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Review Article

Exercise as a treatment for chronic low back pain

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Abstract

BACKGROUND CONTEXT: Exercise is a widely prescribed treatment for chronic low back pain, with demonstrated effectiveness for improving function and work.

PURPOSE: The goal of this article is to review several key aspects about the safety and efficacy of exercise that may help clinicians understand its utility in treating chronic back pain.

STUDY DESIGN/SETTING: A computerized literature search of MEDLINE was conducted using "exercise," "fitness," "back pain," "backache" and "rehabilitation" as search words. Identified abstracts were scanned, and useful articles were acquired for further review. Additional references were acquired through the personal collections of research papers possessed by the authors and by reviewing prior review articles on this subject. These final papers were scrutinized for data relevant to the key aspects about exercise covered in this article.

RESULTS: For people with acute, subacute or chronic low back pain, there is no evidence that exercise increases the risk of additional back problems or work disability. To the contrary, current medical literature suggests that exercise has either a neutral effect or may slightly reduce risk of future back injuries. Exercise can be prescribed for patients with chronic low back pain with three distinct goals. The first and most obvious goal is to improve or eliminate impairments in back flexibility and strength, and improve performance of endurance activities. There is a large body of evidence confirming that this goal can be accomplished for a majority of patients with chronic low back pain. The second goal of exercise is to reduce the intensity of back pain. Most studies of exercise have noted overall reduction in back pain intensity that ranges from 10% to 50% after exercise treatment. The third goal of exercise is to reduce back pain–related disability through a process of desensitization of fears and concerns, altering pain attitudes and beliefs and improving affect. The mechanisms through which exercise can accomplish this goal have been the subject of substantial research.

CONCLUSIONS: Exercise is safe for individuals with back pain, because it does not increase the risk of future back injuries or work absence. Substantial evidence exists supporting the use of exercise as a therapeutic tool to improve impairments in back flexibility and strength. Most studies have observed improvements in global pain ratings after exercise programs, and many have observed that exercise can lessen the behavioral, cognitive, affect and disability aspects of back pain syndromes.

Keywords: Exercise; Back pain; Rehabilitation

Introduction

Over the last few decades, exercise has been promoted with increasing enthusiasm for the treatment of back pain. This has prompted a systematic review of the evidence concerning the effectiveness of exercise, with the conclusion that exercise may be helpful for patients with chronic low back pain in terms of return to normal activities and work [1].

The goal of this article is to review several key aspects about exercise and chronic back pain that may be important to clinicians who desire to use exercise as a treatment option for their patients. First we will review the safety of exercise, in terms of added risk for production of further pain, injury and disability. Next we propose that the clinical use of exercise be viewed in terms of three distinct though interrelated

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goals: 1) improving impaired back function; 2) decreasing back pain symptoms and 3) minimizing disability by diminishing excessive fears and concerns about back pain. The authors aim to enhance clinicians' understanding of the rationale behind exercise as a treatment for low back pain with the hope that this may improve the effective use of this modality.

Exercise and the risk on low back pain

When considering any therapeutic modality, one must consider the risks, the benefits of that versus the risks, and benefits of alternative treatments. With exercise, the primary risks would be the potential for precipitating additional back pain or further spinal degeneration. Indeed, some people note back pain during or after exercise. Are these events just spontaneous bouts of back pain that can occur coincidental to any other human activity? To determine if exercise places individuals at increased or unreasonable risk for these events, it is important to know whether back pain episodes occur with greater frequency in those that exercise regularly compared with those who do not.

