

## Effectiveness of Manual Therapy Combined with Exercise Versus Exercise on Pain Intensity and Disability on Chronic Low Back Pain Patients-A Systematic Review

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### Abstract

**Background:** Manual therapy (MT) and exercise (Ex's) have proven to be effective for CLBP patients. Both modalities are recommended by NICE guidelines in the UK. At present, no Systematic Review (SR) has been carried out to investigate the effectiveness MT and Ex's combined, in comparison to sole use of Ex's for those patients.

**Objective:** To evaluate the effectiveness of MT combined with Ex's, versus Ex's for patients with CLBP.

**Methods:** Systematic searches were conducted on seven bibliographic databases: CINAHL, CENTRAL, MEDLINE, Ovid, PubMed, Science Direct and Google Scholar, from 2000 to 2015. The SR included studies such as RCTs that investigated MT combined with Ex's versus Ex's for treating CLBP.

**Results:** This SR consisted of seven RCT's (N = 1053). four studies concluded that there were no significant differences between combination of MT with Ex's versus Ex's (P = 0.46 for disability) (P = 0.470, for pain) (P = 0.150 for pain - P = 0.374 for disability) (P = 0.0283 for pain, P = 0.226 for disability). However, the remaining three studies did demonstrate that there was a significant difference between the combinations of MT with Ex's compared with exercise only in favour of combination treatment (P < 0.05) (P < 0.001, P = 0.002) (P < 0.001).

**Conclusion:** The results debated the effectiveness of using MT and Ex's together, as opposed to using exercise alone. Approximately, more than half of the aforementioned studies concluded that the combination of MT and Ex's has the same effect of Ex's alone. Conversely, less than half of these studies presented the combination treatment as more effective than Ex's alone. It should be noted that all included studies boast different levels of quality. Furthermore, different types of Ex's and MT techniques were implemented, which may have affected the results.

**Keywords:** Chronic Low Back Pain (CLBP); Recurrence Low Back Pain; Manual Therapy Combined with Exercise; Pain; Disability; Multimodal Intervention; Randomized Control Trails (RCT)

### Abbreviations

LBP: Low Back Pain; CLBP: Chronic Low Back Pain; UK: United Kingdom; MT: Manual Therapy; Ex's: Exercises; SR: Systematic Review; RCTs: Randomized Control Trails; VAS: Visual Analogue Scale; NRS: Numerical Rating Scale; ODI: Oswestry Disability Index; RMDQ: Roland Morris Disability Questionnaire; PEDro: Physiotherapy Evidence Database

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## **Introduction**

Low Back Pain (LBP) is ubiquitous, and can arise at any given moment [1]. Recent research suggested that LBP, more than any other ailment, leads to numerous years living with a disability [2]. The aetiology of LBP is multifactorial, encompassing individual traits, as well as both psychosocial variables and occupational variables [4,5] psychosocial aspects play a fundamental role in guiding the treatment of CLBP patients [20]. Physical findings must be carefully scrutinised by clinicians as they can indicate whether or not the patient has improved [21]. Primarily, patients with CLBP were treated initially with the intent to cure the condition [26]. However, treatment of CLBP is difficult, and many established interventions have limited efficiency [27], MT is commonly used to treat symptoms as part of a multi-modal treatment package and is endorsed by Chou and Huffman; National institute for health and care excellence [NICE] [28-30]. A recent literature review of current national and international guidelines for CLBP consistently recommend Ex's therapy as a treatment for CLBP [31]. Furthermore, Ex's is considered to be highly beneficial for CLBP, as it facilitates improvements in back strength, flexibility, range of motion and fitness [3,36,37]. Nevertheless, researchers observed that, when these alternative exercise treatments were applied on their own, their influence on pain and disability was limited [38,39]. As the recent literature has highlighted several studies that have applied MT along with Ex's to determine whether this combination of two modalities provide better results, as opposed to using each method in isolation when treating CLBP patients. These studies can be differentiated through their individual design and goals. Therefore, only RCT's studies included for the purposes of this SR. Conducting a contemporary SR can enable clinicians and patients to avoid unnecessary cost and time on non-effective intensive programs. At present, current literature would suggest that no SR has been undertaken on MT and Ex's as a combination in comparison to Ex's alone for the treatment of CLBP, though some studies in the literature did support the combined use of MT and Ex's. Recently, the UK Beam Trial Team (2004) conducted RCT study with 12 months follow-up. The findings indicated that, spinal manipulation when combined with Ex's, improved functional status in both the short-term and long-term. However, the authors have not mentioned sufficient information regarding the follow up, which may incite attrition bias [40]. In terms of LBP management, Ex's therapy frequently applied on CLBP patients, the benefits of which have been confirmed by a number of systematic reviews [41-44]. Non-pharmacologic therapies integrated in interdisciplinary CLBP programmes encompass physical modalities, Ex's, education and MT [45]. As their name implies, such therapies are typically employed to supplement rather than replace pharmacotherapy, although no consensus has been reached as to which is the most productive [46]. Nonetheless, Ex's therapy can be undertaken alongside other non-pharmacologic modalities such as MT as individually, it is not sufficient to successfully treat CLBP. The selection of MT was based on the fact that it is frequently applied in a clinical context for the treatment of LBP, recommended by NICE guidelines as adjacent intervention for CLBP, and several RCT's have been conducted with regard to this [28,29]. As a result, this SR aims to investigate the effectiveness of MT combined with Ex's versus Ex's amongst CLBP patients. That being said, CLBP has a multifactorial aetiology and such might require multimodal programs [7]. Furthermore, this SR will employ a robust rating criterion. In particular, the methodology quality of each study reviewed will be analysed using the Physiotherapy Evidence Database (PEDr123o) scale.

