Evaluation of Cognitive Behavioral Therapy on Improving Pain, Fear Avoidance, and Self-Efficacy in Patients with Chronic Low Back Pain: A Systematic Review and Meta-Analysis

Jiajia Yang,1 Wai Leung Ambrose Lo,1,2 Fuming Zheng,1 Xue Cheng,1 Qiuhua Yu,1 and Chuhuai Wang1

1Department of Rehabilitation Medicine, The First Affiliated Hospital, Sun Yat-Sen University, Guangzhou, China
2Guangdong Engineering and Technology Research Center for Rehabilitation Medicine and Translation, The First Affiliated Hospital, Sun Yat-Sen University, Guangzhou, China

Correspondence should be addressed to Chuhuai Wang; wangchuh@mail.sysu.edu.cn

Received 4 September 2021; Revised 9 December 2021; Accepted 24 February 2022; Published 19 March 2022

Academic Editor: Federica Galli

Copyright © 2022 Jiajia Yang et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Background. Cognitive-behavioral therapy (CBT) is commonly adopted in pain management programs for patients with chronic low back pain (CLBP). However, the benefits of CBT are still unclear. Objectives. This review investigated the effectiveness of CBT on pain, disability, fear avoidance, and self-efficacy in patients with CLBP. Methods. Databases including PubMed, EMBASE, Web of Science, Cochrane Library, and PsycINFO were searched. RCTs examining the effects of CBT in adults with CLBP were included. The data about the outcome of pain, disability, fear avoidance, and self-efficacy were retained. Subgroup analysis about the effects of CBT on posttreatment was conducted according to CBT versus control groups (waiting list/usual care, active therapy) and concurrent CBT versus CBT alone. A random-effects model was used, and statistical heterogeneity was explored. Results. 22 articles were included. The results indicated that CBT was superior to other therapies in improving disability (SMD −0.44, 95% CI −0.71 to −0.17, P < 0.05), pain (SMD −0.32, 95% CI −0.57 to −0.06, P < 0.05), fear avoidance (SMD −1.24, 95% CI −2.25 to −0.23, P < 0.05), and self-efficacy (SMD 0.27, 95% CI 0.15 to 0.40, P < 0.05) after intervention. No different effect was observed between CBT and other therapies in all the follow-up terms. Subgroup analysis suggested that CBT in conjunction with other interventions was in favor of other interventions alone to reduce pain and disability (P < 0.05). Conclusion. CBT is beneficial in patients with CLBP for improving pain, disability, fear avoidance, and self-efficacy in CLBP patients. Further study is recommended to investigate the long-term benefits of CBT. This meta-analysis is registered with Prospero (registration number CRD42021224837).

1. Introduction

Low back pain (LBP) is a public health concern that contributes to years lived with disability globally [1]. Globally, the estimated age-standardized point prevalence of LBP was 7.50% in 2017 [2] and ranked ninth for the cause of years lived with disability and health burden [3]. One study from the UK in 2018 claimed that about 10 to 15% of LBP cases go on to develop chronic low back pain (CLBP) which is defined as pain lasting over 12 weeks [4]. A review published in 2015 based on cross-sectional population and cohort studies reported that the CLBP prevalence was 19.6% in those aged between 20 and 59 [5]. CLBP is considered to have multifaceted pathophysiology that is influenced by somatic pathology and psychological and social factors [6]. Psychological indicators such as depression, anxiety, fear avoidance, and low self-efficacy are associated with an increased risk of developing pain and disability in patients with CLBP [7–10]. The management of CLBP includes medication and therapeutic exercise. While these interventions demonstrated modest improvement, pain recurrence remains [11]. One guideline in 2017 recommended a combined psychological and physical approach if previous treatment was ineffective or in cases where medium to high risk of chronicity was identified [12].
Cognitive-behavioral therapy (CBT) is a set of interventions that involve 4 broad components: the patient’s knowledge and understanding about pain and their pain perception, the learning of active coping strategies, maintaining the coping strategies, and problem-solving plans to deal with pain and challenging situation. Although there are several systemic reviews of CBT intervention for pain alleviation in CLBP patients, most reviews have limitations. One is the restriction of a single comparison group [13]. Two reviews did not evaluate the long-term effects of CBT on CLBP patients [13, 14]. Two systemic reviews investigated the long-term effects but were published in the years 2007 and 2015 where their findings may be out-of-date [15, 16]. Therefore, the clinical benefits of CBT to reduce pain and disability immediately after treatment and during follow-up periods remain unclear. An updated pooled estimation of quantitative analysis with a larger sample size than previous studies would provide adequate power to evaluate the posttreatment and long-term effects of CBT in CLBP patients.

Psychological factors such as depression, anxiety, fear avoidance, and low self-efficacy are related to increased risk in patients with CLBP [7–10]. However, there has been already one review that investigated the effects of CBT on depression reduction in patients with CLBP [13]. In addition, there are not enough articles evaluating anxiety to complete a review. Therefore, the psychological outcomes in the present study were fear avoidance and self-efficacy instead of depression and anxiety. Touche et al. made a cross-sectional study to investigate the relationship between psychological variables, lumbar spine range of motion, and pain intensity in patients with CLBP. The results indicated that patients with low self-efficacy tend to increase pain intensity during lifting tasks [17]. Fear avoidance is characterized by escape and avoidance behaviors. The immediate consequences are reduced participation in daily activities due to the expectation of pain exacerbation [18]. For patients with CLBP, longstanding avoidance and physical inactivity have a detrimental impact on the musculoskeletal and cardiovascular systems, leading to disuse syndrome that further worsens the pain problem [19]. Therefore, specific intervention strategies should be implemented to improve self-efficacy and fear avoidance in patients with CLBP to achieve a positive clinical outcome. Wenzel et al. claimed that CBT may modify maladaptive behaviors and overcome avoidance behavior to improve self-care [20]. However, there is still a lack of review about the effects of CBT on improving self-efficacy and fear avoidance for CLBP patients. Therefore, it is imperative to conduct a systemic review to assess (1) the benefits of CBT on pain and disability relief at posttreatment and during different follow-up periods and (2) the effectiveness of CBT on improving fear avoidance and self-efficacy in patients with CLBP.

2. Materials and Methods

This review followed the guidelines for Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) (see Supplementary Material 1 for detailed information of PRISMA Checklist). The protocol was registered with Prospero (registration number CRD42021224837).

