Clinical Practice Guideline: **Exercise Therapy for Treatment of Non-Specific Low Back Pain**

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GUIDELINES

American Specialty Health – Specialty (ASH) considers exercise therapy medically necessary for treatment of patients with non-specific low back pain.

DESCRIPTION/BACKGROUND

Chronic low back pain is a significant problem because of high health care utilization, rising health care costs, and perceived limitations of treatment effectiveness. Most patients with chronic low back pain have what can be described as non-specific low back pain. Non-specific indicates that no specific cause such as, but not limited to, infection, neoplasm, metastasis, osteoporosis, rheumatoid arthritis, fracture, inflammatory process, or radicular syndrome, is detectable. Exercise therapy is one effective treatment option for chronic non-specific low back pain.

Exercise therapy represents a very diverse group of treatment approaches, which makes the discussion of "exercise therapy" as a whole difficult (Hayden et al., 2005).

Hayden et al. (2005) proposed the following specific characteristics of exercise: type, design, delivery, dose, and additional interventions.

Types of exercise therapy include muscle strengthening/stabilization/motor control exercises, stretching/flexibility, coordination/balance/proprioceptive exercises, and general fitness. Muscle strengthening typically involves repetitions of muscle contraction of specific muscle groups aimed to increase muscle strength and/or endurance (Abenhaim et al., 2000). Stretching/flexibility entail movements of one or more joints, intended to lengthen shortened muscles that can be static or dynamic in nature. Coordination and balance exercises involve training in specific movements aimed at improving proprioception and coordination of appropriate muscle groups (Johannsen et al., 1995; Kuukkanen & Malkia, 2000). Finally, general physical fitness routines typically include approaches involving the whole body (e.g., aerobic exercises) (Hayden et al., 2005).

Exercise therapy can also be categorized in terms of program design. Individualized programs are those tailored to the individual based on the history and physical examination. Partially individualized programs involve standard types of exercises, but at varied intensity and/or duration. Finally, standard exercise programs are ones in which all participants receive the same exercise program (Hayden et al., 2005).

Exercise programs can also be delivered in several ways: home, supervised home with follow up, group supervision, and individual supervision. Home exercise entails participants meeting initially with a therapist who provides them an exercise program to do at home, with no supervision or follow up. Home exercise with follow up involves the participants meeting initially with a therapist, doing the exercise program at home, and then having a follow up visit with the therapist at least every 6 weeks. In group supervised exercise, participants attend exercise sessions with 2 or more other individuals, under the guidance of a therapist. Finally, individually supervised exercise sessions entail individuals receiving one-on-one supervision while performing the prescribed exercise program (Hayden et al., 2005).

Dose or intensity (measured by the duration and number of treatment sessions) is also an important characteristic of exercise therapy (Hayden et al., 2005). Programs involving 20 or more hours of exercise are defined as high dose, and less than 20 hours of intervention time as low dose. Factors such as load, resistance, and frequency of repetitions (which can create a further categorization of strengthening exercise into strengthening vs. endurance) may also be important issues when addressing exercise dose (Manniche & Jordan, 1995; Jordan et al., 1998).

EVIDENCE REVIEW

Exercise is one of the few treatments for chronic low back pain with good literature support; however, the effect sizes reported have been small and the exact type of exercise that is most effective cannot be determined. In 2000, van Tulder et al. published a Cochrane review assessing exercise therapy for low back pain relative to pain relief, functional status, overall improvement and return to work. Thirty-nine randomized controlled trials (RCTs) were included, and authors concluded that exercise therapy was not effective for acute low back pain but may be helpful for chronic low back pain. Since 2000, many new trials have been published, which precipitated the need for an updated review (Hayden et al., 2005). In this 2005 review, 61 RCTs were included in the analysis. These studies involved adult participants that could be categorized into acute, subacute, and chronic non-specific low back pain groups. Studies involving low back pain caused by a specific pathology or condition were excluded. Exercise therapy was defined as "a series of specific movements with the aim of training or developing the body by a routine practice or as physical training to promote good physical health." Studies included compared exercise therapy to a) no treatment or placebo treatment, b) other conservative treatment, or c) other exercise group. Outcomes of interest included self-reported pain intensity, condition-specific physical functioning, global improvement, and return to work/absenteeism. Both qualitative and quantitative rating systems were used to allow the most complete use of the available data. Of the total 61 RCTs, 43 trials (3,907 individuals) assessed chronic low back pain. Thirtythree exercise groups had non-exercise comparisons and these trials provided strong evidence that exercise therapy is at least as effective as other conservative interventions. The evidence was conflicting as to whether exercise therapy was more effective than other treatments for chronic low back pain. It also appeared that exercise therapy is most effective when administered in a health care setting rather than as independent home exercises. In many of these trials, other conservative care was used in addition to exercise therapy; including behavioral and manual therapy, advice to stay active and education. As an aside, there is moderate effectiveness of graded-activity exercise programs for the subacute population. Only a small number of these studies were rated at high quality, which may have led to an overestimation of effect. Also, many of the studies lacked information to assess quality and clinical relevance. The most consistent outcome measure was for pain intensity, which limits the ability to discuss other outcome measures. Lastly, authors found potential publication bias, which also may have resulted in an overestimation of the effectiveness of exercise therapy in the chronic low back pain population. Authors also recommend that no further trials on the effectiveness of general exercise therapy for chronic low back pain should be initiated, but rather trials should focus on specific exercise intervention strategies in well-defined low back pain patient populations.

Another review by Liddle et al. (2004) based on 16 RCTs of high to medium quality concluded that exercise as a primary intervention is an effective treatment for chronic low back pain, despite the wide variety of exercise programs offered. Positive results were maintained in 12 of the 16 trials, with supervision as a common feature. Again, authors felt studies did not explain exercise programs adequately and thus, no conclusions could be made regarding what type of exercise is most effective. The inclusion of exercise co-interventions introduced a confounding influence as well.

To this end, a systematic review published in the Journal of Manipulative Physiological Therapeutics in 2007 attempted to determine the effect of unloaded movement facilitation exercises on outcomes for people with non-specific chronic low back pain (NSCLBP) (Slade & Keating, 2007). In the previous systematic review reported by these authors, trunk strengthening was effective for improving function and reducing pain, compared to no exercise for patients with NSCLBP. Treatment effects increased with increasing exercise intensity and adding motivational strategies. Trunk strengthening exercises compared to aerobic training or the McKenzie approach showed no clear benefit (Slade & Keating, 2007). In their next review, 6 high quality RCTs were included. Participants were over 16 years of age with a current episode of low back pain lasting longer than 8 weeks (vs. the typical >12 weeks) with or without a history of low back surgery. Given this duration change, subjects could fall into the subacute category of low back pain rather than the chronic group. Authors stated that these parameters were used to capture the largest number of studies on exercise trials for chronic LBP that included the least number of participants likely to demonstrate a natural recovery process during the intervention time. They also defined low back pain as pain from below the scapulae to the buttock fold, with or without lower extremity radiation. Again, this varied from the previously described reviews. Interventions had to involve unloaded exercises that were likely to facilitate movement of the lumbar spine. If other interventions were involved, the unloaded exercise portion needed to be able to be partitioned out. Unloaded exercises basically referred to McKenzie exercises or yoga. Studies were excluded if they combined unloaded exercises with resistance exercises used to increase strengthening, spinal stabilization exercises or behavioral approaches and could not separate each component.

For NSCLBP without surgery, use of a McKenzie approach produced small effects for short and medium-term pain and short-term function compared to intensive trunk strengthening. There were no observable differences in outcomes when comparing the McKenzie approach to spinal stabilization exercises. When comparing yoga to trunk strengthening and aerobic training in subjects with NSCLBP without surgery, comparable effects were observed for short and medium-term outcomes. Compared to no exercise, yoga displayed a significantly large effect for medium term pain and function. Performing McKenzie exercises and yoga together compared with no exercise, significant, moderate effects on medium-term pain and function were noted in favor of the unloaded exercise. More specifically, within this review one of the RCTs published in the Annals of Internal Medicine (Sherman et al., 2005) attempted to determine whether yoga was more effective than conventional exercise or a self-care book for patients with chronic low back pain. One hundred one adults participated in a 12-week yoga program or conventional therapy program or just received a self-care book. They determined that yoga was more effective than a self-care book. The yoga group consistently reported superior outcomes compared with the exercise group, but these differences were not significant. Limitations included a relatively short follow up period (14 weeks), modest sample sizes, reliance on class instructors for intervention development and the inclusion of relatively highly educated and functional participants (Sherman et al., 2005). Authors stated that it would be virtually impossible to recreate these exercise programs, as minimal descriptions were reported. Authors concluded that there is strong evidence that unloaded movement facilitation exercise compared to no exercise is effective for improving pain and function. However, it appears that when comparing unloaded exercise to other types of exercise, effects are comparable. It may be that for patients with NSCLBP, unloaded exercise is as effective as more vigorous forms of exercise that require more resources for relieving pain and increasing function.

