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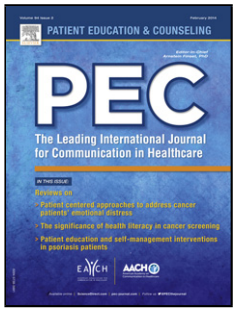

Effectiveness of communicative and educative strategies in chronic low back pain patients: a systematic review

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Effectiveness of communicative and educative strategies in chronic low back pain patients: a systematic review.

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Highlights.

- Patient's LBP awareness/knowledge is a topic still in a grey area of literature
- Pain science education, graded exposure and multimodal interventions are effective
- Graded activity, self-management and coaching provide only short-term or no benefit

Abstract

Objective: To investigate the effectiveness of communicative and educative strategies on 1) patient's low back pain awareness/knowledge, 2) maladaptive behavior modification and 3) compliance with exercise in patients with chronic low back pain.

Methods: A systematic review was conducted. Searches were performed on 13 databases. Only randomized controlled trials enrolling patients ≥ 18 years of age were included. Risk of bias was assessed with the Cochrane Collaboration's tool and interrater agreement between authors for full-texts selection was evaluated with Cohen's Kappa. No meta-analysis was performed and qualitative analysis was conducted.

Results: 24 randomized controlled trials which intervention included communicative and educative strategies were selected. Most of the studies were judged as low risk of bias and Cohen's Kappa was excellent (=0.822). Interventions addressed were cognitive behavioral therapy as unique treatment or combined with other treatments (multimodal interventions), coaching, mindfulness, pain science education, self-management, graded activity and graded exposure.

Conclusions, practice implication: Patient's low back pain awareness/knowledge is still a grey area of literature. Pain science education, graded exposure and multimodal interventions are the most effective for behavior modification and compliance with exercise with benefits also in the long-term, while self-management, graded activity and coaching provide only short-term or no benefits.

Keywords: systematic review, chronic low back pain, education, behavior, adherence.

1. Introduction

1.1. Background

Chronic low back pain (CLBP) – low back pain (LBP) lasting for at least 3 months – is a major health problem leading to more years lived with disability than any other musculoskeletal condition [1–3]. The prevalence of CLBP ranges from 4.2% in 24-39 years old subjects to 19.6% in 20-59 years old individuals [4]. According to the Life Link Health Plan Claims Database of the United States, CLBP leads to the excessive healthcare seeking, increased sick-leave days and

direct costs [5]. In this regard, the Institute of Medicine reports that CLBP-related costs in USA amount to about 34 billion dollars per year [6].

Over the last two decades, there has been a real revolution in the guidelines for the management of CLBP [7]. In fact, nowadays, the lack of biomedical models to explain complex issues related to aetiology, persistence and management of CLBP [8–10], the effectiveness of exercise therapy [11–13], the advances in pain neuroscience [14], the role of psychosocial factors [15,16], the importance of education and behavioral interventions [17] are well documented.

In healthcare settings, educative strategies are all those processes used from clinicians for inducing to the patient the capability of judgment and reasoning about the features related to his clinical condition. In this regard, communication strategies are the ones aimed to optimize the interaction and the transmission of ideas or concepts between healthcare providers and patients aimed to increase therapeutic alliance and to improve the adherence to the treatment. Conversely, all interventions whose rationale is centred on a biomedical model to explain the aetiology, persistence and management of musculoskeletal pain – namely ergonomics-based and biomechanical-based therapies such as back school and postural exercises or traditional manual therapies techniques – contrast with communicative and educative strategies that are based on biopsychosocial vision of care and more in line with the advances in pain neuroscience about CLBP research [8 - 16].

In the context of CLBP, there has been growing interest towards interventions that involves communicative and educative strategies such as cognitive behavioral therapy (CBT), graded exposure. graded activity, reassurance, mindfulness-based stress reduction (MBSR), coaching, health literacy, self-management and pain science education, which nowadays are recommended by the most reliable guidelines [18–24].

Interventions including communicative and educative strategies have already been investigated in previous papers focused on the management of CLBP, but a more in-depth view is needed for some issues, namely in respect to the inclusion criteria and outcomes investigated. Earlier systematic reviews exploring the effectiveness of graded activity, graded exposure, reassurance, coaching and health literacy were carried on patients with acute [25], sub-acute [26], mixed LBP [27,28] or CLBP sometimes enrolled in non-randomized controlled trials. [29]. Only a recent meta-analysis examined graded activity and graded exposure in CLBP patients but only pain, disability, catastrophizing and quality of life were addressed [30]. With regard to self-management, systematic reviews focused exclusively on patients with different LBP durations [31] or CLBP and knee/hip osteoarthritis [32]. Specifically for CLBP patients, a meta-analysis reported low to moderate quality of evidence in favor of self-management, but only pain and disability were investigated [33]. Previous systematic reviews exploring the efficacy of pain science education included patients with various chronic musculoskeletal disorders [34] or only two very low quality RCTs enrolling CLBP patients [35]. Conversely, a recent systematic review reported strong evidence in favor of pain science education towards pain, disability and psychosocial factors in patients with musculoskeletal pain, including CLBP [36]. Also a recent meta-analysis, which restricted its study solely to CLBP, reported moderate quality of evidence supporting pain science education, which exclusively focused on pain and disability at 3 months follow-up [37]. Regarding MBSR, earlier systematic reviews included RCTs conducted on patients with LBP selected irrespective of symptoms source and pain duration [38] or combinations of non-specific CLBP and LBP due to medical conditions [39,40].

Patient education, aimed to allow subjects to understand their own pain condition, increasingly appears to be a key strategy of the treatment of CLBP. Although several methods exist to measure patient's LBP knowledge/awareness – such as Neurophysiology of Pain Questionnaire [41] or Low Back Pain Knowledge Questionnaire [42] – there is no published review on this specific outcome in CLBP patients in the context of communication- and education-based interventions. Furthermore, also maladaptive behavior modification (avoidance, care seeking, drug intake, inactivity, psychosocial factors) is one of the crucial elements of CLBP management, as recommended by clinical guidelines [18–24]. As a part

of behavior modification, compliance with exercise has gained progressively more interest in scientific research, since exercise-based treatments for CLBP are supported by strong evidence [11–13,43,44]. Nevertheless, it is documented that patients with LBP or CLBP do not always faithfully adhere to exercise programs [45,46], potentially affecting outcomes [47,48]. Given that some limiting factors to compliance with exercise have been proposed in literature [49,50], previous systematic reviews investigated interventions aimed to increase compliance with exercise in patients with CLBP or chronic musculoskeletal pain, leading to conflicting results with promising effects of SM-based treatments, cognitive-behavioral interventions and graded behavioral exercise [47,51,52], leaving the debate still open.

1.2. Objectives

The aim of this systematic review was to elaborate the state of the art of scientific literature on the effectiveness of interventions that included communicative and educative strategies on three main outcomes: 1) patient's LBP awareness/knowledge, 2) maladaptive behavior modification and 3) compliance with exercise.

2. Methods

This systematic review was conducted in line with the PRISMA Statement [53] and Cochrane Collaboration guidelines (Cochrane Handbook 5-1). The protocol has been registered with Prospero [54] (CRD42018081242).

2.1 Eligibility criteria.

2.1.1 Study design.

Only RCTs published in English were eligible. No publication date restrictions were applied.

2.1.2. Participants.

Studies which enrolled patients ≥ 18 years of age with CLBP lasting for at least 3 months – according to the definition of chronic pain [55] – were included. RCTs were excluded if they enrolled patients with CLBP due to cancer, infection, rheumatic diseases, fractures, cauda equina syndrome or any other medical condition.

2.1.3. Interventions.

Interventions were eligible if they included communicative and educative strategies aimed at increasing compliance with exercise, modifying patient's maladaptive behavior or LBP awareness/knowledge.

2.1.4. Comparisons.

Waiting lists, usual care, placebo, no intervention, active or passive treatments, other educative interventions were all eligible for inclusion.

2.1.5. Outcome and outcome measures.

To be eligible RCTs had to evaluate at least one of the three following outcomes: 1) maladaptive behavior modification, 2) compliance with exercise or 3) patient's LBP awareness/knowledge assessed with objective measures, patient-reported questionnaires or other modalities.

2.2 Search methods for inclusion of studies.

2.2.1. Electronic searches.

An electronic search was performed between September and February 2018 on PubMed, CINAHL, Embase, PEDro, PsycINFO, The Cochrane Library, Google Scholar, TripDatabase, ProQuest (Health & Medical Collection, Health Management Database, Education), Wiley Online Library, ScienceDirect, BIOMED Central and Web of Science. The search strategies were created depending on the specific settings of each database with the supervision of an expert librarian. The search strings were developed according to the PI(C)O model of clinical question (participants, interventions and outcomes). To make the search strategies sensitive, we did not insert key words for comparisons. Where possible MeSH (Medical Subject Headings) terms were used and combined with Boolean operators (AND, OR, NOT).

Additionally, we conducted a manual search of all bibliographies of the studies assessed for the subsequent full-text selection and references obtained from 18 systematic reviews.

SIGLE database was searched for grey literature. Key search terms were "*chronic low back pain*", "*chronic lower back pain*", "*chronic low back ache*", "*chronic low backache*", "*chronic back pain*".

The full search strategy for PubMed is available in the Appendix A.

2.3. Study selection and data extraction

All titles were screened by the first author (VB) and abstracts were examined by the second author (LS). Then, potentially relevant full-texts papers were requested through the Library Service of the University of Genoa and the University of Ferrara. Where appropriate authors were contacted in order to obtain the full-text paper. Finally, full-texts were independently screened and assessed for eligibility by the two authors (VB, LS).

The two reviewers (VB, LS) individually extracted data using a data extraction form developed in line with the PI(C)OS model of the clinical question and adapted from the Cochrane Collaboration guidelines (Cochrane Handbook 5-1). Data extraction was organized as follows:

- General information (author, publication data, study design, country, setting);
- Participants (sample size, age, gender, diagnostic criteria, pain duration, structures of recruitment);
- Intervention groups (content, procedure, frequency and duration of the intervention, number of participants, professionals in charge for both experimental and control groups);
- Outcome and outcome measures;
- Follow-ups.

The authors (VB, LS) requested missing data by e-mail. Disagreements were solved by a third reviewer (AC) not involved in the data extraction process.

2.4. Inter-rater agreement.

Cohen's Kappa (K) was used to quantify the inter-rater agreement between the two authors (VB, LS) for full-text selection. Cohens' K was interpreted according to Altman's definition [56]: $k<2$ poor, $0.2<k<0.4$ fair, $0.41<k<0.60$ moderate, $0.61<k<0.80$ good, $0.81<k<1.00$ excellent.

