



# Brazilian Journal of Physical Therapy

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## SYSTEMATIC REVIEW

# Overall confidence in the results of systematic reviews on exercise therapy for chronic low back pain: a cross-sectional analysis using the Assessing the Methodological Quality of Systematic Reviews (AMSTAR) 2 tool

Matheus Oliveira Almeida<sup>a,\*</sup>, Tiê Parma Yamato<sup>b</sup>,  
Patricia do Carma Silva Parreira<sup>b</sup>, Leonardo Oliveira Pena Costa<sup>a</sup>, Steven Kamper<sup>b</sup>,  
Bruno Tirotti Saragiotto<sup>a,b</sup>

<sup>a</sup> Masters and Doctoral Programs in Physical Therapy, Universidade Cidade de São Paulo, Rua Cesário Galeno 448, Tatuapé, São Paulo, SP CEP 03071-000, Brazil

<sup>b</sup> Sydney School of Public Health, Sydney Medical School, The University of Sydney, PO Box M179 Missenden Rd, Sydney, NSW 2050, Australia

Received 30 July 2018; received in revised form 12 April 2019; accepted 17 April 2019  
Available online 8 May 2019

### KEYWORDS

Physical therapy;  
Musculoskeletal pain;  
Methodological quality;  
Decision-making

### Abstract

**Objective:** To evaluate the overall confidence in the results of systematic reviews of exercise therapy for chronic non-specific low back pain using the AMSTAR 2 tool.

**Methods:** PubMed, Embase, Cochrane Database of Systematic Reviews, PEDro and CINAHL was searched up to February 2017. Two independent reviewers selected systematic reviews of randomized controlled trials that investigated exercise therapy in patients with low back pain. AMSTAR 2 assessment was performed by pairs of reviewers, and the overall confidence in the results of the systematic reviews were rated as 'High', 'Moderate', 'Low' and 'Critically low'. Descriptive analysis was used to summarize the characteristics of included systematic reviews. The percentage of systematic reviews achieving each item from the AMSTAR 2 and the overall confidence in the results were tabulated.

**Results:** The search identified 38 systematic reviews. Most of the reviews included a median of 10 clinical trials and total sample size of 813 participants per review. Five of 38 (13%) reviews were Cochrane reviews, and 8 (21%) systematic reviews had a protocol published or registered prospectively. The overall confidence in the results of 28 reviews (74%) was rated as 'Critically low', 6 (16%) as 'Low', 1 (2%) as Moderate, while 3 of 38 reviews (8%) were rated as 'High'.

\* Corresponding author at: Universidade Cidade de São Paulo, Rua Cesário Galeno, 448, Tatuapé, São Paulo, SP CEP: 03071-000, Brazil.  
E-mail: [mathewsalmeyda@hotmail.com](mailto:mathewsalmeyda@hotmail.com) (M.O. Almeida).

*Conclusion:* The results demonstrate very low confidence in the results of most systematic reviews of exercise in chronic non-specific low back pain. Clinicians are more likely to deliver the most efficacious interventions to patients by critically appraising systematic reviews using AMSTAR 2 before making their decisions.

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## Introduction

Low back pain (LBP) is a common condition and a significant public health problem across the globe.<sup>1-4</sup> Although a large proportion of patients with an acute episode of non-specific LBP tend to improve spontaneously over time, a large proportion of these people develop chronic LBP,<sup>5</sup> which is disabling and is usually treated with exercise therapy and psychosocial interventions.<sup>6</sup> There are several therapeutic interventions available for treating non-specific LBP and exercise therapy is probably the most commonly used and effective intervention for these people.<sup>6-9</sup>

The effectiveness of exercise for chronic non-specific LBP has been tested in several systematic reviews, including Cochrane<sup>10-12</sup> and non-Cochrane reviews.<sup>13,14</sup> Although these systematic reviews are considered as level 1 evidence and reliable sources for decision making,<sup>15</sup> little attention has been given to their methodological quality and how confident readers can be in their results. As clinicians have been evaluating the quality of clinical trials to interpret the available evidence to determine if findings are relevant to clinical practice, the same needs to be performed for systematic reviews.<sup>16</sup> The quality of systematic reviews can vary substantially, even when different reviews aim to answer the same research/clinical.<sup>17</sup> Therefore, it is necessary to appraise the quality of systematic reviews before the results are implemented into clinical or public health practice. Policymakers have also expressed interest for understanding if systematic reviews are consistent enough from a methodological perspective, to support decision-making.<sup>18</sup> Methodological flaws in systematic reviews could potentially affect results of reviews and introduce bias to conclusions. As biased results from systematic reviews can mislead clinical practice,<sup>19</sup> it is important to assess and report the overall confidence in the findings of systematic reviews of exercise therapy for chronic non-specific LBP.

The Assessing the Methodological Quality of Systematic Reviews (AMSTAR) instrument, published in 2007, is a freely accessible critical appraisal tool for assessing the overall confidence in the results of systematic reviews.<sup>19</sup> Validation studies have shown that AMSTAR has good measurement properties.<sup>20,21</sup> The original instrument has been revised and updated, resulting in the AMSTAR 2, published in 2017.<sup>22</sup> The main modifications include better consideration of risk of bias within included studies and how this is integrated into interpretation of the review; better alignment with the PICO (population/problem; intervention; comparison; outcome) format to frame a clinical question; and more information on studies excluded from the review. The AMSTAR 2 tool could provide an overview of the overall confidence in the results

of systematic reviews of exercise therapy for chronic non-specific LBP, and suggestions for future improvements and recommendations can be made.