In another attempt to tease out what type of exercise is most beneficial, Kofotolis and Kellis (2006) studied the effects of two 4-week Proprioceptive Neuromuscular Facilitation (PNF) programs on muscle endurance, flexibility, and functional performance in women with chronic low back pain. Unfortunately, these programs were only compared to one another and not with another type of exercise program. Results demonstrated that both static and dynamic PNF programs were effective in improving short-term trunk muscle endurance and trunk mobility in people with chronic low back pain. Another RCT by Koumantakis et al. (2005) compared a general trunk muscle endurance exercise program enhanced with specific muscle stabilization exercises with a general exercise approach only. Fifty-five patients with recurrent LBP were randomized to the two groups. Both groups received an 8-week intervention and written instructions. Results indicated that both the general exercise program and the enhanced exercise program provided benefits for patients with recurrent LBP. It appears to be the presence of physical exercise alone, rather than the specific exercise type that is the factor in patient improvement in those with chronic LBP.

Another RCT compared general exercise, motor control exercise, and spinal manipulation therapy for chronic low back pain (Ferreira et al., 2007). Each group received 8 weeks of treatment. General exercise included strengthening, stretching and aerobic exercise, motor control exercise included retraining of specific trunk musculature using ultrasound and feedback, and spinal manipulation therapy involved both mobilization and manipulation. At 8 weeks the motor control group and manipulation group had slightly better outcomes than the general exercise group. At 6 and 12 months, these differences diminished, and similar outcomes were reported. It appears that motor control exercise has better short-term outcomes, while all three are equivalent over the medium and long-term with regards to perceived effectiveness and function (Ferreira et al., 2007). Costa et al. (2009) completed a randomized, placebo-controlled trial with subjects complaining of non-specific low back with or without leg pain for at least 3 months. Subjects were instructed in specific deep trunk muscle isolation exercise training which consisted of 12 individually supervised half-hour sessions over an 8-week period. The placebo group received 20 minutes of detuned short-wave diathermy and 5 minutes of detuned ultrasound for 12 sessions over an 8-week period. Outcomes were measured at 2, 6, and 12 months. This study found that motor control exercise produced short-term improvements in global impression of recovery and activity, but not pain, for people with chronic low back pain. Most of the effects observed in the short term were maintained at the six 6- and 12-month follow-ups (Costa, 2009).

In another review on use of the McKenzie method for chronic LBP by May and Donelson (2008), they suggest that the McKenzie method plays an important role in the classification of subgroups with different needs treatment-wise. It appears that as an intervention, this method produces more positive short-term outcomes than non-specific guideline-based care and equal or slightly better outcomes than stabilization or strengthening routines for patients with chronic LBP (May & Donelson, 2008). Another review on lumbar extension strengthening exercises for chronic LBP by Mayer et al. (2008) suggests that it is an effective intervention over no treatment or most passive modalities, whether used in isolation or as a co-intervention. These subjects report improved pain, disability, and other reported outcomes in the short term. Over the long term, this review suggests that some of the disability and pain benefits are lost. There also appears to be no clear benefit to lumbar extensor strengthening exercises over other exercise programs regarding improvements in pain, disability, strength, and endurance. Standaert et al. (2008) reported that lumbar stabilization exercises for chronic low back pain are effective at improving pain and function in a variety of patients with chronic LBP based on moderate evidence. Moderate evidence also suggests that lumbar stabilization exercises are no more effective than manual therapy. Strong evidence does exist that lumbar stabilization exercises are no more effective than a less specific, general exercise program (Standaert et al., 2008).

There are a few well-designed studies that demonstrate the effectiveness of activity or therapeutic exercise when used in conjunction with other manual interventions in the management of spinal pain. Research has demonstrated the benefit of matching sub-categories of patients to specific interventions. One of the interventions that has shown marked success in the treatment of LBP is manipulation combined with strengthening exercise. Flynn et al. (2002) reported 5 clinical predictors for success with spinal manipulation (Symptom duration <16 days, No symptoms distal to the knee, Fear Avoidance Belief Questionnaire Work Subscale <19, Hip IR >35 degrees, Positive lumbar spring test on at least one lumbar segment). Flynn found a Positive Likelihood Ratio (+LR) of 24 which provides a 95% chance of decreasing disability by >50% within the first two (2) treatments using manipulation. Childs et al. (2004) validated this rule in a multi-center trial and also determined the number needed to treat with thrust manipulation combined with exercise to prevent one patient from experiencing a worsening of disability was only ten. Childs et al. (2006) later reported that patients that met the clinical prediction rules above were 8 times more likely to experience an increase in disability within one week if they were not treated with a combined thrust manipulation/exercise intervention. This Clinical Prediction Rule has also been validated in the Primary Care setting by Fritz et al. (2005). The authors determined a +LR for success with thrust manipulation of 7.2 with the following two factors present: symptoms less than 16 days duration and no symptoms distal to the knee.

The literature demonstrates that an Extension Oriented Treatment Approach (EOTA) is beneficial in patients who demonstrate a directional preference (DP) of symptom centralization with extension postures/exercises (Browder et al., 2007). The average duration of the patients' symptoms was 3 months. The authors compared an EOTA with strengthening exercises and reported the EOTA group demonstrated greater improvements in disability and pain at 1 week follow-up and greater improvement in disability at 4 weeks and 6-month follow-ups as well. The EOTA was provided over the course of 8 sessions (twice a week for 4 weeks) and included the following interventions:

1. Extension-oriented exercises (sustained and repeated) in prone and standing;
2. Posterior to Anterior (PA) lumbar mobilizations, grade I to IV, 10 to 20 oscillations;
3. Home exercise prescription (prone press-up) x10 repetitions every two (2) to three (3) waking hours (may substitute standing extension exercises).

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based practice guidelines for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability, and Health (ICF). In 2012, Delitto et al. authored guidelines for low back pain. The purpose of these low back pain clinical practice guidelines was to describe the peer-reviewed literature and make recommendations related to (1) treatment matched to low back pain subgroup responder categories, (2) treatments that have evidence to prevent recurrence of low back pain, and (3) treatments that have evidence to influence the progression from acute to chronic low back pain and disability. Authors presented "A" level recommendations for treatment of low back pain which included manual therapy, trunk coordination, strengthening and endurance exercises, centralization and directional preference exercises and progressive endurance exercises and fitness activities. Research has determined thrust manipulation is effective in a subgroup of patients as part of a multi-component program including exercise. Lumbar coordination, strengthening and endurance exercises are a common treatment intervention for back pain. They are also referred to in the literature as motor control exercises, transversus abdominis training, lumbar multifidus training and dynamic lumbar stabilization exercises. Delitto et al. (2012) summarized the available literature indicating that clinicians should consider these exercises to reduce low back pain and disability in patients with subacute and chronic low back pain with movement dysfunction and in patients post microdiscectomy. Much of the research demonstrates that these exercises are effective but may be no more effective than a general exercise program. Centralization exercises appear to be beneficial for patients with acute low back pain with referred lower extremity pain. Clinicians should consider using repeated movements and exercises to promote centralization through reduction of lower extremity pain. Also, repeated movements in a specific direction, as noted by treatment response, should be utilized to reduce symptoms and improve mobility in all phases of low back pain. Lastly, progressive endurance exercises and fitness activities are endorsed by most current low back pain guidelines with moderate to high levels of evidence. Aerobic conditioning has been hypothesized to reduce pain perception and improving function in patients with chronic low back pain and other generalized pain.

A meta-analysis by Wang et al. (2012) concluded that core stability exercises are more effective in decreasing pain and may improve physical function in patients with chronic low back in the short-term relative to general exercise. However, over the long term, no significant differences were noted. In 2013, Brumitt et al. (2013a) provided clinical recommendations using the SORT (Strength of Recommendation Taxonomy) method. They concluded that a therapeutic intervention program consisting of motor control exercises OR general back strengthening exercises may be beneficial for patients with low back pain lasting longer than 6 weeks. However, given the SORT evidence rating of 'B' indicates that the evidence is inconsistent or of limited quality. Brumitt et al. (2013b) published another paper analyzing randomized controlled trials that assessed the effects of a motor control exercise approach, a general exercise approach, or both for patients with low back pain that were published in scientific peer-reviewed journals. Fifteen studies were identified (8, motor control exercise approach without general exercise comparison; 7, general exercise approach with or without motor control exercise approach comparison). Authors stated that current evidence suggests that exercise interventions may be effective at reducing pain or disability in patients with low back pain, but it may not be necessary to prescribe exercises purported to restore motor control of specific muscles. A systematic review by Stuber et al. (2014) reviewed the effectiveness of core stability exercises for low back pain in athletes. They concluded that given the low quantity and quality of available literature, no strong conclusions could be formulated.

