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Exercise therapy for chronic nonspecific low-back pain

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Exercise therapy is the most widely used type of conservative treatment for low back pain. Systematic reviews have shown that exercise therapy is effective for chronic but not for acute low back pain. During the past 5 years, many additional trials have been published on chronic low back pain. This articles aims to give an overview on the effectiveness of exercise therapy in patients with low back pain.

For this overview, existing Cochrane reviews for the individual interventions were screened for studies fulfilling the inclusion criteria, and the search strategy outlined by the Cochrane Back Review Group (CBRG) was followed. Studies were included if they fulfilled the following criteria: (1) randomised controlled trials,(2) adult (≥18 years) population with chronic (≥12 weeks) nonspecific low back pain and (3) evaluation of at least one of the main clinically relevant outcome measures (pain, functional status, perceived recovery or return to work).

Two reviewers independently selected studies and extracted data on study characteristics, risk of bias and outcomes at short-term, intermediate and long-term follow-up. The GRADE approach (GRADE, Grading of Recommendations Assessment, Development and Evaluation) was used to determine the quality of evidence.

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In total, 37 randomised controlled trials met the inclusion criteria and were included in this overview. Compared to usual care, exercise therapy improved post-treatment pain intensity and disability, and long-term function.
The authors conclude that evidence from randomised controlled trials demonstrated that exercise therapy is effective at reducing pain and function in the treatment of chronic low back pain. There is no evidence that one particular type of exercise therapy is clearly more effective than others. However, effects are small and it remains unclear which subgroups of patients benefit most from a specific type of treatment.

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Low back pain (LBP) is usually defined as pain, muscle tension or stiffness localised below the costal margin and above the inferior gluteal folds, with or without leg pain (sciatica). LBP is typically classified as being 'specific' or 'nonspecific'. Specific LBP refers to symptoms (such as hernia nucleus pulposus (HNP), infection, inflammation, osteoporosis, rheumatoid arthritis, fracture or tumour) caused by a specific patho-physiologic mechanism.. Only in about 10% of the patients specific underlying diseases can be identified [1]. The vast majority of patients (up to 90%) are labelled as having nonspecific LBP, which is defined as symptoms without a clear specific cause, that is, LBP of unknown origin. Spinal abnormalities on X-rays and magnetic resonance imaging (MRI) are not strongly associated with nonspecific LBP, because many people without any symptoms also show these abnormalities [2].

Nonspecific LBP is usually classified according to the duration as acute (less than 6 weeks), sub-acute (between 6 weeks and 3 months) or chronic (longer than 3 months) LBP. In general, prognosis is good and most patients with an episode of nonspecific LBP will recover within a couple of weeks. However, back pain among primary-care patients is often a recurrent problem with fluctuating symptoms. The majority of back pain patients would have experienced a previous episode and acute exacerbations of chronic LBP are common. LBP is not only a tremendous medical problem, but also a huge socioeconomic problem in Western countries due to high rates of disability and work absenteeism [3]. It is important to provide effective and cost-effective interventions to improve patient outcomes and receive maximum benefits within available health-care budgets.

Evidence-based medicine has become increasingly more important over the past decade. The management of LBP has been positively affected by the availability of more scientific research and better use of critical appraisal techniques to evaluate and apply research findings [4]. A large number of systematic reviews are available within and outside the framework of the Cochrane Back Review Group that have evaluated the therapeutic interventions for LBP [5,6]. This large body of evidence has greatly improved our understanding of what does and does not work for LBP. The evidence from trials and reviews has formed the basis for clinical practice guidelines on the management of LBP that have been developed in various countries around the world.

