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Addition of specific hip strengthening exercises to conventional rehabilitation therapy for low back pain: a systematic review and meta-analysis

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Abstract

Objective: To examine the effectiveness of hip strengthening exercises in reducing pain and disability in persons with low back pain.

Methods: We searched for randomized controlled clinical trials on MEDLINE, the Physiotherapy Evidence Database, the Cochrane Central Register of Controlled Trials, LILACS, Scielo and CINAHL from the earliest date available to June 2020. Studies that included hip strengthening exercises for persons with low back pain and included pain and/or disability as an outcome measure were evaluated by two independent reviewers. Mean difference (MD), and 95% confidence interval (CI) were estimated by random effect models.

Results: Five studies met the eligibility criteria (309 patients). Four studies included hip strengthening in conjunction with other interventions, while one study evaluated hip strengthening as a standalone intervention. Hip strengthening exercises improved pain (MD −5.4 mm, 95% CI: −8.9 to −1.8 mm), and disability (MD −2.9; 95% CI: −5.6 to −0.1) in persons with low back pain compared to interventions in which hip strengthening was not utilized. The quality of evidence for the pain outcome, was assessed as being moderate. The quality of evidence for the outcome of self-reported disability, was assessed as being low.

Conclusion: Addition of specific hip strengthening exercises to conventional rehabilitation therapy may be beneficial for improving pain and disability in persons with low back pain.

Keywords

Spine, exercise, hip, rehabilitation

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Introduction

The pain and disability related to low back pain contributes to considerable use of health-care resources and is the leading indication for physical rehabilitation.[1] Rehabilitation programmes involving exercises have been shown to reduce symptoms, disability and improve functional ability in persons with low back pain.[2–4] However, there is no evidence to support the use of one exercise approach over another since the relative effectiveness of different approaches has been shown to be comparable.[5–7] For example, recent systematic reviews evaluating the effectiveness of trunk muscle exercises concluded that this type of programme is generally comparable to other exercises interventions.[8,9]

Recently, hip muscle strengthening has been advocated for the management of low back pain.[10–12] The rationale for this approach is that hip muscle strength deficits are commonly reported in persons with low back pain. Moreover, the gluteal muscles provide pelvis stability in the frontal plane, which in turn, provides a stable base for the lumbar spine. Evidence in support of this premise is provided by Popovich and Kulig[13] and Avman et al.[14] Popovich and Kulig,[13] studied the influence of hip abductor strength on pelvis and trunk kinematics during a single limb landing task and reported that individuals with weaker hip abductors exhibited greater pelvic obliquity in the frontal plane, excessive trunk motion in the frontal and transverse planes and higher activation of the lumbar paravertebral muscles compared to those with stronger hip abductors.[13]

Although a recent systematic review has reported that persons with low back pain exhibit diminished strength of the hip abductors and extensors compared to persons without low back pain,[15] there has been no systematic review of the literature that has evaluated the effectiveness of hip strengthening exercises in this population. Given the potential role of hip strengthening as an intervention for persons with low back pain,[10,11] the purpose of the current study was to analyze published randomized controlled clinical trials (RCTs) that have investigated the efficacy of addition of specific hip strengthening exercises to conventional rehabilitation therapy in reducing pain and/or disability in persons with low back pain.

Methods

This systematic review was conducted in accordance with Cochrane Collaboration recommendations and reported in accordance with the PRISMA guidelines.[16]

Potential studies were identified by searching the following online sources from the earliest date available to June 2020: Pubmed/MEDLINE, the Physiotherapy Evidence Database, the Cochrane Central Register of Controlled Trials, LILACS and Scielo database. In addition, we checked the reference lists of the articles included in this systematic review to identify other potentially eligible studies. The search strategies were based on three groups of key words: study design, participant/problem and interventions. The optimally sensitive filter developed by Higgins and Green[17] was used to exclude non-controlled clinical trials in PubMed/MEDLINE. The full search strategy used in in PubMed/MEDLINE can be found in Electronic Supplemental File 1 for independent replication.