Lehtola et al. (2016) conducted a randomized controlled trial (RCT) to compare the effects of general exercise versus specific movement control exercise (SMCE) on disability and function in patients with MCI within the recurrent sub-acute LBP group. Subjects attended 5 sessions of either specific or general exercises. Both groups also received a short application of manual therapy. The primary outcome was disability, assessed by the Roland-Morris Disability Questionnaire (RMDQ). The measurements were taken at baseline, immediately after the three months intervention and at twelve-month follow-up. Measurements of 61 patients (SMCE $n = 30$ and general exercise $n = 31$) were completed at 12 months. Patients in both groups reported significantly less disability at 12 months follow up, with the SMCE group showing statistically significantly superior improvement. However, the result did not reach the clinically significant three-point difference. There was no statistical difference between the groups measured with Oswestry Disability Index (ODI). Authors concluded for subjects with non-specific recurrent sub-acute LBP and MCI an intervention consisting of SMCE and manual therapy combined may be superior to general exercise combined with manual therapy. Saragiotto et al. (2016) authored a Cochrane Review on motor control exercise for chronic non-specific low back pain. (CNSLBP). As noted in the previous literature, exercise is a modestly effective treatment for chronic LBP and current evidence suggests that no single form of exercise is superior to another. Authors report that among the most commonly used exercise interventions are motor control exercise (MCE). To clarify, MCE intervention focuses on the activation of the deep trunk muscles and targets the restoration of control and co-ordination of these muscles, progressing to more complex and functional tasks integrating the activation of deep and global trunk muscles. Authors included trials comparing MCE with no treatment, another treatment or that added MCE as a supplement to other interventions. Primary outcomes were pain intensity and disability. They also considered function, quality of life, return to work or recurrence as secondary outcomes. They considered the following time points: short-term (less than 3 months after randomization); intermediate (at least three months but less than 12 months after randomization); and long-term (12 months or more after randomization) follow-up. 29 trials (n = 2,431) were included in this review. The study sample sizes ranged from 20 to 323 participants. Results demonstrate that there is low to high quality evidence that MCE is not clinically more effective than other exercises for all follow-up periods and outcomes tested. When compared to minimal intervention, there is low to moderate quality evidence that MCE is effective for improving pain at short, intermediate and long-term follow-up with medium effect sizes. There was also a clinically important difference for the outcomes function and global impression of recovery compared with minimal intervention. There was moderate to high quality evidence that there is no clinically important difference between MCE and manual therapy for all follow-up periods and outcomes tested. Finally, there was very low to low quality evidence that MCE is clinically more effective than exercise and electrophysical agents (EPA) for pain, disability, global impression of recovery and quality of life with medium to large effect sizes. Minor or no adverse events were reported in the included trials. Authors conclude that given the evidence that MCE is not superior to other forms of exercise, the choice of exercise for chronic LBP should probably depend on patient or therapist preferences, therapist training, costs, and safety.

Macedo et al. (2016) completed a Cochrane Review on the effectiveness of motor control exercise for acute non-specific low back pain. They only included RCTs examining the effectiveness of MCE for patients with acute non-specific LBP. Authors considered trials comparing MCE versus no treatment, versus another type of treatment or added as a supplement to other interventions. Primary outcomes were pain intensity and disability. Secondary outcomes were function, quality of life and recurrence. Authors considered the following follow-up intervals: short term (less than three months after randomization); intermediate term (at least three months but within 12 months after randomization); and long term (12 months or longer after randomization). Only 3 trials were included with study samples ranging from 33 to 123 participants. Evidence of very low to moderate quality indicates that MCE showed no benefit over spinal manipulative therapy, other forms of exercise or medical treatment in decreasing pain and disability among patients with acute and subacute low back pain. Whether MCE can prevent recurrences of LBP remains uncertain and no firm conclusions can be drawn regarding the effectiveness of MCE for acute LBP.

Pilates was also examined in a Cochrane Review as a treatment for non-specific LBP (Yamato et al., 2015). They included RCTs that examined the effectiveness of Pilates intervention in adults with acute, subacute, or chronic non-specific low back pain. The primary outcomes considered were pain, disability, global impression of recovery and quality of life. A total of 6 trials compared Pilates to minimal intervention. They did not find any high-quality evidence for any of the treatment comparisons, outcomes or follow-up periods investigated. However, there is low to moderate quality evidence that Pilates is more effective than minimal intervention for pain and disability. When Pilates was compared with other exercises, the authors found a small effect for function at intermediate-term follow-up. Thus, while there is some evidence for the effectiveness of Pilates for low back pain, there is no conclusive evidence that it is superior to other forms of exercises. The decision to use Pilates for low back pain may be based on the patient's or care provider's preferences, and costs.

A systematic review and meta-analysis by Carey and Freburger (2016) assessed research into the value of exercise as a way to treat and prevent LBP. The study found that exercise alone was linked to a 35% reduction in risk, while the combination of exercise and education was associated with a 45% risk reduction for up to one year. The use of exercise was also found to result in a 78% reduction in sick leave for LBP. Authors found that while education helped to further reduce that risk when combined with exercise, education alone doesn't seem to have much effect, according to authors. They also suggest that for exercise to remain protective against future LBP, it needs to be ongoing.

The Agency for Healthcare Research and Quality (AHRQ) published a Comparative Effectiveness Review in 2016 on noninvasive treatments for LBP. They summarized the research on exercise and LBP with the following key points:

1. For acute LBP, a systematic review found no differences between exercise therapy versus no exercise in pain or function; for subacute LBP, there were no differences in pain or function. Three other trials for acute to subacute LBP found inconsistent results of exercise vs. usual care to improve pain and function.
2. For chronic LBP, a systematic review found exercise was associated with greater pain relief versus no exercise and a more recent review using more restrictive criteria and additional trials were consistent with these earlier findings.
3. More specifically, for chronic LBP, a review found motor control exercise was associated with lower pain scores and better function in the short, intermediate and long term vs. minimal intervention. Another systematic review found MCE associated with lower pain intensity at the short term and intermediate term versus general exercise. No significant findings were noted in the long term. Better function was noted with MCE in the short and long term.
4. For radicular LBP, three trials not included in any systematic reviews found effects that favored exercise versus usual care or no exercise in pain and function, though effect sizes were small.
5. For comparisons of different exercise types, there were no clear differences for patients with acute or chronic LBP.
6. Adverse events were not often reported and if they were, typically muscle soreness and increased pain were reported. No serious harms were reported.

According to Qaseem et al. (2017), moderate-quality evidence showed that exercise therapy resulted in small improvements in pain and function. Specific components associated with greater effects on pain included individually designed programs, supervised home exercise, and group exercise; regimens that included stretching and strength training were most effective. In a systematic review, Vanti et al. (2019) found that pain, disability, quality of life and fear-avoidance similarly improve by walking or exercise in chronic low back pain. Walking may be considered as an alternative to other physical activity. Adding walking to exercise does not induce greater improvement in the short-term. Walking may be a less-expensive alternative to physical exercise in chronic low back pain. Wewege et al. (2018) compared progressive aerobic training (PAT) to progressive resistance training (PRT) for pain, disability, and quality of life (QoL) in people with chronic non-specific low back pain (CNSLBP). Six studies were included, comprising 333 participants. Exercise significantly reduced pain intensity although neither mode proved superior. PRT significantly improved the Short Form Health Survey-Mental Component Score. Authors concluded that PAT and PRT decreased pain intensity in individuals with CNSLBP although neither mode was superior. Resistance exercise improved psychological wellbeing. High-quality RCTs comparing PAT, PRT, and PAT + PRT, are required. Shi et al. (2018) analyzed all evidence available in the literature about effectiveness of the aquatic exercise. Eight trials involving 331 patients were included in the meta-analysis, and the results showed a relief of and physical function after aquatic exercise. However, there was no significant effectiveness with regard to general mental health in aquatic group. Authors concluded that aquatic exercise can statistically significantly reduce pain and increase physical function in patients with low back pain. Shiri et al. (2018) assessed the effect of exercise in population-based interventions to prevent low back pain (LBP) and associated disability. Thirteen randomized controlled trials (RCTs) and 3 nonrandomized controlled trials (NRCTs) qualified for the meta-analysis. Exercise alone reduced the risk of LBP by 33% and exercise combined with education reduced it by 27%. The severity of LBP and disability from LBP were also lower in exercise groups than in control groups. Authors concluded that exercise reduces the risk of LBP and associated disability, and a combination of strengthening with either stretching or aerobic exercises performed 2-3 times per week can reasonably be recommended for prevention of LBP in the general population. Suh et al. (2019) compared the efficiency between 2 exercises: the individualized graded lumbar stabilization exercise (IGLSE) and walking exercise (WE). A randomized controlled trial was conducted in 48 participants with chronic LBP. After screening, participants were randomized to 1 of 4 groups: flexibility exercise (FE), WE, stabilization exercise (SE), and stabilization with WE (SWE) groups. Participants underwent each exercise for 6 weeks. The primary outcome was visual analog scale (VAS) of LBP during rest and physical activity. Secondary outcomes were as follows: VAS of radiating pain measured during rest and physical activity; frequency of medication use (number of times/day); Oswestry disability index; Beck Depression Inventory; endurance of specific posture; and strength of lumbar extensor muscles. The present study showed that lumbar SE and WE significantly improved chronic LBP. Both WE and stabilization with WE significantly improved muscular endurance of back muscles. Moreover, walking and SEs also improved the core stability. It is also worth noting that patients in the WE and SE groups were much more compliant than those in the other exercise groups. This study suggests that lumbar SE and WE should be recommended to patients with chronic LBP because they help not only to relieve back pain but also to prevent chronic back pain through the improvement of muscle endurance.

