Physical Therapy in Sport xxx (2016) 1–7

Contents lists available at ScienceDirect

Physical Therapy in Sport

journal homepage: www.elsevier.com/ptsp

Stabilization exercise compared to general exercises or manual therapy for the management of low back pain: A systematic review and meta-analysis

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ARTICLE INFO

Article history:
Received 13 April 2015
Received in revised form
4 August 2016
Accepted 9 August 2016

Keywords:
Low back pain
Stabilization exercises
Disability
Meta-analysis

ABSTRACT

Aim: We performed a systematic review with a meta-analysis to examine the efficacy of stabilization exercises versus general exercises or manual therapy in patients with low back pain.
Design: We searched MEDLINE, Cochrane Controlled Trials, Scielo, and CINAHL (from the earliest date available to November 2014) for randomized controlled trials that examined the efficacy of stabilization exercises compared to general exercises or manual therapy on pain, disability, and function in patients with low back pain. Weighted mean differences (WMD) and 95% confidence intervals were calculated.
Results: Eleven studies met the inclusion criteria (413 stabilization exercises patients, 297 general exercises patients, and 185 manual therapy patients). Stabilization exercises may provide greater benefit than general exercise for pain reduction and improvement in disability. Stabilization exercise improved pain with a WMD of −1.03 (95% CI: −1.29 to −0.27) and improved disability with a WMD of −5.41 (95% CI: −8.34 to −2.49). There were no significant differences in pain and disability scores among participants in the stabilization exercise group compared to those in the manual therapy group.
Conclusions: Stabilization exercises were as efficacious as manual therapy in decreasing pain and disability and should be encouraged as part of musculoskeletal rehabilitation for low back pain.

1. Background

Low back pain (LBP) is a multifactorial disorder with a high prevalence; most people experience back pain at some point in their life and it has a significant impact on individuals, their families, and the healthcare systems. This disorder causes disability, participation restriction, a career burden, the use of health-care resources, and a financial burden. In addition to medical treatment, musculoskeletal physiotherapy (exercise therapy and manual therapy) is the most common method of conservative intervention for LBP (Amit, Manish, & Taruna, 2013; Hoy, Brooks, Blyth, & Buchbinder, 2010; Smith et al., 2014).

The European Guidelines for Management of Chronic Non-Specific Low Back Pain (Airaksinen et al., 2006) recommend supervised exercise therapy as the first-line treatment. Stabilization exercise programs have become widely used for low back rehabilitation because of its effectiveness in some aspects related to pain and disability (Ferreira, Ferreira, Maher, Herbert, & Refshauge, 2006; Liddle, David Baxter, & Gracey, 2009). Stabilization exercise are exercise interventions that aim to improve function of specific trunk muscles thought to control inter-segmental movement of the spine and enable the patient to regain control and coordination of the spine and pelvis using principles of motor learning such as segmentation and simplification (Hodges and Richardson, 1996;

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http://dx.doi.org/10.1016/j.ptsp.2016.08.004
1466-853X/

Richardson, Jull, Hides, & Hodges, 1999).

Although stabilization exercises have become the major focus in spinal rehabilitation, as well as in prophylactic care, the therapeutic evidence using pain and disability control variables as outcomes remains controversial. Most therapeutic studies have compared stabilization exercise, general exercise, and manual therapy. Systematic reviews to date that have evaluated the effectiveness of exercise therapies have concluded that there is no evidence to support the superiority of one form of exercise over another (Ferreira et al., 2006; Macedo et al., 2010).

In a recent review, Wang et al. (Wang et al., 2012) showed that stability exercise is more effective for decreasing pain than general exercise, and it may improve physical function in patients with chronic LBP. However, the efficacy of stability exercise was not compared with manual therapy. After reviews on this topic were published (Ferreira et al., 2006; Macedo et al., 2010; Wang et al., 2012), new randomized controlled trials (RCTs) have been released (Amit et al., 2013; Inani and Selkar, 2013; Macedo et al., 2012; Sung, 2013). The Cochrane Collaboration recommends that systematic reviews be updated biannually (Higgins and Green, 2006). Moreover, as far as we know, no meta-analysis has been performed on studies comparing segmental stabilization exercise with manual therapy. The meta-analysis technique minimizes subjectivity by standardizing treatment effects of relevant studies into effect sizes (ESs), pooling, and analyzing data to draw conclusions.

