TITLE

Are stabilisation exercises different to other treatments offered by physiotherapists in improving physical activity or reducing disability for people with persistent low back pain? A Systematic Literature Review

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ABSTRACT

Background: Stabilisation exercises (SE) are commonly prescribed for people with persistent low back pain (LBP). However, for some people, it has been hypothesised that SE could draw attention to "protecting" the core, promote hypervigilance and inhibit volitional movement.

Aims: To compare the effectiveness and reported adverse events, in particular fear avoidance, of SE compared with placebo or other treatments offered by physiotherapists on the outcome of disability and activity at 12 and 24 month follow-up.

Design: Systematic literature review

Methods: Key databases were searched from inception to June 2019. Study selection, data extraction, and appraisal of quality criteria using PEDro, were undertaken by two independent assessors.

Findings: Seven studies (n=1820) were eligible. Of six studies reporting adverse effects in the group receiving SE, four reported none, and two reported mild exacerbation of pain locally or elsewhere. Fear avoidance was not investigated in any of the studies.

Three outcomes were reported, ODI (n=1), RMDQ (n=5), PSFS (n=4), only two studies including 24 in addition to 12 month follow up.

SE were more effective than: manual therapy or education (ODI 15.71, 95% CI 19.3 to 10.01) at 12 but not 24 months; placebo for the PSFS (1.5, 95% CI 0.7 to 2.2) but not the RMDQ; and high load lifting (PSFS 1.8 95% CI 2.8 to 0.7) at 12 months. Four studies reported no significant difference for any comparators.

Conclusion: SE are safe and effective and may be superior to other treatments for some outcomes and time points. Their association with fear avoidance is uncertain; none of the studies included this as an outcome.

INTRODUCTION

Low back pain (LBP), is the leading cause of disability worldwide (Global Burden of Disease GBD and Injury Incidence and Prevalence Collaborators, 2017), contributing to 10.7% of total Years of Living with Disability (Vos, 2012). The National Institute for Health and Care Excellent (NICE 2016) recommends a non-invasive approach for the management of non-specific, persistent LBP. They suggest exercise should be tailored to patient's preferences, and consider combined physical and psychological approaches. This includes educating patients about the mechanisms of LBP, encouraging patients to maintain their activity levels (NICE, 2016), and to challenge common misconceptions about LBP, such as "movement will promote damage" (Chartered Society of Physiotherapists, CSP, 2016).

Stabilisation or motor control exercises have been reported as one of the most common types of exercises prescribed by physiotherapists for the management of LBP (Sargiotto et al., 2016). Research studies appear to use the terms "stabilisation exercises" (SE) and "motor control exercises" interchangeably to describe the same concept. This review will use "SE" to encompass both terms.

Four systematic reviews (Macedo et al, 2009; Wang et al, 2012; Smith et al, 2014; Sargiotto et al, 2016) including one Cochrane review (Sargiotto et al, 2016) and one meta-analysis (Wang et al, 2012) of randomized controlled trials (RCTs) have evaluated studies comparing SE with other interventions. The first to be published (Macedo et al, 2009) report that SE was superior to "minimal intervention" in reducing disability at long term follow up but was no different to other forms of exercise in terms of improving pain and function. The latter reviews and meta-analysis confirm that there is no significant difference between SE and other forms of exercise (Wang et al, 2012; Smith et al, 2014, Sargiotto 2016). However, the emphasis within these previous systematic reviews has been on the potential benefits rather than adverse effects of SE.

The fear avoidance model, originally proposed by Waddell 1993, states that fear of pain production and harm during physical activity and work can contribute to persistent pain and disability. This is a broad concept, which may refer to avoidance of specific movements (Leonhardt et al, 2009) or generalized physical inactivity, disuse and deconditioning (Verbundt et al, 2003). Evidence of a causal pathway between fear avoidance and outcome is currently limited (Lee et al, 2015). A consensus study of Australian Pilates trained physiotherapists reported that whilst 100% agreed that SE in the form of Pilates could be indicted for people with low back pain and fear avoidance, 87% indicated precautions (Wells et al, 2014). In 2005 Sullivan suggested that SE that focus on pain and avoidance behavior could exacerbate persistent LBP and should be avoided (Sullivan, 2005). For some people with LBP SE could theoretically draw attention to "protecting" the core, promote hypervigilance and inhibit volitional movement. The primary aims of this review are to report the results of studies that compare the long-term effects (≥12 months) of SE in comparison to other interventions offered by physiotherapists for patients with persistent LBP, and identify the comparative prevalence of increased fear avoidance, harmful or adverse effects.

METHOD

Search strategy

A systematic review was undertaken using PRISMA (Preferred Reporting Items for systemic Reviews and meta-analysis) guidelines. The following databases were searched with the help of a librarian: EMBASE, CINAHL, AMED and Medline via Ovid and EBSCO [1 January 1980 to 1 January 2019] using key words and Boolean operators. Reference lists of eligible publications and previous reviews (Sargiotto et al, 2016; Smith et al., 2014) were hand searched by two independent reviewers (SG and HD).