Many clinical practice guidelines recommend similar approaches for the assessment and management of low back pain. Recommendations include use of a biopsychosocial framework to guide management with initial non-pharmacological treatment, including education that supports self-management and resumption of normal activities and exercise, and psychological programs for those with persistent symptoms (Foster et al., 2018). Jones et al. (2020) discusses the use of pain education with therapeutic exercise to address the psychosocial aspects that are associated with chronic low back pain. Pain education is the umbrella term utilized to encompass any type of education to the patient about their chronic pain. Therapeutic exercise in combination with pain education may allow for more well-rounded and effective treatment for patients with chronic nonspecific low back pain (NS-LBP). They summarized key findings: A thorough literature review yielded 8 studies potentially relevant to the clinical question, and 3 studies that met the inclusion criteria were included. The 3 studies included reports that exercise therapy reduced symptoms. Two of the 3 included studies support the claim that exercise therapy reduces the symptoms of chronic NS-LBP when combined with pain education, whereas one study found no difference between pain education with therapeutic exercise. Authors concluded that there is moderate evidence to support the use of pain education along with therapeutic exercise when attempting to reduce symptoms of pain and disability in patients with chronic NS-LBP. Educational interventions should be created to educate patients about the foundation of pain, and pain education should be implemented as a part of the clinician's strategy for the rehabilitation of patients with chronic NS-LBP.

Owen et al. (2020) examined the effectiveness of specific modes of exercise training in non-specific chronic low back pain (NSCLBP). They included exercise training randomized controlled/clinical trials in adults with NSCLBP. Among 9,543 records, 89 studies (patients=5,578) were eligible for qualitative synthesis and 70 (pain), 63 (physical function), 16 (mental health) and 4 (trunk muscle strength) for Network Meta-analysis (NMA). The NMA consistency model revealed that the following exercise training modalities had the highest probability of being best when compared with true control: Pilates for pain, resistance and stabilization/motor control for physical function, and resistance and aerobic for mental health. Stretching and McKenzie exercise effect sizes did not differ to true control for pain or function. NMA was not possible for trunk muscle endurance or analgesic medication. Authors concluded there is low quality evidence that Pilates, stabilization/motor control, resistance training and aerobic exercise training are the most effective treatments, pending outcome of interest, for adults with NSCLBP. Exercise training may also be more effective than therapist hands-on treatment. Heterogeneity among studies and the fact that there are few studies with low risk of bias are both limitations. Hayden et al. (2020) sought to determine which individuals might benefit the most from exercise for their low back pain. For studies included in this analysis, compared with no treatment/usual care, exercise therapy on average reduced pain, a result compatible with a clinically important 20% smallest worthwhile effect. Exercise therapy reduced functional limitations with a clinically important 23% improvement at short-term follow-up. Not having heavy physical demands at work and medication use for low back pain were potential treatment effect modifiers that were associated with superior exercise outcomes relative to non-exercise comparisons. Lower body mass index was also associated with better outcomes in exercise compared with no treatment/usual care. This study was limited by inconsistent availability and measurement of participant characteristics.

Zhu et al. (2020) compared the effects of yoga for patients with chronic low back pain on pain, disability, quality of life with non-exercise (e.g., usual care, education), physical therapy exercise. A total of 18 randomized controlled trials were included in this meta-analysis. Yoga could significantly reduce pain at 4 to 8 weeks, 3 months, 6 to 7 months, and was not significant in 12 months compared with non-exercise. Yoga was better than non-exercise on disability at 4 to 8 weeks, 3 months, 6 months, 12 months. There was no significant difference on pain, disability compared with physical therapy exercise group. Furthermore, it suggested that there was a non-significant difference on physical and mental quality of life between yoga and any other interventions. Authors concluded that yoga might decrease pain from short term to intermediate term and improve functional disability status from short term to long term compared with non-exercise (e.g., usual care, education). Yoga had the same effect on pain and disability as any other exercise or physical therapy. Yoga might not improve the physical and mental quality of life based on the result of merging the 36 item short form health survey (SF-36) and the 12 item short form health survey (SF-12) data.

Karlsson et al. (2020) assessed the overall certainty of evidence for the effects of exercise therapy, compared with other interventions, on pain, disability, recurrence, and adverse effects in adult patients with acute low back pain within a systematic review. Twenty-four reviews were included, in which 21 randomized controlled trials (n = 2685) presented data for an acute population, related to 69 comparisons. Overlap was high, 76%, with a corrected covered area of 0.14. Methodological quality varied from low to high. Exercise therapy was categorized into general exercise therapy, stabilization exercise, and McKenzie therapy. No important difference in pain or disability was evident when exercise therapy was compared with sham ultrasound, nor for the comparators of usual care, spinal manipulative therapy, advice to stay active, and educational booklet. Neither McKenzie therapy nor stabilization exercise yielded any important difference in effects compared with other types of exercise therapy. Certainty of evidence varied from very low to moderate. Authors concluded that these findings suggest very low to moderate certainty of evidence that exercise therapy may result in little or no important difference in pain or disability, compared with other interventions, in adult patients with acute low back pain.

Skelly et al. (2020) updated the evidence from their 2018 report assessing persistent improvement in outcomes following completion of therapy for noninvasive nonpharmacological treatment for selected chronic pain conditions. They included 233 RCTs (31 new to this update). Many were small (N<70), and evidence beyond 12 months after treatment completion was sparse. The most common comparison was with usual care. Evidence on harms was limited, with no evidence suggesting increased risk for serious treatment-related harms for any intervention. Effect sizes were generally small for function and pain. For chronic low back pain, function improved over short and/or intermediate term for exercise (SOE moderate at short term for exercise). Improvements in pain at short term were seen for exercise (SOE: low). At intermediate term, exercise (SOE: low) were associated with improved pain. Compared with exercise, multidisciplinary rehabilitation improved both function and pain at short and intermediate terms (small effects, SOE: moderate.)

Hayden et al. (2021a) assessed the impact of exercise treatment on pain and functional limitations in adults with chronic non-specific low back pain compared to no treatment, usual care, placebo and other conservative treatments in a Cochrane review. The review includes data for trials identified in searches up to 27 April 2018. Authors included randomized controlled trials that assessed exercise treatment compared to no treatment, usual care, placebo or other conservative treatment on the outcomes of pain or functional limitations for a population of adult participants with chronic non-specific low back pain of more than 12 weeks' duration. They included 249 trials of exercise treatment, including studies conducted in Europe (122 studies), Asia (38 studies), North America (33 studies), and the Middle East (24 studies). Sixty-one per cent of studies (151 trials) examined the effectiveness of two or more different types of exercise treatment, and 57% (142 trials) compared exercise treatment to a non-exercise comparison treatment. Study participants had a mean age of 43.7 years and, on average, 59% of study populations were female. Most of the trials were judged to be at risk of bias, including 79% at risk of performance bias due to difficulty blinding exercise treatments. Authors found moderate-certainty evidence that exercise treatment is more effective for treatment of chronic low back pain compared to no treatment, usual care, or placebo comparisons for pain outcomes at earliest follow-up, a clinically important difference. Certainty of evidence was downgraded mainly due to heterogeneity. For the same comparison, there was moderate-certainty evidence for functional limitations outcomes; this finding did not meet the prespecified threshold for minimal clinically important difference. Certainty of evidence was downgraded mainly due to some evidence of publication bias. Compared to all other investigated conservative treatments, exercise treatment was found to have improved pain and functional limitations outcomes. These effects did not meet the prespecified threshold for clinically important difference. Subgroup analysis of pain outcomes suggested that exercise treatment is probably more effective than education alone or non-exercise physical therapy, but with no differences observed for manual therapy. In studies that reported adverse effects (86 studies), one or more adverse effects were reported in 37 of 112 exercise groups (33%) and 12 of 42 comparison groups (29%). Twelve included studies reported measuring adverse effects in a systematic way, with a median of 0.14 per participant in the exercise groups (mostly minor harms, e.g., muscle soreness), and 0.12 in comparison groups. Authors concluded that moderate-certainty evidence exists that exercise is probably effective for treatment of chronic low back pain compared to no treatment, usual care or placebo for pain. The observed treatment effect for the exercise compared to no treatment, usual care or placebo comparisons is small for functional limitations, not meeting the threshold for minimal clinically important difference. They also found exercise to have improved pain (low-certainty evidence) and functional limitations outcomes (moderate-certainty evidence) compared to other conservative treatments; however, these effects were small and not clinically important when considering all comparisons together. Subgroup analysis suggested that exercise treatment is probably more effective than advice or education alone, or electrotherapy, but with no differences observed for manual therapy treatments. Hayden et al. (2021b) wanted to investigate what the effects of specific types of exercise treatments on pain intensity and functional limitation outcomes for adults with chronic low back pain are in a systematic review with network meta-analysis of randomized controlled trials. Exercise treatments prescribed or planned by a health professional that involved conducting specific activities, postures and/or movements with a goal to improve low back pain outcomes were included in the review. Outcome measures included pain intensity (e.g., visual analogue scale or numerical rating scale) and back-related functional limitations (e.g., Roland Morris Disability Questionnaire or Oswestry Disability Index), each standardized to range from 0 to 100. This review included 217 randomized controlled trials with 20,969 participants and 507 treatment groups. Most exercise types were more effective than minimal treatment for pain and functional limitation outcomes. Network meta-analysis results were compatible with moderate to clinically important treatment effects for Pilates, McKenzie therapy, and functional restoration (pain only) and flexibility exercises (function only) compared with minimal treatment, other effective treatments, and other exercise types. This review found evidence that Pilates, McKenzie therapy and functional restoration were more effective than other types of exercise treatment for reducing pain intensity and functional limitations. Nevertheless, people with chronic low back pain should be encouraged to perform the exercise that they enjoy to promote adherence.