AMSTAR 2 scores can also help clinicians and researchers to distinguish high quality reviews from those that were poorly conducted. As an example, we can cite the use of Kinesiotaping in LBP treatment. While one systematic review with some methodological limitations recommends the use of this technique as an additional therapy,<sup>23</sup> a more recent review with better methodological quality concluded that the current evidence does not support its use in clinical practice for patients with LBP.<sup>24</sup> Another example is about the effectiveness of laser therapy in patients with LBP. There is a Cochrane review that stated that the clinical effect of laser therapy is inconclusive,<sup>25</sup> whereas another review reported that the same intervention is effective in reducing pain in LBP treatment.<sup>26</sup> In these cases, clinicians should evaluate the confidence in the results of the reviews through the AMSTAR 2 assessment to make an adequate clinical decision making.

This study aims to assess the overall confidence in the results of systematic reviews of exercise therapy for chronic non-specific low back pain using the AMSTAR 2 tool.

## Methods

### Study design

This study was a methodological survey of systematic reviews.

### Search

An electronic search for systematic reviews of exercise therapy for non-specific LBP was conducted in the following databases from their inception up to February 2017: PubMed, Embase (via OvidSP), Cochrane Database of Systematic Reviews, CINAHL and PEDro. The full search strategy for each database is described in [Appendix A](#). We did not search for grey literature. Two reviewers (MOA; BTS) screened for study eligibility, and disagreements resolved through discussion or by arbitration of a third reviewer (TPY).

### Inclusion and exclusion criteria

The inclusion criteria used in our study were:

1. Systematic reviews of randomized controlled trials that investigated exercise therapy in patients with chronic non-specific LBP (>3 months of symptoms).
2. If the reviews included studies conducted on patients with different duration of symptoms (i.e., acute and sub-acute), we included if most studies included in the review reported on chronic LBP.
3. Systematic reviews that included any type of exercise therapy (e.g., Pilates, Yoga, general exercise, aerobic exercise, specific exercises) compared with other active intervention, minimal interventions (e.g., advice, placebo) or no treatment.
4. For updated reviews (e.g., updated Cochrane review) we included only the most recent version of the review.
5. Systematic reviews written in English, Portuguese, Spanish, or Dutch, as the authors are able to read these languages.
6. Full texts published on peer-review journals.

We excluded from our study overviews of systematic reviews.

### Data extraction

The following data were extracted from the included reviews:

1. Bibliometric data (authors, location of corresponding author, year of publication, language, journal impact factor).
2. Characteristics of the review (Cochrane review or not, prospective registration or protocol publication, funding for conducting the review, sample size (*n* studies/*n* participants)).
3. Characteristics of the participants included (gender and age).
4. Description of the interventions.

Pairs of reviewers (MOA; BTS; TPY; PP) with experience in systematic reviews (including Cochrane reviews)<sup>10,27–35</sup> performed the data extraction, disagreements were resolved by discussion or arbitration from a third reviewer (LOPC).

### The AMSTAR 2 checklist

The AMSTAR 2 checklist aims to assess the overall confidence in the results of a systematic review. AMSTAR 2 is composed of 16 items scored: ‘yes’, ‘partial yes’, ‘no’, and ‘no meta-analysis’. Of the 16 items, seven are considered as critical domains:

- protocol registered before commencement of the review (item 2);
- adequacy of the literature search (item 4);
- justification for excluding individual studies (item 7);
- risk of bias of included individual studies (item 9);
- appropriateness of meta-analytical methods (item 11);
- consideration of risk of bias when interpreting the results (item 13);
- assessment of presence and likely impact of publication bias (item 15).<sup>22</sup>

The overall confidence in the results of the systematic reviews proposed by the AMSTAR 2 tool<sup>22</sup> was defined as:

1. high (no, or one non-critical weakness: the systematic review provides an accurate and comprehensive summary of the results);
2. moderate (more than one non-critical weakness but no critical flaws: the systematic review provides an accurate summary of the results);
3. low (one critical flaw, with or without non-critical weaknesses: the systematic review may not provide an accurate and comprehensive summary of the results);
4. critically low (more than one critical flaw, with or without non-critical weaknesses: the review should not be relied on to provide an accurate and comprehensive summary of the results).

