A systematic review highlights the need to improve the quality and applicability of trials of physical therapy interventions for low back pain

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Appendix: 3 (PRISMA checklist, search strategy, data extraction guidance document)

ABSTRACT

Objective

To review and assess the methodological quality of randomised controlled trials that test physical therapy interventions for low back pain.

Study Design and Setting

Systematic review of trials of physical therapy interventions to prevent or treat low back pain (of any duration or type) in participants of any age indexed on the Physiotherapy Evidence Database (PEDro). Existing PEDro scale ratings were used to evaluate methodology quality.

Results

This review identified 2215 trials. The majority of trials were for adults (n=2136, 96.4%), low back pain without specific aetiology (n=1863, 84.1%), and chronic duration (n=947, 42.8%). The quality of trials improved over time, however most were at risk of bias. Less than half of the trials concealed allocation to intervention (n=813, 36.7%), used intention-to-treat principles (n=778, 35.1%), blinded assessors (n=810, 36.6%), participants (n=174, 7.9%) and therapists (n=39, 1.8%). These findings did not vary by type of therapy.

Conclusion

The majority of trials that test physical therapy interventions for low back pain have methodological limitations that could bias treatment effect estimates. Greater attention to simple methodological features, such as allocation concealment and the reporting of intention-to-treat effects, would improve the quality of trials testing physical therapy interventions for low back pain.

Key words: low back pain; non-pharmacological; physical therapy; quality; bias; evidence-based medicine

Running title: Quality of physical therapy intervention trials for low back pain

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1. Introduction

Low back pain is a global health problem [1–3]. It is the leading cause of years lost to disability worldwide [4]. In 2013 in the USA, low back pain accounted for approximately \$87.6 billion USD (\$67.5 billion–\$94.1 billion) in personal healthcare spending [5]. The costs attributed to the management of low back pain are rising faster than for any other health condition [5].

Most international clinical practice guidelines recommend that first-line care for low back pain should involve non-pharmacological interventions [6]. The most common non-pharmacological interventions include those provided by physical therapists such as exercise, manual therapy, education and acupuncture. The volume of evidence for physical therapy interventions for low back pain has increased over time. This is partly reflected by the increasing number of randomised controlled trials (RCTs) in the field [7–9]. However, it is unclear whether their methodological quality is also improving [9–11]. Given the nature of physical therapy interventions, it can be difficult to achieve adequate adherence to allocated interventions, and to blind participants and therapists. These challenges introduce the potential for risk of bias in RCTs of physical therapies. The primary aim of this study was to review and assess the methodological quality of RCTs of physical therapy interventions for low back pain.

2. Methods

We conducted a systematic review of RCTs of physical therapy interventions for low back pain. We preregistered the protocol prior to data extraction on the 11th July 2018 on the *Open Science Framework*, (<https://osf.io/pdmgx/>). This study is reported in accordance to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guideline [12], (appendix file A1).

2.1 Data sources and Searches

We searched the Physiotherapy Evidence Database (PEDro) (www.pedro.org.au) to obtain reports of RCTs of physical therapy interventions for low back pain from inception to the 1st July 2019. The search strategy was developed in collaboration with a member of the PEDro steering committee using a combination of PEDro codes (<https://www.pedro.org.au/english/downloads/codes/>) and the term ‘low back pain’. We used a sensitive search strategy as we wanted to identify all RCTs indexed on PEDro related to low back pain. The complete search strategy is described in the appendix file A2.

PEDro is considered the most comprehensive electronic bibliographic database of RCTs of all interventions that are, or could be, provided by physical therapists, indexing up to 99% of relevant RCTs [13–15]. To ensure all RCTs of physical therapy interventions are indexed, PEDro employs

broad inclusion criteria, indexing RCTs from multiple interdisciplinary and RCT specific databases including Medline, Embase, CINAHL, AMED, PsycINFO and CENTRAL (for detailed methodology see https://www.pedro.org.au/english/faq/#question_one). Essentially, PEDro includes trials of any intervention that is or could be within the scope of practice for physical therapists worldwide, such as active (exercise, skill training, respiratory interventions), passive (manual therapy, acupuncture, electrotherapies), education (information, reassurance, psychoeducation), health promotion (physical activity, healthy lifestyle) and ergonomic (orthosis and splints) interventions. PEDro is very highly-accessed by a global audience; in 2019, PEDro was searched on average, every 10 seconds from 216 countries.