Several epidemiological studies have examined the prevalence of back pain related to fitness. Suni et al. [2] evaluated 498 adults and found that low levels of back fitness were associated with back dysfunction and pain, and high fitness related to positive back health. A 25-year prospective observational study of physical exercise among 640 school children found those who exercised at least 3 hours per week had significantly lower lifetime risk for back pain [3]. Croft et al. [4] prospectively followed 2,715 adults with no low back pain and found that greater leisure-time physical activity does not increase the 1-year risk of low back pain and that poor physical health increases the risk of new low back pain episodes. Videman et al. [5] found that low back pain occurred less commonly and that sciatica occurred with equal frequency among former elite athletes compared with controls. For sciatic symptoms, one study comparing over 2,000 workers without sciatic pain to 327 workers with sciatic pain for 1 year found that exercise and most sports activities had no effect on sciatic pain [6]. In summary, these studies suggest that for the general population, exercise does not increase the risk of back pain or sciatica and may actually have a slight protective effect against back pain.

Because exercise does not increase the risk of back pain in the asymptomatic population, it seems plausible that regular exercise by people with back pain may be relatively safe, without adding unreasonable risk for additional injury or pain. Individuals with low back pain could benefit from the general positive health effects of exercise [7]. Also, it would be encouraging if regular exercise benefited individuals with a history of back pain by reducing the risk for future episodes of pain. Fortunately, the effect of exercise on recurrence of back pain (and the related issue of recurrence of work absence because of back pain) has received some study.

Several studies have examined the effect of exercise on recurrence rates of acute low back pain, and a number have reported positive results. In a study of 39 patients with acute back pain, Hides et al. [8] demonstrated a significant short-term and long-term decrease in the number of recurrences of back pain in a group of subjects randomized into treatment consisting of specific spine stabilization exercises compared with a control group. Moffett et al. [9] demonstrated significantly fewer sick days at 1-year follow-up for subjects with low back pain randomized to an exercise program that included strengthening and stretching as compared with traditional general practitioner management. Soukup et al. [10] randomized 77 patients who had completed treatment for an episode of low back pain into a group that underwent 20 sessions of exercises that focused on pelvic, hip and abdominal exercises or a control group. At 12-month follow-up there was a significant reduction in recurrent low back pain episodes in the exercise group, but no differences in subsequent sick leave was noted.

For subacute, recurrent and chronic low back pain, some studies have also suggested that exercise may have a positive influence on the recurrence rates of back pain and work absence. Lindstrom et al. [11] reports on a population sick-listed with subacute low back pain and noted that those randomized to an exercise program had significantly less sick leave resulting from low back pain compared with the control group. Donchin et al. [12] randomized 142 hospital employees reporting three annual episodes of low back pain into a 3-month calisthenics group, a five-session back school or a control group. At 1 year, the calisthenics group reported significantly fewer "painful months" compared with the back school and control groups. Taimela et al. [13] evaluated 125 patients with recurrent or chronic low back pain an average of 14 months after completion of a 12-week active low back rehabilitation program. They found that recurrences of persistent pain occurred significantly less frequently among those who had maintained regular exercise habits after the treatment than among those who had been physically inactive. They also found significantly less work absenteeism among the physically active individuals. They noted that those individuals with the best rehabilitation outcomes were more likely to maintain exercise.

A lack of effect on recurrence of low back pain or work absence has been noted by other studies. Dettori [14] found no differences in recurrence rate among patients with acute low back pain 6 to 12 months after treatment regardless of randomization to a flexion exercise, an extension exercise or a no exercise group for 8 weeks. Faas et al. [15,16] found that exercise therapy for patients with acute low back pain did not reduce sickness absence. Bendix et al. [17] compared patients with chronic back pain undergoing intensive physical training for 39 hours per week for 3 weeks with the effect of outpatient intensive physical training at 1.5 hours three times per week for 8 weeks and found no difference in sick leave at 1-year follow-up. Bentsen et al. [18] randomized 74 women with chronic low back pain to either a dynamic strengthening exercise program at a fitness center or to a home training program. Exercise adherence was better

in the supervised training, but no differences in days of sick leave were noted for either group at 3-year follow-up.