Studies were eligible if they met the following criteria: (a) included adult patients (aged $\geqslant$18 years) with nonspecific low back pain as low back pain ($>$three months duration); (b) a randomized controlled clinical trial design; and (c) included combined hip strengthening exercises to conventional physical therapy as a primary intervention or in conjunction with other interventions. No restrictions were made in terms of the sex of the study participants, the duration of exercise intervention, publication status or language. For the purposes of this systematic review, conventional rehabilitation therapy for persons with low back pain was defined as use of any physical intervention including exercise therapy, manual therapy, thermotherapy, electrotherapy and massage therapy. The primary outcomes of interest were self-reported pain and disability. All outcomes must have been measured with a valid and reliable instrument.

The titles and abstracts from each data source were independently evaluated by two authors (C.S.S. and J.G.) in an unblinded standardized

manner to identify potential studies for review. If at least one of the authors considered a reference eligible, the full text was obtained for complete assessment. The full texts of the selected studies were independently assessed to identify those meeting the criteria for inclusion or exclusion. Disagreements were discussed by the two reviewers and a final decision was reached by consensus.

The two authors who identified potential studies independently extracted the data from the identified articles using a standardized process adapted from the Cochrane Collaboration.[17] Extracted information included: (1) characteristics of the study population, such as sample size, gender and age; (2) aspects of the intervention performed (exercise type, intensity, the frequency and duration, supervision level); (3) follow-up; (4) drop-outs; (5) outcome measures; and (6) results.

The methodological aspects in the studies included were scored using the 11-item PEDro scale,[18] which is based on the 9-item Delphi List developed by Verhagen et al.[19] One item on the PEDro scale (eligibility criteria) is related to external validity and was not used to calculate the methodology score, leaving a score range of 0 to 10.[18] The results of individual study were extracted directly from the PEDro database.

We assessed the certainty of evidence and the strength of recommendations for the outcomes of pain and disability using GRADEpro software.[20] The assessment involved five items: risk of bias, imprecision, inconsistency, indirectness and publication bias. Each item was graded as follows: none (no reduction in points), serious (reduction of 1 point) and very serious (reduction of 2 points). The quality of evidence was interpreted as high quality, moderate quality, low quality or very low quality.[20]

Data synthesis and analysis

Pooled-effect estimates were obtained by comparing the least square mean percentage change from baseline until the end of the study. This was done for each intervention group and results were expressed as the mean difference (MD) between groups. The meta-analysis was performed using the random-effects model, regardless of observed heterogeneity. Only one comparison was made: addition of specific hip strengthening exercises to conventional rehabilitation therapy group versus conventional rehabilitation therapy interventions that did not include hip strengthening exercises. An alpha value of 0.05 was chosen as the threshold for significance. Heterogeneity of the treatment effect was assessed using Cochrane's Q and the I^2 test, in which values greater than 50% were considered indicative of substantial heterogeneity[21] being considered a criterion for downgrade in item imprecision of GRADE. Due to the low number of included studies, no asymmetry statistics were included. All analyses were conducted using Review Manager version 5.3.[22]

Results

The initial search identified 869 records, of which eight were considered potentially eligible and retrieved for full-text eligibility assessment. The reference list of excluded studies after full-text checking can be found in Electronic Supplemental File 2. Five articles met the eligibility criteria and were included for data extraction.[11–13,23,24] Figure 1 highlights the flow of information through the different phases of the systematic review (PRISMA flow diagram).

The number of participants in the five studies analyzed ranged from 30 to 90, resulting in a total of 309 patients. The samples of the selected studies consisted of individuals between the ages of 37 to 56 years. Three studies included individuals of both sexes.[11,12,23] The remaining studies did not report sex distribution. Pain was measured by the numeric pain rating scale and visual analogue scale. In all studies, self-reported disability was assessed by the Oswestry disability index. A comprehensive qualitative evaluation of primary data can be found in Table 1.