The management of LBP comprises a range of different intervention strategies, including surgery, drug therapy and non-medical interventions. Exercise therapy is probably the most widely used type of conservative treatment worldwide. This article summarises the state-of-the-art exercise therapy for LBP. Exercise therapy might be provided as a single treatment or be part of a multimodal or multidisciplinary treatment programme. Physiotherapists or specifically trained exercise therapists usually provide exercise therapy. Some differences may exist between countries. For example, in the Netherlands and Norway Mensendieck, therapists are officially registered exercise therapists. Exercise therapy may be given individually or to groups of patients, under therapist's supervision or consist of home exercises, conducted using machines or not and on land or in water. In addition, various types of exercises exist, such as aerobic, flexion, extension, stretching, stabilising, balance/coordination and muscle-strengthening exercises. Moreover, in the latter group, the exercises may focus on specific muscles (e.g., transversus abdominus or multifidus) or a group of muscles (e.g., trunk, abdomen and back). Finally, exercises may vary in intensity, frequency and duration.

Exercises for prevention of LBP

Nine reviews have been published that evaluated different types of physical exercise interventions in the prevention of LBP. The reviews are essentially based on the same studies, although the most recent reviews also included some recent trials. Eight reviews concluded that there is some evidence of effect of exercise, but effect sizes were reported to be small to moderate [7–14]. One review concluded that there was contradictory evidence that various general exercise/physical fitness programmes reduce future LBP and work loss, and that any effect size was modest [15].

The two most recent systematic reviews of randomised trials on exercises for prevention of LBP had somewhat different conclusions. One review on prevention at the workplace found strong evidence that exercise was effective in reducing the severity and activity interference from LBP and found limited evidence supporting the use of exercise to prevent LBP episodes [7].

Another recent review included studies on prevention of back pain not only at the workplace but also in any setting. The review found strong, consistent evidence to guide prevention of LBP episodes in working-age adults. The authors concluded that there is strong, consistent evidence that exercises are effective, while other interventions are not, including stress management, shoe inserts, back supports, ergonomic/back education and reduced lifting programmes [8].

The studies covered in the reviews included a variety of participants, used different exercise schedules and measured a variety of health outcomes (e.g., duration and intensity of pain, disability and work loss). The occupational populations varied widely and included military staff, nursing staff and hospital employees, airline workers, office workers, postal workers, factory staff, railroad workers and copper smelter employees. The control groups received either no intervention or information and advice. The frequency and duration of the intervention programmes varied substantially, ranging from an intensive ‘block’ programme (8 h daily for 5 weeks) to exercise sessions once per week for 18 months. The contents included instructions for back extensor training followed by regular training sessions for 13 months, training of trunk flexors and general aerobic exercise.

All randomised trials were performed at the workplace or performed in work-specific cohorts, but the contents of the programmes were not described as workplace specific and (in principle) could be performed at the population level.

Most reviews concluded that exercise is effective in the prevention of LBP in working-adults and at the workplace, but there is no consensus on the strength of the evidence. Some reviews concluded that most studies were of high quality and have a low risk of bias [8], while others concluded that there were various limitations and a high risk of bias in most studies [7]. In conclusion, although exercise is widely used at the workplace to prevent LBP, the evidence is not yet consistent and convincing. Future trials are needed that should focus on identifying specific types and doses of exercise for specific populations.

Acute LBP

The Cochrane review by Hayden et al [16]. included 11 trials (1192 subjects) on exercise therapy for acute LBP. None of the randomised controlled trials (RCTs) found exercise therapy in health-care settings to be effective for acute LBP. The meta-analysis showed no difference in short-term pain relief between exercise therapy and no treatment (three trials), with an effect of −0.59 points on a 100-point scale (95% confidence interval (CI), −12.69–11.51), and between exercise and other conservative treatments (seven trials), with an effect of 0.31 points (95% CI, −0.10–0.72). Similarly, there were no significant differences on functional outcomes. The authors found that independent exercise programmes (i.e., home exercises) were less effective than the comparison group. Results were unclear or there were no differences between therapist-delivered exercise programmes and the comparison group (most commonly including advice to stay active). The authors concluded that there is strong evidence that exercise therapy is not more effective than no treatment or other conservative treatments for acute LBP.