In summary, for people with acute, subacute or chronic low back pain, there is no evidence that exercise increases the risk of additional back pain episodes or work disability. (These studies concerning exercise and risk of back pain are summarized in Table 1.) To the contrary, current medical literature suggests that exercise has either a neutral effect or has a slight potentially beneficial effect on that risk. With this in mind, it would appear that exercise is safe for people with back pain, and exploration of the potential benefits of exercise is warranted.

Table 1
Evidence concerning exercise and the risk of back pain

Study	Subjects	Outcome	Conclusion
Asymptomatic			
Suni et al. [2]	498 middle-aged adults	Level of fitness and back health	High fitness was related to back health
Harreby et al. [3]	640 38-year-old adults, previously surveyed at age 14 years	Weekly exercise frequency and prevalence of back pain	3 hours per week of physical activities reduced the prevalence of back pain
Croft et al. [4]	2,715 adults without current back pain	New back pain episodes during year after health survey	Physical leisure-time activities not associated with short-term risk of back pain
Viderman et al. [5]	937 former elite athletes and 620 controls	History of back pain and sciatica	Back pain was less common among athletes than controls
Miranda et al. [6]	7,000 forest industry workers	Survey of work and physical exercise predictor and 1-year incidence of sciatica	Physical exercise and most sports activities had no effect on sciatia
Acute back pain			
Hides et al. [8]	39 adults with back pain randomized to stabilization exercises versus control treatment	Recurrence rate of back pain	2-year recurrence rates 35% for spinal stabilization group versus 75% for controls
Moffett et al. [9]	187 adults with back pain randomized to progressive exercise versus control treatment	Disability, back pain, work loss, medical care	At 1 year, exercise group had less disability, back pain, work absence and medical care
Soukup et al. [10]	77 adults with back pain randomized to exercise versus control treatment	Recurrence rate of back pain	At 1 year, recurrence rate was 32% for the exercise versus 57% for the control group
Dettorri et al. [14]	149 soldiers with back pain were randomized to flexion exercises, extension exercises or a control group	Recurrence of back pain 6–12 months after entry	Similar recurrence rates were noted for each group
Faas et al. [15,16]	473 adults with back pain randomized to exercise, placebo ultrasound or control groups	Recurrence rate for back pain and sickness absence from work	No differences in recurrence rates or work absence were noted
Subacute, recurrent or chronic back pain			
Lindstrom et al. [11]	103 workers with back pain were randomized into a graded exercise versus control group	Back pain–related sick leave at 2-year follow-up	Work absence during second follow-up year was 12.1 weeks for the exercise versus 19.6 weeks for the controls
Donchin et al. [12]	142 workers with recurrent back pain were randomized to calisthenics, back school or control groups	Painful months during 1-year follow-up period	Calisthenics group average 4.5 painful months versus 7.3 and 7.4 for the back school and control groups
Taimela et al. [13]	125 adults with chronic low back pain treated with 12-week exercise program	Exercise compliance and recurrence rates for back pain at 1-year follow-up	Those that continued to exercise experienced fewer recurrences than those who were physically inactive
Bendix et al. [17]	138 adults with low back pain randomized to functional restoration versus less intense physical training	Sick leave at 1 year	No difference noted between groups
Bentsen et al. [18]	74 57-year-old women with chronic back pain were randomized to dynamic strengthening in fitness center versus home exercise	Disability, sick leave and pain at 3-year follow-up	No differences were noted between groups

