Lin et al 47	+	+	-	?	?	+
Luciano et al 48	+	+	-	+	+	?
McCracken et al 49	+	-	-	+	+	?
Plumb-Villardaga et al 50	+	?	-	?	-	?
Scott et al 51	+	+	-	?	?	+
Scott et al 52	+	+	-	+	+	+
Simister et al 53	+	+	-	+	+	?
Taheri et al 54	+	?	-	?	?	?
Trompetter et al 55	+	?	-	?	?	?
Wetherell et al 19	+	+	-	+	+	?
Wicksell et al 56	+	?	-	+	+	?
Wicksell et al 57	+	+	-	+	+	?

FIGURE 2. Quality assessment results.

RESULTS

Literature Search and Trial Selection

The selection process is shown in Figure 1. Initially, 3171 titles were retrieved from the databases. After a review of the title and abstract and the removal of duplicates, 38 trials were identified as potentially eligible. Of them, 17 were further excluded for the following reasons: 11 were derived from the same study population as other included articles,^{21–32} 3 compared two different forms of ACT,^{33–35} and 2 reported no relevant outcomes.^{36,37} Finally, 21 trials were included in the systematic review.

Characteristics of Included Trials

Characteristics of the 21 trials are presented in Table 1. A total of 1962 participants were included. In general, the participants were adults with a mean age between 40 and 60 years, except one of them, which included exclusively older adults in a nursing home with a mean age of 83.³⁸ In all trials, except 2,^{52,54} the majority of the participants were females. Sample size ranged from 19⁴² to 302,⁴⁷ with a median of 70. Fifteen trials included a mixed sample of participants who had different types of chronic pain (general chronic pain), whereas the other 6 trials were conducted for people with a specific diagnosis (3 with fibromyalgia, 1 with whiplash-associated disorders, and 2 with neuropathic pain). However, only 7 trials had reported the distributions of different types of chronic pain, with lower back pain and lower extremity pain being the most common.

The ACT interventions in most trials included 7 to 8 weekly sessions (ranging from 2 to 12). The median of the total length of the ACT intervention is 810 minutes (range: 120 minutes to 1620 minutes). Twelve trials adopted the face-to-face format of ACT, 7 adopted the online format, 1 adopted the telephone format, and 1 adopted the self-help book format. With respect to the control group, 8 trials used a WLC, 7 used treatment as usual (TAU), and the other 6 used active treatment (1 Cognitive behavioural therapy, 2 applied relaxations, 1 minimal support group, 1 physical therapy, and 1 expressive writing). Sixteen trials assessed the outcomes at 3 time points, that is, baseline, posttreatment, and after a period of follow-up, whereas the other 5 trials assessed the outcomes at baseline and posttreatment only. Follow-up periods ranged from 3 to 12 months after the treatment. Where applicable, the outcome data collected at the longest follow-up were used in the main meta-analyses.

Quality Assessment

The risk of bias in the 21 trials is presented in Figure 2. The overall quality of evidence was not satisfactory. All trials were considered at high risk of performance bias because it was impossible to blind participants to whether they had received ACT and researchers to whether they had delivered it, whereas for other domains except “random sequence generation” 40% to 75% of the trials were at unclear risk of bias due to inadequate reporting.

Effects of Interventions

The results of meta-analyses based on data collected at the longest follow-up are presented in Table 2. Sixteen trials were available for pain acceptance (1543 participants), 16 for quality of life (1612 participants), 17 for pain-related functioning (1711 participants), 17 for pain intensity (1640 participants), 12 for anxiety (1430 participants), and 17 for depression (1699 participants). The overall SMD from meta-analysis was 0.67 (95% CI: 0.48, 0.87) for pain acceptance, 0.43 (95% CI: 0.29, 0.57) for quality of life, −0.88 (95% CI: −1.14, −0.63) for pain-related functioning, −0.45 (95% CI: −0.62, −0.27) for pain intensity, −0.35 (95% CI: −0.54, −0.15) for anxiety, and −0.74 (95% CI: −0.98, −0.50) for depression, all favoring ACT. There was significant heterogeneity for all 6 outcomes.