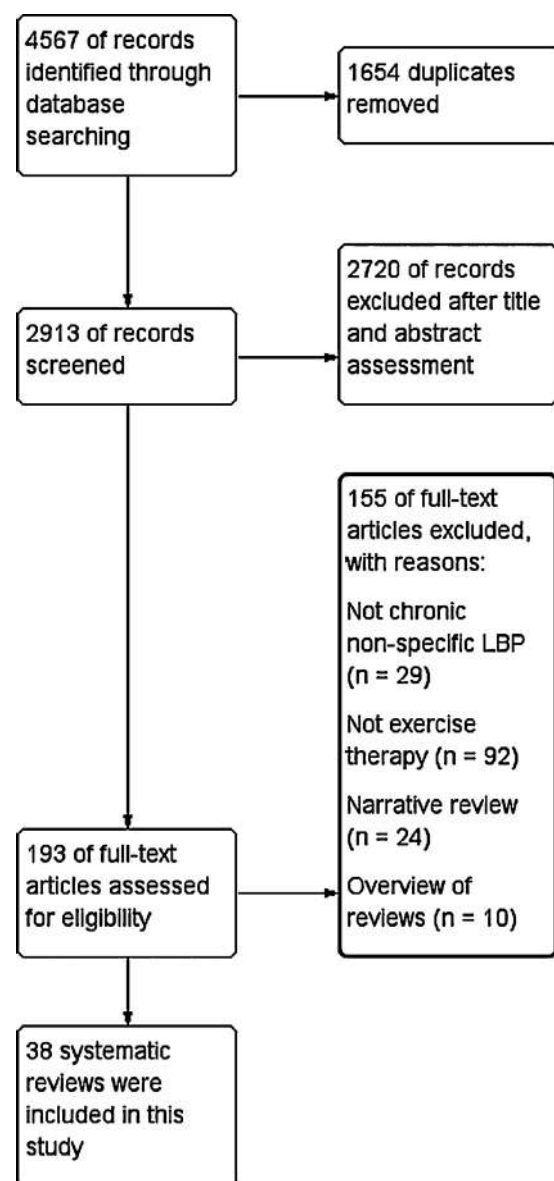


Figure 1 Study flow diagram (search period to February 7th 2017).

Pairs of reviewers (MOA; BTS; TPY; PP) performed the AMSTAR 2 assessment, disagreements were resolved by discussion or arbitration from a third reviewer (LOPC).

## Data analysis

Descriptive analysis was used to summarize the characteristics of all included systematic reviews, as well as separately according to the overall confidence in the results (High, Moderate, Low and Critically low). The percentage of systematic reviews achieving each item from the AMSTAR 2 and the overall confidence in the results were tabulated. Inter-rater agreement of the AMSTAR 2 assessment was calculated using the Cohen's Kappa coefficient. The software STATA 10 was used for all analyses.

## Results

The search identified 193 systematic reviews, of these, 38 fulfilled our inclusion criteria (Fig. 1).<sup>10,11,13,29,36–69</sup> Most of the reviews were conducted in Europe and Oceania, included a median of 10 clinical trials and a total sample size of 813 per review. Five of 38 (13%) reviews were Cochrane reviews, and 8 (21%) systematic reviews had a protocol published or registered prospectively. Nineteen (50%) of the reviews evaluated pain as the primary outcome, 18 (47%) evaluated disability as the primary outcome, 5 (13%) evaluated other primary outcomes and 18 (47%) did not define a primary outcome. Some reviews reported more than one primary outcome (e.g., pain and function). Table 1 describes the characteristics of the included systematic reviews in our study and separately according to the overall confidence in the results. In Table 1, we detailed the characteristics and the AMSTAR 2 assessment of each included systematic review.

### Overall confidence in the results of the systematic reviews

The overall confidence in the results of 28 reviews (74%) was rated as 'Critically low',<sup>13,36,37,39,40,42,44–52,54–62,65–67,69</sup> 6 reviews were rated as 'Low',<sup>29,41,43,53,63,68</sup> 1 review was rated as 'Moderate',<sup>38</sup> while 3 of 38 reviews (8%) were rated as 'High',<sup>10,11,64</sup> (Table 2). The assessment of the 16 items of AMSTAR 2 from each included systematic review is demonstrated in Table 3. The three systematic reviews rated as 'High' and the one rated as 'Moderate'<sup>38</sup> are Cochrane reviews and had a protocol prospectively published. The mean journal impact factor of the systematic reviews rated as 'Critically low' (1.7) was the lowest compared to the other reviews rated as 'Low' (3.2), 'Moderate' (2.8) and 'High' (5.9). The kappa coefficient for the inter-rater agreement of the AMSTAR 2 assessment was 0.73, which indicates substantial agreement.

Full details of the AMSTAR 2 assessment appear in Table 4. Reviews performed most poorly with respect to:

- explaining selection of the study designs (8%);
- reporting sources of funding for included studies (11%);

- assessing potential impact of risk of bias in individual studies on the results of the meta-analyses (13%);
- investigation of publication bias (21%); and
- establishing review methods prior to conduct of the review (21%).

## Discussion

The overall confidence in the results of systematic reviews that evaluated the effectiveness of exercise for people with chronic non-specific low back pain was 'critically low'. Specifically, reviews frequently lacked details on the selection of study designs for inclusion, often did not report the source of funding for included trials and did not assess the potential impact of the risk of bias on the results.

The motivation to conduct this study was that we expected to find a large number of systematic reviews of exercise for low back pain, but we were not sure about the overall confidence in the results of these reviews and consequently if their conclusions are reliable. Unfortunately, as demonstrated by our findings, the overall confidence of the included reviews of exercise for chronic low back pain was very low in general. This scenario is worrying, since exercise is one of the most consistently recommended interventions,<sup>70–73</sup> in the treatment of this high costly and disabling condition.<sup>74</sup> Clinical practice guidelines often base their recommendations in findings from systematic reviews. So, the overall confidence in the results of the systematic reviews is very important to generate unbiased estimates of treatment effects for decision making, alerting clinicians to based their conducts only on high-quality reviews. Understanding how well a systematic review has been conducted is essential for clinicians to determine if the findings are relevant and can be applied to clinical practice.<sup>16</sup>

In our study, the overall confidence in the results were rated as 'High' based on the AMSTAR 2 tool in only three (8%) systematic reviews.<sup>10,11,64</sup> This is consistent with the findings from Martins et al.<sup>75</sup> that reported only 7.5% of the reviews on surgical treatment of low back pain rated as 'Excellent' based on the original AMSTAR tool. In contrast to our findings, the study by Martins et al.<sup>75</sup> reported that, only 22.5% of the reviews were rated as 'very poor'. Oliveira et al.<sup>76</sup> evaluated the methodological quality of systematic reviews of physical therapy interventions using the AMSTAR tool, most of the reviews were rated as 'low' (median 3, 0–11 scale) for the orthopaedics PEDro subdiscipline.