Exercise as a tool to improve back function

Because the most obvious benefit of exercise is its ability to improve or maintain musculoskeletal and cardiovascular function, exercise may be useful for improving back function for patients with low back pain. With this goal in mind, exercise-based spine rehabilitation programs are typically designed around the goals of strengthening the back, increasing back flexibility and improving cardiovascular fitness. This focus resulted from research demonstrating that impairments of trunk strength [19–22], flexibility [23–25] and endurance [26] are present in many people with chronic low back pain. These impairments result in part from long-term inhibition of movements and physical inactivity that results in neurological and physiological changes in the spine. These changes include weakness of the paraspinal musculature, with selective loss of Type 2 muscle fibers [22], alteration of the relaxation response of the paraspinal musculature associated with full spinal flexibility [27] and shortening of muscles and connective tissues of the spinal region. This limitation of movement and activity is largely voluntary, as people both consciously and unconsciously limit activities that induce back pain, or avoid these altogether for fear of producing injury or harm [27]. Inhibition of movements and activities usually begins early in the course of back pain and may be reinforced by health-care providers through their advice to patients to avoid activities and movements that induce pain [28]. Reversal of these impairments in back function can be approached using established principles of exercise.

Exercise for the goal of improving impaired flexibility

Stretching exercises can be used to eliminate impaired flexibility and restore normal trunk range of motion. In order to be successful, however, stretching must be performed at the patient's physiological end range and therefore within the range of motion that may induce back discomfort (Fig. 1). Stretching within the painful range is safe, and acceptable to patients when their health-care providers suggest it with confidence.

Accurate assessment of trunk mobility is helpful for identifying impairments in flexibility and monitoring progress toward improvement. Useful motions to assess include lumbosacral flexion, extension and side bending. Multiple techniques for measuring trunk range of motion are available for clinicians. The most accurate measurements are obtained using dual inclinometers [19]. This technique allows for the measurement of total lumbosacral motion, along with its lumbar and pelvic components. A simpler alternative uses a single inclinometer placed over the T12-L1 interspace and measures total lumbosacral motion only [28]. This technique has been found to be reliable and valid. For total lumbosacral motion, normal values for trunk flexion (100 to 120 degrees), extension (25 to 45 degrees) and side bending (25 to 45 degrees) have been established [19,24]. Straight leg raising

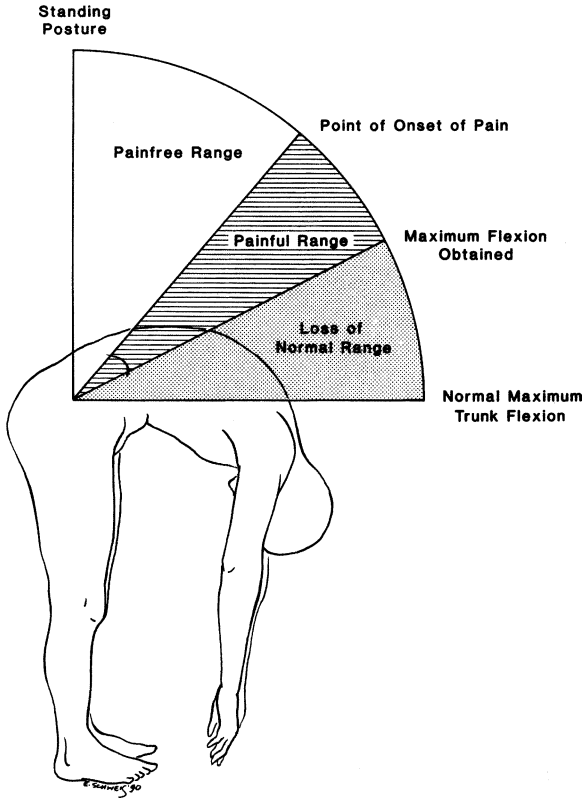

Fig. 1. Frequently observed pattern of trunk flexion for patients with chronic low back pain.

can be measured using an inclinometer by holding it on the tibial tuberosity while passively raising the leg until significant back or leg pain occurs or the pelvis is observed to rotate. Normal values for straight leg raising are 75 to 85 degrees [19,24]. As documented progress can provide important feedback about efficacy to the patients and the medical staff, quantification of flexibility can be done at initial evaluation, after every few therapy sessions and at discharge.