2.1. Criteria for Considering Studies for This Review.

Studies were included in the review if they were randomized controlled trials (RCTs) that evaluated the effects of CBT on patients diagnosed with CLBP.

The inclusion criteria were as follows: (1) patients (>18 years old) diagnosed with chronic low back pain (pain duration >3 months); (2) with or without leg pain; (3) studies adopted CBT alone or CBT combined with other therapies as an intervention arm; (4) CBT delivered face-to-face, web-based, or telephone-based in one to one or group-based setting; (5) the comparison arm that may include waiting list (WL), usual care (UC), or any other active therapies (AT): exercise, physical therapy, or drug therapy; and (6) acceptance and commitment therapy.

Exclusion criteria were as follows: (1) patient population having other specific pathology, including spinal stenosis, lumbar instability, postsurgical pain, pregnancy-related LBP, spinal fractures, cauda equina, or spinal tumors; (2) other chronic pain caused by other pathologies such as rheumatoid arthritis, polymyalgia rheumatic, and fibromyalgia; and (3) lack of documentation of the CBT content.

2.2. Primary and Secondary Outcomes.

Pain intensity and disability level were the primary outcomes. Fear of avoidance and/or self-efficacy were the secondary outcomes. Pain intensity was evaluated by the Visual Analog Scale (VAS) or Numeric Rating Scale (NRS). Disability was measured by the Roland Morris Disability Questionnaire (RMDQ) or the Oswestry Disability Index (ODI) and Activities of Daily Living (ADL). Fear of avoidance was evaluated by the Fear-Avoidance Beliefs Questionnaire (FABQ). Self-efficacy was assessed by the Pain Self-efficacy Questionnaire (PSEQ).

2.3. Search Methods for Identification of Studies and Data Extracted.

Articles were searched in the following five electronic databases: (1) PubMed, (2) EMBASE, (3) Web of Science, (4) Cochrane Library, and (5) PsycINFO. All literature studies published in English between 1st January 1980 and 20th November 2021 were searched without any restriction of countries. Reference lists of all selected articles were independently screened to identify additional studies that were not identified in the initial search. Two reviewers (J. Y., F. Z) screened for eligible studies from titles and abstracts. Potentially relevant studies were obtained in full text and independently assessed for inclusion. Two reviewers (J. Y., F. Z) extracted data and assessed the quality of the evidence independently. Two reviewers (J. Y., X. C) assessed the risk of bias independently. Any disagreement was discussed to reach a consensus during moderation meetings.

The following data were extracted using a standardized format: author’s name, year of publication, the country where the study was conducted, study period, follow-up time, the total number of people included in the study, blinding types, randomization procedure, and
sociodemographic characteristics. The outcome of pain intensity, disability, fear of avoidance, and self-efficacy were recorded before and after the intervention and at the follow-up time points of 3, 6, and 12 months. Outcome values were extracted or converted into mean and standard deviations. If there were missing values, the authors attempted to contact the authors to acquire the missed values.

2.4. Assessment of Risk of Bias in Included Studies. The risk of bias for each study was independently assessed by two reviewers according to the 13 criteria recommended by the Cochrane Back and Neck Review Group [21]. It is a tool that is the same as the recommended Cochrane Collaboration but has additional items relevant to the assessment of nondrug trials. It also contains 6 domains of selection bias, performance bias, detection bias, attritions bias, reporting bias, and other bias. For each study, each criterion was scored as “low,” “high,” or “unclear risk.” A consensus method was adopted to conclude the risk of bias of the included studies. However, if an agreement was not achieved at any stage, a third review author was consulted. The GRADE (Grading of Recommendations Assessment, Development, and Evaluation) guideline was applied to assess the confidence of the effect estimates based on the following criteria: risk of bias, inconsistency, imprecision, indirectness, and publication bias.

2.5. Measures of Treatment Effects. Data analysis was conducted in Review Manager Software 5.4.1. All of the outcomes were performed as the change values of mean difference and standard deviation (SD) before treatment and after treatment. As these outcomes were continuous data from different scales, the effect sizes were calculated by standardized mean difference (SMD) and 95% confidence intervals. A two-sided P value of less than 0.05 was considered statistically significant. A random-effects model was used to analyze the data. A negative effect size indicated that CBT was more beneficial than the comparison therapies. When there were several comparison groups in the same study, we halved the number of participants in the shared intervention group, which corrected the error introduced by double-counting [22].

2.6. Heterogeneity and Sensitivity Analysis. Statistical heterogeneity was examined graphically by forest plots, standardized Chi-squared ($\chi^2$) test, and $I^2$ statistic. $I^2$ statistics were interpreted as follows: statistical significance was considered at a P value of <0.05 and an $I^2$ of >50%. An $I^2$ of $\geq$50% might be considered as substantial heterogeneity. Sensitivity analysis was performed to test the influence of each study by visual evaluation of the funnel plot and exclusion sensitivity plot, searching for any asymmetry. Subgroup analyses were conducted according to different control groups: WL/UC, AT, and CBT + Control vs. Control group.

3. Results

3.1. Searched Studies and Characteristics. The literature search identified 1752 articles from 5 electronic databases. After excluding irrelevant studies, 22 eligible articles, covering 20 separate RCTs, met the inclusion criteria [23–44] (Figure 1). Turner et al. [42] and Cherkin et al. 2016 belong to the same RCT and Harris et al. [30] was part of a larger randomized controlled multicenter trial conducted by Reme et al. [37]. All of the included 20 RCTs were published in English and conducted from nine different countries (6 in the United States, 3 in Germany, 3 in the United Kingdom, 2 in Norway, 2 in Australia, one each in the Netherlands, Sweden, Italy, and Pakistan). In total, 3003 patients were examined. Study sample sizes ranged from 44 to 363 (mean = 152). The intervention types in 15 studies were face-to-face, three studies were Internet-based, and 4 studies were based on telephone, text, audiotape, and mixed methods (face-to-face and telephone). The mean intervention duration of CBT was 10 weeks, ranging from 3 to 54 weeks. Five studies had three months follow-up, 6 studies had six months follow-up, and five included one-year follow-up. One article had nine months of follow-up. The comparison group included WL/UC ($n$ = 12), AT ($n$ = 7). Other detailed descriptions of the characteristics of the included studies are shown in Table 1. The description of CBT and the comparison groups intervention type are shown in Table 2.