Two recent papers summarised the quality and content of 25 international clinical guidelines on the management of LBP [17,18]. There seems to be consensus about the optimal management for acute LBP.

Recommendations for the treatment of acute LBP were rather consistent among the various international guidelines:

- reassure patients on the favourable prognosis, if available, and provide printed patient information;
- advise patients to stay active;
- discourage bed rest;
- prescribe medication if necessary (preferably time contingent):
  - o paracetamol/acetaminophen,
  - o non-steroidal anti-inflammatory drugs;
- if patients do not improve, spinal manipulation is an option for pain relief.

Exercise therapy was not recommended for acute LBP in any of the guidelines.

Chronic LBP

Since the publication of the Cochrane review by Hayden et al. in 2005 [16], many additional trials have been published on exercise therapy for chronic LBP. In this section, we describe the results of all randomised trials on exercise therapy for chronic LBP. We included all trials of the Cochrane review and updated the search in MEDLINE, EMBASE, CINAHL, CENTRAL and PEDro up to 22 December 2008. The search strategy outlined by the Cochrane Back Review Group (CBRG) was followed. The following were included: (1) RCTs,(2) adult (≥18 years) population with chronic (≥12 weeks) nonspecific LBP and (3) evaluation of at least one of the main clinically relevant outcome measures (pain, functional status, perceived recovery or return to work). Two reviewers independently selected additional studies and extracted data on study characteristics, risk of bias and outcomes at short-term, intermediate and long-term follow-up. The GRADE approach (GRADE, Grading of Recommendations Assessment, Development and Evaluation) was used to determine the quality of evidence.

Thirty-seven studies (3957 patients) were included [19–55]. Multiple publications were found for Bendix et al. 1995[6] and 1998 [56,57], Gudavalli et al. [31,58,59], Niemistö et al. [40,60], and Smeets et al [46,61]. Information from all publications was used for the assessment of risk of bias and data extraction; however, only the first or most prominent publication was used for citation of these studies.

The results of the risk of bias assessment are shown in Table 1. All studies were described as randomised; however, the method of randomisation was only explicit in 75.7% ($n = 28$) of the studies. Only 15 studies (40.5%) met six or more of the criteria, which was our pre-set threshold for low risk of bias. Only the criteria regarding the baseline characteristics, timing of outcome measures and description of dropouts were met by 50% or more of the included randomised trials. A summary of effect estimates for exercise therapy in chronic low back pain patients is presented in Table 2.

Exercise therapy versus waiting list controls/no treatment

Eight studies[19,28,29,41,45,46,48,53] were identified as comparing some type of exercise therapy to waiting list controls or no treatment. Five studies reported post-treatment data only, because after the treatment period the waiting list controls also received the treatment. Only two studies[19,46] had intermediate or long-term follow-up.

The pooled mean differences were not statistically significant on post-treatment pain intensity (−4.51 (95%CI–9.49; 0.47)), post-treatment improvement in disability (−3.63 (95%CI–8.89; 1.63)) and pain intensity at intermediate follow-up (−16.46 (95%CI–44.48; 11.57)). Only one study (102 people) reported intermediate outcomes for disability and long-term outcomes for pain intensity and disability. There were no differences between the group receiving exercise therapy and the waiting list control group [46].

Therefore, there is low-quality evidence (serious limitations and imprecision) that there is no statistically significant difference in pain reduction and improvement of disability between exercise therapy and no treatment/waiting list controls for patients with chronic LBP.

Table 1
Risk of Bias of studies investigating exercise therapy for chronic low back pain.