Several methods for stretching are available. Ballistic stretching is not generally recommended because this activates muscle spindle reflexes that are counterproductive for improving muscle length. Techniques using proprioceptive neuromuscular facilitation have been demonstrated to be effective but require a specially trained therapist or partner and are impractical for independent home programs. Static stretching is an effective means of improving flexibility, requires only minimal training and can be done without a therapist. Static stretches must be held for at least 30 seconds in order to induce changes in flexibility and can be repeated in up to four sets with additional benefit. Three sessions of stretching per week improve flexibility, but even greater gains in flexibility are made when stretching is performed five times per week. After flexibility had been increased through a training program, one session of stretching per week is enough to maintain the increases.

Stretching exercises should address the six directions of lumbar motion: flexion, extension, side bending to the right

and left, and rotation to the right and left. Additionally, stretches aimed at improving the length of hip flexors, extensors, rotators, adductors and abductors, hamstrings, quadriceps and calves should be emphasized.

Multiple studies have documented the efficacy of stretching for improving trunk flexibility deficits in patients with chronic back pain, with average improvement of about 20% noted [11,19,25,29–32]. Long-term compliance with a therapeutic stretching regimen has been documented and is generally high [7].

Exercise with the goal of improving impaired back strength

Because multiple studies have shown that the trunk muscles of patients with chronic low back pain are weaker than those of healthy individuals [19–22], many programs advocate strength training to correct this impairment.

Resistance training is the most studied form of exercise used for the development of lumbar extension strength. The effectiveness of a resistance-training program for stimulating adaptation of trunk musculature is dependent on many factors. These include load, frequency, volume and mode of training.

Different authors advocate various modes of resistance training. Some advocate isoinertial resistive training on specifically developed equipment. These include advocates for equipment that isolates the spinal musculature and eliminates pelvic motion by firmly fixing the pelvis [20,21,33–38] and others who allow more contribution of pelvic motion during back extension [13,19,22,39,40]. One advantage of isoinertial exercise equipment for resistance training is that performance level is constantly quantified, thereby giving continuous feedback concerning progress toward treatment goals.

For optimum strength training of deconditioned individuals using isoinertial exercises, the performance of sets of 8 to 12 repetition maximum (RM) is recommended [21,37,41,42]. Training at low loads (less than the RM) may be beneficial for reducing fears and voluntary inhibitions during initial training sessions but does not lead to improvement of strength and therefore should be limited to a few sessions. The frequency of strength training has been studied, and no differences were noted in one versus three times per week [37] or two versus three times per week [42]. Currently, programs recommend once [38] or twice per week for most individuals [20,21,34,36,42–44] with higher frequencies of strength training recommended for disabled workers [19,22,31,32,45] and those with needs for higher levels of strength, such as athletes [42].

In general, improvements of 30% to 80% of volitional muscle strength are observed during these programs [19–22,30–32,34,36,43]. Maintenance of lumbar extensor strength has been demonstrated with training at one time per week [38] and even as low as one time per month [33].

Some advocate strength training using body weight as resistance. Multiple methods are possible, including simple floor exercises, the use of an exercise ball or methods in which the lower or upper part of the body is fixed or supported on a platform or table, and the remaining body is lifted or suspended from the edge of the platform using the strength of the trunk muscles [46–48]. For most of these types of exercise, strength cannot be accurately quantified (although improvements in quality of performance and in number of repetitions is usually noted by the patient and therapist), and potential benefits for improving strength have received limited documentation. For trunk suspension training, measurements of improvement in duration of ability to perform a lumbar isometric hold was documented [46,49].

Exercise with the goal of improving cardiovascular endurance

Some individuals with chronic low back pain exhibit a reduced aerobic capacity compared with healthy controls [26], but as with flexibility and strength, cardiovascular performance is strongly influenced by activity-related increases in pain intensity during testing [50] and therefore poor performance may not indicate real impairments in cardiovascular function [50,51]. Regardless of the reason for diminished performance, improving endurance is a reasonable exercise goal for patients with low back pain.