2.5 Risk of bias.

The Cochrane Collaboration's tool [57] (RoB) was used to assess risk of bias of the included studies. Authors (VB, LS) independently assessed each study. Then, evaluations of each reviewer were compared and discrepancies were resolved with a third reviewer (AC) blinded to the risk of bias assessment process.

2.6 Analysis.

Due to the high heterogeneity of the included studies, mainly related to intervention types, control groups and outcome measures, no meta-analysis was performed and a qualitative analysis was conducted. An alpha of $p<0.05$ was used to define a significant outcome measure and interventions were considered effective if a between-group comparison p-value <0.05 was registered in favour of the experimental group. In case of multiple-arms RCTs, when communicative- and educative-based interventions were given to more than one intervention group, we analysed all between-group comparisons. Otherwise, we considered only intervention groups that differed by one of the communicative- and educative-based interventions. If more than one measure for the same outcome was reported we considered all measures suitable for the analysis. Where available, we reported effect size (Cohen's d).

2.7. External validity.

Applicability of results was discussed (Section 5.3) according to the criteria previously proposed by Peter O. Rothwell [58].

3. Results

The electronic database searches delivered 2458 results. After removal of 577 duplicates, we excluded 1739 records reviewing titles and abstracts, leaving 142 studies eligible for full-text assessment. Then, 117 full-text papers were removed because they did not meet the inclusion criteria. Through manual searches we identified further 101 potentially relevant references. After the screening, 2 studies met the eligibility criteria and were included. Grey literature search on SIGLE database provided 62 results, but all records were excluded reviewing titles and abstracts. The full search process is reported in Fig. 1.

*** Figure 1 here ***

3.1. Study characteristics

In total, 24 RCTs [57-83] (27 full-texts) were included. Study settings, countries, structures of recruitment, health professionals in charge, diagnostic criteria, gender, age, LBP duration, number of participants are given in Table 1.

3.1.1. Study design

Three studies were multiple-arms RCTs [68, 77-79], one study was a multi-centric RCT [81] and one had a crossover design [62]. The remaining studies were parallel RCTs.

3.1.2. Sample

Total patients recruited and then randomized were 2670 and 1867 attended all follow-ups (70%). Minimum sample size was 12 [74] and maximum 459 [79,80]. There were 1437 women (F) and 1233 men (M), with a F/M ratio equal to 1.17. One study [78] did not provide specific data and thus was excluded from this calculation.

3.1.3. Drop-outs and lost to follow-up

There were 525 (19.6%) drop-outs and 277 (10.3%) patients who did not attend to all follow-ups (total N=802; 30%). Details are listed in Table 2.

*** Table 2 here ***

3.1.4. Follow-ups

Most RCTs established short-term endpoint assessments. Overall, follow-ups ranged from a minimum of 15 days [65] or post-treatment [81] to a maximum of 2.5 years [80]. All follow-ups are reported in Table from 5 to 14.

3.1.5. Adverse Effects

Only 8 studies declared the absence of major adverse effects. Minor side effects were reported: pain worsening and depression symptoms easily manageable with psychological or pharmacological interventions [61], worsening of migraine due to yoga postures and LBP with need of chiropractic treatment [72], LBP (*"sprained back"*) [76] and pain exacerbation [77]. The other studies did not provide details about adverse effects.

3.1.6. Type of participants

Participants were all adults ≥ 18 years old with non-specific CLBP. All characteristics of participants are given in Table 1.

3.1.7. Type of interventions

Experimental interventions of included studies were divided in 6 subgroups: 1) multimodal interventions, that is CBT alone or in combinations with other treatments, 2) coaching, 3) mindfulness-based stress reduction (MBSR), 4) pain science education, 5) self-management, 6) graded activity and graded exposure. Graded activity and graded exposure – although they are mainly intended as activity-based strategies – were included since such interventions necessarily embody also a significant component of communicative- and educative-based strategies [26]. Brief descriptions and contents of interventions are reported Appendix B.

3.1.8. Type of control group

In almost half of RCTs, experimental interventions were compared with active treatments (usual physiotherapy or exercise), whereas the remaining studies had recourse to other types of education or waiting lists. Details are given in Table 1.

3.1.9. Type of outcome and outcome measures

The three main outcomes of this systematic review – LBP awareness knowledge, behavior modification and compliance with exercise – were stated as primary outcomes only in 3 studies [59,69,70,76]. In the majority of the remaining RCTs, the latter outcomes were stated as secondary outcomes. Most studies used patient-reported outcome measures for behavior modification, such as the Fear-Avoidance Beliefs Questionnaire [86] or the Pain Self-Efficacy Scale [87], and for LBP knowledge/awareness, such as the Illness Perception Questionnaire [88]. Objective measures, such as step count or daily activity level, were used only in 2 studies. Compliance with exercise was assessed with number of faultless back exercises, frequency (average times per week) and number of home exercise sessions. Outcomes and relative measures are reported in Table 1.

3.2. Risk of bias

Most of the studies were judged as low risk of bias. The most common criteria not met and then rated as high risk of bias were lack of blinding of professionals, participants and assessors. Overall, methods to ensure an effective randomization were appropriate in all but 2 studies [79,80,82], whereas those to conceal the allocation were not suitable in only 1 study [82]. Missing data caused a high risk of bias in only 4 studies [62,65,69,75] and in 2 other RCTs [79,80,82] there was an unclear risk of bias in this domain. Most of the studies followed their protocol and reported results for all outcome measures previously declared in their methods avoiding a reporting bias. Details are listed in Table 3.

*** Table 3 here ****

3.3. Agreement

Inter-rater agreement between the two authors (VB, LS) was excellent (K=0.822) for full-texts selection. Results are reported in detail in Table 4.

*** Table 4 here ***

3.4. Effects of interventions

Overall, there were 31 between group comparisons. Effects of interventions were divided by outcome and then by intervention type.

3.4.1. Communicative- and educative-based interventions on patient's LBP awareness/knowledge.

Multimodal interventions.

At 6 months follow-up, a significant difference was found in favour of Cognitive treatment of illness perception over a waiting list only for 4 out 7 subscales of the Illness Perception Questionnaire [73].

Mindfulness-based stress reduction.

Patients receiving mindfulness-based stress reduction showed significant superior improvements in the short-term compared to a waiting list for self-efficacy [63], but not in the short- and mid-term compared to a health education program in the scores of Mindfulness Attention Awareness Scale [64].

3.4.2. Communicative- and educative-based interventions on patient's maladaptive behavior modification.

Multimodal interventions.

In all 4 RCTs [61,66,82,91], the combination of CBT with physiotherapy or exercise was significantly superior to all comparisons for behavior modification in the short-, medium and long-term, a part for 2 studies without any significant difference for Pain Beliefs Questionnaire, Sickness Impact Profile [66] and Simptoms Checklist [82].

Coaching.

No difference was found between coaching and physiotherapy or presentations focused on physical activity at all follow-ups [69,70,76] for most of the outcome measures, except for a significant difference in favour of coaching over physiotherapy for Pain Rehabilitation Expectations Scale in the short-term [76].

Mindfulness-based stress reduction.

In 2 RCTs, subjects participating to mindfulness-based stress reduction sessions obtained significant improvements over a health education program in the short-term but not in the mid-term [62,63].

Self-management.

Across 3 RCTs, only the difference between the online procedure of self-management and a waiting list reached significant values in favour of self-management, as registered with the Brief Survey of Pain Attitudes and the Pain catastrophizing Scale at 3 weeks follow-up [59]. No other significant between group differences emerged between self-management and waiting list [71] or exercise and yoga [73].

Pain science education.

Overall, in 5 out 7 RCTs pain science education was significantly superior to all comparisons (exercise, back education, dry-needling) in the short-, mid- and long-term [60,65,68,74,75]. Only 2 RCTs reported no difference between pain science education and exercise [67] or usual physiotherapy [77].

Graded activity and graded exposure.

Both in the short- and mid-term, graded exposure gained significant results if compared to graded activity or waiting lists, whereas no significant findings were registered in favour of graded activity compared to physiotherapy or waiting lists [78,81,83,84].

3.4.3. Communicative- and educative-based interventions on compliance with exercise.

Multimodal interventions.

In the trial of Harkaapa et al [79,80] accomplishment to exercise and frequency of exercise was significantly superior in patients who received a combination of relaxation and strengthening exercises and coping strategies education compared to controls who received physiotherapy and coping strategies education or instructions to exercise execution and ergonomics advices, respectively.

Coaching.

In the short-term, participants who were offered coaching combined to physiotherapy showed a significant superior compliance (number of exercise sessions) compared to physiotherapy alone [76].

Results are summarized in tabular format from Table 5 to 14.

*** Table 5 to 14 here ***

4. Discussion

To our knowledge, this is the first systematic review investigating the effectiveness of interventions based on communicative and educative strategies on LBP knowledge/awareness, behavior modification and compliance with exercise in CLBP patients. According to the results rising from the 24 RCTs included, in addition to the consistency of our findings, two major topics of discussion emerged: i) the identification of the most studied and effective strategies as well as the single or combined implementation of these approaches in clinical practice and ii) the applicability of results and the need for specific training for health professionals charged to offer such interventions.

4.1. Most effective strategies and implementation in clinical practice

Overall, we found that multimodal interventions, pain science education and graded exposure were the most studied and effective interventions with benefits also in the long-term. Interestingly, only combinations between CBT, pain science education and graded exposure were proposed. Nevertheless, such combinations were all significantly superior to all comparisons, in particular if combined to physical therapy or exercise on behavior modification. As a whole, results showed that, at best, MBSR and self-management were more effective than no or equal interventions in the short-term, but not superior to other treatments in the mid-term, except for coaching-based technique which gained significant short-term effects if added to physical therapy. Based on these findings, the combination of CBT, pain science education and graded exposure may be the most promising approach to implement in clinical practice for patients with CLBP.

4.2. Applicability of results and training for health professionals

Although all participants were labelled as CLBP, some studies adopted extremely strict criteria for eligibility: age > 65 years old, LBP duration, inconsistency between anamnesis and clinical examination, specific threshold in patient-reported outcome measures (e.g. RMDQ>20), work compensation or job category. These issues reasonably restrict the field of application of results rising from these RCTs. Moreover, study settings were hugely different, namely, outpatient settings, hospitals, universities, and specialized pain clinics or elderly residences. Therefore, not all clinicians may benefit from results of RCTs in which settings were considerably different from their own. With regards to communication and educative strategies, multimodal interventions were offered as "package" treatments, making it difficult to judge the real effect of each approach. Besides, it is conceivable that self-management-based interventions did not faithfully follow clinical application guidelines of this treatment, limiting the immediate usability of results in clinical practice. Mostly, follow-ups were stated in the short-term and it is reasonable that those endpoints are insufficient to detect meaningful outcomes such as behavior modification or compliance with exercise.