Exercise intervention characteristics for each of the studies evaluated are provided in Table 2. The duration of intervention programmes for four out of the five studies evaluated was six weeks (one study did not report programme duration). In general, the hip exercises were focussed on increasing strength

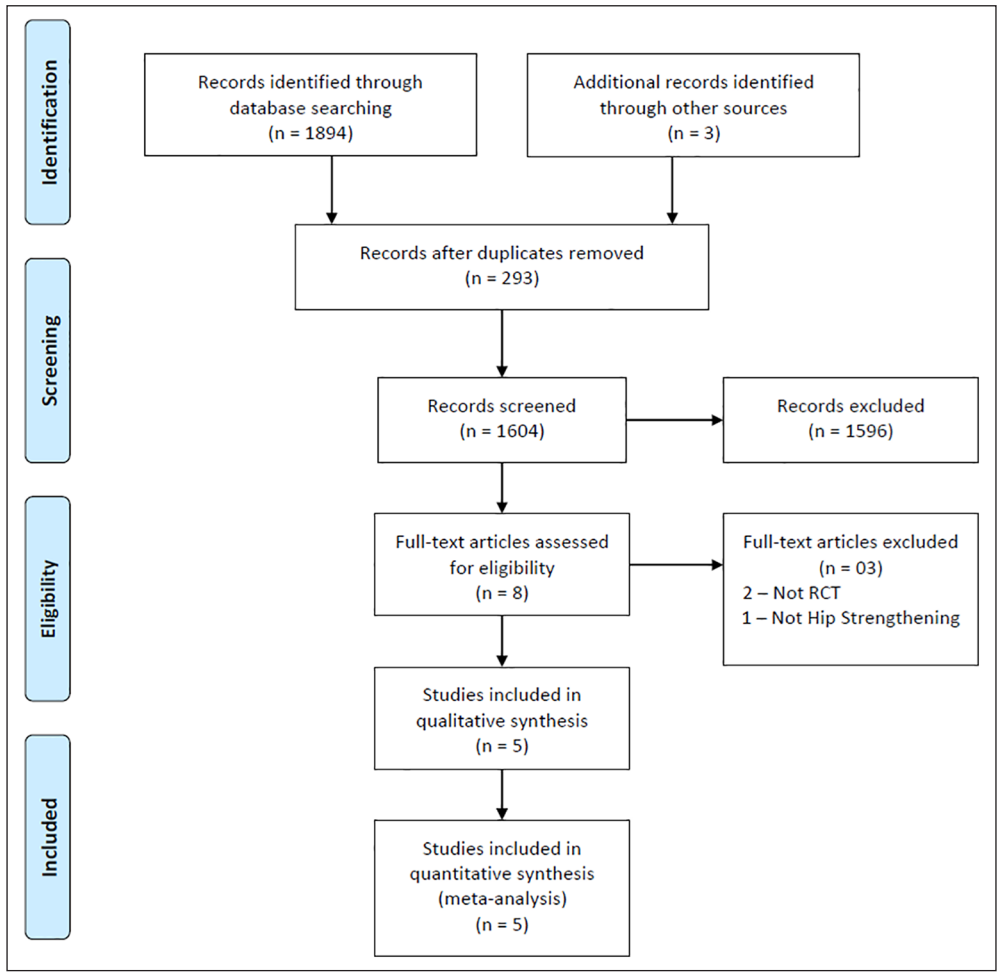

Figure 1. Eligibility and data-synthesis PRISMA flow diagram.

of the hip flexors, extensors, abductors and adductors. All studies indicated that exercises were progressed throughout the intervention period.

Electronic Supplemental File 3 presents results of individual study assessments using the PEDro scale which were extracted directly from the PEDro database. The overall PEDro scores are presented in Table 1. After assessing methodological aspects and risk of bias with the PEDro scale tool, we found that all of the studies used random allocation, and two studies performed concealed allocation.[11,12] Only Kendall et al.[23] blinded the assessors. Patients and therapists were not blinded in any of the studies.