The search terms used in all databases are below:

"low$ back pain OR lumbar pain OR lumbar spine pain OR non-specific low$ back pain"

AND

"motor control exercise OR stabilisation exercise OR stabilization exercise"

AND

"RCT OR randomized control trial OR randomized controlled trial"

Eligibility criteria

Randomised controlled trials comparing SE with any other treatment delivered by a physiotherapist and/or placebo were eligible. Studies must include people aged ≥18 with persistent non-specific low back pain with or without leg pain for ≥ 12 weeks. Only patient-reported outcome measures specific to disability or fear avoidance at ≥12 months were considered. Studies including participants with specific diagnosis including inflammatory diseases, disc prolapses, spondylolisthesis, pregnancy-related back pain, tumours or osteoporosis were excluded.

Study selection

Two independent reviewers (SG and HD) assessed all retrieved titles, and if necessary abstracts and full text manuscripts against eligibility criteria. Studies must have been published in a peer reviewed journals.

Data Extraction

Two reviewers (SG and HD) independently extracted data from each selected study, including information about participants, control and comparator groups, within group and between group differences, confidence intervals, p values and quality appraisal using PEDro scale.

Risk of bias in individual studies

Risk of bias was independently assessed by two reviewers (SG and HD), using PEDro scale. PEDro scale is analyse articles' validity based on their randomisation, allocation, blinding, protocol violation, missing data and effect size, how the effect size is presented and whether between-group statistical comparisons are reported. PEDro is considered as a valid measure of a methodological quality of trials in physiotherapy research (Morton, 2009).

RESULTS

Study selection

The process of study selection is demonstrated through the PRISMA chart (Figure 1). Seven texts describing seven studies were included, sample size varying between 35 and 109 and consisting of a total of 1929 participants. All reported 80% power.

Comparator groups included: graded activity (focus on increasing activity tolerance), general exercise (including class based strengthening and stretching), manual therapy, high load lifting (including dead lifts), sling exercises, education, pain management and

placebo. Outcomes included: The Roland Morris Disability Questionnaire (RMDQ) (Rolland and Morris 1983), scored from 0 and 24 where a lower number indicates less disability, and the Oswestry Disability Index (ODI) (Fairbank and Pynsent, 2000) scored 0-100% where zero indicates less disability, were used to measure function and disability levels. The RMDQ includes a variety of factors, such as fear avoidance beliefs, pain and appetite. The ODI focuses on pain, personal care, lifting, walking, social life and travelling. To measure personalised activity levels a number of studies used Patient Specific Functional Scale (PSFS) (Stratford et al., 1995) in which each patient identifies the activities they struggle with. These are scored from 0 (unable to perform activity) to 10 (able to perform activity at the same level as before injury or problem). One study used the Fear Avoidance Beliefs Questionnaire (Details of the interventions provided for SE and comparator groups are presented in table 1).