Importantly, professionals charged to offer interventions were mostly psychologist or physicians, and rarely physiotherapists. Indeed, only pain science education, coaching- and graded activity-based interventions were delivered exclusively by trained physiotherapists. Concerning MBSR, expert instructors taught the program, whereas in CBT studies the psychologists mainly held the first session and physiotherapists the subsequent sessions (physical therapy or exercise). The latter aspects are the most relevant limits to generalizability of results, due to the substantial difference across training of healthcare professionals. Therefore, since our findings suggest that the most effective approach to induce behavior modification or to increase compliance with exercise is the combination of interventions such as CBT, pain science education and graded exposure, caution is required for all non-trained professionals in these specific fields.

4.3. Consistency

Since we believe this is the first systematic review in this field, the consistency of results is mandatorily challenging. Mainly for LBP awareness/knowledge, the comparison with literature is not possible due to the high heterogeneity and low precision of outcome measures adopted in clinical trials. Also, there is no consensus about the measures that primary studies should adopt, leaving this domain still unknown.

Significant results obtained from multimodal interventions are corroborated by a Cochrane review, which reported high quality of evidence in favor of behavioral interventions in patients with CLBP [89]. Conversely, another Cochrane review exploring behavioral treatments for CLBP drew uncertain conclusions, highlighting the problem concerning the need for valid and reliable measures to assess behavioral modification and which type of patient would benefit most from what type of behavioral intervention [90]. Importantly, the latter 2 reviews and our systematic review did not find the same

outcome measures, confirming there is no homogeneity in these terms. Also the effect of graded exposure and CBT (as part of multimodal interventions) is supported by a recent updated systematic review of 42 studies including graded activity, commitment therapy, graded exposure, CBT, which corroborate the efficacy of these interventions in patients with acute, sub-acute and, mostly (38 studies out 42), CLBP [91]. Results obtained from self-management-based interventions are unclear and previous systematic reviews in this field addressed only pain and disability [31,33]. The latter aspects may be the reason why a recent paper, aimed to investigate the effect of self-management and provide recommendations for research and clinical practice, invited authors of primary studies to include not only outcomes such as pain and disability but also outcomes related to the behavioral domain [92]. Conversely, results regarding the effectiveness of pain science education are in line with conclusions coming from all previous systematic reviews, in particular, combinations of pain science education with manual therapy and exercise [34,36,37]. Non-significant effects of MBSR are consistent with results rising from earlier reviews that have already discussed the inconclusive evidence toward outcomes also not related to self-efficacy [38,39]. Finally, short-term efficacy of coaching-based interventions on the motivational level but not in increasing physical activity are confirmed by results coming from a RCT exploring the effects of the combination of counseling treatment and physical therapy compared with physical therapy only, which revealed no significance between group effect [93].

For compliance with exercise, the positive effects of multimodal interventions are in line with a previous Cochrane review, which supports the effect of coping strategies and positive reinforcement on behavior modification in chronic musculoskeletal patients [51]. A similar conclusion can be found in a review aimed to explore interventions that enhance adherence in physiotherapy in outpatient settings, with significant results from motivational and cognitive-behavioral programs [94]. Regarding coaching-based interventions, literature reports evidence that both corroborates and contradicts preliminary results rising from this systematic review. Indeed, Linton S.J. et al. found that an individualized behavioral program aimed to enhance compliance with exercise was significantly superior to instructions only [95]. Contrariwise, Friedrich M. et al. found no difference at 5 years follow-up between exercise combined with a motivational program and exercise alone [96].

4.4. Strengths and limitations

Our review has several limits. We included interventions based on communicative and educative strategies, but it has to be acknowledged that such communicative and educative mechanisms are not stand-alone interventions and they were assumed because, at base, the included treatments are mediated through such mechanisms. Besides, no meta-analysis was conducted due to the heterogeneity of interventions (content, duration, delivery methods), control groups and outcome measures. Searches for grey literature were limited to SIGLE database and we did not look for relevant papers in single journals, so research in this field may be larger than explored in this systematic review. This paper has also several strengths, including deep and sensitive searches from different electronic sources, supervision of a librarian, direct contact with authors and excellent interrater agreement.

5. Conclusions

Communicative and educative strategies have gained an important relevance in the management of CLBP. The scientific scenario of communicative and educative strategies in this population is actually larger than we explored in this systematic review. Unfortunately, it is not possible to completely examine this field due to the heterogeneity of inclusion criteria and outcome measures adopted in primary studies. The domain of LBP awareness/knowledge is still a grey area of literature both for heterogeneous and non-specific outcome measures. For behavior modification, interventions mainly focused on

psychosocial profile, such as pain science education, graded exposure and multimodal interventions, were the most effective treatments with benefits also in the long-term. The combination of coaching-based treatments and physical therapy showed promising results on compliance with exercise. Nevertheless, results of this systematic review are affected by several limits of applicability related to the administration of interventions, different settings and, mostly, training of healthcare professionals.

5.1. Implications for practice

There is low quality evidence in favour of multimodal interventions on compliance with exercise in the long-term and promising but limited evidence for the addition of coaching-based techniques to usual physical therapy on compliance with exercise in the short-term. Preliminary evidence rising from high-quality RCTs supports coaching-based techniques, but not MBSR, for behavior modification in the short-term. Evidence coming from high-quality RCTs sustains multimodal interventions, pain science education and graded exposure – as well as combinations of CBT, pain science education and graded exposure – on behavior modification in the mid- and long-term.

Since 1) CBT, pain science education and graded exposure are the most effective interventions for all outcomes considered according to results of this systematic review and 2) in most cases such interventions were offered by psychologists or physicians, an appropriate training for physiotherapist and other healthcare professionals is still needed in order to transfer these findings in clinical practice.

5.2. Implications for research

Further research is needed to better investigate the wide domain of communication- and education-based interventions offered to patient with CLBP. Forthcoming primary studies may homogenize the inclusion criteria, standardize the intervention procedures and control groups, adopt a valid and reliable measure to assess compliance with exercise as well as behaviour modification and long-term follow-ups. In future systematic reviews should be clearly declared the mechanisms of communicative and educative strategies to be included. Since there are no currently valid and reliable measures to address LBP knowledge/awareness, future studies, based on close cooperation between psychologists and physiotherapists, should aim to design a standard self-reported instrument capable to measure its impact on diagnosis, prognosis and management of LBP.

Declarations of interest

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Credit Author Statement

Valerio Barbari: Methodology, Investigation, Resources, Data Curation, Visualization, Writing – Original Draft, Writing – Review & Editing. **Lorenzo Storari:** Methodology, Investigation, Resources, Data Curation, Visualization, Writing – Original Draft, Writing – Review & Editing. **Aldo Ciuro:** Conceptualization, Supervision. **Marco Testa:** Conceptualization, Writing – Review & Editing, Supervision.

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Figure 1. Flow Chart.

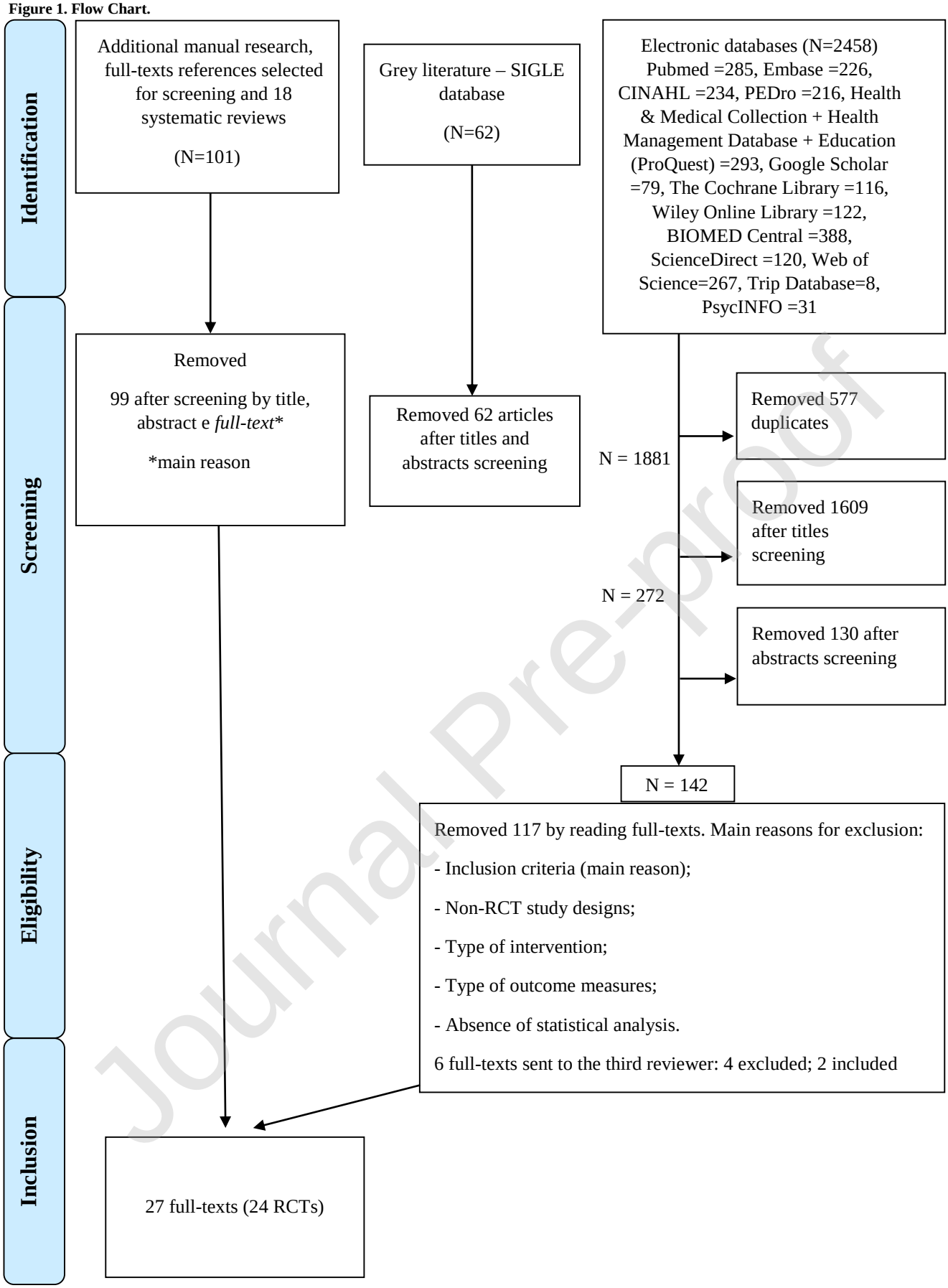

Table 2. Drop-outs and lost to follow-up in the included studies.