The three systematic reviews in which the overall confidence in the results were rated as 'High' in our study evaluated the effectiveness of physical conditioning exercises,<sup>64</sup> Yoga<sup>11</sup> and Pilates<sup>10</sup> in LBP patients. In the review about physical conditioning, authors stated that the effect of intervention on sick leave for workers with LBP remains uncertain.<sup>64</sup> On the other hand, the reviews on Yoga and Pilates conclude that these types of exercises are effective in reducing pain and improving function in patients with LBP, but there is no robust evidence that they are superior to other forms of exercises.<sup>10,11</sup> These reviews highlighted that the decision to use any type of exercise may be based on patient's or clinician's preferences and costs. The only included systematic review rated as 'moderate' evaluated the effects of exercise therapy in general and also concluded

**Table 1** Summary of the characteristics of the 38 included systematic reviews.

	Total	AMSTAR rating			
		High	Moderate	Low	Critically Low
Number of reviews (%)	38	3 (8)	1 (2)	6 (16)	28 (74)
<i>Location, n (%)</i>					
North America	4 (11)	1 (25)	1 (25)	0 (0)	2 (50)
South America	4 (11)	1 (25)	0 (0)	0 (0)	3 (75)
Europe	14 (37)	1 (7)	0 (0)	3 (21)	10 (71)
Asia	4 (11)	0 (0)	0 (0)	0 (0)	4 (100)
Oceania	12 (32)	0 (0)	0 (0)	3 (25)	9 (75)
<i>Impact factor of the journal, mean (SD)</i>	2.3 (1.7)	5.9 (0.2)	2.8	3.2 (1.5)	1.7 (1.2)
<i>Cochrane review, n (%)</i>	5 (13)	3 (60)	1 (20)	1 (20)	0 (0)
<i>Funding, n (%)</i>	10 (26)	1 (10)	0 (0)	2 (20)	7 (70)
<i>Protocol published, n (%)</i>	8 (21)	3 (38)	1 (12)	3 (38)	1 (12)
<i>Number of included trials in the review, median (IQR)</i>	10 (6–15)	12 (11–19)	61	11 (6–17)	9 (5–14)
<i>Total sample size, median (IQR)</i>	813 (502–1585)	1080 (795–2742)	6390	966 (493–1586)	777 (479–1277)
<i>Type of exercise therapy, n (%)</i>					
General exercise	13 (34)	0 (0)	1 (8)	2 (15)	10 (77)
Motor control	7 (18)	0 (0)	0 (0)	2 (29)	5 (71)
Pilates	7 (18)	1 (14)	0 (0)	0 (0)	6 (86)
McKenzie	5 (13)	0 (0)	0 (0)	1 (20)	4 (80)
Yoga	3 (8)	1 (33)	0 (0)	0 (0)	2 (67)
Aerobic	3 (8)	1 (33)	0 (0)	0 (0)	2 (67)
Graded activity	2 (5)	0 (0)	0 (0)	1 (50)	1 (50)

IQR, Interquartile range.

that exercise was effective at reducing pain and improving function in patients with LBP.<sup>38</sup>

Our descriptive analysis showed that the systematic reviews with higher overall confidence in the results are Cochrane reviews and reviews with a registered protocol. This is consistent with previous studies that found that Cochrane reviews are generally better than non-Cochrane reviews.<sup>77,78</sup> Cochrane reviews typically use more rigorous methods, and consequently, are less vulnerable to bias and generally more conservative in their conclusions.<sup>79,80</sup> Further, reviews with protocol registration also generally yielded higher scores using the AMSTAR tool.<sup>76,81,82</sup> The proportion of reviews with protocol registration in our study was low (21%), which is in line with the low proportion (19%) of systematic review registered in the physical therapy field.<sup>76</sup> As occurred with randomized clinical trials, journal editors should stimulate change in editorial policies, requiring review authors to prospectively register their protocols on a database such as PROSPERO. Prospective registration of systematic reviews reduces the probability of bias in the review, since the authors report their methods and statistical analysis a priori, and improve the transparency of the research.<sup>83</sup> It is important to point out that some systematic reviews<sup>38,42,54,55,58,63,66,67</sup> with no registered protocol were performed before the publication of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement in 2009,<sup>84</sup> which first proposed the registry for

protocol of systematic reviews. Subsequently of PRISMA statement, PROSPERO was developed and implemented.

Despite a high proportion (82%) of reviews using appropriate methods for the risk of bias assessment, few of them considered the impact of the quality of included trials on their results. As trials with high risk of bias may overestimate the treatment effect, the results of these reviews should be interpreted with caution. Systematic reviewers should be aware that simply assessing risk of bias is not sufficient, its impact on the reviews' results should be assessed. It is important to say that that the quality of primary studies does not influence the quality of systematic reviews. The AMSTAR 2 does not look for the quality of primary studies. Its objective is to evaluate the methodological quality of systematic reviews, considering how well the systematic review was conducted (literature searching, pooling of data, etc.). Therefore, if a systematic review included primary studies with high risk of bias, but it was well conducted, this review tends to be rated as 'high quality'. Another important finding was the low proportion (21%) of systematic reviews that carried out an adequate investigation of publication bias. Studies with positive results are published more frequent and quickly than negative studies.<sup>85</sup> Systematic reviewers should always investigate if this kind of bias is present, decreasing the possibility of overestimation of treatment effects.