## **Research Methods**

### **Research aim**

1. To investigate effectiveness of Ex's when combined with MT versus Ex's alone on CLBP patients.

### **Research objectives**

1. To review the literature using the available range of databases.
2. To utilise rigorous criteria.
3. To use the PEDro scale to assess the methodology quality of included studies.

### Research question

Does the addition of manual therapy combined with exercise versus exercise alone improve pain and reduce functional disability for chronic low back pain patients?

### Research strategy

This research employs a robust literature review to collect data, using a comprehensive digital search of physiotherapy journals. The search strategy was based on the PICO search framework as shown in table 1. The search was restricted to studies that included MT with Ex's versus Ex's, whilst further search was limited to the studies that were published from 2000 to 2015.

PICO Definition	Key words
Population of the patients	Chronic Low Back Pain
Intervention	Manual Therapy Combined with Exercise versus Exercise
Comparisons	Exercise only
Outcome	Pain and Disability
Study Design	Randomized Control Trails

**Table 1:** PICOS search framework [47].

### Databases

- The cumulative index of nursing and allied health (CINAHL)
- The cochrane central register of control trails (CENTRAL)
- Medline database
- Ovid database
- PubMed database
- Science direct database
- Google scholar.

### Hand search

This process was conducted within the most common journals in LBP and Manual therapy literature. To identify the manuscripts that were not presented in the databases (Appendix 4).

### Citation search

The citation search was undertaken when the articles were founded and key texts identified by the reviewer. As to further search for and identify any titles that related to the combination of MT with Ex's for CLBP patients. This process was utilised to avoid missed keywords.

### **Text mining approach**

The reviewer used a variety of tools in text mining to ensure that all relevant studies were included in this review. This process was carried out by using the following website ([www.nactem.ac.uk/](http://www.nactem.ac.uk/)), which provides an advanced search strategy by concepts using text analysis.

### **Research design**

The search design was a systematic review of randomized control trials. The SR collected and summarised all relevant aspects to the particular research question using an explicit, transparent and systematic method to combine the results of these studies [48]. As well as it helps clinicians to remain up to date and consider the starting point for developing clinical practice guidelines [49,50].

### **Strengths of SR**

1. Prioritize the hierarchy of evidence [51].
2. Lower in cost than alternative methods [52].

### **Limitations of SR.**

1. Time consuming.
2. Inadequate knowledge of research design might provide irregular findings.
3. Publication of studies in different languages might restrict the collection of relevant articles that can be reviewed [52].

### **Inclusion/Exclusion criteria**

#### **Types of study**

- This SR included only RCTs.
- Included only studies written in English to minimise bias [53,54].
- Included only studies that were conducted in the period of 2000 - 2015.

#### **Types of participants**

##### **Included**

- Enrolled adult males and females ( $\geq 18$  years) with CLBP for more than three months with or without radiating pain.
- The number of participants was restricted to at a minimum of 20 patients in each group. It is difficult to ascertain the true differences when the groups have a limited sample size [55].

##### **Excluded**

- CLBP patients were excluded due to a specific pathology or "red flag".
- Patients who have previously undergone spine surgery.

- CLBP patients with cognition impairment or paralysis.
- LBP as result of pregnancy.
- Other factors affecting CLBP patient's f such as torture survivors.

### **Interventions comparisons**

- This SR includes studies that have compared any techniques of MT with any Ex's to any type of Ex's alone for CLBP patients.
- Included studies must have employed at least one of the pain-intensity outcome measures such as Visual Analogue Scale (VAS) or Numerical Rating Scale (NRS), or/and they must employ an outcome measure for disability such as Oswestry Disability Index (ODI) or/and Roland Morris Disability questionnaire (RMDQ) (See appendix 6).

### **Data collection**

All participating studies were collected by the same reviewer. The data extraction form was used in when reviewing literature to accurately record information of relevant studies. In addition, this form reduces the possibility of human error and bias. The data extraction form was provided by the Department of Physiotherapy at the University of Salford (See appendix 1).

### **Data analysis and synthesis**

In systematic reviews, it is common to use a narrative synthesis method to synthesize research in the context of these types of studies. In this method, no statistical techniques are used. If the statistical techniques are involved, then the study is called meta-analysis. In some occasions this could be combined together [56,57].

The literature provides guidance that enable the narrative synthesis to be conducted using a more systematic and transparent method, whilst focusing on synthesis of evidence on efficacy of specific interventions in addition to elements determining the implementation of that interventions [58]. However, the narrative synthesis method has some limitations. For instance it depends on subjective judgment, preference and biases of the reviewer [59]. In this SR, rigorous criteria were used to select the best available evidence. The methodological quality of each study will be assessed using a valid scale (PEDro Scale).

### **Assessment of methodological quality**

This SR used the PEDro scale for the assessment of methodological quality of the included studies. This scale is a valid and reliable tool to assess the methodological quality of RCT's in the physiotherapy field [60]. It uses a simple strategy, not time consuming and minimizes the chance of individual error in assessment of study quality. In addition, included studies will be categorised by PEDro scale, the studies that score 9 - 10 are of "excellent" methodological quality. Those scoring between 6 - 8 are good, 4 - 5 are "fair" and anything scoring below 4 was considered "poor" [61].

## **Results**

### **Search process**

Search processes were undertaken during the aforementioned database yielding (235) studies. In addition, 15 studies were identified through other sources (See appendix 4) and Search Trails Registers (See appendix 5). In order to disregard irrelevant studies, the authors examined the title of all founded studies to identify relevant and duplicate studies. For further investigation of studies, the main

author screen (200) then excluded 130 studies, as they were irrelevant. Full-text of the remaining 70 studies were examined and 63 were excluded as these studies were not RCT's or included sub-acute CLBP patients or were used co-intervention different of author target.