The aim of this systematic review with meta-analysis was to analyze published RCTs that investigated the efficacy of stabilization exercises versus general exercises or manual therapy in patients with LBP.

2. Methods

This review was planned and performed in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher et al., 2009).

2.1. Eligibility criteria

This systematic review included all RCTs that investigated the efficacy of stabilization exercises in patients with non-specific LBP. Studies that compared a stabilization exercises group with a general exercises group or a stabilization exercises group with a manual therapy group were included. Studies were considered for inclusion regardless of publication status, language, or size.

Trials that enrolled patients with chronic non-specific LBP were included in this meta-analysis. For this study was considered the chronic nonspecific LBP as low back pain (>3 months' duration) without leg pain. The studies that enrolled patients with acute LBP in association with neurologic diseases were excluded from this systematic review.

The main outcomes of interest were pain (assessed using visual analog scale, numerical rating scale, or any other instrument or scale) with scores ranging from 0 to 10, disability, and function assessed by any questionnaire.

To be eligible, the RCTs should have randomized patients with chronic LBP to at least one group of stabilization exercises.

For this review, stabilization exercises was considered as prescribed exercises aimed at improving function of specific trunk muscles that control inter-segmental movement of the spine, including the transversus abdominis, multifidus, diaphragm, and pelvic floor muscles (Hodges and Richardson, 1996; Richardson et al., 1999). General exercise were prescribed exercises that included strengthening and/or stretching exercises for the main muscle groups of the body as well as exercises for cardiovascular fitness. Manual therapy comprised physiotherapy based on manual techniques (joint mobilization or manipulation techniques).

2.2. Search methods for identification of studies

We searched for studies on MEDLINE, LILACS, EMBASE, SciELO, Cumulative Index to Nursing and Allied Health (CINAHL), PEDro, and the Cochrane Library, up to November 2014, without language restrictions. A standard protocol for this search was developed and whenever possible, a controlled vocabulary was used (Mesh terms for MEDLINE and Cochrane; EMTREE for EMBASE). Keywords and their synonyms were used to sensitize the search.

For identification of RCTs in PUBMED, the optimally sensitive strategy developed for the Cochrane Collaboration was used (Higgins and Green, 2006). For identification of RCTs in EMBASE, a search strategy using similar terms was adopted. In the search strategy, there were four groups of keywords: study design, participants, interventions, and outcome measures.

We analyzed the reference lists of all eligible articles in order to detect other potentially eligible studies. For ongoing studies or when any data was to be confirmed or additional information was needed, the authors were contacted by e-mail.

The previously described search strategy was used to obtain titles and abstracts of studies that were relevant for this review. Each identified abstract was independently evaluated by two authors. If at least one of the authors considered one reference eligible, the full text was obtained for complete assessment. Two reviewers independently assessed the full text of selected articles to verify if they met the criteria for inclusion or exclusion. In case of any disagreement, the authors discussed the reasons for their decisions and a consensus was reached.

Two authors, independently blinded, extracted descriptive and outcome data from the included studies using a standardized form developed by the authors and adapted from the Cochrane Collaboration's (Higgins and Green, 2006) model for data extraction. We considered: 1) aspects of the study population, such as the average age and sex; 2) aspects of the intervention performed (sample size, type of stabilization exercise performed, presence of supervision, frequency, and duration of each session); 3) follow-up (if the patients included were analyzed); 4) loss to follow-up (if there was a loss in the sample); 5) outcome measures; and 6) presented results. Another author resolved disagreements. Any additional information required from the original author was requested by e-mail.

The risk of bias of included studies was assessed independently by two authors using The Cochrane Collaboration's "Risk of bias" tool (Higgins and Green, 2006). The following criteria were assessed: Random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, intention-to-treat analysis, and completeness of follow-up.