Pain and disability

Four out of the five studies assessed pain as an outcome.[11,13,23,24] The total number of patients in the hip strengthening exercise groups that included pain as a outcome measure was 113, whereas a total of 116 patients were included in the conventional rehabilitation therapy group. The meta-analyses revealed a pooled effect of −4.8 (95% CI: −8.2 to −1.3) in pain reduction for the hip strengthening exercise group versus conventional rehabilitation therapy group (Figure 2).

All studies evaluated assessed self-reported disability as an outcome measure. The total number of

Table 1. Comprehensive qualitative evidence synthesis for hip strengthening exercises on pain and disability.

Study	Sample size	Dropouts (*n*)	Mean age (years)	Diagnosis	Interventions	Outcomes	Adverse events	Key findings	PEDro
Bade et al.[10]	90	12	46.5	LBP	PTE + HSE vs PTE	Pain (NPRS) Disability (ODI)	NR	There was statistical difference in the change in pain and disability between groups ($P < 0.05$). PTE + HSE group improved pain and disability compared with PTE group ($P < 0.05$).	5
Jeong et al.[11]	40	NR	41.2	CLBP	LSE + HSE vs LSE	Disability (ODI) Isometric strength	NR	There was statistical difference in the change in disability, lumbar muscle strength and balance ability between groups ($P > 0.05$). LSEE + HSE group improved disability, lumbar muscle strength and balance ability compared with PTE group ($P < 0.05$).	4
Kendall et al.[24]	80	9	37	NSCLBP	LSE + HSE vs LSE	Pain (VAS) Disability (ODI)	NR	There was no statistical difference in the change in pain and disability between groups ($P > 0.05$).	8
Lee and Kim[12]	69	NR	56.2	CLBP	LSE + HSE vs LSE	Pain (VAS) Disability (ODI)	NR	There was no statistical difference in the change in pain between groups ($P > 0.05$). Mean improvements in ODI were superior in LSE + HSE group ($P < 0.05$).	5
Winter[24]	30	8	44.4	NSCLBP	HSE vs HS	Pain (NPRS) Disability (ODI)	NR	HSE group was more effective than HS in improving disability ($P < 0.05$).	5

NSCLBP: non-specific chronic low back pain; LSE: lumbopelvic stabilization exercises; HSE: hip strengthening exercise; PTE: physiotherapy exercises; HS: hip stretching; ODI: Oswestry disability index; NPRS: Numeric Pain Rating Scale; VAS: visual analogue scale; NR: not reported.

Table 2. Characteristics of the hip strengthening exercise interventions included in this review.

Study	Exercise device	Volume	Frequency (× per week)	Time (minutes)	Length (week)	Supervision
Bade et al.[10]	Elastic resistance	2 sets of 12–15 reps	7	NR	NR	Yes
Jeong et al.[11]	NR	2 sets of 15 reps	NR	NR	6	Yes
Kendall et al.[23]	NR	NR	1	NR	6	NR
Lee and Kim[12]	Elastic bands	3 sets of 10 reps	3	NR	6	Yes
Winter[24]	Elastic bands	2 to 3 sets of 10–15 reps	5	NR	6	Yes

Reps: repetitions; NR: not reported.