**Table 2** Characteristics detailed of each included systematic review.

Study	Country (location of corresponding author)	Cochrane (if it is a Cochrane review or not)	Funding (funding for conducting the review)	Protocol (if there is prospective registration or protocol publication)	Number of included studies in the review	Total sample size (number of participants included)	Meta analysis (if of meta-analyses were performed or not)	Intervention	Comparison
Bystrom 2013 <sup>45</sup>	Sweden	No	No	No	16	2675	Yes	Motor control exercise	General exercise, spinal manual therapy, multimodal physical therapy and minimal intervention
Chang 2015 <sup>36</sup>	Taiwan	No	Yes	No	4	173	No	Core strength training	Typical resistance training
Dunsford 2011 <sup>46</sup>	Australia	No	No	No	4	758	No	McKenzie therapy	Exercise, manual therapy, education and heat
Dvorak 2011 <sup>37</sup>	United States	No	No	No	4	682	No	Exercise therapy	Manual therapy
Gomes-Neto 2017 <sup>47</sup>	Brazil	No	No	No	11	1013	Yes	Motor control	General exercise and manual therapy
Gordon 2016 <sup>48</sup>	United Kingdom	No	Yes	No	14	743	No	Aerobic, motor control and flexibility exercises	Passive and active treatments
Hayden 2005 <sup>38</sup>	Canada	Yes	No	Yes	61	6390	Yes	Exercise therapy	No treatment, placebo, Other conservative therapies and other exercises
Hendrick 2010 <sup>49</sup>	New Zealand	No	No	No	4	311	No	Walking	Conventional therapy and No treatment
Hettinga 2007 <sup>50</sup>	United Kingdom	No	Yes	No	31	3953	No	Exercise therapy	Other treatments
Hilde 2013 <sup>51</sup>	Norway	No	No	No	9	932	No	Flexion and extension exercises	Standard treatments and No treatment
Hill 2013 <sup>52</sup>	United Kingdom	No	No	No	4	711	No	Yoga	Minimal intervention and physical therapy interventions
Kalin 2016 <sup>53</sup>	Switzerland	No	No	No	6	257	No	Sensory discrimination training	No treatment, placebo, exercise and passive treatment
Kool 2004 <sup>54</sup>	Netherlands	No	No	No	14	2796	Yes	Exercises	Usual care and passive therapies
Laird 2012 <sup>39</sup>	Australia	No	No	No	12	696	No	Movement based intervention	General exercise, spinal manipulation and No treatment

Table 2 (Continued)

Study	Country (location of corresponding author)	Cochrane (if it is a Cochrane review or not)	Funding (funding for conducting the review)	Protocol (if there is prospective registration or protocol publication)	Number of included studies in the review	Total sample size (number of participants included)	Meta analysis (if meta-analyses were performed or not)	Intervention	Comparison
Lawford 2016 <sup>56</sup>	Australia	No	No	Yes	7	869	No	Walking	Inactive interventions and Non-pharmacologic intervention
Lewis 2008 <sup>86</sup>	Australia	No	No	No	15	1695	No	Rehabilitation exercises, stabilization and other exercises	Manual therapy, surgery and other treatments
Liddle 2004 <sup>58</sup>	United Kingdom	No	Yes	No	16	1730	No	Strengthening, flexibility and cardiovascular exercises	No treatment, passive therapies, medication and other exercises
Lim 2011 <sup>59</sup>	Singapore	No	Yes	No	7	194	Yes	Pilates	Minimal or other interventions
Lin 2016 <sup>40</sup>	Taiwan	No	No	No	8	500	No	Pilates	Minimal intervention, No intervention and other exercises
Macedo 2010 <sup>41</sup>	Australia	No	No	Yes	15	1654	No	Graded activity	Minimal intervention and other exercises
Machado 2006 <sup>42</sup>	Australia	No	No	No	29	2431	Yes	McKenzie therapy	Passive therapies, advice, exercises, spinal manipulation and back school
McCaskey 2014 <sup>43</sup>	Switzerland	No	No	Yes	18	1380	No	Proprioceptive exercises	Inactive treatments, usual care, home based training, endurance, strengthening and stretching exercises
Merepeza 2014 <sup>44</sup>	Canada	No	No	No	3	796	No	Exercise therapy	Spinal manipulation
Miyamoto 2013 <sup>60</sup>	Brazil	No	No	No	8	363	Yes	Pilates	No treatment, minimal intervention and other interventions
Patti 2015 <sup>61</sup>	Italy	No	No	No	29	1373	No	Pilates	No treatment, minimal intervention and other exercises
Pereira 2012 <sup>62</sup>	Brazil	No	Yes	No	5	139	Yes	Pilates	Lumbar stabilization exercises

Table 2 (Continued)