Thorton et al. (2021) summarized the evidence for non-pharmacological management of low back pain (LBP) in athletes, a common problem in sport that can negatively impact performance and contribute to early retirement. Among 1629 references, 14 randomized controlled trials (RCTs) involving 541 athletes were included. The trials had biases across multiple domains including performance, attrition, and reporting. Treatments included exercise, biomechanical modifications, and manual therapy. There were no trials evaluating the efficacy of surgery or injections. Exercise was the most frequently investigated treatment; no RTS data were reported for any exercise intervention. There was a reduction in pain and disability reported after all treatments. Authors concluded that while several treatments for LBP in athletes improved pain and function, it was unclear what the most effective treatments were, and for whom. Exercise approaches generally reduced pain and improved function in athletes with LBP, but the effect on RTS is unknown. No conclusions regarding the value of manual therapy (massage, spinal manipulation) or biomechanical modifications alone could be drawn because of insufficient evidence. High-quality RCTs are urgently needed to determine the effect of commonly used interventions in treating LBP in athletes. Quentin et al. (2021) conducted a systemic review and meta-analysis on the effects of home-based exercise on pain and functional limitation in LBP. They included 33 studies and 9588 patients. They found that pain intensity decreased in the exclusive home exercise group in the group which conducted exercise both at-home and at another setting. Similarly, functional limitation also decreased in both groups. Relaxation and postural exercise seemed to be ineffective in decreasing pain intensity, whereas trunk, pelvic or leg stretching decreased pain intensity. Yoga improved functional limitation.

Supervised training was the most effective method to improve pain intensity. Insufficient data precluded robust conclusions around the duration and frequency of the sessions and program. Authors concluded that home-based exercise training improved pain intensity and functional limitation parameters in LBP. Van Dillen et al. (2021) sought to determine whether an exercise-based treatment of person-specific motor skill training (MST) in performance of functional activities is more effective in improving function than strength and flexibility exercise (SFE) immediately, 6 months, and 12 months following treatment. The effect of booster treatments 6 months following treatment also was examined. A total of 154 people with at least 12 months of chronic, nonspecific LBP, aged 18 to 60 years, with modified Oswestry Disability Questionnaire (MODQ) score of at least 20% were randomized to either MST or SFE. Data were analyzed between December 1, 2017, and October 6, 2020. Participants received 6 weekly 1-hour sessions of MST in functional activity performance or SFE of the trunk and lower limbs. Half of the participants in each group received up to 3 booster treatments 6 months following treatment. A total of 149 participants (91 women; mean [SD] age, 42.5 [11.7] years) received some treatment and were included in the intention-to-treat analysis. Following treatment, MODQ scores were lower for MST than SFE by 7.9 (95% CI, 4.7 to 11.0; $P < .001$). During the follow-up phase, the MST group maintained lower MODQ scores than the SFE group, 5.6 lower at 6 months (95% CI, 2.1 to 9.1) and 5.7 lower at 12 months (95% CI, 2.2 to 9.1). Booster sessions did not change MODQ scores in either treatment. Authors concluded that people with chronic LBP who received MST had greater short-term and long-term improvements in function than those who received SFE. Person-specific MST in functional activities limited owing to LBP should be considered in the treatment of people with chronic LBP.

According to Chou (2021), low back pain is a common problem that is the leading cause of disability and is associated with high costs. Evaluation focuses on identification of risk factors indicating a serious underlying condition and increased risk for persistent disabling symptoms in order to guide selective use of diagnostic testing (including imaging) and treatments. Nonpharmacologic therapies, including exercise and psychosocial management, are preferred for most patients with low back pain and may be supplemented with adjunctive drug therapies. Surgery and interventional procedures are options in a minority of patients who do not respond to standard treatments. Hlaing et al. (2021) compared the effects of two different exercise regimes, Core stabilization exercises (CSE) and strengthening exercise (STE), on proprioception, balance, muscle thickness and pain-related outcomes in patients with subacute non-specific low back pain (NSLBP). Thirty-six subacute NSLBP patients, [mean age, 34.78 ± 9.07 years; BMI, 24.03 ± 3.20 Kg/m2; and duration of current pain, 8.22 ± 1.61 weeks], were included in this study. They were randomly allocated into either CSE (n = 18) or STE groups (n = 18). Exercise training was given for 30 min, three times per week, for up to 4 weeks. Proprioception, standing balance, muscle thickness of transversus abdominis (TrA) and lumbar multifidus (LM), and pain-related outcomes, comprising pain, functional disability and fear of movement, were assessed at baseline and after 4 weeks of intervention. The CSE group demonstrated significantly more improvement than the STE group after 4 weeks of intervention. Improvements were in: proprioception, balance: single leg standing with eyes open and eyes closed on both stable and unstable surfaces, and percentage change of muscle thickness of TrA and LM. Although both exercise groups gained relief from pain, the CSE group demonstrated greater reduction of functional disability and fear of movement. There were no significant adverse effects in either type of exercise program. Authors concluded that despite both core stabilization and strengthening exercises reducing pain, core stabilization exercise is superior to strengthening exercise. It is effective in improving proprioception, balance, and percentage change of muscle thickness of TrA and LM, and reducing functional disability and fear of movement in patients with subacute NSLBP.

Rathnayake et al. (2021) systematically reviewed the evidence for the effect of self-management interventions (SMIs) with an exercise component added, on pain and disability in people with CLBP. Authors concluded that there is low-quality evidence that SMIs with exercises added have moderately positive effects on pain and disability in patients with CLBP compared to control interventions involving usual care, typically consisting of access to medication, exercise, advice, education, and manual therapy.

Drummond et al. (2021) assessed the effectiveness of sling exercise therapy (SET) in individuals with chronic low back pain (LBP). The search identified 1,204 studies, with 12 studies meeting the inclusion criteria. Meta-analysis comparing SET with general exercise revealed a nonsignificant effect for pain. Meta-analysis comparing SET with motor control training/lumbar stabilization revealed a significant effect favoring SET for pain and disability. Meta-analysis comparing SET with no treatment revealed a significant effect favoring SET for pain. Meta-analysis comparing SET plus modalities with modalities revealed a significant effect favoring the SET plus modalities group for pain and a nonsignificant effect for disability. Sling exercise therapy was more effective than all comparisons for various muscle attributes. The overall level of evidence ranged from very low to moderate. Sling exercise therapy is effective in reducing pain, disability, and improving core muscle activation, strength, thickness, and onset in patients with chronic LBP. Because SET demonstrated comparable outcomes with common active interventions, it provides an opportunity to implement pain-free exercises based on the patient's initial functional level early in the plan of care. Ferreira et al. (2021) assessed whether an exercise and education program was more effective than an education booklet for preventing recurrence of low back pain (LBP). Participants aged 18 years or older who had recovered from an episode of LBP within the previous week were recruited from primary care practices and the community. Participants were randomized to receive either 12 weeks of exercise and education (8 supervised exercise sessions and 3 one-on-one sessions) or a control (education booklet). The primary outcome was time to recurrence of LBP during the 1-year follow-up. Times to recurrence of LBP leading to activity limitation, care seeking, and work absence were secondary outcomes. Data were analyzed with Cox regression using intention-to-treat principles. The same size was 111 (exercise and education, *n* = 57; educational booklet, *n* = 54). At the end of the study period, data completeness was 84.2%. Thirty-six (63%) participants in the exercise and education group and 31 (57%) participants in the control group had a recurrence of LBP. There was no statistically significant difference in time to recurrence of pain between groups (hazard ratio = 1.09; 95% confidence interval: 0.7, 1.8). There was no statistically significant effect for any of the secondary outcomes. Authors concluded that among people recently recovered from LBP, exercise and education may not meaningfully reduce risk of recurrence compared to providing an educational booklet.

Burns et al. (2021) determined whether adding hip treatment to usual care for low back pain (LBP) improved disability and pain in individuals with LBP and a concurrent hip impairment. Seventy-six participants (age, 18 years or older; Oswestry Disability Index, 20% or greater; numeric pain-rating scale, 2 or more points) with LBP and a concurrent hip impairment were randomly assigned to a group that received treatment to the lumbar spine only (LBO group) (*n* = 39) or to one that received both lumbar spine and hip treatments (LBH group) (*n* = 37). The individual treating clinicians decided which specific low back treatments to administer to the LBO group. Treatments aimed at the hip (LBH group) included manual therapy, exercise, and education, selected by the therapist from a predetermined set of treatments. Primary outcomes were disability and pain, measured by the Oswestry Disability Index and the numeric pain-rating scale, respectively, at baseline, 2 weeks, discharge, 6 months, and 12 months. The secondary outcomes were fear-avoidance beliefs (work and physical activity subscales of the Fear-Avoidance Beliefs Questionnaire), global rating of change, the Patient Acceptable Symptom State, and physical activity level. Investigators used mixed-model 2-by-3 analyses of variance to examine group-by-time interaction effects (intention-to-treat analysis). Data were available for 68 patients at discharge (LBH group, *n* = 33; LBO group, *n* = 35) and 48 at 12 months (*n* = 24 for both groups). There were no between-group differences in disability at discharge, 12 months, and all other time points. There were no between-group differences in pain at discharge, 12 months, and all other time points. There were no between-group differences in secondary outcomes, except for higher Fear-Avoidance Beliefs Questionnaire (work subscale) scores in the LBH group at 2 weeks and discharge. Authors concluded that adding treatments aimed at the hip to usual low back physical therapy did not provide additional short- or long-term benefits in reducing disability and pain in individuals with LBP and a concurrent hip impairment. Clinicians may not need to include hip treatments to achieve reductions in low back disability and pain in individuals with LBP and a concurrent hip impairment.