	Drop-outs (n°; %)		Lost to follow-up (n°; %)	
Study	**Intervention group**	**Control group**	**Intervention group**	**Control group**
Carpenter K.M. et al., 2012	7 (10%)	3 (4.3%)	0	13 (18.3%)
Gema B.P. et al., 2018	0	0	-	-
Haas M. et al., 2005	6 (10%)	2 (4%)	-	-
Härkäpää K. et al., 1989-1990	Data not reported			
Leeuw M. et al., 2008	1 (2.3%)	7 (16.2%)	3 (7.1%)	1 (2.3%)
Linden M. et al., 2014	0	0	-	-
Magalhães M.O. et al., 2015	3 (9%)	3 (9%)	-	-
Magalhães M.O. et al., 2018	0	0	0	0
Monticone M. et al., 2013	0	0	0	0
Monticone M. et al., 2015	1 (1.3%)	2 (2.6%)	9 (12%)	9 (12%)
Morone M. E. et al., 2008	6 (31.5%)	1 (5.5%)	1 (5.2%)	4 (22.2%)
Morone M. E. et al., 2009	4 (20%)	1 (5%)	0	0
Morone M. E. et al., 2016	8 (5.7%)	4 (2.8%)	10 (7.1%)	3 (2.1%)
Moseley L. et al., 2004	3 (9.6%)	1 (3.7%)	-	-
Nicholas M.K. et al., 1992	1 (10%)	1 (10%)	0	1 (10%)
Pires D. et al., 2014	1 (3.3%)	5 (15.6%)	0	1 (3.3%)
Ryan C.G. et al., 2010	2 (10%)	2 (11.1%)	5 (25%)	6 (33.3%)
Schaller A. et al., 2016	92 (45.7%)	101 (47.8%)	17 (8.45%)	10 (4.7%)
Schaller A. et al., 2018	92 (45.7%)	101 (47.8%)	71 (35.3%) (17.2%)	73 (34.5%) (17.7%)
Sherman J.K. et al., 2005	Self-Care group: 3 (10%)	Yoga group: - Exercise group: 6 (17.1%)	-	-
Siemonsma P.C. et al., 2013	7 (6.7%)	4 (7.6%)	-	-
Tèllez-Garcìa M. et al., 2014	0	0	-	-
Vibe Fersum K. et al., 2013	8 (13.5%)	1 (1.6%)	8 (13.5%)	10 (16.1%)
Vong K.S. et al., 2011	7 (18.4%)	6 (15.7%)	3 (7.8%)	5 (13.1%)
Wälti P. et al., 2015	3 (21.4%)	3 (21.4%)	-	-
Woods M.P. et al., 2008	Graded Exposure 11 (30.5%); Graded Activity 12 (48%); Waiting List 6 (27.2%)		Graded Exposure -	Graded Activity – Waiting List -

n°: absolute number of drop-outs or lost to follow-up; %: percentage of the absolute number relative to the total of the reference group.

Table 3. Risk of bias in the included studies.

Study	**Random sequence generation (*selection bias*)**	**Allocation concealment**	**Blinding of participants and personnel (*performance bias*)**	**Blinding of outcome assessment (*detection bias*)**	**Incomplete outcome data (*attrition bias*)**	**Selective reporting (*reporting bias*)**	**Other bias**
Carpenter K.M. et al., 2012	+	?	-	-	+	+	+
Gema B.P. et al., 2018	+	+	-	-	+	-	+
Haas M. et al., 2005	+	+	-	-	+	+	+
Härkäpää K. et al., 1989-1990	?	?	-	?	?	?	+
Leeuw M. et al., 2008	+	+	-	-	+	+	+
Linden M. et al., 2014	?	-	-	-	?	+	-
Magalhães M.O. et al., 2015-2018	+	+	-	+	+	+	+
Monticone M. et al., 2013	+	?	-	+	+	+	+
Monticone M. et al., 2015	+	+	-	+	+	+	+
Morone M. E. et al., 2008	+	+	-	?	-	?	-
Morone M. E. et al., 2009	+	+	-	?	+	-	+
Morone M. E. et al., 2016	+	+	-	+	+	?	+
Moseley L. et al., 2004	+	+	-	+	-	?	+
Nicholas M.K. et al., 1992	+	?	-	-	+	+	+
Pires D. et al., 2014	+	+	-	+	+	+	+
Ryan C.G. et al., 2010	+	+	-	+	+	+	+
Schaller A. et al., 2016-2018	+	?	-	-	-	+	-
Sherman J.K. et al., 2005	+	+	-	+	+	+	-
Siemonsma P.C. et al., 2013	+	+	-	+	+	?	+
Tèllez-Garcìa M. et al., 2014	+	+	-	+	+	+	-
Vibe Fersum K. et al., 2013	+	+	-	+	-	+	+
Vong K.S. et al., 2011	+	?	-	+	+	?	+
Wälti P. et al., 2015	+	+	-	+	+	?	?
Woods M.P. et al., 2008	+	?	-	-	+	+	+

+: low risk of bias; ?: unclear risk of bias; - high risk of bias.

Table 4. Interrater agreement between authors for full-texts selection.

Agreement for full-texts selection		Author 1 (VB)		Total
		+	-	
Author 2 (LS)	+	20	3	23
	-	4	117	121
Total		24	120	144

+: positive rating; - negative rating.

3.4.1. Communicative- and educative-based interventions on patient's LBP awareness/knowledge.

Table 5. Multimodal interventions for patient's LBP awareness knowledge.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Siemonsma P.C. et al., 2013 Follow-up: 6 months	Cognitive treatment of illness perception	***Timeline cyclical*** p=0.004 ***Consequences*** p=0.063 ***Personal control*** p=0.001 ***Coherence*** p=0.024	*Timeline* p=0.741 *Treatment control* p=0.113 *Emotional response* p=0.425		Waiting List	Illness Perceptions Questionnaire-Revised (subscales)

←: significant effect in favour of experimental group; →: significant effect in favour of control group.

Table 6. Mindfulness-based stress reduction for patient's LBP awareness knowledge.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Morone N.E. et al. 2008 Follow-up: 8 weeks	Mindfulness-based Stress Reduction	**CPAQ** p=0.008 **CPAQ-activities engagement** p=0.004			Waiting List	Chronic Pain Acceptance Questionnaire-activities engagement
Morone N.E. et al., 2016 Follow-up: 8 weeks, 6 months	Mindfulness-based Stress Reduction		MAAS 8 weeks; p=0.059 MAAS 6 months; p>0.05		Health education program	Mindfulness Attention Awareness Scale

←: significant effect in favour of experimental group; →: significant effect in favour of control group.

3.4.2. Communicative- and educative-based interventions on patient's maladaptive behavior modification.

Table 7. Multimodal interventions for maladaptive behavior modification.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Linden M. et al., 2014 Follow-up: 21 days	Cognitive behavior group therapy for back pain	**FABQ-W** p=0.000 **FABQ-PA** p=0.002 **FABQ-total** p=0.000	SCL-90-R p=0.288 *Somatization* p=0.343		Usual medical management + Physiotherapy	Fear Avoidance Beliefs Questionnaire-Work (FABQ-W); Fear Avoidance Beliefs Questionnaire-Physical Activity (FABQ-PA); Fear-Avoidance Beliefs Questionnaire-total; Symptom Checklist (SCL- 90-R); *Somatization*
Monticone M. et al., 2013 Follow-up: 5 weeks, 12-24 months	Cognitive-behavioral therapy + Exercise	**TSK-13**[MCID] p<0.001; p<0.001; p<0.001			Exercise	Tampa Scale of Kinesiophobia-13 (TSK-13)
Monticone M. et al., 2015 Follow-up: 5 weeks, 12, 24 months	Cognitive-behavioral therapy + Exercise	**TSK-13** p<0.001; p<0.001; p<0.001 **PCS-13**[MCID] p<0.001; p<0.001; p<0.001			Exercise	Tampa Scale of Kinesiophobia-13 (TSK-13); Pain Catastrophizing Scale (PCS-13)
Nicholas M.K. et al., 1992 Follow-up: 5 weeks, 6 months	Cognitive-behavioral therapy + Physiotherapy	**PSEQ** p<0.05; p<0.05 **CSQ** p<0.01; p<0.01 **SIP-O** p<0.05; p<0.01 **Drug intake** p<0.01	**PBQ** p>0.05; p>0.05 **SIP-S** p>0.05; p>0.05		Physiotherapy + 5 psychological sessions (AC)	Pain Beliefs Questionnaire (PBQ); Sickness impact profile (SIP-S, SIP-O); Coping Strategy Questionnaire (CSQ); Pain Self-efficacy Questionnaire (PSEQ); Drug intake

←: significant effect in favour of experimental group; →: significant effect in favour of control group; MCID: minimal clinically important difference.

Table 8. Coaching for maladaptive behavior modification.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome

Vong K.S. et al., 2011 Follow-up: session 1, 5, 10	Motivational Enhancement Therapy + Physiotherapy	**PRES:** ***Proxy efficacy*** p<0.001* ***Working Alliance*** p<0.001* ***Treatment expectancy*** p=0.011*	PSEQ p=0.490		Physiotherapy	Pain Rehabilitation Expectations Scale (PRES); Pain Self-Efficacy Questionnaire (PSEQ)
Schaller A. et al., 2016- 2017 Follow-up: 6, 12 months	Movement Coaching		Total physical activity p=0.30 *Leisure Time* p=0.21; p=0.89 *Workplace* p=0.53; p=0.65 *Transport PA* p=0.68; p=0.77		2 general presentations on health-enhancing physical activity	Global Physical Activity Questionnaire (MET-min/week); Leisure Time; Workplace; Transport

←: *significant effect in favour of experimental group;* →: *significant effect in favour of control group; *: p-values for all follow-ups of the respective study.*

Table 9. Mindfulness-based stress reduction for maladaptive behavior modification.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Morone N.E. et al. 2009 Follow-up: 8 weeks, 4 months	Mindfulness-based Stress Reduction	**CPSES** 8 weeks; p<0.05	4 months: CPSES p>0.05		Health education program	Chronic Pain Self-Efficacy Scale (CPSES)
Morone N.E. et al., 2016 Follow-up: 8 weeks, 6 months	Mindfulness-based Stress Reduction	8 weeks: **CPSES** p=0.007 **CSCSQ** p=0.04	6 months: CPSES p>0.05 PCS p>0.05		Health education program	Chronic Pain Self-Efficacy Scale (CPSES); Pain Catastrophizing Scale of the Coping Strategies Questionnaire (CSCSQ)

←: *significant effect in favour of experimental group;* →: *significant effect in favour of control group.*