Author, year	Randomisation adequate?	Allocation concealed?	Groups similar at baseline?	Patient blinded?	Care provider blinded?	Outcome assessor blinded?	Co-interventions avoided or similar?	Compliance acceptable?	Drop-out rate described and acceptablel?	Timing outcome assessment similar?	Intention-to-treat analysis?	TOTAL SCORE
Alexandre, 2001	?	+	+	–	–	?	?	?	+	+	+	**5**
Bendix, 1995	+	–	+	–	–	+	+	+	+	+	–	**7**
Chatzitheodorou, 2007$	+	?	+	–	–	?	?	?	?	+	–	**3**
Chown, 2008	+	?	+	–	–	–	?	–	–	+	–	**3**
Critchley, 2007$	+	+	+	–	–	–	?	–	–	+	+	**5**
Deyo, 1990	+	+	+	–	–	+	+	+	+	+	–	**8**
Donzelli, 2006$	?	?	?	+	–	+	?	–	?	+	?	**3**
Elnagger, 1991	+	+	+	–	–	+	–	–	–	+	+	**6**
Ferreira, 2007$	+	+	+	–	–	–	+	+	+	+	+	**8**
Frost, 1995 (1998)	+	+	+	–	–	+	–	+	+	+	+	**8**
Galantino, 2004	+	?	?	–	–	–	–	?	–	+	–	**2**
Gladwell, 2006$	?	?	–	–	–	–	?	+	–	+	–	**3**
Goldby, 2006$	+	?	–	–	–	+	?	–	+	+	?	**4**
Gudavalli, 2006$	+	+	+	–	–	+	?	?	–	+	+	**6**
Gur, 2003	?	?	+	–	–	–	?	?	–	+	+	**4**
Harts, 2008	+	+	+	–	–	–	?	+	–	+	+	**6**
Hildebrandt, 2000	+	+	+	–	–	–	+	–	–	+	+	**6**
Johannsen, 1995	–	?	?	–	–	–	–	–	–	+	–	**1**
Kankaanpaa, 1999	+	+	+	–	–	–	–	+	+	+	–	**6**
Koldas, 2008	+	?	+	–	–	–	?	?	+	+	?	**3**
Lewis, 2005$	+	?	–	–	–	+	+	+	+	+	+	**7**
Machado, 2007$	+	?	+	–	–	+	?	–	–	+	+	**5**
Mannion, 1999	+	+	+	+	+	+	+	+	+	+	+	**11**
Marschall, 2008$	?	?	+	–	–	?	?	?	+	+	–	**3**
Niemisto, 2003(2005)	+	+	+	–	–	–	+	+	+	+	+	**8**
Risch, 1993	–	–	+	–	–	–	–	–	+	+	+	**4**
Rittweger, 2002	+	+	+	–	–	–	?	?	+	+	–	**5**
Roche, 2007$	+	?	+	?	–	–	?	?	+	+	?	**4**
Sherman, 2005$	+	+	+	–	–	+	+	+	+	+	+	**8**
Sjögren, 2006$	?	?	?	?	–	?	+	+	+	+	?	**4**
Smeets, 2006$ (2008)	+	+	+	–	–	+	+	+	+	+	+	**9**

(*continued on next page*)

Table 1 (*continued*)

Author, year	Randomisation adequate?	Allocation concealed?	Groups similar at baseline?	Patient blinded?	Care provider blinded?	Outcome assessor blinded?	Co-interventions avoided or similar?	Compliance acceptable?	Drop-out rate described and acceptablel?	Timing outcome assessment similar?	Intention-to-treat analysis?	TOTAL SCORE
Tekur, 2008	+	+	+	–	–	–	?	?	+	?	?	**4**
Tritilanunt, 2001	+	?	+	–	–	–	?	?	+	+	–	**4**
Turner, 1990	+	+	+	–	–	–	–	–	–	+	–	**4**
Williams, 2005$	+	?	+	–	–	?	+	?	–	+	?	**4**
Yelland, 2004	+	+	+	–	–	–	+	+	+	+	+	**8**
Yozbatiran, 2004	?	?	+	–	–	–	?	+	+	+	+	**5**

'+' Fulfils criteria;
'-' did not fulfil criteria
'?' unclear whether this item fulfils criteria.
$ New studies (not included in Cochrane review Hayden et al. 2005)

Table 2
Summary effect estimates for exercise therapy in chronic low back pain patients.