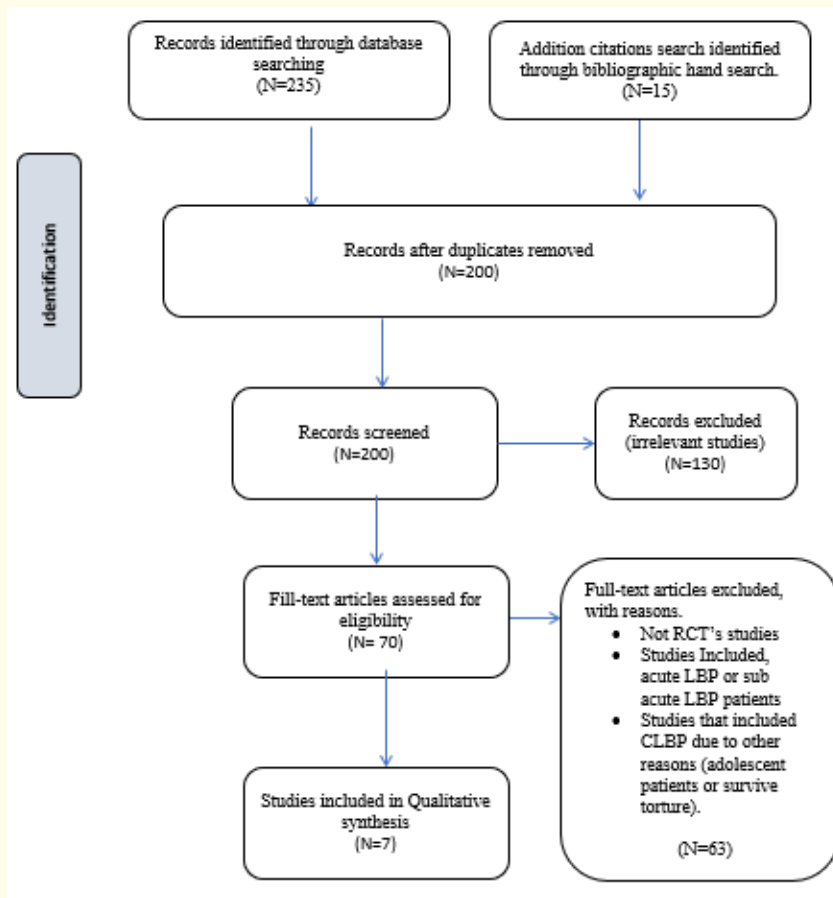


Figure 1: PRISMA flow diagram.

Studies Identifier		Participants	Intervention	Outcome	Measures	Results
Authors	Design	(N) Patients characteristics	Exercise	Exercise pulse manual therapy	Pain and Disability and Follow up	
Aure., et al. 2003	RCT's PEDro Score = 7/10 EL = 1b	49 patients with CLBP  Age 20 -60 years old	General exercise (N = 22) Mean age = 41.4 (36.9-45.9)	Spinal manipulation plus exercise for spine, abdominal and lower limb (N = 27) Mean age = 38.9 (34.1-43.8)	VAS ODI Follow up: before, immediately after session, 4 week, 6 months and 1 year	MT plus EX's shows large significant improvements (P<0.05)

Critchely, <i>et al.</i> 2007	RCT's PEDro Score = 7/10 EL = 1b	212 patients with CLBP	Pain management program Included, strengthening, stretching and light aerobic exercises (N = 69) Mean age = 44 (12) 8 sessions of 90 minutes	Joint mobilization, joint manipulation, massage and exercise. (N = 71) Mean age = 45 (12) 8 sessions	RMDQ NAS 18 months follow up	No significant different between interventions (P = 0.46 for disability)
Szulc, <i>et al.</i> 2015	RCT's PEDro Score = 4/10 EL = 1b	60 patients with CLBP Mean age 44 years	McKenzie method (N = 20) 10 daily sessions within 5 weeks	McKenzie method plus MET exercise at home (N = 20) Standard treatment group (N = 20) Massage + exercise + laser therapy and TENS 10 daily sessions within 5 weeks.	VAS Revised ODI Follow up: before, 24 hours after complete treatment.	McKenzie alone and McKenzie plus MET shows significant improvement in both disability and pain (P < 0.001) for pain and disability
Cecchi, <i>et al.</i> 2010	RCT's PEDro Score = 6/10 EL = 1b	210 patients with CLBP Mean age 40 ± 14 years	Back school included exercise and education (N = 70) women = 49 15 one-hour sessions, 5 day a week for 3 weeks Mean age = 57.9 ± 15.1	Individual physiotherapy included exercise, passive mobilization, soft tissue treatment (N = 70) women = 43 15 session 60 minutes, 5 day a week for 3 weeks Mean age = 60.5 ± 15.8	RMDQ PRS Follow up: at baseline, discharge 3,6,12 months	No significant different between the interventions (P = 0.0283 for pain, P = 0.226 for disability).
Rasmussen, <i>et al.</i> 2008	RCT's PEDro Score = 6/10 EL = 1b	72 patients with CLBP	Extension exercise N = 37 Women = 21 Mean age = 42 (27-65) 3-5 times with gradual increase of extension, at least once per hour For 4 weeks.	Manipulation plus extension exercise N = 35 Women = 17 Mean age = 38 (26-57) Manipulation was performed by the end of manual examination for 3 occasions	VAS Follow up: at Baseline, 4 weeks, 1 year	No statistically significant were found between two groups (P = 0.150)