3.2. Risk of Bias in Included Studies. The risk of bias was assessed based on the Cochrane Back and Neck Review Group (Figure 2). All of the 22 studies randomly assigned patients into groups. Random sequence generation was based on computer ($n$ = 15) [23, 25, 30–33, 36–43], random number table [24, 27] ($n$ = 2), toss dice [26] ($n$ = 1), third office [28, 29, 44] ($n$ = 3), and unclear randomization method [34] ($n$ = 1). Due to the content of CBT intervention, the participants and CBT providers were not blinded in most studies, whereas the outcome assessors were blinded in most studies.

3.3. Quality of the Evidence and Effects of Intervention. The quality of the evidence ranged between high and very low due to the performance bias and high heterogeneity. Fifteen studies that investigated pain intensity and 18 studies that investigated disability were included. Five studies investigated the effect of CBT on self-efficacy and five studies assessed the outcome of fear avoidance. The quality of the evidence and the effect estimates of all the outcomes are shown in Table 3.

3.4. Primary Outcomes. Pain Intensity. Fifteen studies ($n$ = 2169 participants) were involved in comparing the effects of CBT with other therapies before and after the interventions. We found low-quality evidence that there was a better effect of CBT on reducing pain compared with other
therapies. The effect was statistically significant ($\text{SMD} = -0.32$, 95% CI $-0.57$ to $-0.06$, $I^2 = 87\%$, $P = 0.01$). Two articles (Monticone et al. 2013 [33], Khan et al. 2014 [32]) with extreme outliers and accounted for a large percentage of the statistical heterogeneity were excluded. However, the overall effect changed to a negative result ($\text{SMD} = -0.11$, 95% CI $-0.23$ to $-0.01$, $I^2 = 37\%$, $P = 0.07$). There was no statistical significance at the follow-up 3, 6, and 12 months (Figure 3).

Disability. There were 16 trials ($n = 2237$ participants) that compared the effects of CBT to other therapies before and after the interventions. The results showed that CBT provided a significant disability improvement compared with other therapies ($\text{SMD} = -0.44$, 95% CI $-0.71$ to $-0.17$, $I^2 = 89\%$, $P = 0.001$). Two articles [32, 33] with extreme outliers and accounted for a large percentage of the statistical heterogeneity were excluded, while the overall effect remained unchanged ($\text{SMD} = -0.16$, 95% CI $-0.25$ to $-0.06$, $I^2 = 11\%$, $P = 0.001$). Two, 3, and 5 studies measured the pain at 3, 6, and 12 months later, respectively. However, there was no significant difference in all the follow-up times (Figure 4).

3.5. Secondary Outcomes. Self-Efficacy. Five studies included 1060 participants that assessed the results of self-efficacy. We found low-quality evidence that CBT was significantly more effective than other interventions ($\text{SMD} = 0.27$, 95% CI $0.15$ to $0.40$, $I^2 = 74\%$, $P = 0.0008$).

Fear Avoidance. Five studies containing 505 participants measured the outcome of fear avoidance. There was low-quality evidence that CBT may produce better effects compared to other interventions. The effect was statistically significant ($\text{SMD} = -1.24$, 95% CI $-2.25$ to $-0.23$, $I^2 = 96\%$, $P = 0.002$) (Figure 5).

3.6. Subgroup Analysis. We evaluated the subgroup of CBT on posttreatment according to CBT versus control groups (waiting list/usual care, active therapy) and concurrent CBT versus CBT alone about the outcome of pain and disability (Figures 6 and 7). CBT vs. WL/UC. Five studies and six studies compared the effects of CBT with WL/UC on the results of pain and disability, respectively. For the result on pain, low-quality evidence suggested that CBT did not result in a statistically better effect.
Table 1: Basic characteristics of the included studies.

| Author year | Country | Total sample size (male/female) | Educational attainment (primary/high) | Marital status (married/unmarried) | Outcomes | Follow-up time (month) |
|-------------|---------|--------------------------------|--------------------------------------|-----------------------------------|----------|------------------------|
| Balser 1997 | German  | 76 (18/58)                     | NA                                   | NA                                | Pain intensity, disability\(^1\) | 3         |
| Beth 2021   | USA     | 263 (130/131)                  | 6/257                                | 160/103                           | VAS, PESQ | 3                     |
| Buhrman 2004| Sweden  | 51 (19/32)                     | 24/32                                | NA                                | Pain diary | 3                     |
| Carpenter 2012 | USA | 131 (22/109)               | 60/71                                | NA                                | Pain intensity, RMD, FABQ, self-efficacy scale |         |
| Cherkin 2016 | USA     | 341 (224/117)                 | 26/3155                              | 249/92                            | Characteristic pain intensity, RDQ (modified) | 6, 12     |
| Christiansen 2010 | German | 60 (23/37)                    | 48/12                                | 36/24                             | ADL, NRS  | 3                     |
| Godfrey 2020 | UK      | 219 (89/130)                  | 111/134                              | 127/92                            | NRS, RMD, PESQ | 12       |
| Gould 2020  | USA     | 67 (60/7)                     | NA                                   | NA                                | Pain intensity\(^2\), RMDQ |         |
| Harris 2017 | Norway  | 147 (73/74)                   | 87/60                                | 102/45                            | ODI, FABQ |         |
| Ivar brox 2003 | Norway | 61 (25/36)                   | NA                                   | 54/7                              | ODI, FABQ, VAS |         |
| Johnson 2007 | UK      | 234 (94/140)                  | NA                                   | 171/63                            | VAS, RMDQ | 3, 9, 15   |
| Khan 2014   | Pakistan| 54 (25/29)                    | NA                                   | NA                                | VAS, RMDQ |         |
| Monticone 2013 | Italy | 90 (38/52)                   | 82/8                                 | 60/30                             | NRS, RMD, TSK |         |
| Newton 1995 | Australia| 44 (NA)                      | NA                                   | NA                                | Pain diary, PDI |         |
| Petrozzi 2019 | Australia | 106 (52/54)                 | NA                                   | NA                                | PSEQ, RMDQ, NRS | 6, 12   |
| Pincus 2015 | UK       | 99 (35/64)                    | NA                                   | NA                                | RMDQ, NRS | 6         |
| Reme 2016   | Norway   | 308 (140/168)                 | 190/88                               | 215/93                            | ODI      | 6, 12      |
| Rutledge 2018\(^8\) | US | 61 (35/66)                  | 23/36                                | 40/21                             | RMDQ, NRS |         |
| Rutledge 2018\(^8\) | US | 66 (41/25)                  | 10/56                                | 40/26                             | RMDQ, NRS |         |
| Schweikert 2006 | Germany | 363 (339/24)             | NA                                   | NA                                | Pain, Disability\(^3\) | 6         |
| Smeets 2006 | Netherlands| 162 (80/82)                | 104/58                               | NA                                | VAS, RDQ  |         |
| Turner 2016 | USA      | 341 (224/171)                | 26/3155                              | 249/92                            | PESQ     | 6, 12      |