Cardiovascular endurance can be increased by a variety of exercises that are performed for a prolonged period of time at a submaximal level. These include the use of treadmills, exercise bicycles and other endurance training equipment, walking, running, dance, cycling, swimming and various types of aerobics. Training frequencies of three times per week [26,52,53] for at least 15 minutes at 75% of maximum heart rate have been demonstrated to have efficacy in improving endurance [52].

Improvements in performance for endurance activities have been demonstrated after endurance training of patients with low back pain [25,26,31,54,55].

Exercise as a modality to reduce chronic low back pain symptoms

A compelling reason to use exercise for the treatment of chronic back pain is that it may reduce back pain intensity. This effect has been observed in multiple uncontrolled, observational studies. These are summarized in Table 2.

Results from several randomized, controlled studies using a variety of types of exercise have demonstrated a positive effect on pain. Frost et al. [56] noted that an active exercise program consisting of eight sessions over 4 weeks was found to be superior to unsupervised home exercise instruction for pain reduction (38% in the exercise versus 13% in the home exercise group). Torstensen et al. [57] compared an

Table 2
Changes in back pain reported by observational studies using exercise for the treatment of chronic low back pain

Study	Subjects	Type of exercise	Changes in back pain
van der Velde and Mierau [26]	258 patients with chronic low back pain	6-week program of aerobic and flexibility exercises	31% decrease
Wittink et al. [50]	17 patients with chronic low back pain	6-week program of aerobic, stabilizing and endurance exercises	23% decrease
Taimela et al. [13]	125 patients with chronic low back pain	12-week program of strength training and stretching	50% decrease
Leggett et al. [36]	412 patients with chronic low back pain	8-week strength training, endurance training and stretching	50% decrease
Rainville et al. [25]	77 patients with chronic low back pain	6-week program of strength training, stretching and endurance training	32% decrease
Hazard et al. [31]	59 patients disabled with chronic low back pain	3-week program of strength training, stretching and endurance training with behavioral support	26% decrease
Mayer et al. [23]	74 patients disabled with chronic low back pain	3-week program of strength training, stretching and endurance training with behavioral support	10% decrease
Holmes et al. [20]	18 elderly women with chronic low back pain	14-week program of back strengthening	60% decrease
Edwards et al. [45]	54 patients disabled with chronic low back pain	4 weeks of resistive training, work hardening and manual treatments	30% decrease

active graded exercise program consisting of three weekly sessions for 12 weeks with conventional physical therapy and an unsupervised walking program. They observed a 30% pain reduction in the active exercise group versus a 23% pain reduction in the physical therapy group and a 9% pain reduction in the walking group at the end of treatment. Alaranta et al. [58] randomized 378 patients with back pain for less than 6 months and substantial work absences into a 3-week functional restoration program consisting of intensive exercise with educational and behavioral support or a controlled group that received passive physical therapy and low-intensity exercises. The intensive exercise group reported greater pain reduction at follow-up compared with the controlled group (36% versus 20%). Manniche [46] randomized patients into various intensities of back extension strengthening (50 repetitions vs. 15 repetitions vs. controls). He found that the most intensively exercised group had a significantly greater reduction in pain symptoms. Kankaanpää [40] randomized patients with chronic back pain into a 12-week active rehabilitation program consisting of resistive training versus a control group receiving passive treatments and noted a 54% reduction of pain in the active rehabilitation group versus no change in the control group.

Not all studies have demonstrated pain reduction with exercise. Bendix et al. [17] performed a study using functional restoration versus community treatments but noted no change in pain in the treatment or the controlled group. Additionally, low-intensity exercise may have less effect on back pain as Hansen et al. [48] noted no posttreatment differences in pain in patients randomized into treatment consisting of floor exercises versus conventional physical therapy or placebo traction.