Table 10. Self-management for maladaptive behavior modification.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Carpenter K.M. et al., 2012 Follow-up: 3 weeks	Self-management online (WW)	3 weeks: **SOPA-control** p>0.001; effect size=1.01 **SOPA-disability** p<0.001; effect size=-0.72 **SOPA-*harm-exercise*** p>0.001; effect size=-0.80 **SOPA-emotion** p<0.001; effect size=0.82 **SOPA-medication** p<0.001; effect size=-0.88 **SOPA-solicitude** p=0.26; effect size=-0.39 **Self-Efficacy** p<0.001; effect size=0.89 **FABQ-PA** p<0.001; effect size=-0.80 **PCS-rumination** p<0.001; effect size=-0.59 **PCS- magnification** p<0.001; effect size=-0.63 **PCS-helplessness** p<0.001; effect size=-0.77	3 weeks SOPA-Medical Cure p=0.167 FABQ-Work p=0.75		Waiting List	Brief Survey of Pain Attitudes (SOPA)–Control; SOPA-Disability; SOPA-Harm Exercise; SOPA-Emotion; SOPA-Medication; SOPA-Solicitude; SOPA-Medical Cure; Pain Self Efficacy Scale (PSES) (adapted from Arthritis Self-Efficacy Scale); Fear Avoidance Beliefs Questionnaire–Physical Activity (FABQ-PA); Fear Avoidance Beliefs Questionnaire-Work (FABQ-W); Pain Catastrophizing Scale (PCS): -Rumination -Magnification -Helplessness

Haas M. et al., 2005 Follow-up: 6 months	Chronic Disease Self-Management Program - CDSMP		Self-Efficacy-Pain p=0.427 Self-Efficacy- Other p=0.582		Waiting List	2 subscales of Arthritis Self-Efficacy Scale: Self-Efficacy-Pain; Self-Efficacy- Other
Sherman J.K. et al., 2005 Follow-up: 12, 26 weeks	Self-care book		p>0.05 for all FUs and all outcome measures		(1) Exercise (2) Yoga	Drug intake; visits to health care provider

←: significant effect in favour of experimental group; →: significant effect in favour of control group.

Table 11. Pain science education for maladaptive behavior modification.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Gema B.P. et al., 2018 Follow-up: 1 month, 3 months	Pain Science Education + Exercise	1 month: **PCS-13 - TSK-11** *p<0.05 3 months: **PCS-13**, effect size=2.23 T**SK-11**, effect size=1.84 *p<0.001			Exercise	Tampa Scale of Kinesiophobia-11 (TSK-11); Pain Catastrophizing Scale-13 (PCS-13)
Moseley L. et al., 2004 Follow-up: 15 days post-treatment	Pain Science Education	**PCS-13** p<0.05 **SOPA(R)** p<0.05			Back Education	Brief Survey of Pain Attitudes (SOPA-R); Pain Catastrophizing Scale-13 (PCS-13)
Pires D. et al., 2014 Follow-up: 6 weeks, 3 months	Pain Science Education + aquatic Exercise		TSK-13 *p>0.05		Aquatic Exercise	Tampa Scale of Kinesiophobia-13 (TSK-13)
Ryan C.G. et al. 2010 Follow-up: 8 weeks, 3 months	Pain Science Education	**PSEQ** p<0.05 for both follow-ups	TSK-13 *p>0.05 activPAL™ 8 weeks, p>0.05		Pain Science Education + Exercise	Tampa Scale of Kinesiophobia-13 (TSK-13); Pain Self-Efficacy Questionnaire-10 (PSEQ); activPAL™
Téllez- Garcìa M. et al., 2014 Follow-up: 4 weeks	Pain Science Education + Dry Needling	**TSK-17^{MCID}** p<0.05			Dry Needlig	Tampa Scale of Kinesiophobia-17 (TSK-17)
Vibe Fersum K. et al., 2013 Follow-up: 3 months, 12 months	Pain Science Education in a multimodal program (CB-CFT)	**FABQ-PA** *p<0.001 **FABQ-W** *p<0.001 **Care seeking** 12 months p<0.001			Manual Therapy + Exercise	Fear-Avoidance Beliefs Questionnaire-Physical Activity (FABQ-PA); Fear-Avoidance Beliefs Questionnaire-Work (FABQ-W); care seeking
Walti P. et al., 2015 Follow-up: 3 months	Pain Science Education in a multimodal program		FABQ-total p=0.79 PCS p=0.40		Physiotherapy	Fear Avoidance Beliefs Questionnaire-total (FABQ-total); Pain Catastrophizing Scale (PCS)

*←: significant effect in favour of experimental group; →: significant effect in favour of control group; MCID: minimal clinical important difference; *: p-values for all follow-ups of the respective study.*

Table 12. Graded activity and graded exposure for maladaptive behavior modification.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Leeuw M. et al., 2008 Follow-up: post-treatment, 6 months	Graded exposure	**PCS** *p<0.01	RT3 p>0.05		Graded activity	Pain Catastrophizing Scale-13 (PCS-13); Physical activity (RT3)
Magalhães M.O. et al., 2015-2018 Follow-up: 6 weeks, 3-6 months	Graded activity		TSK-17 p=0.321 BQHPA p=0.407 Return to work 3 months; p>0.064 6 months; p<0.68		Physiotherapy	Tampa Scale of Kinesiophobia-17 (TSK-17); Baecke Questionnaire of Habitual Physical Activity (BQHPA); Return to work

Woods M.P. et al., 2008 Follow-up: 4, 8 weeks	Graded exposure	**PSEQ** *p=0.028 **TSK** *p=0.02 **FABQ** *p=0.0277	PCS p=0.076		Graded activity	Pain Self-Efficacy Questionnaire (PSEQ); Pain Catastrophizing Scale (PCS); Tampa Scale of Kinesiophobia (TSK); Fear-Avoidance Beliefs Questionnaire-total
	Graded exposure	**PCS** *p=0.004 **TSK** *p=0.02 **FABQ** *p=0.008	PSEQ p=0.06		Waiting List	
	Graded activity		*p>0.05 for all FUs and all outcome measures		Waiting List	

*←: significant effect in favour of experimental group; →: significant effect in favour of control group; *: p-values for all follow-ups of the respective study; WL: waiting list.*

3.4.3. Communicative- and educative-based interventions on compliance with exercise.

Table 13. Multimodal interventions for compliance with exercise.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Härkäpää K. et al. 1989-1990 Follow-up: 3 months, 1.5-2.5 years	Inpatients (*Modified Swedish Back School*, relaxation and strengthening exercises, coping strategies education)	**Accomplishment to exercise** 3 months; p=0.01 1.5 years; p=0.02 2.5 years; p=0.02 **Frequency of exercise** 3 months; p=0.01 1.5/2.5 years; p<0.01			Outpatients (*Modified Swedish Back School*, physiotherapy back program, coping strategies education)	Accomplishment to exercise (n° of faultless exercises); Frequency of exercise (mean of exercise sessions per week)
	Inpatients	**Accomplishment to exercise** 3 months; p=0.01 1.5 years; p=0.001 2.5 years; p=0.001 **Frequency of exercise** 3 months; p=0.01 1.5/2.5 years; p<0.01			Control (written and oral instructions on back exercises and ergonomics)	
	Outpatients	**Accomplishment to exercise** 3 months; p=0.001 1.5 years; p=0.01 2.5 years; p=0.001	Frequency of exercise 3 months p>0.05 1.5/2.5 years p>0.05		Control	

←: significant effect in favour of experimental group; →: significant effect in favour of control group.

Table 14. Coaching for compliance with exercise.

Study	Experimental intervention	←	No between group difference	→	Control group	Outcome
Vong K.S. et al. (2011) Follow-up: 5 weeks, 10 weeks, 1 month post-intervention	Motivational Enhancement Therapy + Physiotherapy	**Compliance with exercise execution** *p=0.002			Physiotherapy	Compliance with exercise execution (n° of sessions per week)

*←: significant effect in favour of experimental group; →: significant effect in favour of control group; *: p-values for all follow-ups.*

Table 1. Characteristics of the included studies.