A key feature of PEDro is a report of the methodological quality, described as the PEDro scale, for each indexed RCT [15–17]. Eleven items are used to appraise external validity (item 1), internal validity (items 2-9) and statistical reporting (items 10-11) [18]. Items 2 to 11 can be summed to provide a score out of 10, higher scores reflecting increased methodological quality [15,16]. The items have high interrater reliability and the total score is associated with other methodological quality tools such as the Jadad scale [19], and Cochrane Back and Neck Group risk of bias tool [20]. The PEDro quality items are increasingly being used to appraise RCTs beyond physical therapies, including broader health and medical research [17,18].

This review focused on PEDro due to its comprehensive indexing of physical therapy related RCTs[13,14] and quality assessment using relevant, valid and reliable study quality items [18].

2.2 Study Selection

We included all RCTs indexed on PEDro that evaluated interventions aimed to prevent or treat low back pain. We included low back pain of any duration or type, as well as studies of mixed samples that included people with low back pain and other conditions (e.g., participants with either neck or low back pain). We excluded non-English language RCTs when it was not possible to determine eligibility for this review due to the absence of either an abstract or full text for translation.

Two reviewers independently screened all identified records. Eight reviewers, working in duplicate, independently evaluated the titles and abstracts of all identified records against the inclusion criteria. The full text of the record was retrieved when insufficient information was provided in the title and abstract to decide on inclusion. Disagreements were resolved by discussion, or through consensus with a third reviewer.

2.3 Data extraction and Quality Assessment

A custom datasheet for extraction was developed and pilot tested over 5 iterations, each using 20 RCTs. We extracted information to describe the study design, population characteristics, therapy type and methodological quality. First, we extracted study metadata from the PEDro database: study year, study participant age (coded as paediatric <18yrs; adult 18 – 70yrs; geriatric >70yrs); therapy categories ('acupuncture'; 'behaviour modification'; 'education'; 'electrotherapies, heat, cold'; 'fitness training'; 'health promotion'; 'hydrotherapy, balneotherapy'; 'neurodevelopmental therapy, neurofacilitation'; 'orthoses, taping, splinting'; 'respiratory therapy'; 'skill training'; 'strength training'; 'manual therapy' [further coded as stretching, mobilisation, manipulation, massage]; 'no appropriate value in this field'), and individual item score for each of the 11 PEDro items. Description of the PEDro database codes can be found at <https://www.pedro.org.au/english/downloads/codes/>.

Secondly, we extracted additional information from each record: research question (coded as efficacy; effectiveness; economic evaluation; implementation/translation; unclear), intervention aim (prevention; treatment; combination), low back pain duration (acute <6 weeks; sub-acute 6 – 12 weeks; chronic >12 weeks; mixed-duration; not reported) and low back pain classification (non-specific; infection; fracture; inflammatory; radiculopathy; cancer; pregnancy; osteoporosis; mixed diagnosis; other). To ensure consistency between reviewers, a guidance document was (appendix file A3) used by all reviewers.

Two reviewers independently extracted data from included studies onto the custom extraction datasheet. Disagreements between reviewers were resolved through discussion, or through consulting a third reviewer.

We used the PEDro scale to appraise methodological quality. As recommended, we considered items 2-11 on the PEDro scale as the criteria for methodological quality in this study [15,16]. We used the ratings available for each indexed trial on PEDro for both English and non-English language trials. In brief, PEDro scale ratings are conducted independently and in duplicate by trained and experienced PEDro raters (see https://www.pedro.org.au/english/faq/#question_five), with conflicts resolved by a third independent rater.