The mechanisms through which exercise may reduce pain are not currently established. It has been theorized that exercise may reduce back pain through a process of neurological or physiologic desensitization of the pain-producing tissue, through the repeated application of force or stress to that tissue [43].

Of importance, delayed onset muscle soreness is known to peak 1 to 2 days after exercise and may be experienced or interpreted as an exacerbation of back pain by some patients [59]. This muscle soreness occasionally aggravates patients' fears about reinjury and must be addressed effectively in order to avoid undermining the exercise program. Frequent reassurances that fluctuations in pain are expected in response to exercise may be important for the successful use of exercise treatments.

Exercise as treatment for behavioral, cognitive, affective and disability components of chronic back pain

It is recognized that psychosocial, behavioral, cognitive and affective factors play crucial roles in the development of chronic low back pain syndromes and especially back pain–related disability. By understanding the mechanisms by which these factors influence back pain, one can envision ways that exercise may be used as a therapeutic modality to address these issues.

In 1983, a fear-avoidance model of exaggerated pain perception was introduced citing two extreme possible behavioral responses to the threat of pain: confrontation or avoidance [60]. Theoretically, those who were able to effectively confront their pain were able to maintain and increase

their physical/social activities leading to reduction in fear over time and recovery. Those who exhibited primarily avoidance responses were more prone to developing chronic symptoms and associated physical impairment and disability. Philips [61] postulated that pain avoidance was influenced by the expectancy that further exposure to certain stimuli will result in pain and suffering. Subsequent recent research in this area has focused on fear of pain [62,63], fear of work-related activities [24], fear of movement presumed to cause (re)injury [64,65] and pain attitudes and beliefs [66–68], and all have demonstrated that fears, attitudes and beliefs strongly influence back pain–related disability. With this in mind, exercise can potentially be used as a tool to confront fears, reshape attitudes and beliefs and alter behavioral responses to pain.

Exercise performed in a quota-based manner (pre-established performance expectations that are not dependent on pain) may function in part as a fear-desensitizing process. Fordyce et al. [69] conceptualized quota-based, non–pain-contingent exercise as a method of operant conditioning with the goal of decreasing illness (disability) behaviors and reinforcing wellness (exercise) behaviors. They demonstrated that when exercise was delivered this way, significant increases in activity and exercise tolerance, in addition to decreased use of pain medication, were observed. Subsequently, functional restoration programs, which also use quota-based exercise, have demonstrated reductions in disability and a high rate of return to work after treatment [23,31]. Of interest, functional restoration has been shown to directly influence patients' pain attitudes and beliefs, and the magnitude of this influence strongly predicts posttreatment disability [28]. Over the last decade, multiple additional studies using exercise as the primary mode of treatment have demonstrated significant reduction of disability after treatment, presumably in part because of the influence of exercise on these parameters [13,21,26,40,43,56,70]. These are summarized in Table 3.

Increased prevalence of depression, anxiety, substance abuse/dependence, somatization and personality disorders has been documented in patients with chronic low back pain compared with the general population. The estimated current and lifetime prevalence of major depressive disorder in these patients has been found to range between 30% and 65% [21,71,72,73] compared with 5% to 17% for the general US population [74]. Polatin et al. [71] also found a high rate of substance abuse/dependence and anxiety disorders for patients with chronic back pain. It is controversial as to whether these disorders are a consequence of experiencing chronic pain and disability or whether they precede onset, perhaps acting as predisposing factors for chronicity. Gatchel et al. [75] performed psychological evaluations on 421 patients within 6 weeks of onset of back pain and found that major psychopathology was not predictive of chronicity or long-term disability. Recent systematic literature review of studies looking at existing evidence implicating psychological factors in the development of chronicity found that both "distress" (a term used to represent a composite of psychological distress, depressive symptoms and depressed mood)

Table 3
Disability outcomes reported by studies employing exercise for the treatment of back pain