Subgroup Analyses

The results of subgroup analyses are presented in Table 3. The subgroup of “WLC/TAU control” showed a statistically significantly larger mean effect on pain-related functioning, anxiety, and depression than the subgroup of “active treatment control”. The individual trials with active treatment control showed that ACT was as good as Cognitive behavioural therapy¹⁹ and better than the minimal support group,³⁸ applied relaxation,^{41,46} physical therapy,⁴³ and expressive writing⁵⁵ for most outcomes except anxiety. ACT interventions with a greater number of sessions showed a statistically significantly larger mean effect on the quality of life than those with a smaller number of sessions. Longer ACT interventions showed a statistically significantly larger mean effect on all outcomes except pain intensity than shorter ones. The effect sizes of ACT for all outcomes except pain intensity were larger for people with specific diagnoses causing pain than in those with general chronic pain. Of note, the effect sizes of online ACT were not statistically significantly different from those of the face-to-face ACT on all outcomes.

TABLE 2. Effects of ACT on Outcome Measures at Follow-up

Outcome measures	No. studies (significantly favors ACT)	Sample size	SMD (95% CI)	Statistical heterogeneity
Primary outcomes				
Pain acceptance	16 (12/16)	1543	0.67 (0.48, 0.87)*	$\chi^2 = 43.62, P < 0.001, I^2 = 66\%$
Quality of life	16 (8/16)	1612	0.43 (0.29, 0.57)*	$\chi^2 = 25.02, P = 0.05, I^2 = 40\%$
Pain-related functioning	17 (14/17)	1711	−0.88 (−1.14, −0.63)*	$\chi^2 = 88.15, P < 0.001, I^2 = 82\%$
Secondary outcomes				
Pain intensity	17 (7/17)	1640	−0.45 (−0.62, −0.27)*	$\chi^2 = 39.70, P < 0.001, I^2 = 60\%$
Anxiety	12 (6/12)	1430	−0.35 (−0.54, −0.15)*	$\chi^2 = 30.49, P = 0.001, I^2 = 64\%$
Depression	17 (14/17)	1699	−0.74 (−0.98, −0.50)*	$\chi^2 = 78.91, P < 0.001, I^2 = 80\%$

*Indicated significantly favor ACT intervention.

ACT indicates acceptance and commitment therapy; SMD, standardized mean difference.