2.4 Data Synthesis and Analysis

We summarised the extracted data in tables, charts and figures. Categorical variables describing the scope of the evidence and satisfaction of the PEDro scale items were summarised using frequencies and percentages. Continuous variables describing the quality of trials were summarised using the mean, median, standard deviation and interquartile range. All data were analysed in R (Version 3.4.0) [21].

3. Results

3.1 Study selection

Our search identified 2846 RCTs (Figure 1). 539 RCTs were excluded following title and abstract screening; 2 non-English RCTs could not be translated to determine if inclusion criteria were satisfied and 537 RCTs did not include interventions designed to prevent or treat low back pain. Of the remaining 2307 eligible RCTs, we further excluded 47 RCTs published in 2019 to ensure complete data for each year, and 45 RCTs that were not officially rated by PEDro for methodological quality. Finally, we included 2215 RCTs in this study (Figure 1).

Figure 1. Prisma Flow Diagram

3.2 Physical therapy interventions for low back pain

3.2.1 Scope of the evidence

Most commonly, RCTs were conducted in adults aged 18-65 years (n=2136, 96.4%), people who had chronic low back pain (n=947, 42.8%) and people who had non-specific low back pain (n=1863, 84.1%). Fewer RCTs were conducted in paediatric (n=20, 0.9%) and geriatric populations (n=59, 2.7%), or for people with acute symptoms (n=158, 7.1%) or a specific diagnosis (n=352, 15.9%). Very few RCTs evaluated interventions designed to prevent low back pain (n=50, 2.3%) or to implement research findings (n=9, 0.4%) – Table 1.

Table 1. Scope of physical therapy evidence for low back pain in PEDro

Characteristic	Total RCTs N(%)
Publications	2215
Low Back Pain Diagnosis*	
Nonspecific	1863 (84.1%)
Radiculopathy	120 (5.4%)
Pregnancy	69 (3.1%)
Inflammatory	62 (2.8%)
Fracture	28 (1.3%)
Spinal Stenosis	27 (1.2%)
Other	16 (0.7%)
Mixed (≥2 Types)	15 (0.7%)
Osteoporosis	12 (0.5%)
Cancer	2 (0.1%)
Low Back Pain Duration*	
Chronic	947 (42.8%)
Not Reported	878 (39.6%)
Mixed	192 (8.7%)
Acute	158 (7.1%)
Subacute	40 (1.8%)
Age Group	
Adult	2136 (96.4%)
Geriatric	59 (2.7%)
Paediatric	20 (0.9%)
Research Question*	
Effectiveness	1395 (63.0%)
Efficacy	417 (18.8%)
Efficacy / Effectiveness	349 (15.8%)
Economic	45 (2.0%)
Implementation	9 (0.4%)
Research Type*	
Treatment	2140 (96.6%)
Prevention	50 (2.3%)
Treat / Prevent	25 (1.1%)
Therapy	
Manual Therapy (stretching, mobilisation, manipulation, massage)	933 (42.1%)
Strength Training	651 (29.4%)
Education	499 (22.5%)
Electrotherapies, Heat, Cold	417 (18.8%)
Skill Training	319 (14.4%)
Behaviour Modification	306 (13.8%)
Acupuncture	283 (12.8%)
Fitness Training	271 (12.2%)
Orthoses, Taping, Splinting	92 (4.2%)
Hydrotherapy, Balneotherapy	69 (3.1%)

Health Promotion	42 (1.9%)
Neurodevelopmental Therapy, Neurofacilitation	7 (0.3%)
Respiratory Training	5 (0.2%)
Other	91 (4.1%)
Language	
English	1930 (87.1%)
Chinese	158 (7.1%)
German	46 (2.1%)
Dutch	15 (0.7%)
French	15 (0.7%)
Japanese	12 (0.5%)
Portuguese	9 (0.4%)
Spanish	8 (0.4%)
Turkish	7 (0.3%)
Italian	6 (0.3%)
Korean	4 (0.2%)
Norwegian	3 (0.1%)
Danish	1 (0.0%)
Russian	1 (0.0%)

* The classification of each characteristic is described in the guidance document (appendix file A3).