NA: not answer; DDS: Duesseldorf disability scale; HCS: Heidelberg coping scale; \(^1\)pain diary, \(^2\)descriptor differential scale (higher scores indicating higher pain intensity); \(^3\)pain (German school grades). Disability: Hannover functional questionnaire. Primary educational attainment, ≤12 years education. High educational attainment, college or higher educational experience.

Table 2: CBT and comparison group information.

| Author year | Groups | Type of CBT | CBT sessions | CBT duration (W) | Comparison type |
|-------------|--------|-------------|--------------|------------------|-----------------|
| Balser 1997 | CBT + UC vs. UC | Face-to-face | 12 sessions * 120 min | 12 | UC: various forms of medical treatment such as pain medication, nerve blocks, transcutaneous electrical stimulation, and physical therapy, but not surgery. |
| Beth 2021   | CBT vs. PE CBT vs. ER | Face-to-face | 8 sessions * 120 min | 8 | PE: pain education, matched to empowered relief on 4 key factors: duration, structure, format, and site. ER: empowered relief consists of a single-session, 2-hour pain class that includes pain neuroscience education, mindfulness principles, and CBT skills. |
| Buhrman 2004| CBT vs. WL | Internet-based | Webpages | 8 | WL: nonspecific treatment control had been used instead of a waiting list. |
| Carpenter 2012 | CBT vs. WL | Internet-based | Webpages | 3 | WL: nonspecific treatment control had been used instead of a waiting list. |
| Cherkin 2016 | CBT vs. UC, CBT vs. MBSR | Face-to-face | 2 sessions * 120 min * 8 W | 8 | UC: free to seek whatever treatment but no MBSR training or CBT. MBSR: mindfulness-based stress reduction, a program does not focus specifically on a particular condition such as pain. |
| Author year | Groups | Type of CBT | CBT sessions | CBT duration (W) | Comparison type |
|-------------|--------|-------------|--------------|-----------------|-----------------|
| Christiansen 2010 | CBT + UC vs. UC | Face-to-face | 2 sessions * 30 min | 3 | UC: standard outpatient back pain program. |
| Godfrey 2020 | ACT + PT vs. PT | Face-to-face and telephone call | 3 sessions * (60 min + 2 + 20 min) | 6 | PT: usual physical therapy including manual therapy techniques. |
| Gould 2020 | CBT + placebo vs. placebo | Face-to-face | 6 sessions (1 * 90 min + 5 * 60 min) | 8 | Placebo: a dose of benztrapine mesylate 0.125 mg daily was chosen. |
| Harris 2017 | BI vs. BI + CBT vs. BI + PE | Face-to-face | 7 sessions * 90 min | 12 | BI: brief intervention, a brief cognitive, clinical examination program addressing pain and fear avoidance. PE: Group physical exercise consisted of strength and endurance training and relaxation. |
| Ivar brox 2003 | Surgery vs. CBT + PT | Face-to-face | NA | 12 | Surgery: posterolateral fusion with transpedicular screws of the L4-L5 segment and/or the L5-S1 segment. PT: customarily prescribed physiotherapy, including exercises. |
| Johnson 2007 | CBT + UC vs. UC | Face-to-face and leaflet | 8 sessions * 120 min | 6 | UC: received no further intervention and continued to be treated as usual. |
| Khan 2014 | CBT + exercise vs. exercise | Face-to-face | 3 sessions * 12 * 20 min | 12 | Exercise: general exercise protocol under the supervision of a physical therapist. |
| Monticone 2013 | CBT + exercise vs. exercise | Face-to-face | 5 * 60 min + 12 * 60 min | 54 | Exercise: general exercise protocol under the supervision of a physical therapist. |
| Newton 1995 | CBT vs. EMGBF vs. WL | Face-to-face | 5 * 90 min | 4 | EMGBF: electromyographic biofeedback, consisted firstly of a psychoeducational session, then introduced to the pain-tension-pain cycle. WL: nonspecific treatment control had been used instead of a waiting list. |
| Petrozzi 2019 | CBT + PT vs. PT | Internet-based | 5 modules, online-based | 8 | PT: included manual therapy in combination with other modalities such as advice, education, and exercise. |
| Pincus 2015 | CBT vs. PT | Face-to-face | 8 sessions * 50 min | 12 | PT: physiotherapy was delivered as usual within services, with the stipulation that it included at least 60% exercise. |
| Reme 2016 | BI + CBT vs. BI | Audiotaped | 7 sessions * ? min | 8 | BI: brief intervention, a brief cognitive, clinical examination program based on a noninjury model addressing pain and fear avoidance, where return to normal activity and work is the main goal. |
| Rutledge 2018a | CBT vs. UC | Text-based | 12 sessions (1 * 120 min + 11 * 30 min) | 8 | UC: controlled for nonspecific benefits of therapy. |
| Rutledge 2018b | CBT vs. UC | Telephone-based | 12 sessions (1 * 120 min + 11 * 30 min) | 8 | UC: controlled for nonspecific benefits of therapy. |
| Schweikert 2006 | CBT + UC vs. UC | Face-to-face | 6 sessions * 90 min | 3 | UC: standardized conventional 3-week inpatient rehabilitation program consisting of daily physiotherapy, massage of the spinal region, electrotherapeutical measures, 1-hour seminar regarding back training, twice-daily exercise program. |
CBT versus AT. Four studies examined the effects of CBT versus AT on the result of pain and disability, respectively. It was found that there was no better treatment effect comparing CBT to AT on either pain (SMD −0.03, 95% CI −0.51 to 0.46; participants = 667; studies = 4; $I^2 = 88\%$, $P = 0.91$) or disability (SMD 0.03, 95% CI −0.23 to 0.18; participants = 400; studies = 4; $I^2 = 1\%$, $P = 0.81$).