Outcome or Subgroup	Studies	Participants	Statistical Method	Effect Estimate
A1. Exercise versus no treatment/sham/placebo/waiting list controls				
A1.1 Pain post-treatment	5	268	Mean Difference (IV, Random, 95% CI)	−4.51 [−9.49, 0.47]
A1.2 Disability post-treatment	6	331	Mean Difference (IV, Random, 95% CI)	−3.63 [−8.89, 1.63]
A1.3 Pain during intermediate follow-up	2	137	Mean Difference (IV, Random, 95% CI)	−16.46 [−44.48, 11.57]
A2. Exercise therapy versus usual care				
A2.1 Pain post-treatment	2	108	Mean Difference (IV, Random, 95% CI)	−9.23 [-16.02, -2.43]
A2.2 Disability post-treatment	3	188	Mean Difference (IV, Random, 95% CI)	−12.35 [−23.00, -1.69]
A2.3 Disability during intermediate follow-up	2	267	Mean Difference (IV, Random, 95% CI)	−9.23 [−16.02, −2.43]
A2.4 Pain at long-term (12 months) follow-up	2	301	Mean Difference (IV, Random, 95% CI)	−9.23 [−16.02, −2.43]
A2.5 Disability at long-term (12 months) follow-up	3	377	Mean Difference (IV, Random, 95% CI)	−9.23 [−16.02, −2.43]
A3. Exercise therapy versus back school/education				
A3.1 Disability post-treatment	2	139	Mean Difference (IV, Random, 95% CI)	−9.23 −16.02, −2.43]
A3.2 Pain at short-term (3 months) follow-up	3	200	Mean Difference (IV, Random, 95% CI)	−9.23 [−16.02, −2.43]
A3.4 Disability after short-term (3 months) follow-up	3	200	Mean Difference (IV, Random, 95% CI)	−9.23 [−16.02, −2.43]
A3.5 Pain at intermediate (6 months) follow-up	2	141	Mean Difference (IV, Random, 95% CI)	−9.23 [−16.02, −2.43]
A3.6 Disability at intermediate (6 months) follow-up	3	241	Mean Difference (IV, Random, 95% CI)	−4.42 [−9.90, 1.05]
A4. Exercise versus behavioral treatment				
A4.1 Pain post-treatment	2	146	Mean Difference (IV, Random, 95% CI)	1.21 [−5.42, 7.84]
A4.2 Disability post-treatment	2	146	Mean Difference (IV, Random, 95% CI)	0.34 [−2.64, 3.31]
A4.3 Pain during intermediate follow-up	3	258	Mean Difference (IV, Random, 95% CI)	-2.23 [−7.58, 3.12]
A4.4 Disability during intermediate follow-up	3	258	Mean Difference (IV, Random, 95% CI)	1.97 [−3.55, 7.48]
A4.5 Pain during long-term follow-up	3	247	Mean Difference (IV, Random, 95% CI)	-0.88 [-6.34, 4.58]
A4.6 Disability during long-term follow-up	3	243	Mean Difference (IV, Random, 95% CI)	2.77 [−3.43, 8.96]
A5 Exercise versus TENS/Laser/passive modalities				
A5.1 Pain post-treatment	5	286	Mean Difference (IV, Random, 95% CI)	−9.33 [−18.80, 0.13]
A5.2 Disability post-treatment	5	286	Mean Difference (IV, Random, 95% CI)	−2.59 [−8.03, 2.85]
A5.3 Pain during short-term follow-up	2	162	Mean Difference (IV, Random, 95% CI)	1.72 [−6.05, 9.50]
A5.4 Disability during short-term follow-up	2	162	Mean Difference (IV, Random, 95% CI)	1.02 [−0.38, 2.42]
A6. Exercise versus manipulation/manual therapy				
A6.1 Pain post-treatment	3	395	Mean Difference (IV, Random, 95% CI)	5.67 [1.99, 9.35]
A6.2 Disability post-treatment	3	398	Mean Difference (IV, Random, 95% CI)	2.16 [−0.96, 5.28]
A6.3 Pain during short-term follow-up	2	326	Mean Difference (IV, Random, 95% CI)	-1.33 [−10.44, 7.79]
A6.4 Disability during short-term follow-up	2	326	Mean Difference (IV, Random, 95% CI)	0.29 [-3.15, 3.72]
A6.5 Pain during intermediate follow-up	3	461	Mean Difference (IV, Random, 95% CI)	-0.49 [−12.22, 11.23]
A6.6 Disability during intermediate follow-up	3	461	Mean Difference (IV, Random, 95% CI)	2.38 [−5.16, 9.93]
A6.7 Pain during long-term follow-up	4	515	Mean Difference (IV, Random, 95% CI)	2.09 [−2.94, 7.13]
A6.8 Disability during long-term follow-up	5	553	Mean Difference (IV, Random, 95% CI)	−0.70 [−3.14, 1.74]