3.2.2 Volume of RCTs

The largest increase in the absolute number of RCTs published per year was observed between 1998 to 2018, (36 in 1998 vs 133 in 2018). The growth in published RCTs over this 20-year period was 269%; an increase of 9% per year (Figure 2). The top three most investigated interventions were manual therapy (n=933, 42.1%), strength training (n=651, 29.4%) and education (n=499, 22.5%).

Figure 2. Cumulative plot of the number of published RCTs between 1955 to 2018.

3.3 Quality of randomised controlled trials

The mean number of methodological quality items on the PEDro scale satisfied by all published RCTs was 5.4 (SD ± 1.6) out of 10 items (Figure 3). The mean number of items satisfied improved from 2.0 in 1955 to 6.0 in 2018, and this trend plateaued over the last decade from 2018 (Figure 4).

Figure 3. Frequency distribution of the total number of PEDro scale items satisfied by all RCTs. Satisfaction of more PEDro items reflects increased methodological quality.

Figure 4. Annual trend in the mean number of PEDro scale items satisfied by all RCTs

The proportion of RCTs that satisfied each of the methodological quality items of the PEDro scale is provided in Figure 5. Most RCTs reported between group comparisons (n=2084, 94.1%) and point estimates and a measure of variability (n=2025, 91.4%). Less than half of the trials concealed allocation to intervention (n=813, 36.7%), used and reported intention-to-treat effects (n=778, 35.1%), blinded assessors (n=810, 36.6%), participants (n=174, 7.9%) and therapists (n=39, 1.8%).

Figure 5. Percentage of RCTs (n=2215) that satisfied each item of the PEDro scale.

When stratified by therapy, allocation concealment, reporting of intention-to-treat analyses and blinding of assessor, participant and therapist were consistently the least satisfied items (Figure 6). The proportion of RCTs satisfying each item on the PEDro scale has increased over time, although the rates of increase appear to have slowed in the last decade (Figure 7).

Figure 6. Percentage of all included RCTs that satisfied each item of the PEDro scale, stratified by type of therapy.

Figure 7. Trends in the number of RCTs satisfying each PEDro Scale Item over time

4. Discussion

To our knowledge, this review presents the most comprehensive appraisal of RCTs of physical therapy interventions for low back pain. Our findings showed that the majority of RCTs have methodological limitations that could bias treatment effect estimates. Although the quality of RCTs has improved, fundamental and straightforward methodological practices such as allocation concealment and analyses using intention-to-treat principles are not commonly utilised. There are also major gaps in the scope of the evidence-base for relevant populations and therapies, particularly for children and older people. Greater attention in the design of RCTs is needed to improve the evidence for the efficacy and effectiveness of physical therapy interventions for low back pain.

The lack of allocation concealment, blinding and intention to treat analyses has also been reported in previous systematic reviews of low back pain RCTs [9-11]. Our analysis shows that the adoption of allocation concealment and intention-to-treat analysis is improving in low back pain RCTs. This could reflect a greater adoption of these practices in RCTs and/or improved reporting following the introduction of reporting guidelines such as the Consolidated Standards of Reporting Trials (CONSORT)[22] and the relevant extension for non-pharmacological treatments [23]. However, reports of blinding of participants, therapists and assessors have not improved. The difficulties of blinding participants, therapists, and at times, assessors in RCTs of physical therapy interventions has been acknowledged [24–26]. However, allocation concealment and reporting of intention-to-treat effects are usually straightforward and could be easily implemented [24,25,27].

Methodological investigations, including meta-epidemiological studies have provided some insight into the biasing effects of methodological features on treatment effect estimates in RCTs [28–31]. Although the magnitude and direction of bias has been shown to vary [31,32], the influence of unclear or inadequate allocation concealment and lack of blinding are likely greatest when outcome measures are subjective [29,33] – for example self-reported ratings of pain intensity and physical functioning – common to low back pain research. This review shows that methodological limitations that can introduce bias are common in low back pain RCTs. Research that is at high risk of bias is problematic and can lead to misleading results in randomised controlled trials and in the systematic reviews that include them [30,34] producing potentially erroneous conclusions with adverse consequences for patients and policy [35].