Niemisto, 2003	RCTs PEDro Score = 8/10 EL = 1b	204 patients with CLBP	Physicians' consultation group included instruction for exercise such exercise to increase spine mobility, muscles stretch and trunk muscle stability N = 102 Mean age = 36.7 (5.6) Male = 48 (47), Female = 54 (53)	Manipulation with muscles energy technique plus stabilizing exercise N = 102 Mean age 37.3 (5.6) Male = 46 (45), Female = 56 (55) 4 times for 4 weeks	ODI VAS Follow up: at baseline, after 5-week, 1 year after	Manipulation with stabilizing exercise shows statistical difference in reducing pain and disability in short term. (P < 0.001, P = 0.002) for pain and disability
Hurley, et al. 2015	RCTS PEDro Score = 6/10 EL = 1b	246 patients with CLBP (79 men and 167 women)	Group A (exercise class) (N = 83) Male = 24 (29.0) Female = 59 (71.0) Age, mean (SD) = 45.8 (11.1) 1 time per week for 8 weeks Group B walking program (N = 82) Male = 24 (29.0) Female = 58 (71.0) Age, mean (SD) = 46.2 (11.3)	Usual physiotherapy Including advice, exercise and manipulation (N = 81) Male = 31 (38.0) Female = 50 (62.0) Age, mean (SD) = 44.2 (11.7) Visits 5-session ± 3 once a week.	ODI NRS Follow up: at baselines, after 3, 6 months and 1 year	No significant difference was found between groups (P = 0.150 for pain - P = 0.374 for disability)

**Table 2:** Characteristics of included studies.

(MT) Manual Therapy, (EX's) Exercise, (RCT's) Randomized Control Trails, (VAS) Visual Analogue Scale, (ODI) Oswestry Disability Index.

**Quality assessment of included studies**

All clinical trials were evaluated and analysed using PEDro scale. This included studies that had a score ranging between 4 and 8 out of 10 score.

The average scores derived for all of studies was (6.28). The ten criteria for the PEDro scale and assessment of all included studies are shown in table 3.



<b>PEDro Criteria</b>	<b>Aure., et al. 2003</b>	<b>Niemisto., et al. 2003</b>	<b>Critchley., et al. 2007</b>	<b>Rasmussen., et al. 2008</b>	<b>Cecchi., et al. 2009</b>	<b>Szulc., et al. 2015</b>	<b>Hurley., et al. 2015</b>
1. Eligibility criteria were specified (non account to total score)	Yes	Yes	Yes	Yes	Yes	No	Yes
2. Random allocation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Allocation was concealed	Yes	Yes	Yes	Yes	Yes	No	No
4. Similarity between group at baseline	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Blinding of subjects	No	No	No	No	No	No	No
6. Blinding of therapists	No	No	No	No	No	No	No
7. Blinding of assessors	Yes	Yes	Yes	No	No	No	Yes
8. Measure at least one key outcome was obtained from more than 85%of the subjects	No	Yes	No	Yes	Yes	No	No
9. Intention to treat analysis	Yes	Yes	Yes	Yes	No	No	Yes
10. Between group statistical comparisons reported for at least one key outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11. Point and variable measures for at least one key outcome measure	Yes	Yes	Yes	No	Yes	Yes	Yes
Total score from (10)	7/10	8/10	7/10	6/10	6/10	4/10	6/10

**Table 3**

**Summary of results**

The reviewer outlined how the search process was conducted, as well as describing the included studies. Overall, approximately 45% (3 of 7; authors) were demonstrated effectiveness of combination treatment. On the other hand, the remaining (4 of 7; authors), with 55% were conflicted.

**Discussion**

The use of evidence-based treatment for CLBP patients produced a variation of results. As well as appropriate and gold standard for the treatment of patients with CLBP have not issued yet [62]. Proper treatment play a crucial role in reducing the experience of long term lower back pain and significant disability [63]. Therefore, different guidelines were issued across the globe for the management of lower back pain, though they provided similar recommendations such as exercise for CLBP patients. Nevertheless majority of these guidelines do not recommend a specific type of exercise [31]. In addition, the manual therapy has been investigated widely, and it was recommended for CLBP [36]. This systematic review has investigated the effectiveness of the combination of manual therapy with exercise versus exercise on CLBP patients. Seven studies were included as these studies fulfilled the inclusion and exclusion criteria. All the included trials were RCTs and investigated different types of MT combined with different Ex’s versus Ex’s. For the purpose of this SR, the researcher found that the findings of all included studies were conflicting. Two RCT’s studies with good methodological quality [64,65] (7;10 - 8;10, n = 253 patients) investigated manipulation combined with EX’s versus Ex’s, along one year follow up. The authors gave patients treatment via general exercises, stabilizing exercise, exercise for trunk stability and spinal mobility. Both the PEDro was used scale to determine the methodological quality. Both studies reported that manipulation with exercises was more effective in reducing