General informations (Author, years, study design, country)	Population (characteristics, number, age, gender, recruitment)	Interventions (number of participants, content, frequency, duration and professional in charge)	Comparisons (number of participants, content, frequency, duration and professional in charge)	Outcomes and outcome measures
Communicative- and educative-based interventions on patient's LBP awareness/knowledge				
Multimodal interventions (MI) for patient's LBP awareness knowledge				
Siemonsma P.C. et al., 2013 **RCT** **Netherlands**	CLBP>3 months Age=18-70 years N=156 Patients recruited by mail with written information and a screening questionnaire.	N=104, Age=45.6±12.9, F=56 Cognitive treatment of illness perceptions (CTIP): 10-14 sessions of individual treatment lasting 1 session of 1 hour per week. Phase 1: detection of disease perceptions based on the answers to the IPQ-R. Phase 2: challenge of incorrect beliefs of patients, questioned by the interview with professionals with the aim of arousing doubt about beliefs (especially the benefit of bed rest). Phase 3: proposal of alternative perceptions of the disease according to the promotion of the activity. Phase 4: confirmation and reinforcement of alternative disease perceptions in ADL. Professional in charge: 4 physiotherapists e 3 occupational therapists expert in CTIP. Supervision of professionals appointed by a psychologist to monitor the progress with patients.	N=52, Age=47.1±11.1, F=31 Waiting list. Both groups: request not to participate in other treatments during the study period. Monitoring of "co-interventions" with diaries.	Evaluation and modification of the perception of illness (7 sub-scale) – Illness Perceptions Questionnaire (IPQ) Also assessed: visits to the GPs, physiotherapist, alternative doctors or taking drugs.
Mindfulness-based stress reduction (MBSR) for patient's LBP awareness knowledge				
Morone, N.E. et al., 2008 **RCT*** **Pennsylvania, USA** *cross-over after 8 weeks of treatments	CLBP>3 months Age≥65 years (mean 75 [65-84]) N=37 Recruited older adults patients from an adult pain clinic, flyers placed in the University of Pittsburgh Medical Center, and newspaper ads.	N=19, Age= 74.1±6.1, M=9, F=10 Mindfulness-based stress reduction (MBSR): 1 group session of 90 minutes each, once a week for 8 weeks. Program (3 techniques): regular activities such as sitting, walking or lying on the back transformed into a meditation through direct breathing and awareness of thoughts and feelings. Techniques: 1) body scan 2) sitting practice 3) walking meditation. Protocol (1st week): introduction to MBSR principles. Assignment of home objectives (6-7 days/week) lasting 50 minutes (45 meditation +5 diary filling). Delivery of the audiotape material, daily diary and readings. From the 2nd week onwards: discussion about experiences with MBSR, problem solving, presentation of material focused on stress, pain and mind-body connection, introduction of quite sitting and walking meditation. Professional in charge: two of the authors with experience of about 30 years in mindfulness meditation.	N=18, Age =75.6±5.0, M=7, F=11 Waiting list	Pain acceptance – Chronic Pain Acceptance Questionnaire (CPAQ) + The Activity Engagement (CPAQ sub-scale) Adherence: not stated as an outcome, results analysis (drop-out rate + attendance - mean of meditated days per week - mean of meditated minutes per day)
Morone, N.E. et al., 2016 **RCT** **Pennsylvania, USA**	CLBP>3 months Age≥65 years (mean: 74.5±6.6) N=282 randomized Patients recruited (outpatient) from the metropolitan area of Pittsburgh, Pennsylvania. Most by direct mail (letters and brochures), email (mailing list), announcements (local news), leaflets (hospitals and clinics).	N=140, M=47 (33.6 %) 8 weeks MBSR program: transformation of regular activities such as sitting, walking and lying down in meditation through breathing and awareness of feelings and thoughts. Methods: body scan, sitting practice, walking meditation, mindful stretching. In addition 60-minute monthly sessions to encourage the competence of participants associated with discussions on topics that have emerged during the 8 weeks. Professional in charge: local experts.	N=142, M=48 (33.8%) 8 weeks of health education program based on the 10 keys to healthy aging, previously proposed by Newman AB and colleagues. Instructions on active and dynamic programs for elderly adults related to relevant topics for aging, such as the management of hypertension. Offered the same stretching exercises as the experimental group. No information about pain. In addition, recall classes with a monthly frequency of 1 hour. Professional in charge: local experts.	Self-efficacy – Chronic Pain Self-Efficacy Scale (CPSES) Catastrophizing – Catastrophizing Scale of the Coping Strategies Questionnaire (CSCSQ) Self-reported mindfulness – Mindful Attention Awareness Scale (MAAS)
Communicative- and educative-based interventions on patient's maladaptive behavior modification				
Multimodal interventions (MI) for maladaptive behavior modification				
Linden M. et al., 2014 **RCT** **Germany**	CBLP>6 months Age (mean)=50 years N=103, F=68% Patients recruited in the orthopedic department of a rehabilitation center in Germany (unit of 95 inpatients).	N=53, Age=50.4±6.9, F=68% Cognitive-behavior group therapy for back pain (CBT-BP): 3 group sessions per week, each 90 minutes. Objectives: stress reduction, changes in beliefs, pain management, global wellness, change in avoidance behavior. 1st session: exposure of management strategies. 2nd session: instructions for resuming work and adopting a pain diary. 3rd session: explaining of fear-avoidance model, discussion on change behavior. 4th-5th session: take consciousness of behaviors and their consequences as well as somatic answers. 6th session: patient engagement, encouragement for the gradual recovery and identification of specific avoided activities. Professional in charge: MD specialized in CBT.	N=50, Age=49.7±7.1 F=68% Both groups were treated for 21 days, regularly visited by a doctor as needed. Participation in balneotherapy, massage, electrotherapy and general physiotherapy were offered. In addition, occupational therapy to support the return to work and information about coping strategies were also given.	Fear- Avoidance – Fear-Avoidance Beliefs Questionnaire (FABQ) The Symptom Checklist-90-GSI + "somatization"
Monticone M. et al., 2013 **RCT**	CLBP>3 months Age>18 years N=90	N=45, Age=48.96±7.97, M=18, F=27 ET + CBT (cognitive behavioral therapy): identification of the avoided situations of patients, explanation of the fear-avoidance model, education to self-management and awareness, graded exposure to situations previously identified as dangerous by the patient and continuous discussions in order to reacquire coping strategies, motivation and planning goals. 1 session (60 minutes) per	N=45, Age=49.71±7.01, M=20, F=25 Exercise training (ET): individual multimodal program consisting of active and passive spinal column mobilization, strengthening and motor control exercise. Professional in charge: 2 physiotherapists	Fear of movement – Tampa Scale of Kinesiophobia (TSK-13)

Italy	Outpatient patients referred to the research hospital in question.	week for 5 weeks (preliminary/instructive phase, 1st phase), 1 meeting psychologist-patients per month (reinforcement phase, 2nd phase). Professional in charge: psychologist.	supervised by a physiatrist. 1 session of 60 minutes per week for 5 weeks (preliminary phase). Request to continue performing the exercise 2 times per week (reinforcement phase).	
Monticone M. et al., 2015 **RCT** **Italy**	CLBP>3 months N=150 Age>18 years Outpatient patients referred to the research hospital in question.	Exercise program (EX) + Cognitive behavioral therapy (CBT). EX: basic exercise for isolated contractions of the core muscles, task-oriented progression of exercise (different postures and functional tasks), coordination exercises, balance and complex functional tasks for daily activities. Sessions of 1 hour two times per week. Professional in charge: physiotherapist. CBT group-based: explanation of the fear-avoidance model, pain education and identification of incorrect beliefs through group discussions. Sharing and debate about beliefs, learning solutions through education in pain physiology and active and paced (=pacing) approach with gradual increase. Relaxation and attention techniques to deal with graded exposure and pain control, as well as flair-ups. Professional in charge: psychologist; 1 session per week, for 5 weeks.	Exercise program (usual-care rehabilitation): individualized for each patient and in a group (n=5) format. Procedures: passive mobilization of the lumbar spine, strengthening exercises, stretching and motor control. Both groups: duration of 5 weeks; exercise program of the same duration as EX-CBT. Professional in charge: physiotherapist.	Fear of movement – Tampa Scale of Kinesiophobia (TSK-13) Catastrophizing – Pain Catastrophizing Scale (PCS-13)
Nicholas M.K. et al., 1992 **RCT** **Australia**	CBLP=5.5 years of mean duration Age=20-60 years N=20, M=11, F=9 Recruited from the pain clinic at one of Sidney's largest hospitals, general practitioners.	Both groups: standard physiotherapy program (FKT) → information, reinforcement exercise for the back muscles in the pool and in dry modalities, additional written material (typologies-frequency of exercises) and encouragement for execution at home. Professional in charge: physiotherapist. Cognitive-behavioral treatment (relaxation training included) + FKT. N=10. Pain education: consequence of inactivity, depression and impotence, consequences of chronic pain and incorrect coping strategies. Encouragement to reduce medications (after medical consultation), to identify long-term behavioral goals (exercise, activity, work). Facilitation: encouraging the pacing of the activities and the gradual increase of activities/exercises according to the objectives plan. In addition: progressive muscle relaxation (delivery of 3 videos and encouragement to the progressively self-management). Professional in charge: psychologist. Procedures: 2 sessions per week (2h and 1.5h each) for 5 weeks. First hour of the 1st session: physiotherapist and then psychologist; 2nd session: senior physiotherapist.	N=10 FKT with the same methods. In addition, 5 sessions with the psychologist for the attention-control condition: sessions with the possibility for patients to discuss life-related problems with chronic pain, history of symptoms, treatments received, effect of symptoms on daily and family life as well as on work and lifestyle. No pain education, compliance with the exercise, coping strategies, division of activities, pacing or progression of the exercises.	Beliefs about pain – Pain Beliefs Questionnaire (PBQ) Sickness impact – Sickness impact profile (SIP-S, SIP-O) Drug intake Coping – Coping Strategy Questionnaire (CSQ) Motivational status – Pain Self-efficacy Questionnaire (PSEQ) Adherence to the exercise (no statistical analysis, only general data provided)
Coaching for maladaptive behavior modification				
Vong K.S. et al., 2011 **RCT** **China**	CLBP>3 months N=76 Age=18-65 years Patient recruited by an outpatient department of local physiotherapy.	N=38, Age= 44.6±11.2, M=16, F=22 Motivational Enhancement Therapy (+ general physiotherapy): during physiotherapy sessions (10), transfer of skills designed to increase patient motivation and involvement in treatment in order to induce correct behavioral changes. MI (counseling technique adapted to the specific patient: empathic expression, development of disagreement, support of self-efficacy, work alliance) + proxy efficacy (patient confidence in the skills of their therapists to act directly on the modification of the behavior of the individual). Professional in charge: properly trained physiotherapist (8 hours of motivational training before the study).	N=38, Age= 45.1±10.7, M=12, F=26 Conventional physiotherapy: 10 sessions (30 minutes each) for 8 weeks with also 15 minutes of interferential therapy (IT) and individualized exercises (EX). IT: electrodes placed on the paravertebral muscles from L2 to S1 on both sides (frequency 80-100 Hz). EX: motor control exercise and abdominal strengthening, stretching, also prescribed at home.	Motivational Status – Pain Rehabilitation Expectations Scale (PRES) and Pain Self-Efficacy Questionnaire (PSEQ) Exercise compliance – frequency of exercise performed at home: number of daily sessions performed at home multiplied for number of training days per week
Schaller A. et al., 2016-2017 **RCT** **Germany**	CLBP>3 months N=412 Age=18-65 years M=286, F=126 Recruited patients from a hospital rehabilitation medical center.	N=201, Age=49.7±8.3, M=143 Movement Coaching (interactive and solution-oriented coaching): approach consisting of 3 components: 1. Face-to-face (intervention in small groups for 3 times lasting 60 minutes focused on training with respect to intention). 2. Support for the adoption of daily physical activity– 2 times - (tailored telephone aftercare) and in particular the social needs of the patients: social acceptance, sociality, health research) – 8 e 12 weeks after rehabilitation. 3. Web 2.0 available after 6 months post-rehabilitation: online platform to provide additional social support and increase physical activity involvement. Professional in charge: doctor in physical education with expertise in rehabilitation and health management.	N=211, Age=51.1±7.8, M=143 Low intensity control group: two general 30-minute presentations focusing on the involvement in physical activity, during the rehabilitation period, with the possible download from the homepage.	Global physical activity – Motivational Enhancement Therapy (MET-min/week) - evaluated Global Physical Activity Questionnaire Sub-scale: free time (MET-min/week), job (MET-min/week) and transport (MET-min/week)
Mindfulness-based stress reduction (MBSR) for maladaptive behavior modification				
Morone, N.E. et al., 2009 **RCT** **Pennsylvania, USA**	CLBP>3 months Age≥65 years N=40 Patients recruited from the greater Pittsburgh area through newspaper ads, flyers and flyers at the medical center and city university.	N=20, *Age= 78±7.1 years, M=5, F=11 (*details provided only for16/20 patients) Mindfulness-based stress reduction (MBSR): same procedures as Morone N.E. et al. (2008).	N=20, *Age=73±6.2, M=8, F=11 (*details provided only for 19/20 patients) 8-week health education program: lessons, group discussions and homework based on the "health" topic argued in the discussions. Emphasizing the "brain health" theme during the weeks. Main topics: pain medications, complementary treatments for spinal pain, types of spinal pain, food and health. Delivery of material to promote participation and retention, such as the book "Keep your brain active". For each session: 45-60 minutes of lessons and 30-45 minutes of	Self-efficacy – Chronic Pain Self-Efficacy Scale (CPSES - 3 sub-scale) Mindfulness – Mindful Attention Awareness Scale (MAAS) + Facet Mindfulness Questionnaire (FFMQ) which separates mindfulness into 5 domains[1] Meditation practice 4 months after the program (6 YES/NO questions)[2] [1]statistical analysis not applied [2]not defined as an outcome, data from the results