Study	Country (location of corresponding author)	Cochrane (if it is a Cochrane review or not)	Funding (funding for conducting the review)	Protocol (if there is prospective registration or protocol publication)	Number of included studies in the review	Total sample size (number of participants included)	Meta analysis (if of meta-analyses were performed or not)	Intervention	Comparison
Rackwitz 2006 <sup>63</sup>	Germany	No	Yes	No	7	551	No	Stabilizing exercises alone or combined with other therapies	Other physical therapy interventions
Saragiotto 2016 <sup>29</sup>	Australia	Yes	Yes	No	29	2431	Yes	Motor control exercises	Minimal intervention, manual therapy and other exercises
Schaafsma 2013 <sup>64</sup>	Netherlands	Yes	No	Yes	25	4404	Yes	Physical conditioning exercises	Usual care
Searle 2015 <sup>65</sup>	Australia	No	No	No	45	4462	Yes	Exercise therapy	Wait list, usual care, electrotherapies, manual therapy
Slade 2006 <sup>66</sup>	Australia	No	No	No	15	903	Yes	Strengthening exercises	No exercises, other exercises and surgeries
Slade 2007 <sup>67</sup>	Australia	No	No	No	6	830	Yes	Unloaded movement facilitation exercises	Stabilization exercises, education, chiropractic and usual care
Surkitt 2012 <sup>68</sup>	Australia	No	No	Yes	6	474	No	Directional preference exercises	No treatment and other conservative treatments
Touche 2008 <sup>55</sup>	Spain	No	No	No	3	141	No	Pilates	Back school and No treatment
Van der Giesser 2012 <sup>69</sup>	Netherlands	No	No	No	10	680	No	Graded activity	Usual care, active physical treatments and wait list
Wang 2012 <sup>13</sup>	China	No	Yes	No	5	414	Yes	Core stability exercise	General exercise
Wieland 2017 <sup>11</sup>	United States	Yes	No	Yes	12	1080	Yes	Yoga	No exercise and other exercises
Yamato 2015 <sup>10</sup>	Brazil	Yes	Yes	Yes	10	510	Yes	Pilates	Minimal interventions and other exercises



**Table 3** AMSTAR 2 assessment of each included systematic review.

Study	AMSTAR 2 ITEMS																Overall rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Bystrom 2013 <sup>45</sup>	Yes	No	No	Partial Yes	Yes	No	No	Partial Yes	Yes	No	Yes	No	No	No	No	Yes	Critically low
Chang 2015 <sup>36</sup>	No	No	No	Partial Yes	Yes	No	No	No	Yes	No	No MA	No MA	No	No	No MA	Yes	Critically low
Dunsford 2011 <sup>46</sup>	Yes	No	No	Partial Yes	Yes	Yes	No	Partial Yes	Yes	No	No MA	No MA	No	No	No MA	Yes	Critically low
Dvorak 2011 <sup>37</sup>	Yes	No	No	Partial Yes	No	No	No	Yes	Yes	No	No MA	No MA	No	No	No MA	No	Critically low
Gomes-Neto 2017 <sup>47</sup>	Yes	No	No	Yes	Yes	Yes	Partial Yes	No	Yes	No	Yes	No	No	Yes	No	No	Critically low
Gordon 2016 <sup>48</sup>	No	No	No	Partial Yes	No	No	No	Partial Yes	No	No	No MA	No MA	No	No	No MA	Yes	Critically low
Hayden 2005 <sup>38</sup>	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Moderate
Hendrick 2010 <sup>49</sup>	No	No	No	Yes	Yes	Yes	No	Yes	Yes	No	No MA	No MA	Yes	No	No MA	No	Critically low
Hettinga 2007 <sup>50</sup>	No	No	No	No	No	Yes	No	Partial Yes	Yes	No	No MA	No MA	Yes	No	No MA	Yes	Critically low
Hilde 2013 <sup>51</sup>	No	No	No	Partial Yes	No	No	No	Yes	Partial Yes	No	No MA	No MA	Yes	Yes	No MA	No	Critically low
Hill 2013 <sup>52</sup>	No	No	No	Yes	No	No	Yes	Partial Yes	Yes	No	No MA	No MA	No	No	No MA	No	Critically low
Kalin 2016 <sup>53</sup>	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No MA	No MA	No	Yes	No MA	Yes	Low
Kool 2004 <sup>54</sup>	No	No	No	Partial Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No	Critically low
Laird 2012 <sup>39</sup>	No	No	No	Partial Yes	Yes	Yes	Yes	Partial Yes	Yes	No	No MA	No MA	No	No	No MA	Yes	Critically low
Lawford 2016 <sup>56</sup>	Yes	Yes	No	Yes	Yes	Yes	No	Partial Yes	Yes	No	No MA	No MA	No	Yes	No MA	Yes	Critically low
Lewis 2008 <sup>86</sup>	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No MA	No MA	No	No	No MA	No	Critically low
Liddle 2004 <sup>58</sup>	No	No	Yes	Partial Yes	No	No	No	Partial Yes	Yes	No	No MA	No MA	Yes	No	No MA	Yes	Critically low
Lim 2011 <sup>59</sup>	Yes	No	No	Partial Yes	Yes	No	Yes	No	Yes	No	Yes	No	No	Yes	Yes	Yes	Critically low
Lin 2016 <sup>40</sup>	No	No	No	Partial Yes	Yes	Yes	Partial Yes	Partial Yes	Yes	No	No MA	No MA	No	No	No MA	No	Critically low
Macedo 2010 <sup>41</sup>	Yes	Yes	No	Partial Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Low
Machado 2006 <sup>42</sup>	Yes	No	No	Yes	Yes	Yes	Partial Yes	Partial Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Critically low
McCaskey 2014 <sup>43</sup>	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	Yes	Low
Merepeza 2014 <sup>44</sup>	Yes	No	No	Partial Yes	No	No	No	Partial Yes	Yes	No	No MA	No MA	No	No	No MA	No	Critically low
Miyamoto 2013 <sup>50</sup>	Yes	No	No	Partial Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No	Critically low
Patti 2015 <sup>61</sup>	Yes	No	No	Partial Yes	Yes	Yes	No	No	No	No	No MA	No MA	No	No	No MA	Yes	Critically low