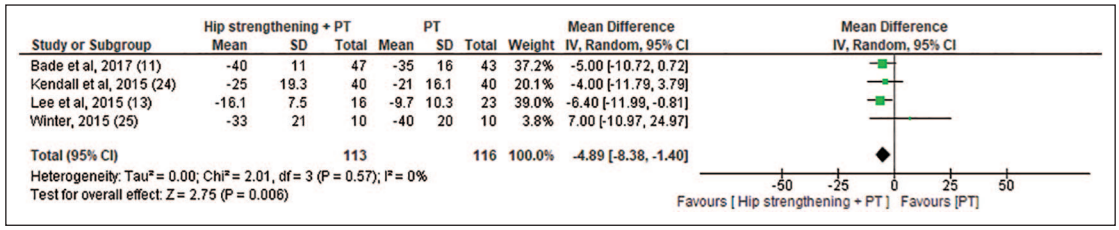

Figure 2. Specific hip strengthening exercises to conventional rehabilitation therapy group versus conventional rehabilitation therapy group for pain outcome (100 mm pain scale).

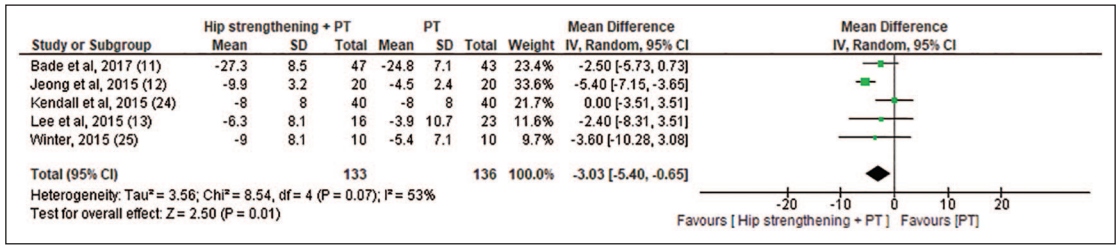

Figure 3. Specific hip strengthening exercises to conventional rehabilitation therapy group versus conventional rehabilitation therapy group for disability outcome (Oswestry disability index).

patients in the hip strengthening exercise groups that included self-reported disability as an outcome measure was 133, whereas 136 patients were included in the conventional rehabilitation therapy group. The meta-analyses revealed a pooled effect of −3.0 (95% CI: −5.4 to −0.6) in disability reduction for the hip strengthening exercises group versus conventional rehabilitation therapy group (Figure 3).

The quality of evidence according to the GRADE system is presented in Table 3. The quality of evidence for the pain outcome, measured by the Numeric Pain Rating Scale and visual analogue scale, was assessed as being moderate. The quality of evidence for the outcome of self-reported disability as measured by the Oswestry disability index, was assessed as being low.

Discussion

Taking into account the small number of eligible studies, this systematic review revealed that the addition of specific hip strengthening exercises to conventional rehabilitation therapy may be effective in reducing pain and self-reported disability compared to conventional exercise therapy in

Table 3. Summary of findings.

Hip strengthening exercises in low back pain						
Patient or population: Low back pain Setting: Clinical rehabilitation Intervention: Combined hip strengthening exercises to conventional physical therapy Comparison: Conventional physical therapy						
Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Mean in PT group	Mean in hip strengthening + PT group				
Pain	The mean pain was 0	The mean pain in the intervention group was 3.53 lower (6.16 lower to 0.9 lower)	–	209 (3 RCTs)	⊕⊕⊕◯ MODERATE[a]	
Disability	The mean disability was 0	The mean disability in the intervention group was 2.87 lower (6.78 lower to 1.04 higher)	–	249 (4 RCTs)	⊕⊕◯◯ LOW[a,b]	

*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).
CI: confidence interval; MD: mean difference.
GRADE Working Group grades of evidence
High certainty: We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
Very low certainty: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

[a]Studies without allocation concealment, random allocation and/or sample size calculation.
[b]Meta-analysis with statistical significance in heterogeneity test and high I^2.

persons with low back pain. These findings add to the growing body of literature indicating that various exercise interventions are beneficial for persons with low back pain. Furthermore, our findings are in agreement with two previous systematic reviews that investigated the influence of hip strengthening exercises on pain and disability in patients with other musculoskeletal conditions.[25,26]