Exercise therapy versus usual care

A total of six studies[27,33,40,50,54,55] investigated the effect of exercise therapy compared to usual care. Four of these studies had an intermediate or long-term follow-up. Statistical pooling of three studies[27,54,55] showed a significant decrease in pain intensity and disability in favour of the exercise group (weighted mean difference (WMD)−9.23 (95%CI–16.02;−2.43) and−12.35 (95%CI–23.00;−1.69)), respectively. One study[54] reported on pain and disability at short-term follow-up, and found no statistically significant differences between the exercise group and the control group receiving home exercises. Two studies[27,40] showed a statistically significant pooled WMD for disability at intermediate follow-up of−5.43 (95%CI–9.54;–1.32). One study[40] found a statistically significant difference at intermediate follow-up for pain relief for the exercise group compared to the usual care group. Three studies[27,50,60] reported on pain and/or disability at long-term follow-up. The pooled WMD for pain was not statistically significant (−4.94 (95%CI–10.45; 0.58)); the WMD for disability was statistically significant in favour of the exercise group (WMD–3.17 (95%CI–5.96;−0.38)).

One study[33] reported recovery at post-treatment and during intermediate and long-term follow-up. There was a statistically significant difference between the groups at 3 and 6 months follow-up in favour of the exercise group compared with usual care ($p < 0.001$). Eighty percent of the patients in the exercise group regarded themselves recovered at 3 months follow-up as compared to 47% in the usual care group.

There is low-quality evidence (serious limitations and imprecision) for the effectiveness of exercise therapy compared to usual care on pain intensity and disability.

Exercise therapy versus back school/education

Three studies with a high risk of bias were identified [24,30,49]. Post-treatment results for disability were reported in two studies, with a significant pooled WMD of−11.20 (95%CI–16.78;−5.62). One study reported on pain post-treatment and found no statistically significant difference between both intervention groups [49]. The pooled mean differences for pain and disability at 3 months follow-up were−7.63 (95%CI–17.20; 1.93) and−2.55 (95%CI–10.07; 4.97), respectively.

Two studies[24,30] reported intermediate outcomes on pain and three studies[24,30,44] reported on disability. The pooled WMDs showed no statistically significant differences between the groups:−5.58 (95%CI–16.65; 5.48) and–4.42 (95%CI–9.90; 1.05), respectively. Only one study ($n = 346$) reported long-term outcomes, and these were not statistically significantly different between the groups [30].

The data provided very low quality evidence (serious limitations, imprecision and inconsistency) that there was no statistically significant difference in effect on pain and disability at short-term and intermediate follow-up for exercise therapy compared to back school/education.