Table 3 (Continued)

Study	AMSTAR 2 ITEMS																Overall rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Pereira 2012 <sup>62</sup>	Yes	No	Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No	No	Yes	Critically low
Rackwitz 2006 <sup>63</sup>	Yes	No	No	Partial Yes	Yes	Yes	Yes	Partial Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	Yes	Low
Saragiotto 2016 <sup>29</sup>	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
Schaafsma 2013 <sup>64</sup>	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	High
Searle 2015 <sup>65</sup>	Yes	No	No	Yes	Yes	No	Yes	Partial Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Critically low
Slade 2006 <sup>66</sup>	Yes	No	No	Yes	No	Yes	No	No	Yes	No	Yes	No	No	No	No	No	Critically low
Slade 2007 <sup>67</sup>	Yes	No	No	Yes	No	No	Yes	Partial Yes	Yes	No	Yes	No	No	No	No	Yes	Critically low
Surkitt 2012 <sup>68</sup>	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	No MA	No MA	Yes	Yes	No MA	No	Low
Touche 2008 <sup>55</sup>	No	No	No	Partial Yes	Yes	Yes	No	Partial Yes	Yes	No	No MA	No MA	No	No	No MA	No	Critically low
Van der Giessen 2012 <sup>69</sup>	Yes	No	No	Yes	Yes	No	Yes	Partial Yes	Yes	No	No MA	No MA	No	No	No MA	Yes	Critically low
Wang 2012 <sup>13</sup>	Yes	No	No	Partial Yes	Yes	Yes	Partial Yes	Partial Yes	Yes	No	Yes	No	Yes	No	No	Yes	Critically low
Wieland 2017 <sup>11</sup>	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High
Yamato 2015 <sup>10</sup>	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High

Items: (1) Did the research questions and inclusion criteria for the review include the components of PICO?; (2) Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?; (3) Did the review authors explain their selection of the study designs for inclusion in the review?; (4) Did the review authors use a comprehensive literature search strategy?; (5) Did the review authors perform study selection in duplicate?; (6) Did the review authors perform data extraction in duplicate?; (7) Did the review authors provide a list of excluded studies and justify the exclusions?; (8) Did the review authors describe the included studies in adequate detail?; (9) Did the review authors use a satisfactory technique for assessing the RoB in individual studies that were included in the review?; (10) Did the review authors report on the sources of funding for the studies included in the review?; (11) If MAs was performed did the review authors use appropriate methods for statistical combination of results?; (12) If MAs was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the MAs or other evidence synthesis?; (13) Did the review authors account for RoB in individual studies when interpreting/ discussing the results of the review?; (14) Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?; (15) If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias and discuss its likely impact on the results of the review?; (16) Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?

AMSTAR, Assessing the Methodological Quality of Systematic Reviews; MA, meta-analysis; RoB, risk of bias.

**Table 4** Overall confidence assessment (AMSTAR 2 tool) of the 38 included systematic review.

AMSTAR 2 ITEMS	Yes <i>n</i> (%)	Partial yes <i>n</i> (%)	No <i>n</i> (%)	No MA <i>n</i> (%)
1. Did the research questions and inclusion criteria for the review include the components of PICO?	27 (71)	-	11 (29)	-
<b>2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?</b>	<b>8 (21.1)</b>	<b>0 (0)</b>	<b>30 (78.9)</b>	-
3. Did the review authors explain their selection of the study designs for inclusion in the review?	3 (7.9)	-	35 (82.1)	-
<b>4. Did the review authors use a comprehensive literature search strategy?</b>	<b>19 (50)</b>	<b>18 (47.4)</b>	<b>1 (2.6)</b>	-
5. Did the review authors perform study selection in duplicate?	28 (73.7)	-	10 (26.3)	-
6. Did the review authors perform data extraction in duplicate?	23 (60.5)	-	15 (39.5)	-
<b>7. Did the review authors provide a list of excluded studies and justify the exclusions?</b>	<b>16 (42.1)</b>	<b>4 (10.5)</b>	<b>18 (47.4)</b>	-
8. Did the review authors describe the included studies in adequate detail?	14 (36.8)	17 (44.7)	7 (18.5)	-
<b>9. Did the review authors use a satisfactory technique for assessing the RoB in individual studies that were included in the review?</b>	<b>35 (82.1)</b>	<b>1 (2.6)</b>	<b>2 (5.3)</b>	-
10. Did the review authors report on the sources of funding for the studies included in the review?	4 (10.5)	-	34 (89.5)	-
<b>11. If MAs was performed did the review authors use appropriate methods for statistical combination of results?</b>	<b>17 (44.7)</b>	-	-	<b>21 (55.3)</b>
12. If MAs was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the MAs or other evidence synthesis?	5 (13.2)	-	12 (31.6)	21 (55.3)
<b>13. Did the review authors account for RoB in individual studies when interpreting/ discussing the results of the review?</b>	<b>15 (39.5)</b>	-	<b>23 (60.5)</b>	-
14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	16 (42.1)	-	22 (57.9)	-
<b>15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias and discuss its likely impact on the results of the review?</b>	<b>8 (21.1)</b>	-	<b>9 (23.6)</b>	<b>21 (55.3)</b>
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	25 (65.8)	-	13 (34.2)	-

AMSTAR, Assessing the Methodological Quality of Systematic Reviews; MA, meta-analysis; RoB, risk of bias. Items in bold are the item considered as critical domains in the AMSTAR 2.