pain intensity and disability level in CLBP than exercises alone. Finding the difference to be statically significant ( $P < 0.05$ ) ( $P < 0.001$ ,  $P = 0.002$ ) for pain and disability. The results of these two studies were consistent in reducing pain and disability level for short-term period. However, effectiveness in reducing pain and disability for long term was conflicted. These results were similar to the RCTs study by UK Beam Trail Team. However, this study was not included in this SR as it is not predominantly for CLBP [34]. In addition, the study with fair methodological quality (rated by Pedro 4; 10) conducted by Szulc., *et al.* investigated extension Ex's combined with muscles energy technique versus extension Ex's on CLBP [66]. The finding of this study reported a clinically significant reduction in pain and disability level in short term period ( $P < 0.001$ ,  $P < 0.001$ ). In contrast, three studies were found with good methodological quality ( $N = 530$  patients) (rated by PEDro-scale as 7, 6, 6 out of 10) [67-69]. They reported that there was no significant difference between groups and suggested that the combination of MT with Ex's treatment has the same effect as Ex's alone ( $P = 0.46$  for disability) ( $P = 0.470$ , for pain) ( $P = 0.150$  for pain-  $P = 0.374$  for disability respectively). All authors of these three studies provided patients with manipulation techniques with Ex's versus Ex's. When observing the quality of these trials, some bias resources threaten the results. Rasmussen., *et al.* For example, did not provide information about the method used for randomisation of patients in groups. On the other hand, Critchley., *et al.* and Hurley., *et al.* utilised a computer generator for the randomisation process. In terms of intervention sessions given to patients, Critchley., *et al.* gave a 30 minute- 12 treatment sessions with 18 months follow up [67]. In Rasmussen., *et al.* study only three manipulation sessions were given to the combination group -with follow up of one year- which is considered an inadequate number of treatment sessions to reflected noticeable effect of interventions. This may then lead to bias [68,70]. However, in the study by Hurley., *et al.* there was no restriction in the number of visits and it was subjected to the therapist decision during the one-year follow up. Giving all participants the same number of treatment sessions is very important when conducting such a study otherwise the results will be underestimated and may lead to time biased of treatment [69-71]. The majority of included studies (five studies) utilised manipulation techniques for the combination therapy group. However, Cecchi., *et al.* provided in his study mobilisation techniques combined with Ex's for the combination treatment group. The results reported that there is no significant difference between groups ( $P = 0.0283$  for pain,  $P = 0.226$  for disability). The use of different MT techniques can affect the results. In this study, the randomisation process was clearly defined. The patients were given one hour-15 treatment sessions for three weeks with a one-year follow up. The potential limitation of this systematic review could fall with reviewer bias [72]. In addition, it includes studies utilised different types of Ex's combined with different techniques of MT, which might lead to inaccurate results. In contrast, the strength of this SR is that the authors consider studies design, population, and valid and reliable outcome measures for CLBP patients. Although there are direct, pre-existing reviews about the combination of modalities for LBP. There is not existed systematic review for combination of MT with Ex's versus Ex's on CLBP. Evidence is increasing in the literature in support of multimodal interventions. Nevertheless, this evidence remains inconsistent. Geisser., *et al.* (2005) propose that collaborative treatment is most effective for those with low-level pain and minimal disability. For those with higher-level ailments, a multidisciplinary treatment plan may prove more successful [73]. Though these findings may prove valuable for both clinicians and CLBP patients, practitioners should be mindful of individual patient requirements and the financial implications of certain treatment plans. NICE's guidelines recommended MT as an additional intervention alongside Ex's for CLBP [30]. In addition, the exercises were recommended according to the preference and capabilities of patients. The recent SR argued that there is no exercise superior to others [74]. As well as Shamus., *et al.* recommended that the manual therapy have the greatest benefit when combined with additional physical therapy intervention [75].

## Conclusion

To sum up, the results outlined that less than half of the studies under analysis believed combination therapy to be more effective than exercise alone. Clinicians should understand how this might cause conflict within the literature, with regards to the effectiveness of MT and Ex's when treating CLBP patients. This study concluded that, the combination of the exercise with manual therapy versus exercise alone was debated in term of its ability to reduce the pain and disability level of CLBP patients. Likewise, using a mixture of exercise with different types of manual therapy techniques on CLBP patients will lead to inaccurate results. The future research should concentrate on the investigation of the specific techniques of manual therapy combined with specific exercise versus specific exercise on CLBP.

Appendixes

Appendix 1: Data extraction form

Data characteristics	Study contents
Generic information Date of data extraction Title Author Journal and publication details Identification of the reviewer Notes	
Specific information Care setting Population - describe target population (age, gender, diagnosis) Inclusion criteria, Exclusion criteria, Recruitment procedure, Subject characteristics (age, etc.) and Numbers Outcomes- content, What was measured (domains) Answer options Baseline, After intervention, Tool Methodological quality-design Psychometric properties Reliability (types) Who conducted the measurement? How was validity assessed? Sensitivity - does the technique adjust for confounding variables? Responsiveness Applicability Individual options Is subjective evaluation included?	
Outcome measures and results Length of follow up Dropouts Missing data Discrete data (p value) Comparison to other tools	
Reviewer check for multiple publications	
Second reviewer Discrepancies with first reviewer	

Appendix 2: Red flag

Red flags			
Age	History	Symptoms	Findings
Presentation under 20 years	Violent trauma	Constant, progressive, non-mechanical pain	Persisting severe restriction of lumbar flexion
Onset over 55 years	Past history of cancer Systemic steroids Drug abuse HIV	Neurological symptoms Systemically unwell Weight loss Thoracic pain	Neurological signs Structural deformity

Source: Waddle, et al. (1999).

Appendix 3: Yellow flags

Yellow flags		
	Occurrence	Chronicity
Individual factors	Age Physical fitness Strength of back and abdominal muscles Smoking	Obesity Low educational level High levels of pain and disability
Psychosocial factors	Stress Anxiety Mood/emotions Cognitive functioning Pain behaviour	Distress Depressive mood Somatisation
Occupational factors	Manual handling of materials Bending and twisting  Whole-body vibration  Job dissatisfaction Monotonous tasks Work relations/social support Control	Job dissatisfaction Unavailability of light duty on return to work Job requirement of lifting for 3/4 of the day

Source: van Tulder (2002).