Exercise therapy versus behavioural treatment

Three studies, one with a low risk of bias, were identified comparing exercise therapy with a behavioural treatment. [8,32,34] Two studies reported post-treatment pain and disability, and the pooled WMDs were 1.21 (95%CI–5.42; 7.84) and 0.34 (95%CI–2.64; 3.31), respectively.

All three studies reported intermediate and long-term follow-up on pain intensity and disability. For intermediate follow-up, the pooled WMDs for pain and disability were−2.23 (95%CI–7.58; 3.12) and 1.97 (95%CI–3.55; 7.48), respectively. Long-term results showed a pooled WMD for pain intensity of−0.88 (95%CI–6.34; 4.58) and a pooled WMD for disability of 2.77 (95%CI–3.43; 8.96).

There is low-quality evidence (serious limitations and imprecision) that there are no statistically significant differences between exercise therapy and behavioural therapy on pain intensity and disability at short- and long-term follow-up.

Exercise therapy versus transcutaneous electrical nerve stimulation/laser therapy/ultrasound/massage

Five studies, two with a low risk of bias, were identified comparing exercise therapy with passive therapies: transcutaneous electrical nerve stimulation (TENS), low-level laser therapy, ultrasound, thermal therapy and ultrasound [21,23,32,35,54]. The pooled WMDs for post-treatment pain intensity and post-treatment disability were−9.33 (95%CI–18.80; 0.13) and−2.59 (95%CI–8.03; 2.85), respectively. Two studies[23,54] reported on short-term pain intensity and disability, and the pooled mean differences were 1.72 (95%CI–6.05; 9.50) and 1.02 (95%CI–0.38; 2.42), respectively. One study with a low risk of bias[35] reported intermediate and long-term outcomes, and found a statistically significant difference for pain intensity of 16.8 and 21.2 points, respectively, in favour of exercise therapy. In addition, a statistically significant difference was found for disability.

Low-quality evidence (serious limitations, inconsistency and imprecision) that there is no statistically significant difference in effect between exercise therapy compared to TENS/laser/ultrasound/massage on the outcomes pain and disability at short-term follow-up has been provided.

Exercise therapy versus spinal manipulation

Five studies, two with a low risk of bias, were identified comparing exercise treatment with spinal manipulation or manual therapy [26,30,31,39,52]. Post-treatment data were available for three studies. The pooled WMDs for pain intensity and disability were 5.67 (95%CI 1.99; 9.35) and 2.16 (95%CI–0.96; 5.28), respectively. One study reported a statistically significant difference in global perceived effect post-treatment[26] in favour of spinal manipulation. Two studies reported short-term effects on pain intensity and disability, and the pooled WMDs were−1.33 (95%CI–10.11; 7.79) and 0.29 (95%CI–3.15; 3.72), respectively [30,31]. Intermediate results on pain and disability were reported by three studies[26,30,31], and the pooled WMDs were–0.49 (95%CI–12.22; 11.23) and 2.38 (95%CI–5.16; 9.93), respectively. All the studies reported long-term results on disability and the pooled WMD–0.70 (95%CI−3.14; 1.74). Four studies reported long-term results on pain intensity, and the pooled WMD was 2.09 (95%CI–2.94; 7.13). Global perceived effect was reported by one study during intermediate and long-term follow-up. No statistically significant between-group differences were found in this study [26].

The data provided low-quality evidence (inconsistency and imprecision) that there was no statistically significant difference in effect (pain intensity and disability) for exercise therapy compared to manual therapy/manipulation at short- and long-term follow-up.

Exercise therapy versus psychotherapy

One study with a high risk of bias was identified [37]. Post-treatment results showed a statistically significant difference in disability scores between both groups in advantage of the exercise group. No post-treatment differences between both groups were found for pain intensity. At 6 months follow-up, both disability and pain intensity scores were lower in the exercise group compared to the psychotherapy group, but not statistically significant.