Figure 1: PRISMA 2009 Flow Diagram

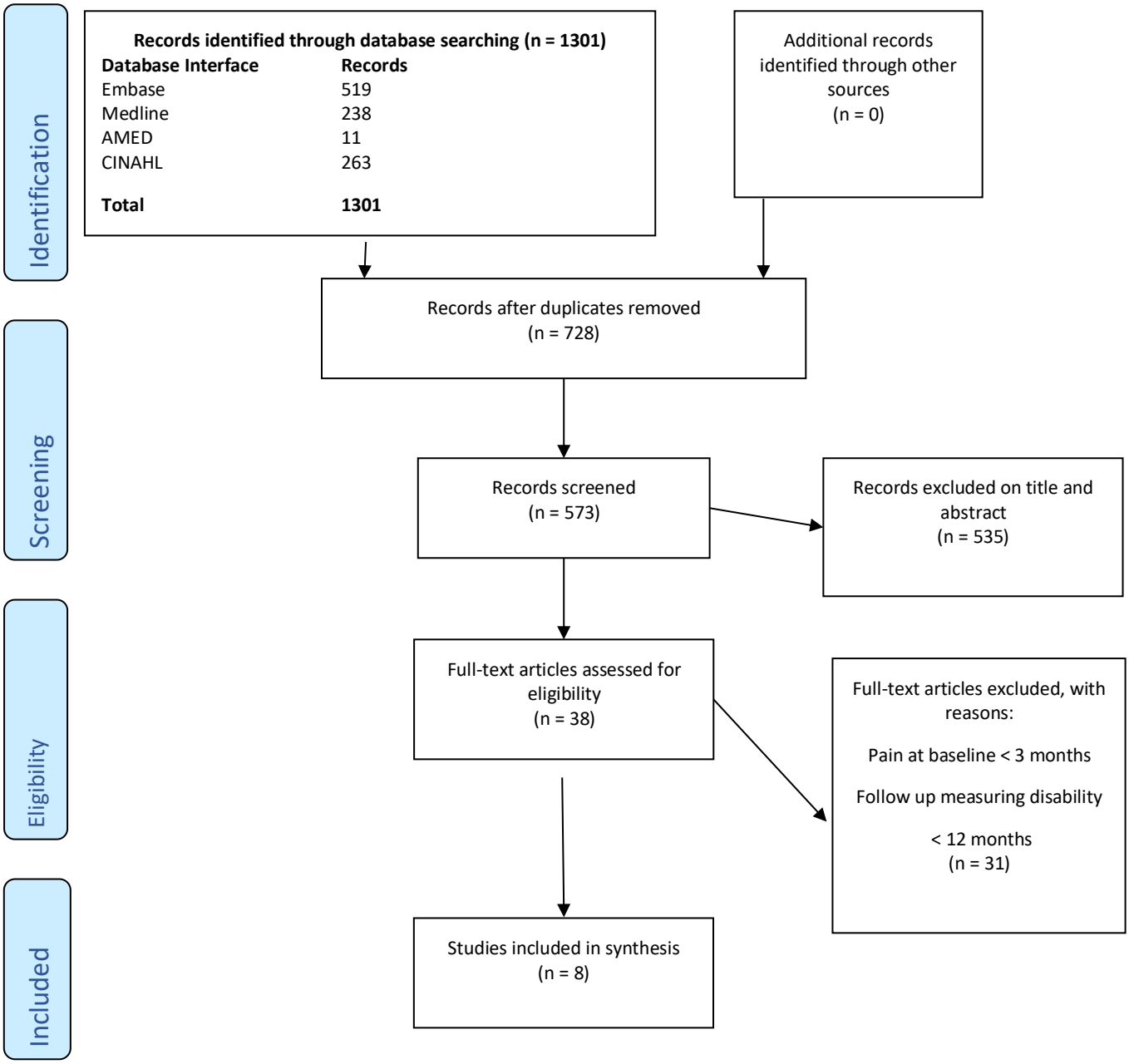

Table 1: Summary of eligible studies (n=7)

Study	Sample size	SE group	SE group: Number (N) at start, Mean age & gender (G)	Comparator Intervention/s group	Comparator group: Number (N) at start Mean age & gender
Michaelson et al. 2016	70	***Pain education*** ***SE + Home exercise programme:*** *First stage*: activation of stabilising muscles of lumbar spine in supine, sitting, four-point kneeling, standing, with upper and lower limb movement. *Second stage*: postural correction exercises, reducing over-activity of mobilising muscles. *Third stage:* implementation of desired movement into dynamic tasks.	N=35 Age: 42 Female: 19	***Pain education*** ***High Load Lifting:*** Dead lift exercise: stabilising muscles of lower back, Valsalva manoeuvre, started at ten kilograms including the barbell, whilst physiotherapist ensuring neutral position. Gradual increase in load, seventy to eighty-five percent of maximal repetition.	N=35 Age 42 F: 20
Ferreira et al. 2007	240	***SE*** CBT approach + encouraged to exercise once a day. Progressive inter-segmental movements of the spine, including Transverse Abdominis, Multifidus, diaphragm, pelvic floor. Progressively increased the functional difficulty of the tasks.	N=80 Age: 52 Female: 53	***Group General exercise:*** CBT approach + encouraged to exercise once a day Class-based exercise group: improve own performance rather than competition. Strengthening and stretching ten exercises for one minute each. Cool down, relaxation, “tip of the day”. Modelled on Klaber Moffett and Frost 2000 ***Spinal Manual Therapy:*** Mobilisations for lumbar spine and pelvis. Patients asked to not seek any other advice/treatment.	N=80 Age 45 F 56 N=80 Age 54 F 56
Costa et al. 2009	154	***SE:*** *First stage*: coordination of trunk muscles and activation of TA and Multifidus, ten repetitions, hold for ten seconds, whilst maintaining normal respiration. *Second stage*: activation of muscles above but in dynamic tasks.	N=77 Age: 55 Female: 45	***Placebo:*** Twenty minutes of detuned shortwave diathermy, five minutes detuned ultrasound for 12 sessions over eight weeks.	N=77 Age 53 Female 48

Goldby et al. 2006	302	***SE:*** Ten weekly sessions Back School (1x 3 hours) Functionally progressive exercise class: selective training for TA, Multifidus, PF.	N=84 Age: 43 Female: 57	***Manual therapy*** Ten sessions of manual therapy Back School (1 x 3 hours) ***Education*** Back School (1 x 3 hours) Back in Action education booklet (Cherkin 1996)	N=89 Age: 41 Female: 62 N=40 Age: 41 Female 27
Aasa et al. 2015	70	***SE:*** Control of the lumbar-pelvic region in supine, sitting, four-point kneeling, standing, with the upper and lower limbs. Applying these principles in dynamic tasks.	N=35 Age 42 Female 19	***High Load Lifting:*** Dead lift exercise: activating stabilising muscles. Barbell, with the bar twenty-two point five centimetres off the ground. Progression both through increasing the weight and number of reps.	N=35 Age 42 Female 20
Macedo et al. 2012	172	***SE:*** Individualised programme given based on the assessment. Ten repetitions of ten seconds. Static and dynamic tasks. Progression guided by pain.	N=86 Age: 49 Female: 57	***General Activity and CBT approach:*** Aim to increase activity tolerance, by ignoring illness behaviours and reinforcing wellness behaviours. Based on patient specific identified problematic activities. Progressed in time contingent manner: Participants received daily quotas and were instructed only perform agreed amount.	N=86 Age: 50 Female: 45
Critchley et al. (2007)	212	***SE:*** Eight session of ninety min with physiotherapist and physiotherapy assistant. Programme was individualised.	N=72 Age: 44 Female: 51	***Individualised programme including Back Care Advice:*** 12 sessions, thirty minutes, combination of MT, massage, HEP- trunk muscle retraining, stretches, general spinal mobility. ***Pain management and Back Education and CBT approach:*** Eight sessions, ninety minutes. Back pain education with group general strengthening, stretching and light aerobic exercise.	N= 71 Age: 45 Female: 42 N=69 Age: 44 Female: 43

Legend: LBP: low back pain, HLL: high load lifting, HEP: home exercise programme, GE: general exercise, GA: graded activity, TA: Transfers Abdominus, PF: pelvic floor, IP: individual physiotherapy, CBT: cognitive behavioural therapy, MT: manual therapy

Methodological quality

The selected studies were critically appraised using the Physiotherapy Evidence Database scale (PEDro 1999). Table 2 shows the rating for each item for each study. In the three situations where there was a disagreement, a discussion between the reviewers always reached a consensus without the need for a third person.