TABLE 3. Subgroup Analyses on Outcome Measures at Follow-up

Outcomes	Criteria	Subgroup	No. studies (significantly favors ACT)	SMD (95% CI)	Statistical heterogeneity <i>I</i> ² (%)	Test for subgroup differences	
Primary outcomes	Pain acceptance	Control group	Active treatment	5 (3/5)	0.48 (0.17, 0.79)	71	$\chi^2 = 2.51, P = 0.11,$ $I^2 = 60.1\%$
			WLC	11 (9/11)	0.79 (0.56, 1.03)	58	—
	Format of delivery	Face-to-face	10 (8/10)	0.75 (0.47, 1.04)	73	$\chi^2 = 0.78, P = 0.38,$ $I^2 = 0\%$	
		Online	6 (4/6)	0.58 (0.33, 0.83)	51	—	
	No. sessions	≤ 7 sessions	7 (6/7)	0.69 (0.55, 0.83)	1	$\chi^2 = 0.02, P = 0.89,$ $I^2 = 0\%$	
		> 7 sessions	7 (5/7)	0.72 (0.31, 1.13)	80	—	
	Intervention length	Long (> 810 min)	5 (5/5)	0.91 (0.70, 1.11)	0	$\chi^2 = 7.40, P = 0.007,$ $I^2 = 86.5\%$	
		Short (< 810 min)	8 (5/8)	0.46 (0.21, 0.71)	69	—	
	Pain type	General chronic pain	12 (8/12)	0.55 (0.36, 0.75)	60	$\chi^2 = 10.49, P =$ $0.001, I^2 = 90.5\%$	
		Specific diagnosis	4 (4/4)	1.10 (0.83, 1.38)	0	—	
Quality of life	Control group	Active treatment	6 (4/6)	0.39 (0.19, 0.60)	54	$\chi^2 = 0.14, P = 0.71,$ $I^2 = 0\%$	
			WLC	11 (4/11)	0.45 (0.26, 0.63)	29	—
	Format of delivery	Face-to-face	12 (6/12)	0.50 (0.30, 0.69)	44	$\chi^2 = 1.25, P = 0.26,$ $I^2 = 20.3\%$	
		Online	4 (2/4)	0.33 (0.12, 0.55)	38	—	
	No. sessions	≤ 7 sessions	8 (2/8)	0.25 (0.12, 0.39)	0	$\chi^2 = 6.25, P = 0.01,$ $I^2 = 84.0\%$	
		> 7 sessions	7 (6/7)	0.59 (0.36, 0.83)	46	—	
	Intervention length	Long (> 810 min)	7 (6/7)	0.62 (0.43, 0.80)	17	$\chi^2 = 10.53, P < 0.001,$ $I^2 = 90.5\%$	
		Short (< 810 min)	6 (1/6)	0.23 (0.09, 0.37)	0	—	
	Pain type	General chronic pain	12 (4/12)	0.34 (0.21, 0.48)	26	$\chi^2 = 5.11, P = 0.02,$ $I^2 = 80.4\%$	
		Specific diagnosis	4 (4/4)	0.73 (0.42, 1.04)	15	—	
Pain-related functioning	Control group	Active treatment	6 (5/6)	−0.60 (−0.80, −0.40)	42	$\chi^2 = 4.38, P = 0.04,$ $I^2 = 77.2\%$	
			WLC	12 (10/12)	−1.05 (−1.43, −0.68)	84	—
	Format of delivery	Face-to-face	11 (8/11)	−0.86 (−1.22, −0.50)	83	$\chi^2 = 0.06, P = 0.81,$ $I^2 = 0\%$	
		Online	6 (6/6)	−0.93 (−1.33, −0.52)	82	—	
	No. sessions	≤ 7 sessions	8 (6/8)	−0.80 (−1.13, −0.48)	79	$\chi^2 = 0.36, P = 0.55,$ $I^2 = 0\%$	
		> 7 sessions	9 (8/9)	−0.97 (−1.39, −0.54)	85	—	
	Intervention length	Long (> 810 min)	7 (7/7)	−1.16 (−1.64, −0.68)	85	$\chi^2 = 5.26, P = 0.02,$ $I^2 = 81.0\%$	
		Short (< 810 min)	8 (5/8)	−0.56 (−0.73, −0.40)	25	—	
	Pain type	General chronic pain	12 (9/12)	−0.63 (−0.76, −0.50)	25	$\chi^2 = 7.58, P = 0.006,$ $I^2 = 86.8\%$	
		Specific diagnosis	5 (5/5)	−1.65 (−2.36, −0.93)	82	—	
Secondary outcomes	Pain intensity	Control group	Active treatment	5 (2/5)	−0.32 (−0.53, −0.11)	37	$\chi^2 = 1.93, P = 0.16,$ $I^2 = 48.2\%$
			WLC	13 (6/13)	−0.53 (−0.76, −0.31)	58	—
	Format of delivery	Face-to-face	11 (3/11)	−0.36 (−0.57, −0.16)	44	$\chi^2 = 1.27, P = 0.26,$ $I^2 = 21.5\%$	
		Online	6 (4/6)	−0.57 (−0.86, −0.28)	70	—	
	No. sessions	≤ 7 sessions	7 (2/7)	−0.34 (−0.50, −0.18)	19	$\chi^2 = 1.17, P = 0.28,$ $I^2 = 14.5\%$	
		> 7 sessions	8 (4/8)	−0.55 (−0.90, −0.20)	75	—	
	Intervention length	Long (> 810 min)	7 (4/7)	−0.55 (−0.83, −0.26)	62	$\chi^2 = 0.23, P = 0.63,$ $I^2 = 0\%$	
		Short (< 810 min)	8 (4/8)	−0.45 (−0.71, −0.19)	65	—	
	Pain type	General chronic pain	13 (5/13)	−0.41 (−0.56, −0.26)	40	$\chi^2 = 1.57, P = 0.21,$ $I^2 = 36.3\%$	
		Specific diagnosis	4 (3/4)	−0.86 (−1.55, −0.18)	77	—	
Anxiety	Control group	Active treatment	6 (1/6)	−0.12 (−0.28, 0.05)	21	$\chi^2 = 9.17, P = 0.002,$ $I^2 = 89.1\%$	