CBT plus Control vs. Control. For the outcome of pain, eight studies were included in comparing the effects of combined CBT and control with the control alone. The results showed CBT plus control provided a better effect on pain-relieving than control alone (SMD −0.67, 95% CI −1.21 to −0.13; participants = 1035; studies = 8; $I^2 = 94\%$, $P = 0.01$), and 9 studies included the outcome of disability within the design of CBT plus control versus control. Statistically significant better effects were found (SMD −0.81, 95% CI −1.35 to −0.27; participants = 1243; $I^2 = 95\%$, $P = 0.003$). However, when two articles [32, 33] with extreme outliers were excluded, the overall effect of pain changed to a negative result (SMD −0.12, 95% CI −0.25 to 0.02, $I^2 = 0\%$, $P = 0.09$) and the effect of disability remained unchanged (SMD −0.13, 95% CI −0.25 to −0.01, $I^2 = 0\%$, $P = 0.03$).

### 3.7. Heterogeneity Inspection and Sensitivity Analysis

By visual inspection, outliers were removed to assess their influence on the overall effect. Two articles [32, 33] included in the analysis showed extreme outliers and raised the heterogeneity to very high values. For Monticone et al. [33], it
4.1. Pain and Disability during Different Periods.

For pain intensity immediately after the intervention, 15 studies of low-quality evidence supported the small or very small benefits of CBT over other therapies for reducing pain. However, this finding must be interpreted with caution as there were two outlier articles with high heterogeneity that result in contradicting results upon removal of those two studies. Sixteen studies of low quality of evidence reported CBT was superior to other therapies immediately after intervention to reduce disability. The quality of evidence was hampered by the high heterogeneity and performance bias. Thus, further well-designed RCTs are required to provide high-quality evidence.

4.2. Secondary Outcomes and Subgroup Analysis.

Subgroup analysis indicated significant improvement in pain and disability when CBT is provided in conjunction with other therapies. Compared to alternative active treatments, the intervention regime that incorporated CBT as an adjunct produced significant improvements in the domains of the pain experience, cognitive coping, appraisal (positive coping measures), and reduced behavioral expression of pain [48, 49]. This is among the first review to measure the effect of CBT on improving self-efficacy. Moderate evidence for the improvement of self-efficacy suggested CBT had
Figure 3: Pain intensity immediately after intervention and during the follow-up period. Compared with other therapies, the overall effect of CBT on pain outcome immediately after intervention was significant ($P < 0.05$). All the follow-up periods failed to show statistical significance.

better effects compared with other therapies. Three out of the five included studies showed significant self-efficacy improvements associated with CBT [27, 42, 43], but the high heterogeneity of the studies prevented quantitative comparisons. Self-efficacy has been highlighted to influence the improvement of pain intensity and functioning. Pre- to posttreatment changes in self-efficacy for managing pain mediated the effects of CBT on pain [50]. However, the effect of CBT on self-efficacy has not been studied adequately and further studies are recommended.
reduce fear avoidance. In patients with CLBP, regression analysis showed that fear avoidance beliefs about work accounted for 23% of the variance of disability in activities of daily living and 26% of the variance of work loss, even after allowing for the severity of pain [51]. A similar review showed that a decrease in avoidance values during treatment was associated with less pain and disability [52]. Therefore, early CBT treatment may promote the recovery of pain and disability.

Considering the potential influence of sociodemographic characteristics, we also investigated the pooled effects from the aspects of educational background, gender,
**Self-efficacy**

| Study or Subgroup | CBT | Control | Other therapies | Weight (%) | Std. Mean Difference | Std. Mean Difference |
|------------------|-----|---------|-----------------|------------|----------------------|----------------------|
|                  | Mean | SD     | Total | Mean | SD | Total | IV, Random, 95% CI | IV, Fixed, 95% CI |
| Beth 2021        | 8.49 | 12.34  | 44 | 4.11 | 11.95 | 87 | 11.9% | 0.36 [0.00, 0.73] |
| Beth 2021        | 8.49 | 12.34  | 44 | 3.19 | 11.01 | 88 | 11.8% | 0.46 [0.09, 0.83] |
| Carpenter 2012   | 2.1  | 1.91   | 63 | 0.2  | 2.25  | 68 | 12.2% | 0.90 [0.54, 1.26] |
| Godfrey 2020     | 4.1  | 15.45  | 111 | 2.5 | 14.72 | 108 | 22.5% | 0.11 [-0.16, 0.37] |
| Petruss 2019     | 5.1  | 11.14  | 54 | 6.5  | 13.42 | 52 | 10.9% | -0.11 [-0.45, 0.27] |
| Turner 2016      | 4.02 | 6.45   | 56 | 1.33 | 6.7  | 113 | 15.1% | 0.40 [0.08, 0.73] |
| Turner 2016      | 4.02 | 6.45   | 56 | 4.36 | 7.03 | 116 | 15.6% | -0.05 [-0.37, 0.27] |
| Total (95% CI)   | 428  | 632 100.0% | 0.27 [0.15, 0.40] |

Test for overall effect: Z = 4.24 (P < 0.0001)

**Fear-avoidance**

| Study or Subgroup | CBT | Control | Other therapies | Weight (%) | Std. Mean Difference | Std. Mean Difference |
|------------------|-----|---------|-----------------|------------|----------------------|----------------------|
|                  | Mean | SD     | Total | Mean | SD | Total | IV, Random, 95% CI | IV, Fixed, 95% CI |
| Rised 1997       | -0.62 | 0.77  | 36 | 0.21 | 0.81  | 40 | 17.0% | 0.51 [0.09, 0.93] |
| Carpenter 2012   | -1  | 1.37   | 63 | 0.13 | 1.35  | 68 | 17.3% | -0.80 [-1.16, -0.45] |
| Harris 2017      | -4.22 | 5.63  | 21 | -3.41 | 5.88  | 61 | 16.9% | -0.14 [-0.63, 0.36] |
| Harris 2017      | -4.22 | 5.63  | 21 | -5.11 | 5.69  | 45 | 16.8% | 0.16 [-0.57, 0.86] |
| Ivar brox 2003   | -9.9 | 5.68   | 26 | -2.2 | 5.7  | 35 | 16.7% | -1.34 [-1.90, -0.77] |
| Monticone 2013   | -2.49 4.057 | 45 | -1.43 4.83 45 | 15.6% | -0.50 [-5.96, 4.24] |
| Total (95% CI)   | 211  | 294 100.0% | -1.24 [-2.25, -0.23] |

Test for overall effect: Z = 2.41 (P = 0.02)

**Figure 5:** Self-efficacy and fear avoidance after intervention. The overall effect of CBT on self-efficacy and fear avoidance after intervention was in favor of other therapies (P < 0.05).