Table 2: PEDro Scale Score

Author	1	2	3	4	5	6	7	8	9	10	11	Total
Ferreira et al., 2007	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	9
Costa et al., 2009	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	10
Goldby et al., 2006	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	7
Michaelson et al., 2016	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	7
Aasa et al., 2015	Y	Y	N	Y	N	Y	N	N	N	Y	Y	6
Macedo et al., 2012	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	9
Critchley et al., 2007	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	7

Legend N= did not meet the criteria and Y= met the criteria.

Fear avoidance, adverse effects or harm

None of the studies included within this review used outcome measures that specifically quantified fear avoidance. Six studies, reported adverse effects (table 3). Of these studies, four specified that no adverse effects were reported in SE groups (Michaelson et al., 2016; Ferreira et al., 2007; Aasa et al., 2015; Critchley et al., 2007) and two studies (Macedo et al., 2012 and Costa et al., 2009) reported “mild” and “temporary exacerbation of pain”. Macedo et al., 2012, reported the adverse effects of both groups (SE and graded activity) together.

Table 3: Adverse effects

Study	Adverse effects in SE groups	Adverse effects in comparator groups
Aasa et al., 2015	"No adverse effects reported"	2 participants in heavy load lifting reported adverse effects
Costa et al., 2009	3 patients reported "mild adverse effects" all were "temporary exacerbation of pain" None withdrew from the trial	2 patients in placebo group reported "mild adverse effects" all were "temporary exacerbation of pain" None withdrew from the trial
Crichley et al., 2007	"No serious adverse effects were reported by any of the participants"	"No serious adverse effects were reported by any of the participants"
Ferreira et al., 2007	"No adverse events were reported"	"No adverse events were reported"
Goldby et al., 2006	No mention	No mention
Michealson et al., 2016	"No adverse effects were reported"	2 participants in heavy load lifting reported adverse effects
Macedo et al., 2012	"mild" adverse effects reported in SE (n=19) & Graded Activity (n=17) groups: Summary: temporary exacerbation of pain (n=27), increased pain in pre-existing MSK conditions such as knee arthritis (n=7), development of shin splints (n=1) & hip bursitis (n=1). Graded Activity group: 1 participant experienced exacerbation of pain at 6 months, attributed to one of the home exercises.	

Disability measured by ODI at 12 and 24-months follow up

One study (Goldby et al., 2006) measured disability at 12 and 24 months follow up using the ODI (Table 4). Within-group differences were reported using percentages with 38.80% reduction in disability at the 12-month follow up in the SE group, 24.50% in the manual therapy group and 19.80% in the education group. The magnitude of between-group difference is not stated, but the p value of the between-group outcome is stated

as significant (p=0.0098). At 24-months follow up there was no significant difference (p=0.33) between SE and education or manual therapy.

Disability measured by RMDQ at 12 and 24-months follow up

Five studies (Costa et al., 2009; Ferreira et al., 2007; Critchley et al., 2007; Macedo et al., 2012; Michaelson et al., 2016) used RMDQ as an outcome measure at 12 months follow up (Table 5). Between-group differences were not statistically significant (p>0.05) in any of the five studies. In summary: Costa et al. (2009), n=145, reported a between-group difference of -1.0 (95% CI: -2.8 to 0.8, p=0.271). Critchley et al. (2007), n=212 patients, did not report CI for the between-group difference, but stated a non-significant result (p=0.46). Ferreira et al. (2007), n=240, reported no significant difference between SE and general exercise (-0.6, 95% CI: -2.5 to 1.2), SE versus manual therapy (-1.8, 95% CI: -3.6 to 0). Macedo et al. (2012), n=172 patients, reported a difference of -0.6 (95%CI -2.0 to 0.9, p=0.45) between groups when comparing SE with graded activity. Michaelson et al. (2016), n=70, reported no significant between-group difference between SE and high load lifting (-0.2, 95%CI: -1.5 to 1.1, p=0.74). Only one study (Michaelson et al., 2016) reported the outcome of the RMDQ, followed up patients at 24 months (Table 5). Michaelson et al (2016), n= 70, comparing SE and high load lifting reported a no significant between group difference of –1.7 (95% confidence interval (CI) –2.6 to –0.8, p=0.99).

Function measured by PSFS at 12-months

Table 6 shows the results of four studies which measured patient-reported activity levels using the PSFS, all at 12 months only. Two studies reported a statistically significant difference (Costa 2009; Aasa 2015), both in favour of SE. Costa et al., 2009, compared SE and placebo, and reported a significant between-group difference of 1.5 (95% CI: 0.7 to 2.2, p<0.001) and Aasa et al., 2015, compared high load and SE lifting, reported a significant between-group difference of -1.8 (95%CI: -2.8 to -0.7, p<0.001).