(Continued)

TABLE 3. (continued)

Outcomes	Criteria	Subgroup	No. studies (significantly favors ACT)	SMD (95% CI)	Statistical heterogeneity I^2 (%)	Test for subgroup differences
Depression	Format of delivery	WLC	7 (5/7)	-0.60 (-0.87, -0.33)	52	—
		Face-to-face	9 (4/9)	-0.24 (-0.37, -0.10)	75	$\chi^2 = 0.86, P = 0.35, I^2 = 0\%$
	No. sessions	Online	3 (2/3)	-0.34 (-0.51, -0.17)	44	—
		≤ 7 sessions	4 (1/4)	-0.15 (-0.40, 0.11)	62	$\chi^2 = 3.37, P = 0.07, I^2 = 70.4\%$
	Intervention length	> 7 sessions	8 (5/8)	-0.48 (-0.73, -0.23)	52	—
		Long (> 810 min)	6 (4/6)	-0.52 (-0.74, -0.30)	29	$\chi^2 = 11.50, P < 0.001, I^2 = 91.3\%$
	Pain type	Short (< 810 min)	4 (0/4)	-0.06 (-0.21, 0.08)	0	—
		General chronic pain	9 (4/9)	-0.23 (-0.40, -0.05)	52	$\chi^2 = 10.81, P < 0.001, I^2 = 90.8\%$
		Specific diagnosis	3 (2/3)	-0.84 (-1.17, -0.52)	0	—
	Control group	Active treatment	6 (3/6)	-0.31 (-0.61, -0.01)	75	$\chi^2 = 11.23, P < 0.001, I^2 = 91.1\%$
	Format of delivery	WLC	12 (12/12)	-0.96 (-1.19, -0.73)	55	—
		Face-to-face	11 (8/11)	-0.72 (-1.09, -0.36)	84	$\chi^2 = 0.02, P = 0.88, I^2 = 0\%$
	No. sessions	Online	6 (6/6)	-0.76 (-0.98, -0.53)	44	—
		≤ 7 sessions	7 (5/7)	-0.54 (-0.81, -0.26)	71	$\chi^2 = 1.69, P = 0.19, I^2 = 40.9\%$

ACT indicates acceptance and commitment therapy; SMD, standardized mean difference; WLC, waitlist control.

Sensitivity Analyses

The results of sensitivity analyses are mostly consistent with those of the main analyses. The only difference was observed in the subgroup analysis according to “type of control group”, but it could be due to chance (false positive) given the large number of sensitivity analyses conducted. Specifically, in the main analysis, the trials with WLC/TAU control showed a statistically higher mean effect on pain-related functioning than the trials with active treatment control (SMD -1.08 vs -0.60, $P = 0.04$). In the sensitivity analysis, this difference became statistically insignificant, but the trend towards a larger effect in the subgroup of WLC/TAU control remained (SMD -0.94 vs -0.56, $P = 0.12$).