The quality of evidence was independently scored by two researchers based on the PEDro scale (Olivo et al., 2008) that consisted of 11 items based on a Delphi list (Verhagen et al., 1998). The PEDro scale is a useful tool for assessing the quality of physical therapy and rehabilitation trials (Olivo et al., 2008). One item on the PEDro scale (eligibility criteria) is related to external validity and is generally not used to calculate the method score, leaving a score range of 0–10 (Maher, Sherrington, Herbert, Moseley, & Elkins, 2003).

2.3. Statistical assessment

Pooled-effect estimates were obtained by comparing the least square mean percentage change from the baseline to the study end for each group, and were expressed as the weighted mean difference between groups. Calculations were performed using a random-effects model. Two comparisons were made: stabilization exercises group versus general exercises group and stabilization exercises group versus manual therapy group. An α value of 0.05 was considered significant. Statistical heterogeneity of the treatment effect among studies was assessed using Cochran's Q-test and the inconsistency *I* (Hoy et al., 2010) test, in which values between 25% and 50% were considered indicative of moderate heterogeneity, and values > 50% were considered indicative of high heterogeneity (Higgins, Thompson, Deeks, & Altman, 2003). All analyses were conducted using Review Manager Version 5.0 (Cochrane Collaboration). (CollaborationAvailab).

3. Results

The initial search led to the identification of 653 abstracts, from which 24 studies were considered as potentially relevant and were retrieved for detailed analysis. After complete reading of 24 articles, 13 were excluded. Finally, 11 papers (Akbari, Khorashadizadeh, & Abdi, 2008; Amit et al., 2013; Ferreira et al., 2007; França, Burke, Hanada, & Marques, 2010, 2012; Goldby, Moore, & Doust, 2006; Inani and Selkar, 2013; Macedo et al., 2012; Rasmussen-Barr, Nilsson-Wikmar, & Arvidsson, 2003; Sung, 2013; Unsgaard-Tøndel, Fladmark, Salvesen, & Vasseljen, 2010) met the eligibility criteria. Fig. 1 shows the PRISMA flow diagram of studies for this review. Each of the papers was scored using the PEDro scale. Table 1 presents the results of individual assessment by the PEDro scale.

The final sample ranged from 30 to 172 participants, and the mean age ranged from 59 to 67 years. All studies analyzed in this review included outpatients with documented LBP.

The parameters used in the application of stabilization exercises have been reported, and all studies described the progressive nature of the programs. The duration of stabilization exercises programs ranged from 4 to 12 weeks. The duration of sessions varied from 20 to 60 min in the studies. The frequency of sessions ranged from one to three times per week. Table 2 summarizes the characteristics of included studies.

3.1. Pain intensity

In total, eight trials assessed pain intensity (Akbari et al., 2008; Amit et al., 2013; Ferreira et al., 2007; França et al., 2010; Goldby et al., 2006; Macedo et al., 2012; Rasmussen-Barr et al., 2003; Sung, 2013). The meta-analyses showed (Fig. 2) a significant improvement in pain of −1.03 (95% CI: −1.79 to 0.27, $N = 603$) for participants in the stabilization exercises group compared to the general exercises group.

Three studies compared stabilization exercise to manual therapy (Ferreira et al., 2007; Goldby et al., 2006; Rasmussen-Barr et al., 2003). A non-significant difference in pain of −0.38 (95% CI: −0.98 to 0.22, N = 358; Fig. 3) was noted for participants in the stabilization exercises group compared to the manual therapy group. Age