**Subgroup analysis of pain**

| Study or Subgroup | CBT | Control | Other therapies | Weight (%) | Std. Mean Difference | Std. Mean Difference |
|------------------|-----|---------|-----------------|------------|----------------------|----------------------|
|                  | Mean | SD     | Total | Mean | SD | Total | IV, Random, 95% CI | IV, Fixed, 95% CI |
|                  | Mean | SD | Total | Mean | SD | Total | IV, Random, 95% CI | IV, Fixed, 95% CI |
| Beth 2021        | 4.15 | 11.95 | 117 | 2.52 | 14.72 | 108 | 22.5% | 0.11 [-0.16, 0.37] |
| Beth 2021        | 4.15 | 11.95 | 117 | 6.5  | 13.42 | 52 | 10.9% | -0.11 [-0.45, 0.27] |
| Turner 2016      | 4.02 | 6.45   | 56 | 1.33 | 6.7  | 113 | 15.1% | 0.40 [0.08, 0.73] |
| Turner 2016      | 4.02 | 6.45   | 56 | 4.36 | 7.03 | 116 | 15.6% | -0.05 [-0.37, 0.27] |
| Total (95% CI)   | 428  | 632 100.0% | 0.27 [0.15, 0.40] |

Test for overall effect: Z = 4.24 (P < 0.0001)

**Figure 6:** The outcome of the pain of different control subgroups. Combined CBT with other therapies showed a greater overall effect than other therapies alone (P < 0.05).

Educational attainment may play a role in CBT intervention outcomes. Participants with higher educational background (college grade or higher) may benefit from the CBT and marital status (see Supplementary materials 2. Subgroup analysis of pain and disability from sociodemographic characteristics: sFig.1, sFig.2). The results showed that...
intervention in pain relief ($P = 0.04$). One published responder analysis in 2021 also showed some predictors for the treatment effects of yoga, physical therapy, and self-care book, including having higher school education, income, employment, few work-related fear avoidance beliefs, and high pain self-efficacy [53]. One article analyzed the factors that might negatively affect the outcome of CBT in patients with low back pain. It was reported that CLBP patients with anxiety, strong focus on pain, and high medical dependency may be categorized to a nonadaptation group for CBT [54].

4.3. Agreements and Disagreements with Other Studies or Reviews. The findings of the primary outcomes for CBT were in line with previous systematic reviews [14, 15] which indicated a greater effect on reducing pain disability. Another review included 10 RCTs that showed CBT + PT was advantageous for reducing pain and disability and enhancing functional capacity in CLBP patients [13], which was consistent with our subgroup conclusion that CBT combined with other therapies was superior to other therapies alone in improving pain and disability. For the outcome of fear avoidance, a study conducted by Baez et al. [55] reported similar findings to the present study. The authors concluded that there was inconsistent, patient-oriented evidence (grade B) to support the use of CBT and psychoeducation to treat fear avoidance beliefs in patients with acute, subacute, and chronic low back pain. However, this review did not give a specific analysis of each type of back. The findings of this study about the follow-up effects of CBT on pain and disability were inconsistent with the findings reported in another meta-analysis conducted by Richmond et al. [16]. The study reported a moderate to large significant effect in favor of CBT compared with active treatment at short- (6–12 weeks) and long-term (26–52 weeks) follow-up. This inconsistency may be explained by different inclusion criteria between the two studies. We included patients diagnosed with chronic low back pain (pain duration >3 months), whereas Richmond et al. included LBP patients at both chronic and subacute (<6 weeks) phases. Secondly, we analyzed pain and disability outcomes at different follow-up time points which compared the CBT with any control therapies. Richmond et al. [16] divided the comparison group into WL/UC and guideline-based active treatments. Therefore, the included RCTs to analyze were different. The most recent review investigated the effects of preoperative CBT on patients who were scheduled to undergo spine surgery for a degenerative disorder of the lumbar spine. The results showed that there were no additional effects of CBT interventions on outcomes in patients scheduled for lumbar surgery compared to usual care. This may be caused by the included patients at high risk for poor postoperative outcomes [56].
4.4. Clinical Significance. The minimal clinical significance will be considered if the pain severity was reported to be a 30% reduction from baseline [57]. Ten of the included studies indicated CBT induced a clinically significant reduction in pain intensity or disability level [23, 24, 28, 29, 32–34, 39, 43, 44], whereas 7 studies reported limited or no clinical effects [25, 30, 31, 35, 38, 40, 41]. Five studies did not report the clinical significance of CBT [26, 27, 36, 37, 42]. Despite the pooled significant effects on reduced disability, improved fear avoidance, and self-efficacy, the results must be interpreted with caution since the effect was estimated by the pooled SMD. There was also a lack of consistency in the implementation of CBT regimes and control therapies. Therefore, no firm conclusion could be drawn on the clinical significance of the observed effect.

4.5. Limitations. One of the limitations is the variations and differences between the deliveries of CBT intervention protocol of the included studies which might influence the outcome. CBT is a tailored intervention and the exact protocol, such as intervention delivery format, duration time, and the professional qualification of the providers, may vary between studies. The inherent inability to blind participants to the treatment received was a source of potential performance bias favoring CBT intervention. These substantial differences in the CBT program are particularly problematic for the direct comparison between different studies. Another limitation is that the present review only included research studies published in English which may cause language bias.

5. Conclusion

CBT intervention may be beneficial in reducing pain and disability in people with chronic low back pain. CBT as an adjunct to other types of therapy may be more effective than CBT or other therapies alone in reducing pain and disability. CBT may be effective in improving fear avoidance and self-efficacy. Further study is recommended to investigate the long-term benefit of CBT to enable the development of an appropriate strategy to maintain the benefits.