Nava-Bringas et al. (2021) compared the effectiveness of lumbar stabilization exercises and flexion exercises for pain control and improvements of disability in individuals with chronic low back pain (CLBP) and degenerative spondylolisthesis (DS). A randomized controlled trial was conducted in a tertiary public hospital and included 92 individuals over the age of 50 years who were randomly allocated to lumbar stabilization exercises or flexion exercises. Participants received 6 sessions of physical therapy (monthly appointments) and were instructed to execute exercises daily at home during the 6 months of the study. The primary outcome (measured at baseline, 1 month, 3 months, and 6 months) was pain intensity (visual analog scale, 0-100 mm) and disability (Oswestry Disability Index, from 0% to 100%). Secondary outcomes were disability (Roland-Morris Disability Questionnaire, from 0 to 24 points), changes in body mass index, and flexibility (fingertip to floor, in centimeters) at baseline and 6 months, and also the total of days of analgesic use at 6-month follow-up. Mean differences between groups were not significant for lumbar pain, radicular pain, for Oswestry scores, and for Roland Morris scores. Authors state that the findings from the present study reveal that flexion exercises are not inferior to and offer a similar response to stabilization exercises for the control of pain and improvements of disability in individuals with CLBP and DS.

De Campos et al. (2021) evaluate the evidence from randomized controlled trials (RCTs) on the effectiveness of prevention strategies to reduce future impact of low back pain (LBP), where impact is measured by LBP intensity and associated disability. 27 published reports of 25 different trials including a total of 8341 participants fulfilled the inclusion criteria. The pooled results, from three RCTs (612 participants), found moderate-quality evidence that an exercise program can prevent future LBP intensity, and from 4 RCTs (471 participants) that an exercise and education program can prevent future disability due to LBP. It is uncertain whether prevention programs improve future quality of life (QoL) and workability due to the overall low-quality and very low-quality available evidence. Authors concluded that this review provides moderate-quality evidence that an exercise program, and a program combining exercise and education, are effective to reduce future LBP intensity and associated disability. It is uncertain whether prevention programs can improve future QoL and workability. Further high-quality RCTs evaluating prevention programs aiming to reduce future impact of LBP are needed.

George et al. (2021) updated a clinical practice guideline for treatment of low back pain. Findings relative to exercise included the following:

- Exercise For Acute Low Back Pain
    - Physical therapists can use exercise training interventions, including specific trunk muscle activation, for patients with acute low back pain (LBP) (grade C).
- Exercise For Acute Low Back Pain With Leg Pain
    - Physical therapists may use exercise training interventions, including trunk muscle strengthening and endurance and specific trunk muscle activation, to reduce pain and disability for patients with acute LBP with leg pain (grade B).
- Exercise For Chronic Low Back Pain
    - Physical therapists should use exercise training interventions, including trunk muscle strengthening and endurance, multimodal exercise interventions, specific trunk muscle activation exercise, aerobic exercise, aquatic exercise, and general exercise, for patients with chronic LBP (grade A).
    - Physical therapists may provide movement control exercise or trunk mobility exercise for patients with chronic LBP (grade B).
- Exercise For Chronic Low Back Pain With Leg Pain
    - Physical therapists may use exercise training interventions, including specific trunk muscle activation and movement control, for patients with chronic LBP with leg pain (grade B).
- Exercise For Chronic Low Back Pain With Movement Control Impairment
    - Physical therapists should use specific trunk muscle activation and movement control exercise for patients with chronic LBP and movement control impairment (grade A).
- Exercise For Chronic Low Back Pain In Older Adults
    - Physical therapists should use general exercise training to reduce pain and disability in older adults with chronic LBP (grade A).
- Exercise For Postoperative Low Back Pain
    - Physical therapists can use general exercise training for patients with LBP following lumbar spine surgery (grade C).

Gianola et al. (2022) assessed the effectiveness of interventions for acute and subacute non-specific low back pain (NS-LBP) based on pain and disability outcomes in a systematic review with network meta-analysis. Forty-six RCTs (*n*=8765) were included. At immediate-term follow-up, for pain decrease, exercise was considered one of the most efficacious treatments against an inert therapy. Similar findings were confirmed for disability. Fernández-Rodríguez et al. (2022) sought to determine which type of exercise is best for reducing pain and disability in adults with chronic low back pain (LBP) in a systematic review with a network meta-analysis (NMA) of randomized controlled trials

(RCTs). Authors included 118 trials (9710 participants). There were 28 head-to-head comparisons, 7 indirect comparisons for pain, and 8 indirect comparisons for disability. Compared with control, all types of physical exercises were effective for improving pain and disability, except for stretching exercises (for reducing pain) and the McKenzie method (for reducing disability). The most effective interventions for reducing pain were Pilates, mind-body, and core-based exercises. The most effective interventions for reducing disability were Pilates, strength, and core-based exercises. On SUCRA analysis, Pilates had the highest likelihood for reducing pain (93%) and disability (98%). Authors concluded that although most exercise interventions had benefits for managing pain and disability in chronic LBP, the most beneficial programs were those that included (1) at least 1 to 2 sessions per week of Pilates or strength exercises; (2) sessions of less than 60 minutes of core-based, strength, or mind-body exercises; and (3) training programs from 3 to 9 weeks of Pilates and core-based exercises.

Grooten et al. (2022) aimed to identify systematic reviews of common exercise types used in CLBP, to appraise their quality, and to summarize and compare their effect on pain and disability. The included reviews were grouped into nine exercise types: aerobic training, aquatic exercises, motor control exercises (MCE), resistance training, Pilates, sling exercises, traditional Chinese exercises (TCE), walking, and yoga. Out of the 253 full texts that were screened, we included 45 systematic reviews and meta-analyses. The quality of the included reviews ranged from high to critically low. Due to large heterogeneity, no meta-analyses were performed. Authors found low-to-moderate evidence of mainly short-term and small beneficial effects on pain and disability for MCE, Pilates, resistance training, TCE, and yoga compared to no or minimal intervention. Authors conclude that findings show that the effect of various exercise types used in CLBP on pain and disability varies with no major difference between exercise types. Essman and Lin (2022) highlighted the role of exercise in preventing and managing acute and chronic axial low back pain (LBP). They note that no single exercise method has been shown to be more effective than another. Overall, their review summarizes the beneficial role of a personalized exercise program and related counseling strategies in the prevention and management of LBP.

Bagg et al. (2022) estimated the effect of a graded sensorimotor retraining intervention (RESOLVE) on pain intensity in people with chronic low back pain. This parallel, 2-group, randomized clinical trial recruited participants with chronic (>3 months) nonspecific low back pain from primary care and community settings. A total of 276 adults were randomized (in a 1:1 ratio) to the intervention or sham procedure and attention control groups delivered by clinicians at a medical research institute in Sydney, Australia. Participants randomized to the intervention group (*n* = 138) were asked to participate in 12 weekly clinical sessions and home training designed to educate them about and assist them with movement and physical activity while experiencing lower back pain. Participants randomized to the control group (*n* = 138) were asked to participate in 12 weekly clinical sessions and home training that required similar time as the intervention but did not focus on education, movement, and physical activity. The control group included sham laser and shortwave diathermy applied to the back and sham noninvasive brain stimulation. Among 276 randomized patients completed follow-up at 18 weeks. The mean pain intensity was 5.6 at baseline and 3.1 at 18 weeks in the intervention group and 5.8 at baseline and 4.0 at 18 weeks in the control group, with an estimated between-group mean difference at 18 weeks of -1.0 point, favoring the intervention group. In this randomized clinical trial conducted at a single center among patients with chronic low back pain, graded sensorimotor retraining, compared with a sham procedure and attention control, significantly improved pain intensity at 18 weeks. The improvements in pain intensity were small, and further research is needed to understand the generalizability of the findings.

Fleckenstein et al. (2022) investigated the effects of individualized interventions, based on exercise alone or combined with psychological treatment, on pain intensity and disability in patients with chronic non-specific low-back-pain. Fifty-eight studies (*n* = 10084) were included. At short-term follow-up (12 weeks), low-certainty evidence for pain intensity and very low-certainty evidence for disability indicates effects of individualized versus active exercises, and very low-certainty evidence for pain intensity, but not (low-certainty evidence) for disability compared to passive controls. At long-term follow-up (1 year), moderate-certainty evidence for pain intensity and disability indicates effects versus passive controls. Sensitivity analyses indicates that the effects on pain, but not on disability (always short-term and versus active treatments) were robust. Pain reduction caused by individualized exercise treatments in combination with psychological interventions (in particular behavioral-cognitive therapies) is of clinical importance. Certainty of evidence was downgraded mainly due to evidence of risk of bias, publication bias and inconsistency that could not be explained. Individualized exercise can treat pain and disability in chronic non-specific low-back-pain. The effects at short term are of clinical importance (relative differences versus active 38% and versus passive interventions 77%), especially in regard to the little extra effort to individualize exercise. Sub-group analysis suggests a combination of individualized exercise (especially motor-control based treatments) with behavioral therapy interventions to booster effects.