Two studies reported no significant between group differences. Ferreria et al., (2007), reported no significant difference between SE and general exercise (1.1, 95%CI: -1.0 to 3.2), or SE and manual therapy (0.8, 95%CI -1.2 to 2.9) and Macedo et al., (2012), reported no significant between group difference between SE and graded activity (-0.4, 95% CI -1.1 to 0.3, p=0.25).

Table 4: Disability measured by Oswestry Disability Index (ODI) at 12 and 24 months

Outcome at 12 months ODI															
Author		**Experimental: SE**				**Comparator 1: Education**				**Comparator 2: MT**				**Between-group difference**	
		Baseline	**12 m**	**Difference**	**p value**	**Baseline**	**12 m.**	**Difference**	**p value**	**Baseline**	**12 m.**	**Difference**	**p value**	**Difference (95% CI)**	**p value**
Goldby et al., 2006	Mean:	40.47	24.76			33.54	26.9			39.17	29.56				
	SD	15.62	17.44	38.80%	<0.001	12.21	19.6	19.80%	0.079	13.73	20.52	24.50%	<0.001	15.71 (19.3 to 10.01)	0.0098
	N:	84	71			40	28			89	74				
Outcome at 24-months ODI															
Author		**Experimental: SE**				**Comparator 1: Education**				**Comparator 2: MT**				**Between-group difference**	
		Baseline	**24 m**	**Difference**	**p value**	**Baseline**	**24 m.**	**Difference**	**p value**	**Baseline**	**24 m.**	**Difference**	**p value**	**Difference (95%CI)**	**p value**
Goldby et al., 2006	Mean:	40.47	27			33.54	27			39.17	31				
	SD	15.62	21	NS	NS	12.21	18	NS	NS	13.73	20	NS	NS	NS	0.33
	N:	84	35			40	19			89	37				

Legend: 12m, 12 month follow up, 24m, 24 month follow up, SD, standard deviation, NS, Not stated, N, number, MT, Manual therapy

Table 5: Disability measured by Rolland Morris Disability Questionnaire (RMDQ) at 12 and 24 months

Outcome at 12 months RMDQ															
Author		**Experimental: SE**				**Comparator 1: GE, Education, GA, HLL, individual physiotherapy**				**Comparator 2: MT, placebo, pain management**				**Between-group difference**	
		Baseline	**12 m.**	**Difference**	**p value**	**Baseline**	**12 m.**	**Difference**	**p value**	**Baseline**	**12 m.**	**Difference**	**p value**	**Difference (95% CI)**	**P value**
Costa et al. 2009	Mean: SD N:	13.1 5 77	11.4 7.8 69	NS	NS					13.4 4.9 77	12.3 6.4 76	NS	NS	-1.0 (-2.8 to 0.8)	0.271
Critchley et al. 2007	Mean: SD: N:	12.8 NS 72	7.6 NS 53	NS	NS	11.1 NS 71	8.1 NS 55	NS	NS	11.5 NS 69	5.8 NS 46	NS	NS	NS	0.46
Ferreira et al. 2007	Mean: SD N:	14 5.3 80	8.8 6.5 65	NS	NS	14.1 5.5 80	9.6 6.9 73	NS	NS	12.4 5.7 80	9.2 6.6 73	NS	NS	SE versus GE -0.6 (-2.5 to 1.2) SE versus MT -1.8 (-3.6 to 0)	NS
Macedo et al. 2012	Mean: SD: N:	11.4 4.8 86	7.4 6.7 75	NS	NS	11.2 5.3 86	8 6.9 80	NS	NS					-0.6 (-2.0 to 0.9)	0.45
Michaelson et al. 2016	Mean: SD: N:	7.1 3.9 35	4.9 3.6 23	NS	<0.001	7.2 4.3 35	3.6 4.2 23	NS	<0.001					-0.2 (-1.5 to 1.1)	0.74

Outcome at 24-months RMDQ											
Author		**Experimental: SE**				**Comparator 1: HLL**				**Between-group difference**	
		Baseline	**24 m.**	**Difference**	**p value**	**Baseline**	**24 m.**	**Difference**	**p value**	**Difference (95%CI)**	**P value**
Michaelson et al., 2016	Mean: SD N:	7.1 3.9 35	3.6 3.7 31	NS	NS	7.2 4.3 35	3.8 3.9 27	NS	NS	–0.01 (-1.2 to 1.2)	0.99

Legend: 12m, 12 month follow up, 24m, 24 month follow up, SD, standard deviation, NS, Not stated, N, number, MT, Manual therapy, GE General exercise, HLL, High load lifting, GA, Graded activity

Table 6: Function measured by Patient Specific Functional Scale (PSFS) at 12-months