Investigation of Publication Bias

The funnel plots for all outcomes except anxiety were asymmetric (Fig. 3). However, due to the substantial heterogeneity among trials in all these meta-analyses, it is hard to say whether the asymmetry was caused by publication bias or other issues, such as the true difference between small trials and large ones.¹⁸

DISCUSSION

This systematic review of 21 trials found that ACT was effective for all 6 outcomes, consistent with previous meta-analyses.^{13,14,58} The largest effect size was observed for pain-related functioning, congruent with ACT models. Compared with other outcomes such as pain intensity,

pain-related functioning is a more proximate indicator of the aim of ACT. Pain-related functioning experienced by chronic pain patients depends on the degree, to which people allow pain sensations to interfere with their daily life and the degree, to which people are able to encounter the stressors in daily life in the face of pain. Thus, increased acceptance of pain sensations instead of fighting them may be related to the larger improvement of pain-related functioning.

Subgroup analyses showed that the effect sizes of longer ACT were significantly larger than those of shorter ACT for most outcomes, possibly because longer treatment time allows the explicit formulation of life values and emphasis on committed action of the ACT model.⁵⁹ Of note, the effect sizes of shorter ACT were statistically significant as well, meaning that it was also better than the control group. Besides, the online format of ACT was found to be as effective as the face-to-face format of ACT. These findings have important implications for practice because shorter ACT and online ACT are appealing to people who have less time or are less willing to receive the traditional ACT. Future studies may focus on how to improve these brief or more convenient ACT models to increase their efficacy.

Subgroup analyses also showed that the effect sizes of ACT in people with the specific diagnosis were significantly larger than in those with general chronic pain for most outcomes. One explanation for this could be the comorbidity of psychological disorders among people with a specific diagnosis.⁶⁰ Previously, Zautra et al⁶¹ showed that