Appendix 4: Other resources were used for search process

Other electronic resource	Number of article retrieved
The spine journal	5
European spine journal	3
Manual therapy journal	7
Total	15

Appendix 5: Search strategies

CINHAL Databases

S12	manual therapy and exercise and multimodal	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	36
S11	"manual therapy with exercise"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	67
S10	10. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	20,053
S9	recurrence back pain	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	60
S8	8. ("lumbopelvic pain")	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	0
S7	lumbopelvic pain.ab	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	0
S6	experience low back pain	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	94
S5	low back pain	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	12,708
S4	("back pain")	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	19,764
S3	back pain.jm	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	0
S2	control clinical trail	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	2
S1	randomized control trial	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Basic Search Database - CINAHL	1,426

CENTRAL database

Search Name:

Date Run: 15/11/16 21:09:33.993

Description:

ID	Search	Hits
#1	MeSH descriptor: [Back Pain] explode all trees	3378
#2	back	18210
#3	MeSH descriptor: [Back Pain] explode all trees	3378
#4	(lumbopelvic pain)	63
#5	(low next back next pain)	5761
#6	(lbp)	863
#7	(#1 or #2 or #3 or #4 or #5 or #6)	18286
#8	manual therapy with exercise versus exercise	678
#9	manual therapy with aerobic exercise versus exercise	149
#10	manual therapy and exercise and multimodal intervention	77
#11	manipulation enriched exercise versus exercise only	11
#12	(manual therapy and exercise)	1257
#13	(#8 or #9 or #10 or #11 or #12)	1263
#14	(#7 and #13)	525 studies

Figure A

Medline database

S1. randomized controlled trial.pt.

S2. controlled clinical trial.pt.

S3. (MM "muscle, Skeletal")

S4. manual therapy with exercise versus exercise only

S5. (Manual therapy with exercise)

S6. (Manual therapy AND exercise AND interdisciplinary)

- S7. Manual therapy combined or adjacent exercise AND multimodal
- S8. Or /1-8
- 00. S1-S8 = (69,505)
- S10. low back pain
- S11. experience Back Pain
- S12. backache
- S13. lumbopelvic pain
- S14. recurrence back pain
- S15. (Manual therapy combined exercise versus exercise AND chronic low back pain)
- S16. Manual therapy AND low back pain
- S17. exercise and manual therapy
- S18. exercise and manual therapy and multimodal
- S19. exercise and interdisciplinary
- S20. manual therapy and interdisciplinary
- S21. (exercise and manual therapy and interdisciplinary and low back pain)
- S22. OR/10-21
- S23. AND S10, S21 = (1090 studies).

**Ovid database**

- 1 Randomized Controlled Trail/ 0 Advanced
- 2 Single blinded study/ 0 Advanced
- 3 Double blinded procedure.mp. [mp = ti, ab, tx, ct, sh, bt, hw, ot, id, tc, tm, nm, kf, px, rx, an, ui] 34 Advanced.
- 4 Low back pain.mp. [mp = ti, ab, tx, ct, sh, bt, hw, ot, id, tc, tm, nm, kf, px, rx, an, ui]
- 75905 Advanced.
- 5 experience back pain.mp. [mp = ti, ab, tx, ct, sh, bt, hw, ot, id, tc, tm, nm, kf, px, rx, an, ui] 511 Advanced.

6 chronic back pain.mp. [mp = ti, ab, tx, ct, sh, bt, hw, ot,

id, tc, tm, nm, kf, px, rx, an, ui] 8643 Advanced.

7 Backache.mp. [mp = ti, ab, tx, ct, sh, bt, hw, ot, id, tc,tm, nm, kf, px, rx, an, ui] 10105 Advanced

8 1 or 2 or 3 or 4 or 5 or 6 or 7 89052 Advanced

9 manual therapy with exercise versus exercise.mp.

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0 Advanced

10 (chronic low back pain and multimodal intervention).mp. [mp = ti, ab, tx, ct, sh, bt, hw, ot, id, tc, tm,nm, kf, px, rx, an, ui] 14 Advanced

11 (back pain and interdisciplinary).mp. [mp = ti, ab, tx, ct,sh, bt, hw, ot, id, tc, tm, nm, kf, px, rx, an, ui]2538 Advanced

12 “manual therapy and exercise and disability and pain

and low back pain “.mp. [mp = ti, ab, tx, ct, sh, bt, hw, ot,id, tc, tm, nm, kf, px, rx, an, ui]0 Advanced

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14 (disability and low back pain).mp. [mp = ti, ab, tx, ct, sh,

bt, hw, ot, id, tc, tm, nm, kf, px, rx, an, ui]

22486 Advanced

15 9 or 10 or 11 or 12 or 13 or 14 24380 Advanced

16 8 and 15 23587 Advanced

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18 remove duplicates from 13 713 Advanced

19 remove duplicates from 5376 Advanced.

### PubMed databases

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OR "exercise"[All Fields])) AND (multimodal [All Fields] AND ("Intervention (Amstelveen)"[Journal] OR "intervention"[All Fields] OR "Interv Sch Clin"[Journal] OR "intervention"[All Fields]) AND ("recurrence"[MeSH Terms] OR "recurrence"[All Fields]) AND ("low back pain"[MeSH Terms] OR ("low"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "low back pain"[All Fields])) AND #14) AND #15) AND ("back pain"[MeSH Terms] OR ("back"[All Fields] AND "pain"[All Fields]) OR "back pain"[All Fields]) AND #7) AND (8. [All Fields] AND ("musculoskeletal manipulations"[MeSH Terms] OR ("musculoskeletal"[All Fields] AND "manipulations"[All Fields]) OR "musculoskeletal manipulations"[All Fields] OR "manual"[All Fields] AND "therapy"[All Fields]) OR "manual therapy"[All Fields])) AND ("exercise"[MeSH Terms] OR "exercise"[All Fields]) AND multimodal [All Fields]) Schema: all",0,18:19:01 #18,"Search (((((((((((("low back pain"[MeSH Terms] OR ("low"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "low back pain"[All Fields] OR ("lower"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "lower back pain"[All Fields]) AND ("back pain"[MeSH Terms] OR ("back"[All Fields] AND "pain"[All Fields]) OR "back pain"[All Fields])) AND (("random allocation"[MeSH Terms] OR ("random"[All Fields] AND "allocation"[All Fields]) OR "random allocation"[All Fields] OR "randomized"[All Fields]) AND ("prevention and control"[Subheading] OR ("prevention"[All Fields] AND "control"[All Fields]) OR "prevention and control"[All Fields] OR "control"[All Fields] OR "control groups"[MeSH Terms] OR ("control"[All Fields] AND "groups"[All Fields]) OR "control groups"[All Fields]) AND ("tnf-related apoptosisinducing ligand"[MeSH Terms] OR ("tnf-related"[All Fields] AND "apoptosis-inducing"[All Fields] AND "ligand"[All Fields]) OR "tnf-related apoptosis-inducing ligand"[All Fields] OR "trail"[All Fields])))) AND ("recurrence"[MeSH Terms] OR "recurrence"[All Fields]) OR (experience [All Fields] AND ("back pain"[MeSH Terms] OR ("back"[All