			discussion and "exercises for the brain" (total about 90 minutes).	
Morone, N.E. et al., 2016 **RCT** **Pennsylvania, USA**	CLBP>3 months Age≥65 years (mean: 74.5±6.6) N=282 randomized Patients recruited (outpatient) from the metropolitan area of Pittsburgh, Pennsylvania. Most by direct mail (letters and brochures), email (mailing list), announcements (local news), leaflets (hospitals and clinics).	N=140, M=47 (33.6 %) 8 weeks MBSR program: transformation of regular activities such as sitting, walking and lying down in meditation through breathing and awareness of feelings and thoughts. Methods: body scan, sitting practice, walking meditation, mindful stretching. In addition 60-minute monthly sessions to encourage the competence of participants associated with discussions on topics that have emerged during the 8 weeks. Professional in charge: local experts.	N=142, M=48 (33.8%) 8 weeks of health education program based on the 10 keys to healthy aging, previously proposed by Newman AB and colleagues. Instructions on active and dynamic programs for elderly adults related to relevant topics for aging, such as the management of hypertension. Offered the same stretching exercises as the experimental group. No information about pain. In addition, recall classes with a monthly frequency of 1 hour. Professional in charge: local experts.	Self-efficacy – Chronic Pain Self-Efficacy Scale (CPSES) Catastrophizing – Catastrophizing Scale of the Coping Strategies Questionnaire (CSCSQ) Self-reported mindfulness – Mindful Attention Awareness Scale (MAAS)
Self-management (SM) for maladaptive behavior modification				
Carpenter K.M. et al., 2012 **RCT*** **Seattle, USA** *preliminary intervention of a new CBT online intervention: Wellness Workbook (WW**)**	CLBP>6 months N=141 Age>40 years F=83% Patients recruited through an ad on the internet and advertisements in major and alternative newspapers in cities chosen because of ethnic diversity (Houston, Atlanta, New York) and with a prize of $135 for the website test and the completion of assessments.	N=70 Direct access to the WW. WW (self-management): 6 chapters including acute and chronic pain education, role of beliefs and pain, rationale of stress and relaxation, behavioral concepts about physical activity, staying active and behavioral guidelines for meditation exercises, relaxation and exercises with the general objective of promoting behavior modification and self-management. Program separated into 6 chapters (1h/1.5 h of time each) divided in targets, open questions, educational material for interactive exercises, meditation, chapter summaries and examples on how to put into practice the skills/knowledge learned. Modalities: animations, images, graphs and texts, stories of real patients, interaction with the personalized user, guided relaxation exercises and meditation. Professional in charge 1: psychologist (program developer). Professional in charge 2: external consultant expert in pain medicine and pain psychology (review of site content).	N=71 Waiting list	Beliefs and attitude about pain – Brief Survey Of Pain Attitudes (SOPA) Fear-Avoidance - Fear Avoidance Beliefs Questionnaire (FABQ) Self-efficacy – Pain Self Efficacy Scale (PSES) (adapted from Arthritis Self-Efficacy Scale) Catastrophizing – Pain Catastrophizing Scale (PCS)
Haas M. et al., 2005 **RCT** **USA**	CLBP>3 months N=109 Age>60 years M=9%, F=91% Recruited by ads in local newspapers, flyers in centers: community, business and chiropractic clinic, newsletters, presentation of the program to organizational meetings, email of doctors.	N=60, F= 81.6%, Age=78.6±7.5 CDSMP: 1 workshop/week for 6 weeks (2.5 hours each) with the aim of increasing self-efficacy. Procedures: encouragement to develop security necessary for health control. Transfer of self-management principles: symptoms, treatment options, sharing with third parties, feedback, problem solving, fear management. Format: workshop period and additional book, group interaction period and team objectives period. Professional in charge: two lay persons also affected by CLBP.	N=49, F=87.8%, Age=75.5±7.5 Waiting List	Self-efficacy – 2/3 sub-scales from Arthritis Self-Efficacy Scale (ASES)
Sherman J. K. et al., 2005 **RCT** **USA**	CLBP>3 months Age=44±13 N=101 Patients recruited through invitations (letters) and responses to announcements. Setting: no profit, integrated health care system.	N=36, F=11, M=25, Age=44±12 years Yoga group. Procedures: 75-minute weekly lessons for 12 weeks of reinforcement exercises, breathing exercises, maintained postures. Daily home maintenance was encouraged via illustrative flyers. Participants received an audio CD for home yoga management**.** Professional in charge: health cooperative, which through the mailing list contacted the patients who had turned 3-15 months before to the GP.	N=35; F=13; M=22), Age=42±15 years Exercise: weekly lessons of 75 minutes for 12 weeks in which therapeutic education related to LBP was offered, as well as aerobic and strengthening exercises or stretching. Daily home maintenance was encouraged. Professional in charge: the same of yoga group. N=30; F=10; M=20). Age=45±11 years Self-care: delivery of the "The Back Pain Help Book" for the knowledge and management of the LBP, as well as the appropriate lifestyle modification. Professional in charge: the same of yoga group.	Use of medications / drugs / recourse to other health professionals Adherence to the treatment (logbook of weekly activities)* *no coupled comparisons were made between the groups - only comparison between the 3 groups - and no data to perform analyses were provided.
Pain science education (PSE) for maladaptive behavior modification				
Gema B.P. et al., 2018 **RCT**	CLBP>6 months N=56 Age= 20-75	N=28, M=6, F=22, Mean age:=44.9±9.6 Both groups participated in exercise sessions with the difference that the intervention group first participated in a PSE session. Second session was held in the following month. All patients were instructed to perform the exercise program at home.	N=28, M=6, F=22. Mean age:=49.2±10.5 Therapeutic exercise: motor control exercises for the lumbar spine, stretching and aerobic exercise. First session: demonstrations of the exercises to the	Catastrophizing – Pain Catastrophizing Scale (PCS) Fear of movement – Tampa Scale of Kinesiophobia (TSK-11)

Spain	Recruited through ads placed in 4 private physiotherapy clinics and at the University of Alcala in Madrid.	1. PSE: 2 educational sessions of 30-50 minutes each, offered to patient divided into groups from 4 to 6 people. First session focused on explanations of concepts and presentations of the neurophysiology of pain. In addition, a flyer was delivered to the participants with the aim of reinforcing the concepts presented during the session. Second session (1 month later): discussion and analysis of the concepts previously exposed. Professional in charge: expert physiotherapist in PSE. 2. Therapeutic exercise: same methods as control group.	participants with the supervision of a physiotherapist. Second session (1 month later): corrections and confirmations of the exercises. Professional in charge: expert physiotherapy in motor control exercise.	Compliance***** (Likert 5 points scale) *not provided detailed data (graphically only) or statistical analysis - absent data (email with authors)
Moseley L. et al., 2004 **RCT** **Australia**	CLBP>6 months N=58 M=25 F=33 Recruited volunteers using a project advertising note in 3 different private rehabilitation clinics.	N=31; Age=42±10. M=13; F=18 3 hours of individual session of PSE in oral format focused on nervous system, synapses, neuroplasticity, with reference to the book "Textbook of pain" (Wall and Melzack, 1999). Use of diagrams and examples to facilitate learning. In addition, booklet delivery with the same concepts for daily home reading. Professional in charge: physiotherapist.	N=27; Age=45±6 years. M=12; F=15 3 hours individual session of Back Education (20 minutes break) focused on anatomy and physiology of bone, joints and muscles, posture, ergonomics, principles of strength, endurance and stretching. Delivery of a brochure with the same topics for home reading. Professional in charge: physiotherapist.	Beliefs and attitudes about pain – Brief Survey Of Pain Attitudes [SOPA(R)] Catastrophizing – Pain Catastrophizing Scale (PCS)
Pires D. et al., 2014 **RCT** **Portugal**	CLBP>3 months N=62; M=22; F=40 Age=18-65 years Patients recruited from the waiting list of a Portuguese outpatient clinic**.**	N=30; M=10; F=20 Mean age:=50.9±6.2 years 1. PSE: 2 group sessions (90 minutes each) focusing on topics such as the origin of acute pain in the nervous system, transition from acute to chronic pain, central sensitization, role of the brain in pain perception, psychosocial factors related to pain, behavioral and cognitive responses related to pain, flare-ups and pacing through the use of metaphors and images. 2. Aquatic exercise: same methods as the control group. Professional in charge: physiotherapist.	N=32, Mean age:=51.0±6.3 years. M=12, F=20 Aquatic exercise: exercises program 2 sessions per week performed in a therapeutic pool (33°C) with groups of patients from 6 to 9 and sessions lasting from 30 to 50 minutes. Phases: 1. warm-up, 2. specific exercises, 3. cool down. Professional in charge: physiotherapist.	Fear of movement – Tampa Scale of Kinesiophobia (TSK-13)
Ryan C.G. et al., 2010 **RCT** **Scotland**	CLBP>3 months N=38 Age=18-65 years F=25, M=13 Patients recruited from 5 physiotherapy departments.	N=18, Mean age:=45.5±9.5 years, M=7, F=11 PSE: 1 session of 2 hours and 30 minutes focused on the biology of pain using diagrams and freehand drawings. In addition, delivery of the book "The Back Book" (Burton, 1999). Primary objective: to increase self-efficacy and reduce avoidance behavior, as well as improve patient knowledge about the physiology of pain**.** Professional in charge: physiotherapist.	N=20, M=6, F=14. Mean age:= 45.2±11.9 years PSE: same methods as experimental group. Exercise: 6 exercise classes once a week for a total of 6 weeks. Each session had a duration of 40-55 minutes. Program: graduated circuit aerobic exercises with some core stability exercises ("Back to fitness exercise"): 1. Warm-up (10 minutes), 2. Aerobic phase (20-30 minutes), 3. Cooling down. Professional in charge: physiotherapist	Fear of movement – Tampa Scale of Kinesiophobia (TSK) Self-efficacy – Pain Self-Efficacy Questionnaire (PSEQ) Physical activity: step-counts (activPAL™ device)
Tèllez-Garcìa M. et al., 2014 **RCT** **Spain**	CLBP>3 months N=12 Age=18-65 years M=4, F=8 Patients recruited from patients sent by their general practitioners for physiotherapy treatments.	N=6, Mean age:=36±5 years. M=2, F=4 1. PSE: 2 individual one-to-one educational sessions of 30 minutes each, once a week after the 2nd and 3rd dry needling sessions. Topics covered: neurophysiology of acute and chronic pain as well as the role of beliefs in relation to pain through PowerPoint support based on the book "Explain Pain" (Butler & Moseley, 2003) and material to be read at home with concepts expressed during the sessions. 2. Dry needling (DN): same methods as control group. Professional in charge: experts physiotherapists.	N=6, Mean age:=37±13 years. M=2, F=4 DN: 3 sessions (once a week) on active trigger points of gluteus medius and quadratus lomborum performed by an expert clinician with the patient in lateral decubitus. Professional in charge: expert physiotherapist.	Fear of movement – Tampa Scale of Kinesiophobia (TSK)
Vibe Fersum K. et al., 2013 **RCT** **Norway**	CLBP>3 months N=94; M=46; F=48 Age=18-65 years Patients recruited from private outpatient physiotherapeutic services, general practitioners and the spine clinic at Haukeland University Hospital through advertisements in local newspapers.	N=51; Age=41±10.3 years; M=24; F=27. Cognitive-functional therapy (CB-CFT): 1. Cognitive components: individual oral PSE sessions lasting 1 hour (1st session) and 30/45 minutes thereafter, focusing on the vicious circle of pain, psychosocial factors involved in chronic pain, sensitization and difference between pain and damage; weekly session the first 2/3 sessions up to 1 session every 2/3 weeks. 2. Functional exercises designed to normalize behavior and posture. 3. Functional integration of the exercises in previously avoided or provocative activities (specific for each patient). 4. Physical activity program (walking, exercise bike) based on patient preferences and impairments. Duration: 12 weeks. Professional in charge: 3 trained physiotherapists (106 hours of training on CB-CFT).	N=43; Age=42.9±12.5 years; M=22; F=21 Manual therapy and therapeutic exercises (MT-EX): joint mobilization techniques or manipulations of the back/pelvis. In addition, for 82.5% of participants, exercises during sessions or home exercise program including general or motor control exercises in line with Richardson et al. (1998). Duration: 1 hour the first session and 30 minutes the subsequent sessions. Professional in charge: expert OMPT physiotherapist.	Fear- Avoidance – Fear-Avoidance Belief Questionnaire (FABQ) Sick days Medication research - questions about subsequent treatments in the 3 months of intervention and questionnaire at 12 months. Questions: - Need for other interventions after finishing? - What treatments? - How many?
Wälti P. et al., 2015 **RCT** **Switzerland**	CLBP>3 months N=28 Age=18-60 years M=13, F=15 Patients recruited through chiropractors, general	N=14, Mean age=41.57 ±9.77 years. F=9, M=5 Multimodal treatment: 1. Education: individual PSE sessions focusing on pain neurophysiology, cortical dysfunction in pain and body perception. In addition, delivery of the book "Explain Pain" (Butler & Mosely, 2003) for home reading in view of the questions submitted via the web interface later. 2. Sensory retraining: through "sensory retraining tool" training on tactile discrimination at the lumbar level with progression from the recognition of single letters to three-letter words. 3.	N=14, Mean age=41.71 ±12.21 years, F=6, M=8 UPT (usual physiotherapy): active treatment (strength training, stretching and neuro-dynamics) and passive treatment (electrotherapy, manual therapy, massage). In addition, basic education provided individually with respect to the correct behavior to be adopted in case of flare-ups with the invitation to restore the normal	Fear-avoidance – Fear-Avoidance Belief Questionnaire (FABQ) Catastrophizing – Pain Catastrophizing Scale (PCS) Sick days Drugs intake* Treatment adherence*