Data Availability

The data of primary and secondary results supporting this meta-analysis are from previously reported studies and datasets, which have been cited.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Authors’ Contributions

Jiajia Yang and Wai Leung Ambrose Lo contributed equally to this work.

Acknowledgments

This research was supported by the National Natural Science Foundation of China (grant number: 82002375).

Supplementary Materials

Supplementary Material 1: PRISMA Checklist. Supplementary Material 2: subgroup analysis of pain and disability from sociodemographic characteristics: sFig.1, sFig.2. (Supplementary Materials)

References

[1] R. Buchbinder, M. van Tulder, B. Öberg et al., “Low back pain: a call for action,” Lancet, vol. 391, no. 10137, pp. 2384–2388, 2018.
[2] A. Wu, L. March, X. Zheng et al., “Global low back pain prevalence and years lived with disability from 1990 to 2017: estimates from the Global Burden of Disease Study 2017,” Annals of Translational Medicine, vol. 8, p. 299, 2020.
[3] G. B. D. Diseases and C. Injuries, “Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019,” Lancet, vol. 396, pp. 1204–1222, 2020.
[4] Y. Chen, P. Campbell, V. Y. Strauss, N. E. Foster, K. P. Jordan, and K. M. Dunn, “Trajectories and predictors of the long-term course of low back pain: cohort study with 5-year follow-up,” Pain, vol. 159, pp. 252–260, 2018.
[5] R. D. Meucci, A. G. Fassa, and N. M. Faria, “Prevalence of chronic low back pain: systematic review,” Revista de Saúde Pública, vol. 49, 2015.
[6] I. Urits, A. Hubble, E. Peterson et al., “An update on cognitive therapy for the management of chronic pain: a comprehensive review,” Current Pain and Headache Reports, vol. 23, no. 8, p. 57, 2019.
[7] R. Hayward and S. Stynes, “Self-efficacy as a prognostic factor and treatment moderator in chronic musculoskeletal pain patients attending pain management programmes: a systematic review,” Musculoskeletal Care, vol. 19, 2020.
[8] M. E. Ibrahim, K. Weber, D. S. Courvoisier, and S. Genevay, “Big five personality traits and disabling chronic low back pain: association with fear-avoidance, anxious and depressive moods,” Journal of Pain Research, vol. 13, pp. 745–754, 2020.
[9] J. S. Trinderup, A. Fisker, C. B. Juhl, and T. Petersen, “Fear avoidance beliefs as a predictor for long-term sick leave, disability and pain in patients with chronic low back pain,” BMC Musculoskeletal Disorders, vol. 19, p. 431, 2018.
[10] V. E. B. de Moraes, S. M. de Goes, L. P. Damiani, and C. A. de Mattos Pimenta, “Self-efficacy and fear avoidance beliefs in chronic low back pain patients: coexistence and associated factors,” Pain Management Nursing, vol. 15, pp. 593–602, 2014.
[11] M. Artus, D. A. van der Windt, K. P. Jordan, and E. M. Hay, “Low back pain symptoms show a similar pattern of improvement following a wide range of primary care treatments: a systematic review of randomized clinical trials,” Rheumatology, vol. 49, no. 12, pp. 2346–2356, 2010.
[12] T. F. de Campos, “Low back pain and sciatica in over 16s: assessment and management NICE guideline [NG59],” Journal of Physiotherapy, vol. 63, p. 120, 2017.
[13] A. Hajihassani, M. Rouhani, M. Salavati, R. Hedayati, and A. H. Kahlace, “The influence of cognitive behavioral therapy on pain, quality of life, and depression in patients receiving
physical therapy for chronic low back pain: a systematic review,” *PM&R*, vol. 11, no. 2, pp. 167–176, 2019.

[14] A. Hall, H. Richmond, B. Copsey et al., “Physiotherapist-delivered cognitive-behavioural interventions are effective for low back pain, but can they be replicated in clinical practice? A systematic review,” *Disability and Rehabilitation*, vol. 40, pp. 1–9, 2018.

[15] B. M. Hoffman, R. K. Papas, D. K. Chatkoff, and R. D. Kerns, “Meta-analysis of psychological interventions for chronic low back pain,” *Health Psychology*, vol. 26, pp. 1–9, 2007.

[16] H. Richmond, A. M. Hall, B. Copsey et al., “The effectiveness of cognitive behavioural treatment for non-specific low back pain: a systematic review and meta-analysis,” *PLoS One*, vol. 10, no. 8, Article ID e0134192, 2015.

[17] R. L. Touche, M. Grande-Alonso, P. Arnes-Prieto, and A. Paris-Alemany, “How does self-efficacy influence pain perception, postural stability and range of motion in individuals with chronic low back pain?” *Pain Physician*, vol. 22, no. 1, pp. E1–E13, 2019.

[18] P. H. T. G. Heuts, J. W. S. Vlaeyen, J. Roelofs et al., “Pain-related fear and daily functioning in patients with osteoarthritis,” *Pain*, vol. 110, no. 1, pp. 228–235, 2004.

[19] J. W. S. Vlaeyen and S. J. Linton, “Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art,” *Pain*, vol. 85, no. 3, pp. 317–332, 2000.

[20] A. Wenzel, “Basic strategies of cognitive behavioral therapy,” *Psychiatric Clinics of North America*, vol. 40, no. 4, pp. 597–609, 2017.

[21] S. M. Rubinstein, A. de Zoete, M. van Middelkoop, W. J. J. Assendelft, M. R. de Boer, and M. W. van Tulder, “Benefits and harms of spinal manipulative therapy for the treatment of chronic low back pain: systematic review and meta-analysis of randomised controlled trials,” *BMJ*, vol. 364, pp. i689, 2019.

[22] M. Cumpton, T. Li, M. J. Page et al., “Updated guidance for trusted systematic reviews: a new edition of the cochrane handbook for systematic reviews of interventions,” *Cochrane Database of Systematic Reviews*, vol. 10, Article ID ED000142, 2019.

[23] D. C. Cherkin, K. J. Sherman, B. H. Balderson et al., “Effect of mindfulness-based stress reduction vs. cognitive behavioral therapy or usual care on back pain and functional limitations in adults with chronic low back pain: a randomized clinical trial,” *JAMA*, vol. 315, no. 12, pp. 1240–1249, 2016.