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#6,"Search ((recurrence or experience back pain))",396927,18:12:00

#5,"Search ((back pain and disability))",7806,18:11:45

#4,"Search randomized control trail",396,18:11:31

#3,"Search ((back pain and multimodal))",303,18:11:07

#2,"Search back pain",56734,18:10:35

#1,"Search lower back pain",33802,18:10:02

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### Science direct database

1. Recurrence back pain AND manual therapy adjacent with exercise
2. experience back pain AND interdisciplinary intervention

- 3. "back pain AND multimodal treatment"
- 4. Chronic low back pain AND manual therapy synergistic exercise (219 studies).

Google Scholar

- 1. "manual therapy with exercise" "randomized clinical trial" chronic back pain
- 2. Manual therapy with exercise AND multimodal AND RCT's AND chronic low back pain.

Appendix 6

Pain and disability questionnaires

Visual analogue scale (VAS) and numerical rating scale (NRS)

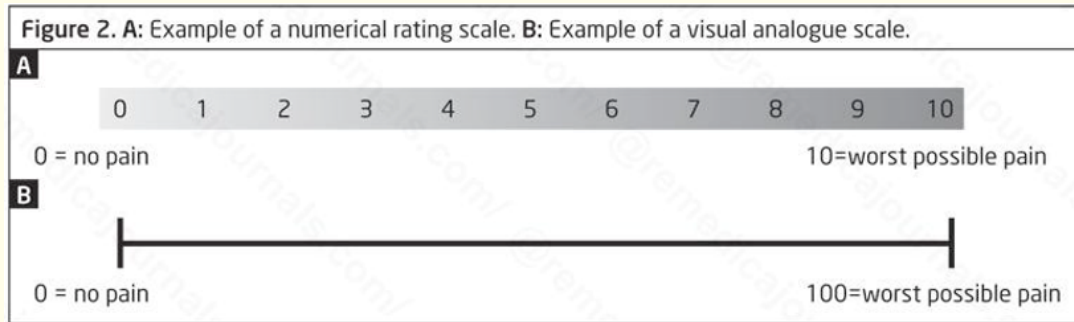


Image courtesy of Remedica Journals  
http://www.remedicajournals.com/Companion-Animals/BrowseIssues/Volume-1-Issue-1/Article-Recognition-and-Management-of-Pain-in-Cats

Figure B

Oswestry disability index

Please complete this questionnaire. It is designed to tell us how your back pain affects your ability to function in everyday life.

I have "Chronic Pain" or pain that has bothered me for 3 months or more:  Yes  No

Check one of the following:

- Prior to Surgery
- After Surgery 3 Months
- After Surgery 1 year
- After Surgery 6 weeks
- After Surgery 6 Months
- After Surgery 2 years

Please answer each section below by checking the One Choice that applies the most to you at this time. (You may feel that more than one of the statements relates to you at this time, but it is very important that you Please check only one choice that best describes your problem at this time.

**Section 1: Pain Intensity**

- I can tolerate the pain I have without having to use pain killers. [0 points]
- The pain is bad, but I manage without taking pain killers. [1 point]
- Pain killers give complete relief from pain. [2 points]
- Pain killers give moderate relief from pain. [3 points]
- Pain killers give very little relief from pain. [4 points]
- Pain killers have no effect on the pain, and I do not use them. [5 points]

**Section 2: Personal Care**

- I can look after myself normally without causing extra pain. [0 points]
- I can look after myself normally, but it causes extra pain. [1 point]
- It is painful to look after myself and I am slow and careful. [2 points]
- I need some help but manage most of my personal care. [3 points]
- I need help every day in most aspects of self-care. [4 points]
- I do not get dressed wash with difficulty and stay in bed. [5 points]

**Section 3: Lifting**

- I can lift heavy weights without extra pain. [0 points]
- I can lift heavy weights, but it gives extra pain. [1 point]

Oswestry Low Back Pain Disability Questionnaire

Oswestry Disability Index

**Section 3: Lifting (Cont.)**

- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned for example on a table. [2 points]
- Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned. [3 points]
- I can lift only very light weights. [4 points]
- I cannot lift or carry anything at all. [5 points]

#### **Section 4: Walking**

- Pain does not prevent me walking any distance. [0 points]
- Pain prevents me walking more than 1 mile. [1 point]
- Pain prevents me walking more than 0.5 miles. [2 points]
- Pain prevents me walking more than 0.25 miles. [3 points]
- I can only walk using a stick or crutches. [4 points]
- I am in bed most of the time and have to crawl to the toilet. [5 points]

#### **Section 5: Sitting**

- I can sit in any chair as long as I like. [0 points]
- I can only sit in my favorite chair as long as I like. [1 point]
- Pain prevents me sitting more than 1 hour. [2 points]
- Pain prevents me from sitting more than 0.5 hours. [3 points]
- Pain prevents me from sitting more than 10 minutes. [4 points]
- Pain prevents me from sitting at all. [5 points]