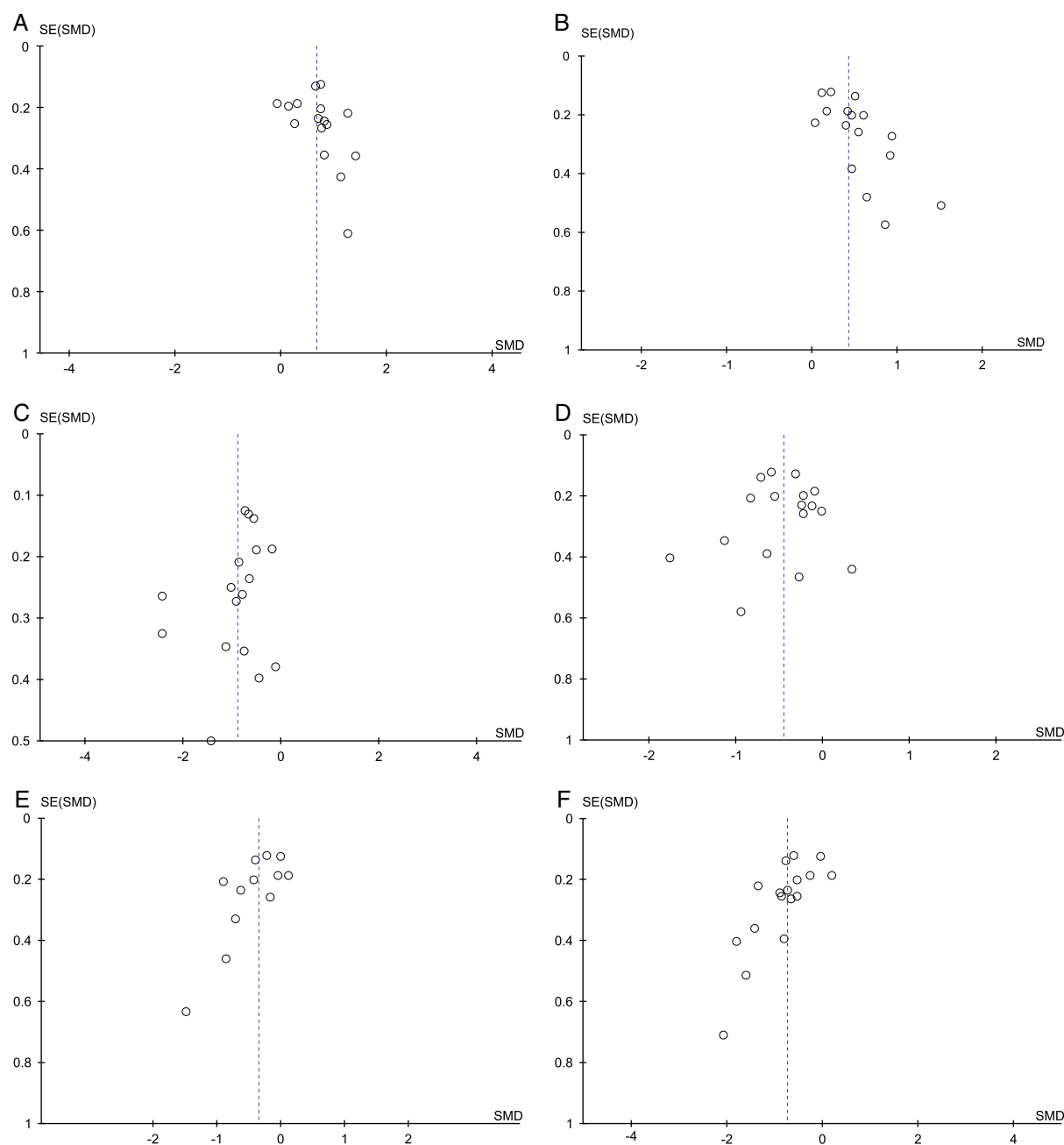


FIGURE 3. A, Funnel plots for pain acceptance. B, Funnel plots for quality of life. C, Funnel plots for pain related functioning. D, Funnel plots for pain intensity. E, Funnel plots for anxiety. F, Funnel plots for depression.

rheumatoid arthritis patients with recurrent depression benefited more from an acceptance-based intervention, as compared with those without recurrent depression. In our meta-analysis, most trials in the subgroup of specific diagnosis ($n = 5$) were conducted in patients with fibromyalgia ($n = 3$), which share some pathophysiology and symptoms with depression.⁶² Thus, it is possible that the people with fibromyalgia had higher comorbidity of depression and thus benefitted more from ACT.

This systematic review has some limitations. First, statistical heterogeneity was substantial in many meta-analyses and remained after the 5 preplanned subgroup analyses were conducted. It implied that some heterogeneity

remained unexplained although subgroup analyses showed that the effects changed with some factors. The heterogeneity might be partly caused by the different demographic characteristics such as sex, age, and ethics across studies. However, the substantial overlapping in terms of sex composition and age range of participants among the included studies precluded us from doing meaningful subgroup analyses according to these factors, and more powerful analysis such as meta-regression was not allowed due to the small number of trials.

Second, the quality of trials included in this systematic review is not satisfactory, mainly because it was impossible to blind participants to whether they had received ACT, and

this could have introduced bias in the reporting of outcomes, which were all subjective. However, such biases are almost unavoidable in any trials of psychological interventions and are not confined to ACT trials only.⁶³ In this sense, the evidence we summarized is already the best in the current state of the scientific literature.

Third, SMD instead of mean difference was used as the effect measure in meta-analyses since the tools adopted to measure the same outcomes varied across studies. With SMD, it can be known whether the effect is statistically significant or not, but the numeric value of SMD (conceptually equal to mean difference divided by its SD) is different from the change caused by ACT of the original tools (ie, mean difference), which makes it harder to interpret.

CONCLUSIONS

This meta-analysis shows that ACT was effective in improving pain acceptance, quality of life, pain-related functioning, pain intensity, anxiety, and depression, and it was not inferior to and even better than some other available treatments. Thus, psychologists, social workers, and counselors may consider ACT as an additional alternative treatment option for people with chronic pain and incorporate ACT in their intervention designs. Although the effects of ACT were greater in some subgroups (eg, the trials conducted in people with a specific diagnosis causing pain and those delivering longer ACT interventions), they were statistically significant in most subgroups, including those of shorter ACT and online ACT. Further studies may try to refine these shorter or more convenient ACT models, which could be particularly relevant to some people.

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