Exercise therapy versus other forms of exercise therapy

Eleven studies compared different exercise interventions with each other [25,26,34,36,38,42–44,47,51,53]. Data of these studies could not be pooled because of the heterogeneity of the types of interventions.

Two studies found statistically significant differences between different exercise interventions. One study [47], with a high risk of bias, reported statistically significant difference in pain relief at 3 months follow-up of an aerobic exercise training programme compared with a lumbar flexion exercise programme of 3 months. One large trial[26] with a low risk of bias ($n = 240$) compared a general exercise programme (strengthening and stretching) with a motor control exercise programme (improving function of specific trunk muscles) of 12 weeks. The motor control exercise group had slightly better outcomes (mean adjusted between-group difference function being 2.9 and global perceived effect 1.7) than the general exercise group at 8 weeks. Similar group outcomes were found at 6 and 12 months follow-up.

A total of nine studies did not find any statistically significant differences between the various exercise interventions [25]. Sherman et al [44]. compared a 12-week yoga (viniyoga) programme with a 12-week conventional exercise class programme. Back-related function in the yoga group was superior to the exercise group at 12 weeks.

Discussion

The effectiveness of the different treatment strategies

No significant treatment effects of exercise therapy compared to no treatment/waiting list controls were found on pain intensity and disability. Compared to usual care, pain intensity and disability were significantly reduced by exercise therapy at short-term follow-up. Adverse events were not reported in any of the included studies.

The Cochrane review, published in 2005, on the effectiveness of exercise for LBP found evidence for the effectiveness on pain and function in chronic patients [16]. We also found evidence for the effectiveness for exercise therapy compared to usual care. However, we applied strict inclusion criteria regarding chronic LBP, so our meta-analyses not only excluded some of the studies included in the Cochrane review, but included some new studies as well. Nevertheless, results are comparable despite the new studies that are conducted in the recent years. It is therefore also striking that the quality of the included studies was still generally poor.

This overview included 11 studies comparing different types of exercise treatments with each other. Very small to no differences were found in these studies. A recent review on the outcome of motor control exercises on nonspecific LBP concluded that motor control exercise is superior to minimal intervention, but is not more effective than manual therapy [62]. Only two of the 11 included studies comparing different forms of exercises found statistically significant differences between the exercise groups. One study found aerobic exercises[47] and another study preferred motor control exercises to be more effective than the control [26].

None of the significant differences found in this overview study reached a difference >10%, where in most studies a difference of 15–20% is defined as clinically relevant. Therefore, the differences found in this overview must be regarded as small and not clinically relevant.

Of particular note is the heterogeneity among the studies. This heterogeneity could have been caused by differences in interventions, differences in control groups, duration of the intervention and the risk of bias of the different studies. Therefore, the results of the meta-analyses with heterogeneity should be interpreted with some caution.

The methodological quality of the studies was generally poor resulting in a high risk of bias. Blinding of the patient and blinding of the care provider were not properly conducted in many studies. Blinding of patients is also difficult in many RCTs investigating the effectives of exercise therapy. The quality of future RCTs in the field of back pain should be improved to reduce bias in systematic reviews and overviews, as it has been demonstrated that statistical pooling of trials with a high risk of bias may result in overestimation of treatment effects. Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate. These studies should focus on specific populations and should be well described. Further, more studies are needed to investigate the different forms of exercise interventions and, finally, the description of these studies should include the compliance and co-interventions of the study groups.

Implications for practice

Exercise therapy seems to be effective for the prevention of LBP, but only few recent trials are conducted. This therapy is not effective for acute LBP, whereas it is effective for chronic LBP; however, there is no evidence that any type of exercise is clearly more effective than others. Subgroups of patients with LBP might respond differently to various types of exercise therapy, but it is still unclear which patients benefit most from what type of exercises. Adherence to exercise prescription is usually poor, so supervision by a therapist is recommended. If home exercises are prescribed, strategies to improve adherence should be used. Patient's preferences and expectations should be considered when deciding which type of exercise to choose.

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