Some have questioned the need for allocation concealment and intention-to-treat analysis to protect against bias in low back pain RCTs [36]. In addition, the recent MetaBLIND study found no difference in average treatment effects between RCTs that masked participants, healthcare providers and outcome assessors versus studies that did not mask [37]. These findings must be interpreted with caution. It is possible that these crude associations between methodological techniques and bias reflect limitations in the meta-epidemiological approaches used, such as confounding bias [37]. There may be common causes (confounders) of the methodological technique and the trial outcome which could bias the true causal effect of techniques such as blinding [38]. Replication studies that use a causal inference approach to mitigate confounding bias in meta-epidemiological studies are needed before recalling important methodological safeguards in trials.

Blinding participants and therapists in RCTs of physical therapy interventions is difficult, and at times, can be impossible to establish and/or to maintain [24,39,40]. These difficulties partly reflect the challenge of developing and delivering indistinguishable sham control interventions [40,41]. There are a several examples where trialists have devised creative and convincing sham control interventions, for example; in acupuncture [42], electrophysical[43], educational[44], spinal manipulative therapy[45,46] and exercise[47] interventions. The blinding of outcome assessors is comparatively more straightforward [24], but in some situations, still may not be feasible due to increased logistical demands and persisting risk of unblinding. Although not assessed in this review, blinding of the data analyst is an additional practice which can be more easily implemented to minimise the risk of bias [48,49].

The importance of blinding in physical therapy RCTs may become less relevant if replications of the the MetaBLIND study show that blinding does not have a causal effect on treatment effects [38]. Although such findings could remove blinding from quality appraisal tools, there is insufficient

evidence to support this. The removal of blinding could improve the apparent quality of non-pharmacological trials including those relevant to physical therapy.

Although the evidence-base for physical therapy interventions is growing, and abundant in some areas, this review shows that there remains substantial gaps. Low back pain affects people across the lifespan [1,50,51], yet there are comparatively few published RCTs in children or adolescents (n=20) and older adults (n=59). There is also little research aimed to prevent the onset of low back pain in asymptomatic individuals (n=50) and preventing progression to chronic symptoms in people with acute (n=158) and sub-acute (n=40) low back pain. Very few RCTs focused on interventions to implement research findings (n=9), which may contribute to the observed evidence-practice gap [3].

Our review has some limitations. We relied on the reporting of study methods to assess methodological quality, rather than assessing the conduct of the study itself. Although all available methodological quality assessment tools share this problem, we were unable to examine the impact of poor reporting from the included RCTs on the PEDro scale rating. Secondly, the choice of tool and method used for appraising the quality of RCTs is likely to influence the rating of methodological quality. We chose the PEDro scale, a tool specifically developed for physical therapy interventions with acceptable measurement properties [18]. Finally, our review focused on one database – PEDro. We chose PEDro because it is the most comprehensive bibliographic databases of RCTs of physical therapy interventions, indexing up to 99% of relevant studies [13,14]. Despite this, we acknowledge that some trials of physical therapy interventions for low back pain may have been missed.

5. Conclusion

The majority of RCT evidence of physical therapy interventions for low back pain is at risk of bias. Although quality is improving on average, fundamental but simple to implement methodological features such as concealment of allocation and reporting intention-to-treat effects are not commonly applied. The number of published RCTs relevant to low back pain has dramatically increased over time. Trials most commonly test exercise, education, and manual therapy interventions in adults with chronic, non-specific low back pain. Other interventions such as health promotion, and populations including children and older people are not well represented. Further efforts to improve the quality and applicability of the evidence are warranted.

Contributors

AC, MB and JM conceived the idea for the study. AC, HL, MB, EO, AT, SK and JM contributed to the design of the study. AC, HL, EO, AT, SK, TF, MJ and JB contributed to data collection. AC and HL analysed the data. AC drafted the first version of the manuscript. All authors contributed to revising the manuscript and approved of the final submitted version.

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Ethics approval

Ethics approval was not required for this study.

Conflicts of interests

The authors declare that they have no competing interests.

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