Author		Experimental: SE				Comparator 1: GE, GA, HLL				Comparator 2: Education, placebo, MT				Between-group difference	
		Base-line	12 m.	Difference	p value	Baseline	12 m.	Differ-ence	p value	Baseline	12 m.	Differ-ence	p value	PSFS Difference (95%CI)	P value
Ferreira et al., 2007	Mean	10.7	15.7	NS	NS	10.1	13.9	NS	NS	11.2	15.2	NS	NS	MT v GE 0.3 (-1.7 to 2.3) MC v GE 1.1 (-1.0 to 3.2) MC v MT 0.8 (-1.2 to 2.9)	NS
	SD	4.0	6.8			4.2	7.2			4.6	6.8				
	N	80	65			80	73			80	73				
Costa et al. 2009	Mean	3.3	5.5	NS	NS					3.3	4.0	NS	NS	1.5 (0.7 to 2.2)	< 0.001
	SD	1.7	2.6							1.8	2.6				
	N	77	69							77	76				
Macedo et al. 2012	Mean	3.7	5.9	NS	NS	3.6	6.1	NS	NS					-0.4 (-1.1 to 0.3)	0.25
	SD	1.6	2.2			1.6	2.3								
	N	86	75			86	80								
Aasa et al. 2015	Mean	3.8	8	89% of MIC	NS	4.8	7.3	69% of MIC	NS					-1.8 (-2.8 to -0.7)	< 0.001
	SD	NS	NS			NS	NS								
	N	35	25			35	26								

Legend: 12m, 12 month follow up, SD, standard deviation, NS, Not stated, N, number, MT, Manual therapy, GE, General exercise, HLL, High load lifting, GA, Graded activity

Summary of results

A summary of results with respect to study quality appraisal using PEDro is presented in table 7, where p values are as stated in the text.

Table 7: Summary of Study Quality (PEDro) and Results (12 months unless otherwise indicated)

Author	Outcome	Quality of evidence	Outcome Measures	Significance
Costa et al. (2009)	No significant difference between SE and placebo	10- Excellent	RMDQ	P= 0.271
	Significant difference for PSFS in favour of SE		PSFS	P< 0.001
Macedo et al. (2012)	No significant difference between SE and Graded Activity.	9- Excellent	RMDQ	P= 0.45
			PSFS	P= 0.25
Ferreira et al. (2007)	No significant difference between SE, Manual Therapy & General Exercise.	9- Excellent	RMDQ	P not stated
			PSFS	
Michaelson et al. (2016)	At 12 and 24 months: No significant difference between SE and High Load Lifting.		RMDQ (12)	P= 0.74
			RMDQ (24)	P= 0.99
Goldby et al. (2006)	At 12-months: Significant difference between SE, Manual Therapy or Education, in favour of SE.	7- Good	ODI (12)	P= 0.0098
	At 24-months: No significant difference		ODI (24)	P= 0.33
Critchley et al. (2007)	No significant difference between individual treatment, SE, individual physiotherapy and pain management.	7- Good	RMDQ	P= 0.46
Aasa et al. (2015)	Significant difference between SE versus High Load Lifting, in favour of SE.	6- Good	PSFS	P<0.001

Legend: PEDro: Physiotherapy Evidence Database, SE: Stabilisation Exercises, RMDQ: Rolland Morris Disability Questionnaire, PSFS: Patient Specific Functional Scale, ODI: Oswestry Disability Index

DISCUSSION

This review had two main objectives. Firstly, to summarise the evidence for effectiveness of SE in comparison to other physiotherapy treatments at long term follow up. Secondly, to seek whether SE cause any adverse effects or increased fear avoidance.

Five studies reported the RMDQ at 12 months and one study at 24 months. These included the three highest quality studies. There was no statistically significant difference between SE and comparator groups.

Just one study and of good quality reported the ODI. This included 12 and 24 month follow up, with only the former being statistically significant in favour of SE in comparison to manual therapy or education (Goldby et al, 2006).

Four studies, report the PSFS at 12 months, none at 24 months. These included the three highest quality studies. One excellent and one good quality study reported a statistically significant difference in favour of the SE group. These were in comparison to placebo (Costa et al, 2009) and high load lifting (Aasa et al, 2015). No significant difference was reported between SE and general exercise (Macedo et al, 2012) or manual therapy or general exercise (Ferreira et al, 2007), both excellent quality studies.

Given the wide confidence intervals, these results suggest there is a wide variability in the comparative effectiveness of SE and other treatments offered by physiotherapists. Future research could look at identifying patient characteristics that may be associated with the outcome of a specific exercise intervention. Identifying prognostic factors associated with a positive or negative response to SE could be used to guide treatment selection.

The objective of this review was to investigate the reporting of adverse effects associated with SE. The CONSORT checklist of successful reporting of trials encompasses reporting harms caused by an intervention. This is important because an intervention may be effective for some but cause harm in others.

Whether or not SE are associated with fear avoidance remains unanswered as it was not measured in any of the studies in our review. Two studies of the effectiveness of SE for LBP which did not fulfil the eligibility criteria for review, have measured fear avoidance, both using the Fear Avoidance Beliefs Questionnaire

(FABQ) (Waddell 1993). Marshall et al. (2013) followed up participants for a maximum of 6 months and Unsgaard-Tøndel et al. (2010) measured only pain, not disability, at 12 month follow up and were therefore not eligible for our review. Marshall et al (2013) and Unsgaard-Tøndel et al (2010) report no significant between-group differences at any time point in terms the FABQ.

The current evidence suggests that SE are equally as effective as other interventions offered by physiotherapists in the long-term. However, given the absence of any studies specifically measuring and reporting fear avoidance at one year follow up we are unable to conclude whether or not fear avoidance is affected. Given the increasing interest in the potential for health professionals to contribute or exacerbate fear avoidance, we recommend consideration of the patient's beliefs and expectations prior to providing these exercises. Persistent LBP is a complex and multidimensional disorder and management needs to involve both cognitive, behavioural and physical components.