Study	Population	Treatment	Percent change in functional outcome
Taimela et al. [13]	156 adults with recurrent or chronic back pain	12-week progressive exercise program	38% reduction in physical impairment score
Risch et al. [21]	54 adults with chronic back pain	10-week progressive resistance exercise program	15% reduction in physical scale of Sickness Impact Profile
Mayer et al. [23]	116 disabled workers with chronic back pain	3-week functional restoration program	8% reduction of Million Visual Analog disability scores
van der Velde and Mierau [26]	137 adults with chronic back pain	6-week general conditioning program	33% reduction of Oswestry disability scores
Rainville et al. [28]	58 disabled workers with chronic back pain	7-week functional restoration program	25% reduction in Million Visual Analog disability scale
Hazard et al. [31]	59 disabled workers with chronic back pain	6-week functional restoration program	41% reduction in Oswestry disability scores at 1 year
Kankaanpää et al. [40]	59 adults with chronic back pain randomized to active exercise versus passive control group	12-week active exercise program	56% reduction in Pain Disability Index in exercise group at 1 year, 20% increase in controls
Rainville et al. [43]	77 adults with chronic back pain	6-week active exercise program	28% reduction in Oswestry disability scores at 1 year
Frost et al. [56]	81 adults with chronic back pain randomized to fitness program versus education and home exercise control group	4-week fitness program	25% reduction in Oswestry disability scores in fitness group versus 7% reduction in control group
Mannion et al. [70]	137 adults with chronic back pain randomized to aerobics, functional restoration or active physiotherapy	12 weeks of stretching and aerobic conditioning, functional restoration or individual physiotherapy	At 6 months, Roland Morris disability scores decreased 30% in the aerobic and functional restoration groups versus 3% in the physiotherapy group

and somatization were significant predictors of unfavorable outcome [76]. Similar systematic review looking at whether psychosocial factors at work and in private life are risk factors for the occurrence of low back pain found strong evidence for low social support in the workplace and low job satisfaction as risk factors for low back pain, whereas there was insufficient evidence found for psychosocial factors in private life [77].

Of interest, several studies of exercise have documented improvements in depression scores after treatment [13,19,31,32,67]. In these studies, pretreatment depression scores were generally in the mild to moderate range, and the improvement in depression scores noted might reflect more of an improvement in mood because of improved functional abilities and pain than improvement in major depression symptoms.

Given the relatively high prevalence of psychological/affective disorders in the chronic low back pain population, a brief look at the literature investigating the effects of exercise on these disorders without concurrent low back pain seems warranted. Most of this research has studied the effects of aerobic training on depression. Overall, the literature suggests that exercise treatment is more effective in treating depression than no treatment, and as effective as psychotherapy and antidepressant medication. Unfortunately, the majority of studies have significant methodological weaknesses, and in the last decade only three randomized clinical trials of exercise as a treatment for depression have been published [78–80] of which only one included both an adequate sample size and satisfactory follow-up [80].

The presence of compensation involvement has been found by multiple studies of exercise to be a negative prognostic factor in terms of both pain and disability reduction [45,67,81–84]. However, the physiological results from exercise are relatively unaffected by involvement with compensation, therefore making exercise of measurable benefit to this population [67].

Conclusions

In summary, exercise can be viewed as being safe for individuals with chronic back pain, because there is no evidence to suggest that regular exercise increases the risk of future back pain or degeneration. There is modest evidence to suggest that the regular performance of exercise may indeed decrease this risk. Exercise can be perceived as useful for addressing three distinct aspects of the chronic back pain syndrome. First, exercise can be useful for improving impairments in function that are frequently present in patients with chronic low back pain, including reduced back flexibility, strength and cardiovascular endurance. Second, there is modest evidence to suggest that the regular performance of exercise may directly reduce back pain intensity. Finally, exercise may be useful for reducing back pain–related disability because it may be used as a tool to lessen excessive fear and concerns about back pain and alter stifling pain attitudes and beliefs.

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