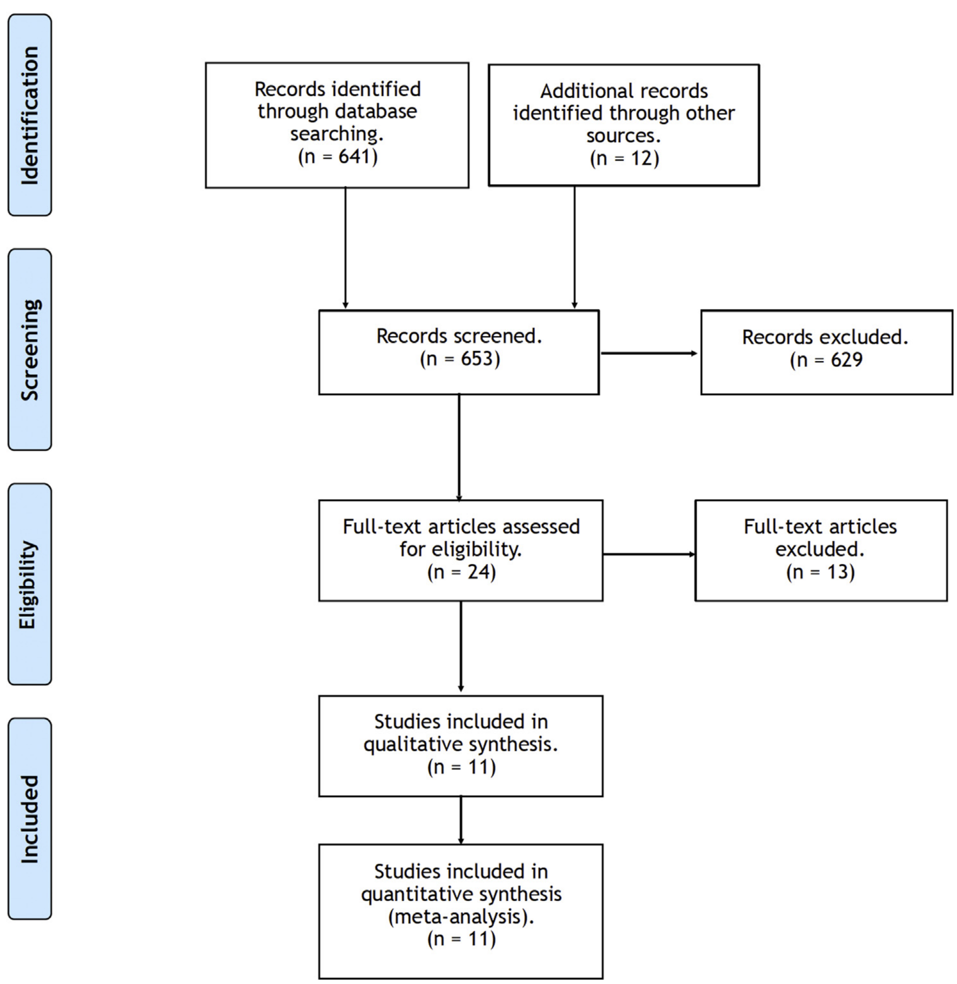

Fig. 1. Search and selection of studies for systematic review according PRISMA.

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Table 1
Study quality on the PEDro scale.

	Estudo	1	2	3	4	5	6	7	8	9	10	11	Total
1	Ferreira et al., 2007	✓	✓	✓	✓			✓	✓	✓	✓	✓	8
2	Sung, 2013	✓	✓	✓	✓			✓			✓	✓	6
3	Inani & Selkar, 2013	✓	✓		✓				✓		✓	✓	5
4	Macedo et al., 2012	✓	✓	✓	✓			✓	✓	✓	✓	✓	8
5	Amit et al., 2013	✓	✓	✓	✓			✓	✓	✓	✓	✓	8
6	França et al., 2012	✓	✓	✓	✓			✓	✓	✓	✓	✓	8
7	Unsgaard-Tøndel et al., 2010	✓	✓	✓	✓				✓	✓	✓	✓	7
8	França et al., 2010	✓	✓	✓	✓			✓	✓		✓	✓	7
9	Akbari et al., 2008	✓	✓		✓			✓			✓	✓	5
10	(Goldby et al., 2006)	✓	✓					✓			✓	✓	4
11	Rasmussen-Barr et al., 2003	✓	✓		✓				✓		✓	✓	5

1: eligibility criteria and source of participants; 2: random allocation; 3: concealed allocation; 4: baseline comparability; 5: blinded participants; 6: blinded therapists; 7: blind assessors; 8: adequate follow-up; 9: intention-to-treat analysis; 10: between-group comparisons; 11: point estimates and variability.
Item 1 does not contribute to the total score.

Table 2
Characteristics of the interventions in the trials included in the review.