[24] H.-D. Basler, C. Jakle, and B. Kröner-Herwig, “Incorporation of cognitive-behavioral treatment into the medical care of chronic low back patients: a controlled randomized study in German pain treatment centers,” *Patient Education and Counseling*, vol. 31, no. 2, pp. 113–124, 1997.

[25] J. I. Brox, R. Sorensen, A. Friis et al., “Randomized clinical trial of lumbar instrumented fusion and cognitive intervention and exercises in patients with chronic low back pain and disc degeneration,” *Spine (Phila Pa 1976)*, vol. 28, pp. 1913–1921, 2003.

[26] M. Buhrman, S. Fältenhag, L. Ström, and G. Andersson, “Controlled trial of Internet-based treatment with telephone support for chronic back pain,” *Pain*, vol. 111, no. 3, pp. 368–377, 2004.

[27] K. M. Carpenter, S. A. Stoner, and J. M. Mundt, “An online self-help CBT intervention for chronic lower back pain,” *The Clinical Journal of Pain*, vol. 28, pp. 14–22, 2012.

[28] S. Christiansen, G. Oettingen, and B. Dahme, “A short goal-pursuit intervention to improve physical capacity: a randomized clinical trial in chronic back pain patients,” *Pain*, vol. 149, pp. 444–452, 2010.

[29] H. M. Gould, J. H. Atkinson, T. Chircop-Rollick et al., “A randomized placebo-controlled trial of desipramine, cognitive behavioral therapy, and active placebo therapy for low back pain,” *Pain*, vol. 161, pp. 1341–1349, 2020.
[42] J. A. Turner, M. L. Anderson, B. H. Balderson, A. J. Cook, K. J. Sherman, and D. C. Cherkin, “Mindfulness-based stress reduction and cognitive behavioral therapy for chronic low back pain: similar effects on mindfulness, catastrophizing, self-efficacy, and acceptance in a randomized controlled trial,” *Pain*, vol. 157, no. 11, pp. 2434–2444, 2016.

[43] B. D. Darnall, A. Roy, A. L. Chen et al., “Comparison of a single-session pain management skills intervention with a single-session health education intervention and 8 sessions of cognitive behavioral therapy in adults with chronic low back pain,” *JAMA Network Open*, vol. 4, no. 8, Article ID e2113401, 2021.

[44] E. Godfrey, V. Wileman, M. Galea Holmes et al., "Physical therapy informed by acceptance and commitment therapy (pact) versus usual care physical therapy for adults with chronic low back pain: a randomized controlled trial," *The Journal of Pain*, vol. 21, no. 1-2, pp. 71–81, 2020.

[45] G. Mansell, K. Storheim, I. Lochting, E. L. Werner, and M. Grotle, "Identification of indirect effects in a cognitive patient education (COPE) intervention for low back pain," *Physical Therapy*, vol. 97, pp. 1138–1146, 2017.

[46] R. J. Smeets, S. Beelen, M. E. Goossens, E. G. Schouten, J. A Knottnerus, and J. W. Vlaeyen, "Treatment expectancy and credibility are associated with the outcome of both physical and cognitive-behavioral treatment in chronic low back pain,” *The Clinical Journal of Pain*, vol. 24, pp. 305–315, 2008.

[47] M. Monticone, C. Cedraschi, E. Ambrosini et al., "Cognitive-behavioural treatment for subacute and chronic neck pain," *The Cochrane Database of Systematic Reviews*, Article ID CD010664, 2015.

[48] E. H. Kaapa, K. Frantsi, S. Sarna, and A. Malmivaara, "Multidisciplinary group rehabilitation versus individual physiotherapy for chronic nonspecific low back pain: a randomized trial," *Spine (Phila Pa 1976)*, vol. 31, pp. 371–376, 2006.

[49] S. Morley, C. Eccleston, and A. Williams, "Systematic review and meta-analysis of randomized controlled trials of cognitive behaviour therapy and behaviour therapy for chronic pain in adults, excluding headache," *Pain*, vol. 80, no. 1, pp. 1–13, 1999.

[50] J. A. Turner, S. Holtzman, and L. Mancl, "Mediators, moderators, and predictors of therapeutic change in cognitive-behavioral therapy for chronic pain," *Pain*, vol. 127, no. 3, pp. 276–286, 2007.

[51] G. Waddell, M. Newton, I. Henderson, D. Somervile, and C. J. Main, "A fear-avoidance beliefs questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability," *Pain*, vol. 52, no. 2, pp. 157–168, 1993.

[52] E. J. Roseen, H. Gerlovin, D. T. Felson, A. Delitto, K. J. Sherman, and R. B. Saper, "Which chronic low back pain patients respond favorably to yoga, physical therapy, and a self-care book? Responder analyses from a randomized controlled trial," *Pain Medicine*, vol. 22, pp. 165–180, 2021.

[53] K. Shimizu, K. Inage, S. Orita et al., "Background factors for chronic low back pain resistant to cognitive behavioral therapy," *Scientific Reports*, vol. 11, p. 8227, 2021.

[54] M. M. Wertli, E. Rasmussen-Barr, U. Held, S. Weiser, L. M. Bachmann, and F. Brunner, "Fear-avoidance beliefs-a moderator of treatment efficacy in patients with low back pain: a systematic review,” *The Spine Journal*, vol. 14, no. 11, pp. 2658–2678, 2014.

[55] S. Baez, M. C. Hoch, and J. M. Hoch, "Evaluation of cognitive behavioral interventions and psychoeducation implemented by rehabilitation specialists to treat fear-avoidance beliefs in patients with low back pain: a systematic review,” *Archives of Physical Medicine and Rehabilitation*, vol. 99, pp. 2287–2298, 2018.

[56] E. R. C. Janssen, I. M. Punt, M. J. Clemens, J. B. Staal, T. J. Hoogeboom, and P. C. Willems, "Current prehabilitation programs do not improve the postoperative outcomes of patients scheduled for lumbar spine surgery: a systematic review with meta-analysis,” *Journal of Orthopaedic & Sports Physical Therapy*, vol. 51, pp. 103–114, 2021.

[57] R. W. Ostelo, R. A. Deyo, P. Stratford et al., "Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change,” *Spine (Phila Pa 1976)*, vol. 33, pp. 90–94, 2008.