#### **Section 6: Standing**

- I can stand as long as I want without extra pain. [0 points]
- I can stand as long as I want but it gives me extra pain. [1 point]
- Pain prevents me from standing for more than 1 hour. [2 points]
- Pain prevents me from standing for more than 30 minutes. [3 points]
- Pain prevents me from standing for more than 10 minutes. [4 points]
- Pain prevents me from standing at all. [5 points]

Oswestry Low Back Pain Disability Questionnaire

Oswestry Disability Index

#### **Section 7: Sleeping**

- Pain does not prevent me from sleeping well. [0 points]
- I can sleep well only by using tablets. [1 point]

- Even when I take tablets I have less than 6 hours sleep. [2 points]
- Even when I take tablets I have less than 4 hours sleep. [3 points]
- Even when I take tablets I have less than 2 hours of sleep. [4 points]
- Pain prevents me from sleeping at all. [5 points]

**Section 8: Sex life**

- My sex life is normal and causes no extra pain. [0 points]
- My sex life is normal but causes some extra pain. [1 point]
- My sex life is nearly normal but is very painful. [2 points]
- My sex life is severely restricted by pain. [3 points]
- My sex life is nearly absent because of pain. [4 points]
- Pain prevents any sex life at all. [5 points]

**Section 9: Social life**

- My social life is normal and gives me no extra pain. [0 points]
- My social life is normal but increases the degree of pain. [1 point]
- Pain has no significant effect on my social life apart from limiting energetic interests such as dancing. [2 points]
- Pain has restricted my social life and I do not go out as often. [3 points]
- Pain has restricted my social life to my home. [4 points]
- I have no social life because of pain. [5 points]

Oswestry Low Back Pain Disability Questionnaire

Oswestry Disability Index

**Section 10: Traveling**

- I can travel anywhere without extra pain. [0 points]
- I can travel anywhere but it gives me extra pain. [1 point]
- Pain is bad but I manage journeys over 2 hours. [2 points]
- Pain restricts me to journeys of less than 1 hour. [3 points]



- Pain restricts me to short necessary journeys under 30 minutes. [4 points]
- Pain prevents me from traveling except to the doctor or hospital. [5 points]

### **Interpretation**

Simply add up your points for each section and plug it in to the following formula in order to calculate your level of disability:  $\text{point total} / 50 \times 100 = \% \text{ disability}$  (aka: 'point total' divided by '50' multiply by '100 = percent disability).

**Example:** On my last ODI I scored a 18. So,  $18/50 \times 100 = 36\%$  disability:

### **ODI scoring:**

- 0% to 20% (minimal disability): Patients can cope with most activities of daily living. No treatment may be indicated except for suggestions on lifting, posture, physical fitness and diet. Patients with sedentary occupations (ex. secretaries) may experience more problems than others.
- 21% - 40% (moderate disability): Patients may experience more pain and problems with sitting, lifting and standing. Travel and social life are more difficult. Patients may be off work. Personal care, sleeping and sexual activity may not be grossly affected. Conservative treatment may be sufficient.
- 41% - 60% (severe disability): Pain is a primary problem for these patients, but they may also be experiencing significant problems in travel, personal care, social life, sexual activity and sleep. A detailed evaluation is appropriate.
- 61% - 80% (crippled): Back pain has an impact on all aspects of daily living and work. Active treatment is required.
- 81% - 100%: These patients may be bed bound or exaggerating their symptoms. Careful evaluation is recommended.

### **The Roland-Morris disability questionnaire**

When your back hurts, you may find it difficult to do some of the things you normally do.

This list contains sentences that people have used to describe themselves when they have back pain. When you read them, you may find that some stand out because they describe you *today*.

As you read the list, think of yourself *today*. When you read a sentence that describes you today, put a tick against it. If the sentence does not describe you, then leave the space blank and go on to the next one. Remember, only tick the sentence if you are sure it describes you today.

1. I stay at home most of the time because of my back.
2. I change position frequently to try and get my back comfortable.
3. I walk more slowly than usual because of my back.
4. Because of my back I am not doing any of the jobs that I usually do around the house.

5. Because of my back, I use a handrail to get upstairs.
6. Because of my back, I lie down to rest more often.
7. Because of my back, I have to hold on to something to get out of an easy chair.
8. Because of my back, I try to get other people to do things for me.
9. I get dressed more slowly than usual because of my back.
10. I only stand for short periods of time because of my back.
11. Because of my back, I try not to bend or kneel down.
12. I find it difficult to get out of a chair because of my back.
13. My back is painful almost all the time.
14. I find it difficult to turn over in bed because of my back.
15. My appetite is not very good because of my back pain.
16. I have trouble putting on my socks (or stockings) because of the pain in my back.
17. I only walk short distances because of my back.
18. I sleep less well because of my back.
19. Because of my back pain, I get dressed in help from someone else.
20. I sit down for most of the day because of my back.
21. I avoid heavy jobs around the house because of my back.
22. Because of my back pain, I am more irritable and bad tempered with people than usual.
23. Because of my back, I go upstairs more slowly than usual.
24. I stay in bed most of the time because of my back.

**Note to users:**

- This questionnaire is taken from: Roland MO, Morris RW. A study of the natural history of back pain. Part 1: Development of a reliable and sensitive measure of disability in low back pain. *Spine* 1983; 8: 141-144.
- The score of the RDQ is the total number of items checked - i.e., from a minimum of 0 to a maximum of 24.
- It is acceptable to add boxes to indicate where patients should tick each item.
- The questionnaire may be adapted for use on-line or by telephone.

## Disclosure

"I declare that on part of this systematic review has been taken from existing published or unpublished material without due acknowledgement and that all secondary material used herein has been fully referenced".

Sign: Saeid Al Matif.

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