	Study	Participants stabilization exercise	Participants general exercise	Participants manual therapy	Muscles	G-US (yes/no)	Time (min/d)	Frequency (x/wk)	Duration (wk)	Supervision (yes/no)
1	Ferreira et al., 2007	73	65	73	TrA, MF, DPG, PF	Yes	60	2	8	Yes
2	Sung, 2013	46	73		DA	No	20	1	4	No
3	Inani and Selkar, 2013	15	15		TrA, MF	No	NI	3	36	Yes
4	Macedo et al., 2009	86	86		TrA, MF, DPG, PF	Yes	60	2	14	Yes
5	Amit et al., 2013	40	40		TrA	No	30–40	3	18	Yes
6	França et al., 2012	15	15		TrA, MF	No	30	2	12	Yes
7	Unsgaard-Tøndel et al., 2010	36	37		TrA, MF, PF	Yes	40	1	8	Yes
8	França et al., 2010	15	15		TrA, ML	No	30	2	16	Yes
9	Akbari et al., 2008	25	24		TrA, MF, DPG, PF	No	30	2	16	Yes
10	(Goldby et al., 2006)		84	89	TrA, MF, DPG, PF	Yes	60	NI	10	Yes
11	Rasmussen-Barr et al., 2003		24	23	DA, MF	No	45	1	6	Yes

G-US = guided for ultrasonography; LBP = low back pain; TrA = transversus abdominis; ML = multifidus; DPG = diaphragm; PF = pelvic floor, DA = deep abdominal.

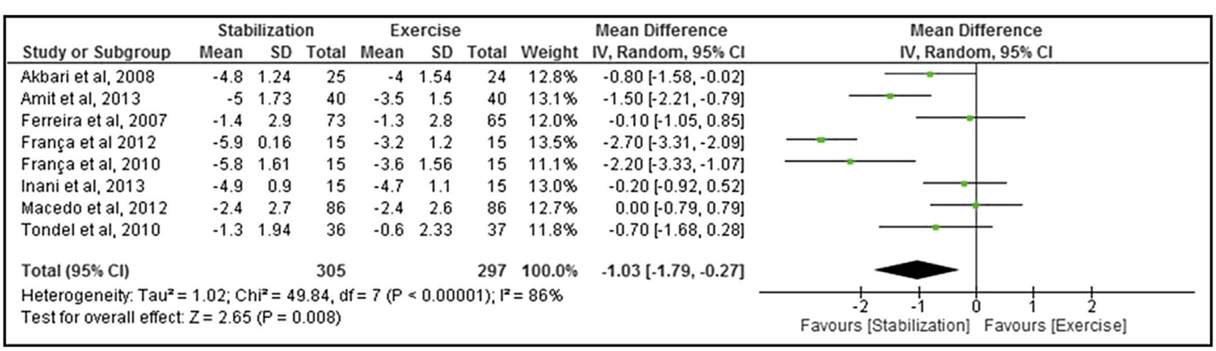

Fig. 2. Stabilization exercise versus general exercise: Pain. Review Manager (RevMan). Version 5.2 The Cochrane Collaboration, 2013.

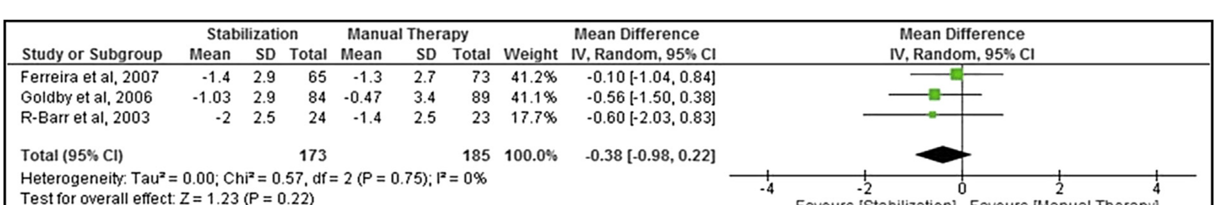

Fig. 3. Stabilization exercise versus manual therapy: Pain. Review Manager (RevMan). Version 5.2 The Cochrane Collaboration, 2013.

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mean.