Niederer et al. (2022) investigated how risk of bias and intervention type modify effect sizes of exercise interventions that are intended to reduce chronic low back pain intensity. Potential effect modifiers were risk of bias, exercise modes, study, and meta-analyses characteristics. Data from 26 systematic reviews (k = 349 effect sizes, *n* = 18,879 participants) were analyzed. There was a clinically relevant effect overestimation in studies with a high risk of bias due to missing outcomes and low sample size. There was a clinically relevant underestimation of the effect when studies were at high risk of bias and outcome measurement. Motor control and stabilization training had the largest effects; stretching had the smallest effect. Authors concluded that the effects of exercise trials at high risk of bias may be overestimated or underestimated. After accounting for risk of bias, motor control and stabilization exercises may represent the most effective exercise therapies for chronic low back pain. Cashin et al. (2022) aimed to synthesize and appraise the current research to provide practical, evidence-based guidance concerning exercise prescription for non-specific CLBP. Systematic reviews show exercise is effective for small, short-term reductions in pain and disability, when compared with placebo, usual care, or waiting list control, and serious adverse events are rare. A range of individualized or group-based exercise modalities have been demonstrated as effective in reducing pain and disability. Authors conclude that to promote recovery, sustainable outcomes and self-management, exercise can be coupled with education strategies, as well as interventions that enhance adherence, motivation, and patient self-efficacy.

García-Moreno et al. (2022) upgraded the evidence of the most effective preventive physiotherapy interventions to improve back care in children and adolescents. Twenty studies were finally included. The most common physiotherapy interventions were exercise, postural hygiene, and physical activity. The mean age of the total sample was 11.79 years. Authors concluded that recent studies provide strong support for the use of physiotherapy in the improvement of back care and prevention of non-specific low back pain in children and adolescents. Based on GRADE methodology, they found that the evidence was from very low to moderate quality and interventions involving physical exercise, postural hygiene and physical activity should be preferred. Lindberg and Leggit (2022) summarized that there is low- to moderate-quality evidence that exercise reduces pain and improves function in patients with chronic low back pain compared with no treatment, usual care, and other conservative interventions such as education, manual therapy, and electrotherapy. This effect is clinically significant in the short term (six to 12 weeks) but less pronounced six months after treatment completion. The review does not recommend a specific exercise regimen to treat chronic low back pain.

Prat-Luri et al. (2023) analyzed the effect of trunk-focused exercise programs (TEPs) and moderator factors on chronic nonspecific low back pain (LBP). Forty randomized controlled trials (n = 2391) were included. TEPs showed positive effects for all outcomes versus control. There were small effects in favor of TEPs versus general exercises for pain and disability. Trunk and/or hip range-of-motion improvements were associated with greater reductions in pain and disability. Low body mass was associated with higher pain reduction. Authors concluded that trunk-focused exercise programs had positive effects on pain, disability, quality of life, and trunk performance compared to control groups, and on pain and disability compared to general exercises. Increasing trunk and/or hip range of motion was associated with greater pain and disability reduction, and lower body mass with higher pain reduction.

Ijzelenberg et al. (2023) evaluated the benefits and harms of exercise therapy for acute non-specific low back pain in adults compared to sham/placebo treatment or no treatment at short-term, intermediate-term, and long-term follow-up. This is an update of a Cochrane Review first published in 2005. Authors included RCTs that examined the effects of exercise therapy on non-specific LBP lasting six weeks or less in adults. Major outcomes for this review were pain, functional status, and perceived recovery. Minor outcomes were return to work, health-related quality of life, and adverse events. Main comparisons were exercise therapy versus sham/placebo treatment and exercise therapy versus no treatment. Outcomes were evaluated at short-term follow-up (time point within three months and closest to six weeks after randomization; main follow-up), intermediate-term follow-up (between nine months and closest to six months), and long-term follow-up (after nine months and closest to 12 months). Authors included 23 studies (13 from the previous review, 10 new studies) that involved 2,674 participants and provided data for 2,637 participants. Included studies were conducted in Europe (*N* = 9), the Asia-Pacific region (*N* = 9), and North America (*N* = 5); and most took place in a primary care setting (*N* = 12), secondary care setting (*N* = 6), or both (*N* = 1). In most studies, the population was middle-aged and included men and women. They judged 10 studies (43%) at low risk of bias with regard to sequence generation and allocation concealment. There is very low-certainty evidence that exercise therapy compared with sham/placebo treatment has no clinically relevant effect on pain scores in the short term. There is very low-certainty evidence that exercise therapy compared with sham/placebo treatment has no clinically relevant effect on functional status scores in the short term. There is very low-certainty evidence that exercise therapy compared with no treatment has no clinically relevant effect on pain or functional status in the short term. Owing to insufficient reporting of adverse events, authors were unable to reach any conclusions on the safety or harms related to exercise therapy. Authors concluded that exercise therapy compared to sham/placebo treatment may have no clinically relevant effect on pain or functional status in the short term in people with acute non-specific LBP, but the evidence is very uncertain. Exercise therapy compared to no treatment may have no clinically relevant effect on pain or functional status in the short term in people with acute non-specific LBP, but the evidence is very uncertain.

Li et al. (2023) evaluated the effects of different exercise therapies on chronic low back pain and provided a reference for exercise regimens in CLBP patients. This study included 75 randomized controlled trials (RCTs) with 5,254 participants. Network meta-analysis results showed that tai chi, yoga (SMD, -1.76; 95% CI -2.72 to -0.81), Pilates exercise, and sling exercise showed a better pain improvement than conventional rehabilitation. Tai chi and yoga showed a better pain improvement than no intervention provided. Yoga and core or stabilization exercises showed a better physical function improvement than conventional rehabilitation. Yoga and core or stabilization exercises showed a better physical function improvement than no intervention provided. Authors concluded that compared with conventional rehabilitation and no intervention provided, tai chi, toga, Pilates exercise, sling exercise, motor control exercise, and core or stabilization exercises significantly improved CLBP in patients. Compared with conventional rehabilitation and no intervention provided, yoga and core or stabilization exercises were statistically significant in improving physical function in patients with CLBP. Due to the limitations of the quality and quantity of the included studies, it is difficult to make a definitive recommendation before more large-scale and high-quality RCTs are conducted.

Kazeminia et al. (2023) aimed to estimate the results of randomized clinical trials (RCT) about the effect of pelvic floor muscle-strengthening exercises on reducing low back pain. Nineteen RCTs with a sample size of 456 subjects in the intervention group and 470 in the control group were included in the meta-analysis. Authors concluded that based on the results of the present meta-analysis, pelvic floor muscle-strengthening exercises significantly reduce the low back pain intensity. Therefore, these exercises can be regarded as a part of a low back pain management plan.

Wong et al. (2023) compared the effects of Pilates exercise (PE) with other forms of exercise on pain and disability in individuals with chronic non-specific low back pain (CNSLBP) and to inform clinical practice and future research. Eleven RCTs were included. A low certainty of evidence supported PE was more effective than general exercise (GE) in pain reduction. Moreover, very low levels of certainty were revealed for effectiveness of PE compared with direction-specific exercise (DSE) for pain reduction and equivalence of PE and spinal stabilization exercise (SSE) for pain and disability. Authors concluded that their review found no strong evidence for using one type of exercise intervention over another when managing patients with CNSLBP. Existing evidence does not allow this review to draw definitive recommendations. In the absence of a superior exercise form clinicians should work collaboratively with the patient, using the individual's goals and preferences to guide exercise selection. Further appropriately designed research is warranted to explore this topic further.

Zaina et al. (2023) identified evidence-based rehabilitation interventions for persons with non-specific low back pain (LBP) with and without radiculopathy and developed recommendations from high-quality clinical practice guidelines (CPGs) to inform the World Health Organization's (WHO) Package of Interventions for Rehabilitation (PIR). Four high-quality CPGs were identified. Recommended interventions included (1) education about recovery expectations, self-management strategies, and maintenance of usual activities; (2) multimodal approaches incorporating education, exercise, and spinal manipulation; (3) nonsteroidal anti-inflammatory drugs combined with education in the acute stage; and (4) intensive interdisciplinary rehabilitation that includes exercise and cognitive/behavioral interventions for persistent pain. No high-quality CPGs for people younger than 16 years of age were found. Authors concluded that these recommendations emphasize the potential benefits of education, exercise, manual therapy, and cognitive/behavioral interventions.

Gilliam et al. (2023) assessed the effectiveness of mind-body (MB) exercise interventions provided by physical therapists for reducing pain and disability in people with low back pain (LBP). Randomized controlled trials evaluating the effects of Pilates, yoga, and tai chi interventions performed by physical therapists on pain or disability outcomes in adults with musculoskeletal LBP were included. Eight trials, 7 reporting on Pilates and 1 reporting on yoga, were included. Short-term outcomes for pain and indicated MB exercise was more effective than control intervention. Tests for subgroup differences between studies with exercise vs non-exercise control groups revealed a moderating effect on short-term outcomes where larger effects were observed in studies with non-exercise comparators. Long-term outcomes for pain and disability suggested that MB exercise is not more effective than control interventions for pain or disability. Quality of the evidence ranged from very low to low. Authors concluded that physical therapist-delivered MB exercise interventions, which overwhelmingly consisted of Pilates, were more effective than control in the short and long-term for pain and in the short-term for disability, with differences in the short-term effects lessened when compared with an active intervention. Pilates interventions delivered by physical therapists represent a viable tool for the clinical management of chronic LBP.