	practitioners and rheumatologists upon presentation of the study. Patient also recruited through advertisements through local newspapers.	Motor retraining: progressions in motor control exercise with progression from the motor image to functional execution. Professional in charge: physiotherapist.	activities and instructions on the home exercise program via the web. Professional in charge: physiotherapist.	(consider as feasibility related outcome) *no statistical analysis conducted on this outcome
Graded activity (GA) and graded exposure (GE) for maladaptive behavior modification				
Leeuw M. et al., 2008 **RCT** **Netherlands**	CLBP>3 months Age=18-65 years N=85 Recruited outpatients from 2 rehabilitation centers, 4 rehabilitation hospital departments, 1 anaesthesiology hospital department 2 departments of occupational physics.	N=42, Age=46.45±9.33, M=47,6% Graded Exposure (GE): 16 sessions in total. First session: education and subsequent hierarchical stratification of the activities considered "fear-eliciting" and avoided by the patient (through PHODA). Two subsequent sessions: education provided by the physician and the physiotherapist on the rational of the intervention. Gradual but systematic exposure to previously identified individual and personal activities. Behavioral tests so that the patient can verify the validity of his beliefs with respect to the consequences of the activities after the intervention. Professional in charge: psychologist, doctor and physiotherapist.	N=43, Age= 44.21±9.54, M=55.8% Graded Activity (GA): 26 sessions in total. First education session compared to the rational and 2 subsequent sessions (doctor for the 1st and physiotherapist for the 2nd) on the emphasis on the harmful effects of immobility and benefits of activity. Specific goals for each patient were identified and baselines to establish activity tolerance were created. Procedure according to the time-contingent logic (starting from 70-80% of the baseline) with instructions to not diverting the intensity of the activities from the pre-established quotes. Professional in charge: psychologist (1st session), physiotherapist and occupational therapist for the following sessions	Catastrophizing – Pain Catastrophizing Scale - (PCS) Daily activity – RT3 (battery-operated activity monitor worn at the belt)
Magalhães M.O. et al., 2015*-2018** **RCT** **Brazil** *follow-up until 6 weeks **until 6 months	CLBP N=66 Age=18-65 years M=27%, F=73% Patients recruited from a rehabilitation clinic affiliated with a public hospital in the city of São Paulo.	N=33, Age=47.2±10.5 years, M=9, F=24 Both experimental groups: 6 weeks, 1-h exercise sessions, 2 times/week. Graded activity: same protocol as Macedo et al. (2008), and Smeets et al. (2006), based on progressive sessions of exercises with the aim of increasing physical well-being and inducing a change in the patient's behavior, as well as attitudes to pain. Procedure: treadmill and lower limb muscles strengthening (quadriceps, hamstrings and trunk). First 2 weeks: 50% of maximum tolerable load; 3/4 weeks 60%, the last weeks 70%. In addition, delivery of a booklet with concepts of "Back Book". Professional in charge: expert clinician (mean of 7 years of experience).	N=33, Age=46.6±9.5 years. M=8, F=25 Physiotherapy exercise group: based on protocol of Franca et al. (2010, 2012): stretching, strengthening and motor control of muscles of lower limb and thoraco-lumbo-pelvic region. No education about home exercise.	Return to work – YES/NO scale* Fear of Movement – Tampa Scale of Kinesiophobia (TSK-17) Daily physical activity – Baecke Questionnaire of Habitual Physical Activity *only 3 and 6 months
Woods M.P. et al., 2008 **RCT** **Canada**	CLBP>6 months N=83 Age=18-65 years *M, F age and data provided only for patients who have completed the study. Patients recruited through newspaper ads, through emails and posters placed in local hospitals and in medical and physiotherapy clinics.	Both groups: 8 sessions of 45 minutes 2 times/week. 1. GivE (graded in vivo exposure) (N=36). Patient education with respect to a cognitive-behavioral perspective of the fear-avoidance model, the consequences and application of graded exposure techniques. Session 1 (interview): patient education, formulation of problems and fearful activities for the patient and recognition of the hierarchy of these activities. Session 2: exposure to activities according to the hierarchy associated with behavioral tests to challenge the beliefs of patients. Last session: review of the process. Professional in charge: psychologist in training supervised by a senior psychologist. 2. GA – graded activity (N=25). Based on the principles of operating conditioning, modifying health behaviors and promoting positive reinforcement of predefined activity quotes (Vlayen et al., 2002). Professional in charge: physiotherapist.	N=22 Waiting list	Self-efficacy – Pain Self-Efficacy Questionnaire - (PSEQ) Fear of movement – Tampa Scale of Kinesiophobia (TSK-17) Fear-avoidance – Fear-Avoidance Belief Questionnaire - (FABQ) Catastrophizing – Pain Catarophizing Scale - (PCS)
Communicative- and educative-based interventions on compliance with exercise				
Multimodal interventions (MI) for compliance with exercise				
Härkäpää K. et al., 1989-1990 **RCT*** **Finland** *part I and III	CLBP>2 years N=459 Age=35-54 years M=63% Patients recruited by email between "blue collar" workers from the Finnish state railways, the postal service, telecommunications facilities, and various companies in the	1. Inpatients: 3 weeks program. In addition, massage therapy and exercise therapy (prescribed by a physician). N=156; M=99; F=57 2. Outpatients: 15 sessions of back exercise program. N=150; M=91; F=59 Both programs were followed by the Modified Swedish Back School (back and relaxation exercises) delivered by a physiotherapist, 2 group discussions with a psychologist (coping strategies and chronic pain management) and a discussion on back care with a physician. 2nd treatment (1.5 years): 1. Inpatients: 2 weeks program. 2. Outpatients: 8 sessions. For both treatment groups "refreshes" related to topics previously learned were offered.	N=153; M=99; F=54 Written and oral instructions on back exercises. No drug-therapy. Assessment endpoints were the same of the intervention groups.	(1989) Compliance: Accomplishment to exercise (%) – number of faultless exercise (0-4 scale) Frequency to exercise – mean of sessions per weeks (interview) (1990) Compliance: Accomplishment to exercise (%) – number of faultless exercise (0-4 scale) Frequency of back exercises (1=never, 4=daily) Frequency of relaxation exercises

	Finnish metropolitan area and farms in southern Finland.			Compliance ergonomic instructions (1=always, 4=never) through the past month
Coaching for compliance with exercise				
Vong K.S. et al., 2011 **RCT** **China**	CLBP>3 months N=76 Age=18-65 years Patient recruited by an outpatient department of local physiotherapy.	N=38, Age= 44.6±11.2, M=16, F=22 Motivational Enhancement Therapy (+ general physiotherapy): during physiotherapy sessions (10), transfer of skills designed to increase patient motivation and involvement in treatment in order to induce correct behavioral changes. MI (counseling technique adapted to the specific patient: empathic expression, development of disagreement, support of self-efficacy, work alliance) + proxy efficacy (patient confidence in the skills of their therapists to act directly on the modification of the behavior of the individual). Professional in charge: properly trained physiotherapist (8 hours of motivational training before the study).	N=38, Age= 45.1±10.7, M=12, F=26 Conventional physiotherapy: 10 sessions (30 minutes each) for 8 weeks with also 15 minutes of interferential therapy (IT) and individualized exercises (EX). IT: electrodes placed on the paravertebral muscles from L2 to S1 on both sides (frequency 80-100 Hz). EX: motor control exercise and abdominal strengthening, stretching, also prescribed at home.	Motivational Status – Pain Rehabilitation Expectations Scale (PRES) and Pain Self-Efficacy Questionnaire (PSEQ) Exercise compliance – frequency of exercise performed at home: number of daily session performed at home multiplied for number of training days per week