Strengths of included systematic reviews should also be highlighted. Around 70% of the reviews defined adequately the research questions and inclusion criteria, using the PICO (problem, intervention, comparison and outcomes) components. Most of reviews also performed study selection (74%) and data extraction (60%) in duplicate, and only 1 review<sup>50</sup> did not use a comprehensive literature search strategy.

Our results are limited to systematic reviews in the field of exercise therapy for patients with chronic low back pain. Therefore, the scenario for other types of interventions for a wide range of health conditions is still unknown. More studies are needed in order to externally validate our findings using different sets of reviews, conditions and interventions.

In conclusion, the findings of our study demonstrate very low overall confidence in the results of most systematic reviews of exercise in chronic non-specific low back pain. Our study highlights the need to improve the quality of systematic reviews in this field, to avoid biased recommendations for clinical decision making.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Conflicts of interest

The authors declare no conflicts of interest.

## Appendix A. Search strategy for each database

### Pubmed

- 1 dorsalgia.ti,ab,kw.
- 2 exp Back Pain/
- 3 "backache" ti,ab
- 4 (lumbar adj pain) ti,ab
- 5 coccyx.ti,ab
- 6 coccydynia.ti,ab
- 7 sciatica.ti,ab
- 8 exp sciatic neuropathy/
- 9 "spondylosis" ti,ab
- 10 "lumbago" ti,ab
- 11 lumbago.ti,ab,kw.
- 12 (disc adj degeneration) ti,ab
- 13 (disc adj prolapse) ti,ab
- 14 (disc adj herniation) ti,ab
- 15 OR / #1-14
- 16 systematic review /
- 17 meta-analysis /
- 18 (#16 OR #17)
- 19 (#15 AND #19)

### Embase

- 1 dorsalgia.ti,ab,kw.
- 2 (back pain or backache or back ache).ti,ab,kw.
- 3 exp LOW BACK PAIN/
- 4 exp BACKACHE/
- 5 (lumb\$ adj3 pain).ti,ab,kw.

- 6 coccyx.ti,ab,kw.
- 7 coccydynia.ti,ab,kw.
- 8 sciatica.ti,ab,kw.
- 9 sciatica/
- 10 exp ISCHIALGIA/
- 11 spondylosis.mp.
- 12 lumbago.ti,ab,kw.
- 13 back disorder\$.ti,ab,kw.
- 14 or/1-13
- 15 systematic review /
- 16 meta-analysis /
- 17 (#15 OR #16)
- 18 (#14 AND #17)

### Cochrane Database of Systematic Reviews

- #1 MeSH descriptor: [Back Pain] explode all trees
- #2 dorsalgia
- #3 backache or back ache
- #4 MeSH descriptor: [Back Pain] explode all trees
- #5 lumb\* near pain or coccyx or coccydynia or sciatica or spondylosis
- #6 MeSH descriptor: [Spine] explode all trees
- #7 MeSH descriptor: [Spinal Diseases] explode all trees
- #8 lumbago or discitis or disc near herniat\*
- #9 spinal fusion
- #10 facet near joint\*
- #11 MeSH descriptor: [Intervertebral Disk] explode all trees
- #12 postlaminectomy
- #13 arachNoiditis
- #14 failed near back
- #15 MeSH descriptor: [Cauda Equina] explode all trees
- #16 lumb\* near vertebra\*
- #17 spinal near steNosis
- #18 slipped near (disc\* or disk\*)
- #19 degenerat\* near (disc\* or disk\*)
- #20 steNosis near (spine or root or spinal)
- #21 displace\* near (disc\* or disk\*)
- #22 prolap\* near (disc\* or disk\*)
- #23 MeSH descriptor: [Sciatic Neuropathy] explode all trees
- #24 sciatic\*
- #25 back disorder\*
- #26 back near pain
- #27 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26)
- #28 systematic review
- #29 meta-analysis
- #30 (#28 or #29)
- #31 (#27 AND #30)

### PEDro

Problem: Pain  
AND  
Body Part: lumbar spine, sacro-iliac joint or pelvis  
AND  
Method: systematic review

### CINAHL

- S1 "lumbago"
- S2 (MH "Spondylolisthesis") OR (MH "Spondylolysis")
- S3 (MH "Thoracic Vertebrae")

S4 S1 or S2 or S3  
 S5 lumbar N2 vertebra  
 S6 (MH "Lumbar Vertebrae")  
 S7 "coccydynia"  
 S8 "coccyx"  
 S9 "sciatica"  
 S10 (MH "Sciatica")  
 S11 (MH "Coccyx")  
 S12 S5 or S6 or S7 or S8 or S9 or S10 or S11  
 S13 backache or "back ache"  
 S14 lumb\* W3 pain  
 S15 back pain  
 S16 (MH "Low Back Pain")  
 S17 (MH "Back Pain")  
 S18 "dorsalgia"  
 S19 S13 S14 or S15 or S16 or S17 or S18 or S34  
 S20 S4 or S12 or S19  
 S21 systematic review  
 S22 meta-analysis  
 S23 S21 or S22  
 S24 S20 and S23

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