Limitations

The limitation of this review is that only studies published in English language were included. Secondly, the search was only inclusive to 'adults' over 18 years old, however NICE guidelines for LBP (2016) apply to young adults over 16 years old.

CONCLUSION

This review's highest quality evidence demonstrates that for RMDQ, SE are equally, but no more or no less effective than other physiotherapy treatments for persistent LBP. However for the PSFS, two of four studies, one excellent and one good quality, reported superiority of SE compared to placebo or high load lifting. There was no difference when compared to other forms of exercise.

Fear avoidance has not been specifically measured and reported in studies investigating the effectiveness of SE at longer term follow up. As with any treatment intervention, physiotherapists should take a personalised approach and aim to understand what type of intervention is going to be most likely successful, depending on patient's presentation, preferences and lifestyle.

KEY WORDS

Adverse effects, Disability, Fear avoidance beliefs, Persistent low back pain, Physiotherapy, Stabilisation exercises

KEY POINTS

1. Stabilisation exercises are safe and equally effective to other treatments offered by physiotherapists for improving disability.
2. For some disability outcomes and time points, stabilisation exercises are superior to placebo and some other treatments offered by physiotherapists.
3. There is no current evidence showing that stabilisation exercises cause adverse effects.
4. The association between stabilisation exercises, fear avoidance and disability at long term follow up (≥ 12 months) is uncertain; none of the studies included this as an outcome.

REFLECTIVE QUESTIONS

1. Should physiotherapists consider stabilisation exercises when treating patients with low back pain?
2. How can clinicians ensure that their language does not promote fear avoidance?
3. What are the most common considerations for clinicians when treating chronic conditions?

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Reference List

Aasa, B, Berglund, L, Michealson, P., Aasa, U., 2015. Individualized Low-Load Motor Control Exercises and Education Versus a High Load Lifting Exercise and Education to Improve Activity, Pain Intensity, and Physical Performance in Patients with Low Back Pain: A Randomized Controlled Trial. Journal of Orthopaedics and Sports Physical Therapy 45 (2), 77-85. https://doi.org/10.2519/jospt.2015.5021.

CONSORT CHECKLIST: Transparent Reporting of Trials., 2010. CONSORT Checklist. [ONLINE] Available at: http://www.CONSORT Checklist -statement.org/. [Accessed 20/04/2017].

Costa, L., Maher, C., Latimer, J., Hodges, R., Herbert, R., Refshauge, K., McAuley, J., Jennings, M., 2009. Motor Control Exercise for Chronic Low Back Pain: A Randomized Placebo-Controlled Trial. Physical Therapy 89 (12), 1275- 1285. https://doi.org/10.2522/ptj.20090218.

Chartered Society of Physiotherapy., 2016. Back Pain Myth Busters [ONLINE] Available at: https://www.csp.org.uk/conditions/back-pain/back-pain-myth-busters. [Accessed 27/6/2019].

Critchley, D. J., Radcliffe, J., Noonan, S., Jones, R. H., Hurley, M. V., 2007. Effectiveness and cost-effectiveness of three types of physiotherapy used to reduce chronic low back pain disability: a pragmatic randomized trial with economic evaluation. Spine 15 (14), 1474-1481. https://doi.org/10.1097/BRS.0b013e318067dc26.

Fairbank, J.C., Pynsent, P. B., 2000. The Oswestry Disability Index. Spine 15 (22), 2940-52. https://www.ncbi.nlm.nih.gov/pubmed/11074683.

Ferreira, M., Ferreira, P., Latimer, J., Herbert, R., Hodges, P., Jennings, M., Maher, C., Refshauge, K., 2007. Comparison of general exercise, motor control exercise and spinal manipulative therapy for chronic low back pain: a randomised controlled trial. Pain 131, 31-37. https://doi.org/10.1016/j.pain.2006.12.008.

Global Burden of Disease GBD and Injury Incidence and Prevalence Collaborators., 2017. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries,1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 388,1545–602. https://doi.org/10.1016/S0140-6736(16)31678-6.

Goldby, L., Moore, A., Doust, J., Trew, M., 2006. A Randomized Controlled Trial Investigating the Efficiency of Musculoskeletal Physiotherapy on Chronic Low Back Disorder. Spine 31, 1083-1093. https://doi.org/10.1097/01.brs.0000216464.37504.64.

Lee, H., Hübscher, M., Moseley, G. L., Kamper, S. J., Traeger, A. C., Mansell, G., McAulley, J. H., 2015. How does pain lead to disability? A systematic review and meta-analysis of mediation studies in people with back and neck pain. Pain 156 (6), 988-997. https://doi.org/10.1097/j.pain.0000000000000146.

Leonhardt, C., Lehr, D., Chenot, J., Keller, S., Lukeman, J., Basler, H., Baum, E., Doner-Banzhoff, N., Pfighsten, M., Hildebrand, J., Kochen, N., Becker, A., 2009. Are fear-avoidance beliefs in low back pain patients a risk factor for low physical activity or vice versa? A cross-lagged panel analysis**.** Psychosocial Medicine 6, 1-12. https://doi.org/10.3205/psm000057.