3.2. Disability

Seven trials assessed disability (Ferreira et al., 2007; França et al., 2010, 2012; Inani and Selkar, 2013; Macedo et al., 2012; Sung, 2013; Unsgaard-Tøndel et al., 2010). Five of these studies measured disability using the Oswestry Disability Index (França et al., 2010, 2012; Inani and Selkar, 2013; Sung, 2013; Unsgaard-Tøndel et al., 2010), and two assessed disability using the Roland-Morris Disability Questionnaire (Ferreira et al., 2007; Macedo et al., 2012). In four individual trials, significant improvements were found in the stabilization exercises group compared to the general exercises group as measured by the Oswestry Disability Index. The meta-analyses showed a significant improvement in disability of −5.41 (95% CI: −8.34 to −2.49, N = 209; Fig. 4) for participants in the stabilization exercises group compared to the general exercises group.

As assessed using the Roland-Morris Disability Questionnaire, the non-significant difference in disability of −0.75 (95% CI: −2.26 to 0.75, N = 310; Fig. 5) was noted for participants in the stabilization exercises group compared to the general exercises group.

Three studies compared stabilization exercise to manual therapy (Ferreira et al., 2007; Goldby et al., 2006; Rasmussen-Barr et al., 2003). A non-significant difference in disability of −0.17 (95% CI: −0.38 to 0.03, N = 358) was found for participants in the stabilization exercises group compared with manual therapy (Ferreira et al., 2007; Goldby et al., 2006; Rasmussen-Barr et al., 2003). (Fig. 6) Owing to the differences between instruments used to measure disability (stabilization exercises group versus manual therapy group), a meta-analysis was performed using the standardized mean difference. All studies included patients of both genders, but there was an overall predominance of female. The mean age ranged from 38 (Rasmussen-Barr et al., 2003) to 53 (Ferreira et al., 2007) years. All studies analyzed in this review included outpatients with documented chronic nonspecific LBP (pain duration > 12 weeks).

The parameters used in the application of manual therapy have been reported. The duration of manual therapy programs ranged from 8 (Ferreira et al., 2007) to 12 (Goldby et al., 2006; Rasmussen-Barr et al., 2003) weeks. The duration of sessions varied from 45 (Rasmussen-Barr et al., 2003) to 60 (Ferreira et al., 2007; Goldby et al., 2006) min in the studies. The frequency of sessions ranged from one (Rasmussen-Barr et al., 2003) to two (Ferreira et al., 2007) times per week. Table 2 summarizes the other characteristics of included studies.

3.3. Function

Two trials assessed function using the Patient-Specific Functional Scale (Macedo et al., 2012; Verhagen et al., 1998). The non-significant difference in function of 0.01 (95% CI: −1.18 to 1.21, N = 310) (Fig. 7); was noted for participants in the stabilization exercises group compared with the general exercises group.

3.4. Risk of bias in the included studies

The studies did not have enough detail for assessing the potential risk of bias. Details regarding the generation and concealment of the random allocation sequence were poorly reported. Six studies presented objective evidence of the random allocation characteristics. The studies presented objective evidence of balance in baseline characteristics. Only three studies stated that the measurements were blinded.

4. Discussion

In the present systematic review, a meta-analysis of 8 studies indicated that stabilization exercises were more effective than general exercises in reducing pain. Five studies demonstrated a significant improvement in disability between patients treated with stabilization exercises compared with those treated with general exercises. Moreover, the meta-analysis of three studies demonstrated that stabilization exercises were as efficacious as manual therapy in decreasing pain and disability.

In our meta-analysis the mean of pain in the analyzed studies was 6.01 at baseline, being 2.1 at the end of the stabilization exercises on a 0–10 pain scale. Specifically, the WMD in pain was −1.03 favoring stabilization exercises, what represents an improvement of 39% in pain. Considering pain, for patients with subacute or chronic LBP, the minimally clinically important change for pain on a visual analog scale (0–10) should at least be 20%. If a numerical rating scale (0–10) is used it seems reasonable to suggest that the minimally clinically important change should at least be 25% for patients with chronic LBP (Ostelo and de Vet, 2005).

The results of this review are consistent with the findings of a previous systematic review (Ferreira et al., 2006; Macedo et al., 2010) on the effects of stabilization exercise on nonspecific LBP. Our meta-analysis indicated that stabilization exercise can be more effective than general exercise in improving pain and disability in the short term, but it was not superior to manual therapy. In another systematic review by Pereira et al. (Pereira et al., 2012), stabilization exercise and Pilates offered no significant improvement in functionality.