Ram et al. (2023) determined the effect of higher versus lower intensity exercise intensity on pain, disability, quality of life and adverse events in people with CLBP. Four trials (n = 214 participants, 84% male) reported across five studies were included. Higher intensity exercise reduced disability more than lower intensity exercise at end-treatment but not at 6-month follow-up. Higher intensity exercise did not reliably improve pain and quality of life more than lower intensity exercise. Adverse events did not differ between exercise intensities. All studies were at high risk of bias. Based on very low certainty evidence from a limited number of studies, exercise intensity does not appear to meaningfully influence clinical outcomes in people with CLBP.

Almeida et al. (2023) evaluated the effectiveness of the McKenzie method in people with (sub)acute non-specific low back pain in a Cochrane review. This review included five RCTs with a total of 563 participants recruited from primary or tertiary care. Three trials were conducted in the USA, one in Australia, and one in Scotland. Three trials received financial support from non-commercial funders and two did not provide information on funding sources. All trials were at high risk of performance and detection bias. None of the included trials measured adverse events. McKenzie method versus minimal intervention (educational booklet; McKenzie method as a supplement to other intervention - main comparison): There is low-certainty evidence that the McKenzie method may result in a slight reduction in pain in the short term but not in the intermediate term. There is low-certainty evidence that the McKenzie method may not reduce disability in the short term nor in the intermediate term. McKenzie method versus manual therapy: There is low-certainty evidence that the McKenzie method may not reduce pain in the short term and may result in a slight increase in pain in the intermediate term. There is low-certainty evidence that the McKenzie method may not reduce disability in the short term nor in the intermediate term. McKenzie method versus other interventions (massage and advice): There is very low-certainty evidence that the McKenzie method may not reduce disability in the short term nor in the intermediate term. Authors concluded that based on low- to very low-certainty evidence, the treatment effects for pain and disability found in our review were not clinically important. Thus, they can conclude that the McKenzie method is not an effective treatment for (sub)acute NSLBP.

Gilanyi et al. (2023) determined the effect of exercise on pain self-efficacy in adults with nonspecific chronic low back pain (NSCLBP). Authors included randomized controlled trials that compared the effect of exercise on pain self-efficacy to control, in adults with NSCLBP. Seventeen trials were included, of which eight (*n* = 1121 participants; 60.6% female; mean age: 49.6 years) were included in the meta-analysis. Exercise increased pain self-efficacy by 3.02 points on the 60-point Pain Self-Efficacy Questionnaire. The certainty of evidence was moderate; all trials were at high risk of bias. Authors concluded that there was moderate-certainty evidence that exercise increased pain self-efficacy in adults with NSCLBP.

Santos et al. (2023) evaluated the efficacy of Pilates on pain, functional disorders, and quality of life in patients with chronic low back pain (CLBP). Nineteen randomized controlled trials with a total of 1108 patients were included. Compared with the controls, this meta-analysis revealed that Pilates may have positive efficacy for pain relief and the improvement of functional disorders in CLBP patients, but the improvement in quality of life seems to be less obvious.

Verville et al. (2023) evaluated benefits and harms of structured exercise programs for chronic primary low back pain (CPLBP) in adults to inform a World Health Organization (WHO) standard clinical guideline. Thirteen RCTs rated with overall low or unclear risk of bias were synthesized. Assessing individual exercise types (predominantly very low certainty evidence), pain reduction was associated with aerobic exercise and Pilates vs. no intervention, and motor control exercise vs. sham. Improved function was associated with mixed exercise vs. usual care, and Pilates vs. no intervention. Temporary increased minor pain was associated with mixed exercise vs. no intervention, and yoga vs. usual care. Little to no difference was found for other comparisons and outcomes. When pooling exercise types, exercise vs. no intervention probably reduces pain in adults and functional limitations in adults and older adults (moderate certainty evidence). Authors concluded with moderate certainty that structured exercise programs probably reduce pain and functional limitations in adults and older people with CPLBP.

Zhang et al. (2023) compared the efficacy of different exercises therapy on CLBP, dysfunction, quality of life, and mobility in the elderly. Sixteen articles (18 RCTs) were included, comprising a total of 989 participants. The quality of included studies was relatively high. Meta-analysis results indicated that exercise therapy could improve visual analog scale (VAS), Oswestry disability index (ODI), short-form 36-item health survey physical composite summary (SF-36PCS), short-form 36-item health survey mental composite summary (SF-36MCS), and timed up and go test (TUG). Exercise therapy effectively improved VAS, ODI, and SF-36 indexes in the elderly. Based on the subgroup, when designing the exercise therapy regimen, aerobics, strength, and mind-body exercise (≥ 12 weeks, ≥ 3 times/week, ≥ 60 min) should be considered carefully, to ensure the safety and effectiveness for the rehabilitation of CLBP patients.

Roren et al. (2023) critically reviewed available evidence regarding the efficacy of physical activity for people with LBP. They reported that in acute and subacute LBP, exercise did not reduce pain compared to no exercise. In chronic low back pain (CLBP), exercise reduced pain at the earliest follow-up compared with no exercise. In a recent systematic review, exercise improved function both at the end of treatment and in the long-term compared with usual care. Exercise also reduced work disability in the long-term. Authors were unable to establish a clear hierarchy between different exercise modalities. Multidisciplinary functional programs consistently improved pain and function in the short- and long-term compared with usual care and physiotherapy and improved the long-term likelihood of returning to work compared to non-multidisciplinary programs.

Heidari et al. (2023) aimed to systematically analyze the efficacy of aquatic exercise on pain intensity, disability, and quality of life among adults with low back pain. Out of 856 articles, 14 RCTs (n = 484 participants; 257 in the experimental groups and 227 in the control groups) met inclusion criteria. Pooled results illustrated that aquatic exercises significantly reduced pain, improved disability, and improved quality of life in both the physical component score and the mental component score when compared with a control group. Authors concluded that the current review showed that aquatic exercise regimens were effective among adults with low back pain. High-quality clinical investigations are still needed to support the use of therapeutic aquatic exercise in a clinical setting.

Babiloni-Lopez et al. (2023) aimed to systematically review and synthesize evidence (i.e., active [land-based training] and nonactive controls [e.g., receiving usual care]) regarding the effects of water-based training on patients with nonspecific chronic low-back pain (NSCLBP). The included studies satisfied the following criteria: (a) NSCLBP (≥12 weeks) patients, (b) water-based intervention, (c) control group (land-based trained; nonactive group), and (d) outcomes related to pain, disability, quality of life, or flexibility. The main outcome analyzed in the meta-analysis was pain intensity. Secondary outcomes included disability, body mass index, and flexibility. After intervention, pain intensity was reduced compared with nonactive controls and a similar reduction was noted when compared with land-based trained group. Greater decrease in disability and greater increase in sit-and-reach were noted after intervention compared with the nonactive group. In conclusion, water-based exercise therapy reduces pain intensity, disability, and increases flexibility in NSCLBP compared with nonactive subjects and was equally effective compared with land-based exercise to reduce pain. Favorable effects may be expected at ≤8 weeks. However, due to several methodological issues (e.g., high heterogeneity), for the improvement of most outcomes, authors were unable to provide other than a weak recommendation in favor of intervention compared with control treatment.

Ceballos-Laito et al. (2023) evaluated the effectiveness of hip interventions on pain and disability in patients with LBP in the short-, medium-, and long-term. A total of 2,581 studies were screened. Eight were included in the meta-analysis involving 508 patients with LBP. The results provided very low certainty that both hip strengthening and hip stretching improved pain and disability in the short-term, respectively. No benefits were found in the medium- or long-term. The risk of bias, heterogeneity, and imprecision of the results downgraded the level of evidence. Very low certainty evidence suggests a positive effect of hip strengthening in isolation or combined with specific low back exercise and hip stretching combined with specific low back exercise for decreasing pain intensity and disability in the short-term, in patients with LBP.

PRACTITIONER SCOPE AND TRAINING

Practitioners should practice only in the areas in which they are competent based on their education training and experience. Levels of education, experience, and proficiency may vary among individual practitioners. It is ethically and legally incumbent on a practitioner to determine where they have the knowledge and skills necessary to perform such services.

It is best practice for the practitioner to appropriately render services to a patient only if they are trained, equally skilled, and adequately competent to deliver a service compared to others trained to perform the same procedure. If the service would be most competently delivered by another health care practitioner who has more skill and expert training, it would be best practice to refer the patient to the more expert practitioner.

Best practice can be defined as a clinical, scientific, or professional technique, method, or process that is typically evidence-based and consensus driven and is recognized by a majority of professionals in a particular field as more effective at delivering a particular outcome than any other practice (Joint Commission International Accreditation Standards for Hospitals, 2020).
Depending on the practitioner's scope of practice, training, and experience, a member's condition and/or symptoms during examination or the course of treatment may indicate the need for referral to another practitioner or even emergency care. In such cases it is prudent for the practitioner to refer the member for appropriate co-management (e.g., to their primary care physician) or if immediate emergency care is warranted, to contact 911 as appropriate. See the *Managing Medical Emergencies (CPG 159 – S)* clinical practice guideline for information.

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