The minimally clinically important change in pain using the visual analogue scale for persons with low back pain population has been reported to be 20%.[27] Analyzing the results of each study individually, the addition of specific hip strengthening exercises to conventional rehabilitation therapy was effective in reducing pain by more than 25% for each of the studies evaluated. Similarly, the addition of hip strengthening to conventional rehabilitation resulted, on average, in a 12.1 decrease is the Oswestry index disability score. This finding is relevant as Maughan and Lewis[28] reported that an 8-point change in the Oswestry index represents the minimal clinically important difference.[28]

Despite the positive findings of the studies evaluated, the results of this systematic review are limited by the lack of high-quality and large sample studies. In addition, the quality of evidence for the outcomes pain and disability were determined to be moderate and low, respectively. For example, statistically significant heterogeneity was identified among the included studies. Substantial heterogeneity ($I^2 = 53\%$) was identified in the analysis of the disability outcome. In addition, patients and

therapists were not blinded in any of the included studies and assessors were blinded in only one of the studies evaluated.[23] Most of the studies evaluated (80%) failed to report the method for concealed allocation. Intention-to-treat analysis was reported only for one study.[23]

There was considerable variation in the exercise parameters of the studies included in the present review. In general, hip strengthening exercises focussed only on the abductors and extensors and external rotators, while in the study conducted by Lee and Kim targeted all hip muscle groups (included the flexors and adductors).[12] Furthermore, the hip strengthening exercise protocols employed frequencies that ranged from one to seven times per week.

Included studies also varied in terms of exercise volume (sets and repetitions). The lack of a structured exercise programme without adequate control of intensity, volume and frequency may impact the potential benefits resulting from strengthening exercises.[29,30] It is important to note that one of the studies that reported superior improvements with the addition of hip strengthening exercises also included mobilization techniques to improve hip range of motion.[10] Thus, the superior improvements in pain and disability reported in the Bade et al. study cannot be attributed only to the addition of hip strengthening exercises.

Strengthening exercises are a safe and low-cost intervention to improve low back pain and disability.[31] Despite the positive effects of exercise interventions for persons with low back pain, the best type of exercise programme remains unclear. Although the mechanism by which hip strengthening is effective as an intervention for low back pain is not known, we postulate that the gluteal muscles provide pelvis stability, which in turn provides a stable base for spine function (especially during single limb tasks). As such, hip strengthening may be an important adjunct to trunk muscle strength training which well supported for persons with low back pain.[8]

Apart from the methodological limitations identified for the studies included in the current systematic review, there are limitations of our approach that should be considered when interpreting the reported findings. First, we did not search for unpublished articles, which can lead to selection/publication bias. Pain and function were the only outcomes evaluated in this review, which may have resulted in an outcome bias. For example, four out of the five studies included in the current systematic review did not evaluate any physical outcome measures such as functional tests, strength, biomechanical measures (kinetics and kinematics), or biopsychosocial questionnaires. Finally, evaluator bias cannot be discounted in such studies. In addition, no systematic review protocol was found to be registered prior to this systematic review. To minimize bias however, we followed strict methodological parameters in accordance with Cochrane recommendations[17] and PRISMA guidelines.[16] It is important to note that the quality of evidence for the outcome disability was determined to be low. Thus, our results should be viewed in light of the considerable variation in the exercise programme, and of the small number of included studies, although this ultimately reflects the body of evidence about addition of specific hip strengthening exercises and relevant outcomes for persons with low back pain. Large, high quality randomized trials are needed to full assess the effectiveness of hip strengthening for low back pain. In addition, comparative studies are needed to determine the best type of exercise intervention for low back pain.

Taking in account the available studies, the addition of specific hip strengthening exercises to conventional rehabilitation therapy may be beneficial for improving pain and disability in persons with low back pain.

Clinical message

- The addition of specific hip strengthening exercises to conventional rehabilitation therapy may be effective in reducing pain and disability in persons with low back pain.

Declaration of conflicting interests

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Supplemental material

Supplemental material for this article is available online.

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