Previously, two other meta-analyses (Rackwitz et al., 2006; Wang et al., 2012) reported that specific stabilization exercises was better than ordinary medical care provided by a general practitioner to reduce pain over the short and intermediate terms. However, in a recent meta-analysis, Macedo et al. (Macedo, Maher, Latimer, & McAuley, 2009) demonstrated that stabilization exercises were superior to minimal intervention, but not more effective than manual therapy. Macedo and coworkers' results are in agreement with those of our meta-analysis (Macedo et al., 2009).

Contrary to our results, the meta-analysis by Macedo et al.

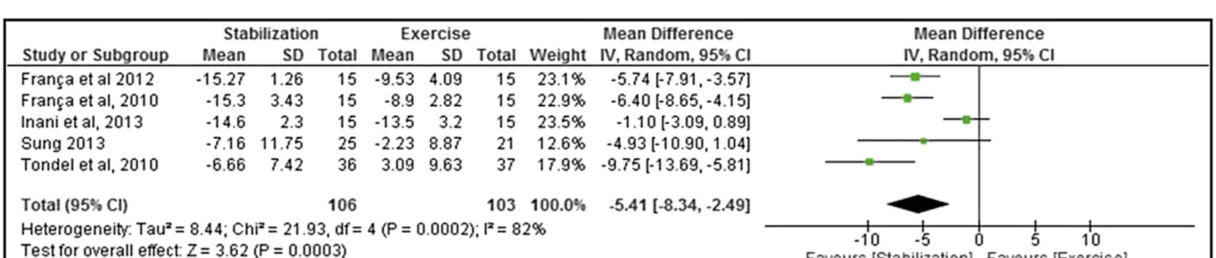

Fig. 4. Stabilization exercise versus exercise: Disability by ODI. Review Manager (RevMan). Version 5.2 The Cochrane Collaboration, 2013.

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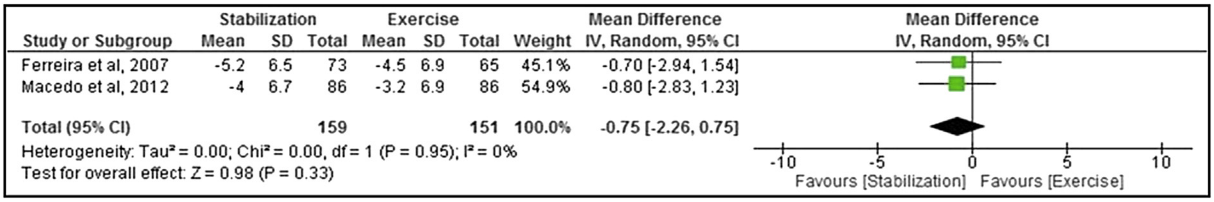

Fig. 5. Stabilization exercise versus exercise: Disability by RMDQ. Review Manager (RevMan). Version 5.2 The Cochrane Collaboration, 2013.

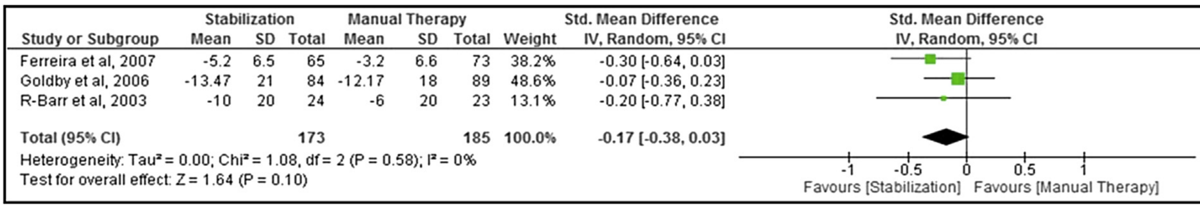

Fig. 6. Stabilization exercise versus manual therapy: Disability. Review Manager (RevMan). Version 5.2 The Cochrane Collaboration, 2013.