Macedo, L. G., Maher, C. G., Latimer, J., McAuley, J.H., 2009. Motor control exercise for persistent, nonspecific low back pain: a systematic review. Physical Therapy 89 (1), 9-25. https://doi.org/10.2522/ptj.20080103.

Macedo, L., Latimer, J., Maher, C., Hodges, P., McAuley, J., Nicholas, M., Tonkin, L., Stan-ton, C., Stanton, T., Stafford, R., 2012. Effect of Motor Control Exercises Versus Graded Activity in Patients with Chronic Nonspecific Low Back Pain: A Randomized Controlled Trial. Physical Therapy 92 (3), 363-377. https://doi.org/10.2522/ptj.20110290.

Marshall, P. W., Kennedy, S., Brooks, C., Lonsdale, C., 2013. Pilates exercise or stationary cycling for chronic nonspecific low back pain: does it matter? a randomized controlled trial with 6-month follow-up. Spine 38 (15), 952-959. https://doi.org/10.1097/BRS.0b013e318297c1e5.

Michealson, P., Holmberg, D., Aasa, B., Aasa, U., 2016. High load lifting exercise and low load motor control exercises as interventions for patients with mechanical low back pain: a randomised controlled trial with 24-month follow up. Journal of Rehabilitation Medicine 48, 456-463. https://doi.org/10.2340/165019772091.

Morton, N. A., 2009. The PEDro scale is a valid measure of the methodological quality of clinical trials: a demographic study. Australian Journal of Physiotherapy 55 (2), 129-133. https://doi.org10.1016/S0004-9514(09)70043-1.

National Institute for Health and Care Excellence (NICE)., 2016. Low back pain and sciatica in over 16s: assessment and management. [ONLINE] Available at: https://www.nice.org.uk/guidance/ng59/chapter/Recommendations. [Accessed 21/04/2017].

Physiotherapy Evidence Based Database (PEDro)., 1999. PEDro Scale. [Online] Available at: https://www.pedro.org.au/english/downloads/pedro-scale/ [Accessed: 20/04/2017].

Roland, M., Morris, R., 1983. 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 8, 141-144. https://insights.ovid.com/crossref?an=00007632-198303000-00004.

Saragiotto, B. T., Maher, C.G., Yamato, T.P., Costa, L.O.P., Costa L.C., Costa, L.O., Ostelo R. W., Macedo L.G., 2016. Motor control exercise for chronic non-specific low-back pain. Cochrane Database of Systematic Reviews 2016 Issue 1. Art. No.: CD012004. https://doi.org/10.1002/14651858.CD012004.

Smith, B., Littlewood, C., May, S., 2014. An update of stabilisation exercises for low back pain: a systematic review with meta-analysis. Bio Med Central Musculoskeletal Disorders 15 416, 1-21. https://doi.org/10.1186/1471-2474-15-416.

Stratford, P., Gill, C., Westaway, M., Binkley, J., 1995. Assessing Disability and change on individual patients: a report of a patient specific measure. Physiotherapy Canada 47, 258-263. https://doi.org/10.3138/ptc.47.4.258.

Sullivan, G. M., 2011. Getting Off the “Gold Standard”: Randomized Controlled Trials and Education Research. Journal of Graduate Medicine Education 3 (3), 285-289. https://doi.org/10.4300/JGME-D-11-00147.1.

Sullivan, P., 2005. Diagnosis and classification of chronic low back pain disorders: maladaptive movement and motor control impairments as underlying mechanism. Manual Therapy 10 (4), 242-255. https://doi.org/10.1016/j.math.2005.07.001.

Unsgaard-Tøndel, M., Fladmark, A. M., Salvesen, Ø., Vasseljen, O., 2010. Motor control exercises, sling exercises, and general exercises for patients with chronic low back pain: a randomized controlled trial with 1-year follow-up. Physical Therapy 90 (10), 1426-1440. https://doi.org/10.2522/ptj.20090421.

Verbundt, J. A., Seelan, H., Vlaeyen, J., 2003. Disuse and deconditioning in chronic low back pain: concepts and hypotheses on contributing mechanisms. European Journal of Pain 7, 9-12. https://doi.org/10.1016/S1090-3801(02)00071-X.

Vos, T; Vos, A. D., Flaxman, M., Naghavi, et al., 2012. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 380, 2163-2196. https://doi.org/10.1016/S0140-6736(12)61729-2.

Waddell G, Newton M., Henderson I., Somerville., D., Main, C. J., 1993. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain 52, 157-168. https://doi.org/10.1016/0304-3959(93)90127-B.

Wang, X. Q., Zheng, J. J., Yu., Z. W., Bi, X., Lou, S. J., Cai., B., Hua, Y. H., Wu., M., Wei, M. L., Shen, H. M., Chen, Y., Pan, Y.J., Xu, G. H., Chen, P. J., 2012. A meta-analysis of core stability exercise versus general exercise for chronic low back pain. Plos, 7 (12), 1-7. https://doi.org/10.1371/journal.pone.0052082.

Wells, C., Kolt, G. S., Marshall, P., Bialocerkowski, A., 2014. The Definition and Application of Pilates Exercise to Treat People With Chronic Low Back Pain: A Delphi Survey of Australian Physical Therapists. Physical Therapy 94 (6), 792-805. https://doi.org/10.2522/ptj.20130030.