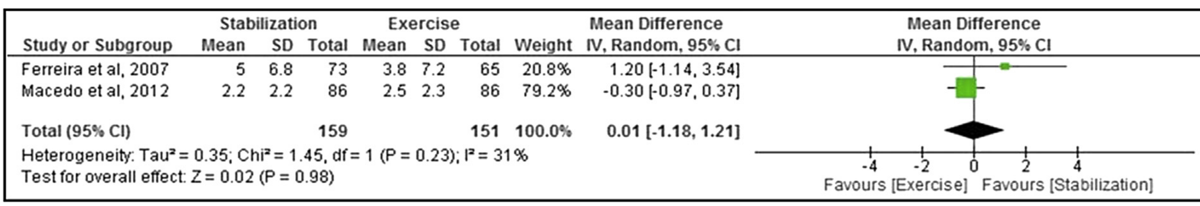

Fig. 7. Stabilization exercise versus general exercise: Function. Review Manager (RevMan). Version 5.2 The Cochrane Collaboration, 2013.

(Macedo et al., 2009) also demonstrated that stabilization exercises were not more effective than other forms of exercise. This disagreement can be explained by several different approaches currently in use for stabilization exercise to treat LBP.

A standard protocol and definition for stabilization exercises is yet to be established. Therefore, there is a wide variation among studies in how the exercises were named and implemented (Lewis et al., 2005). Nevertheless, multiple studies have shown that not all subjects with LBP benefit equally from stabilization exercise (Hicks, Fritz, Delitto, & McGill, 2005).

A recent review of studies has shown that therapy that is specifically directed at well-defined subgroups leads to improved effectiveness of interventions (Karayannis, Jull, & Hodges, 2012). The identification of predictive factors in patients with LBP should allow the prescription of the most appropriate treatment intervention, maximizing the likelihood of a favorable clinical outcome (Brennan et al., 2006; Fersum et al., 2010).

In the present review, the included studies did not report concealment allocation or randomization in an appropriate manner. Thus, the effectiveness of stabilization exercises may be even lower in studies with proper randomization and concealment allocation. Our meta-analysis showed that stabilization exercise was as efficient as manual therapy for improving in pain and disability. However, the total number of patients involved in the meta-analysis was too small to identify relatively small disparities between the effects of stabilization exercise and manual therapy.

It is difficult to make a definitive and pragmatic recommendation regarding stabilization exercise for patients with LBP. There was a variation in the duration of exercise programs, progression criteria, muscle activation, and type of feedback used during the interventions. However, with the exception of the study of Ferreira et al. (Ferreira et al., 2007) did not inform which protocol was used for stabilization, the protocol used in the studies were based on the protocol proposed by Richardson & Hodges (Hodges and Richardson, 1996; Richardson et al., 1999).

Caution is warranted when interpreting the present results given the significant heterogeneity found in primary analyses. The use of different instruments for assessment and intervention programs (session time and duration of intervention) can compromise the comparisons. The studies used different scales and time periods to measure pain intensity (e.g., pain in last 24 h, pain in the last months) and disability (e.g. the Roland Morris Disability Index and the Oswestry Disability Index) and the duration of intervention and the time points of follow-up were different. Despite the differences in frequency and duration, stabilization exercise using the principles proposed by Richardson & Hodges (Hodges and Richardson, 1996; Richardson et al., 1999). were superior to general exercise that prioritizes exercise of superficial muscles.

One of the limitations of this review was that the findings were based on relatively low quality data that led to a high risk of bias. Additional research is required to ascertain the positive effects of stabilization exercise over time and to determine their essential attributes, such as mode, intensity, frequency, duration, and timing. New RCTs testing different stabilization exercise for LBP should be conducted to determine the optimal treatment approach. Additionally, it will be important to match exercise prescription to clinical/treatment characteristics of a patient subgroup or individual patient.

5. Conclusion

Stabilization exercises and/or manual therapy can be encouraged as part of musculoskeletal rehabilitation for patients with LBP. However, the best prescription program, needs to be determined by

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new RCTs.

Conflict of interest

None.

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Please cite this article in press as: Gomes-Neto, M., et al., Stabilization exercise compared to general exercises or manual therapy for the management of low back pain: A systematic review and meta-analysis, *Physical Therapy in Sport* (2016), http://dx.doi.org/10.1016/j.ptsp.2016.08.004