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Exercise for the prevention of non-specific chronic low back pain: systematic review

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Abstract

Low back pain is the most common musculoskeletal condition in the general population, affecting almost 80% of individuals during their lifetime. It is also a major public health burden, associated with numerous consequences such as disability, low quality of life, care seeking, work loss, compensation, generating substantial healthcare costs.

The purpose of this article was to determine if exercise therapy (recreational exercises, aerobics, stretching, core strength and stabilization exercises) may prevent the recurrence of non-specific low back pain (NSLBP). A specific program focusing on one area of fitness may not be appropriate, but a multimodal prevention training program integrating major physical activity contents (muscular endurance, strength, stretching and aerobic fitness) seems promising and can be beneficial for NSCLBP. Until now, based on what we know from the literature, prevention of NSCLBP using ET is complex, difficult and remains unclear because there is limited evidence for many aspects of prevention in LBP.

Keywords: non-specific chronic low back pain, recurrent low back pain, physical activity, exercise therapy, prevention, rehabilitation.

Introduction

Low back pain (LBP) is the most common musculoskeletal condition in the general population, affecting almost 85% of individuals during their lifetime. As the population ages, the global number of individuals with low back pain is likely to increase substantially over the coming decades (Hoy et al., 2012). It is also one of the most burdensome health problems, generating enormous costs for treatment and a lot of time lost from work (Steffens et al., 2016; Macedo et al., 2013). Its management comprises a range of different intervention strategies including surgery, drug therapy and non-medical intervention such as rehabilitation (Paolucci et al., 2019).

The secondary prevention of LBP is classically described as a prevention of the development of chronic low back pain (CLBP) arising from an acute episode of LBP. Considering the latter, 60-70% of patients with acute LBP are symptom-free after treatment, but a considerable amount of patients will experience one or more relapses within a year of the first occurrence of LBP (Niederer et al., 2018; Machado et al., 2017).

Overall, the non-specific chronic low back pain (NSCLBP) is important not so much for its existence as for its consequences, such as recurrence (including severity and disability), care seeking, work loss, health-related quality of life, compensation. Therefore, the consequences of common LBP are a primary concern for prevention (Burton et al., 2005).

Whereas the vast majority of LBP episodes are associated with return to work in a convenient time, recurrent and CLBP is widely acknowledged to account for a substantial proportion of total work absenteeism. This is reflected in the social costs of LBP, where some 80% of the health care and social costs are for the treatment of this pathology, and 10% are spent with chronic pain and disability. These issues present interpretative difficulties in the matter of prevention, where low back pain and its consequences tend to occur in an episodic manner (Burton et al., 2005). However, there is great interest in preventing recurrent episodes using physical activity (PA) or exercise therapy (ET) because they are a common treatment method. Recurrences can be more expensive to treat than the original episode, and can be as debilitating as the initial episode. Therefore, the prevention of such episodes may be an important component in the management of patients with LBP (Macedo et al., 2013).

ET is one of the most commonly recommended treatment methods for patients with CLBP, with clear evidence for effectiveness, but it is unknown whether exercise therapy is effective for the prevention of LBP

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recurrences (Macedo et al., 2013; Koes et al., 2010; Henchoz & Kai-Lik, 2008). A plethora of established and validated exercises are available for the therapy of LBP, but for secondary and tertiary prevention the number is lower. The preventive approaches used for relapse prevention are twofold: ET during treatment and ET following primary / initial treatment. Conflicting evidence supporting the relevance of exercise during initial treatment exists, but moderate evidence supports the relevance of exercise programs subsequent to primary care (Niederer et al., 2018; Macedo et al., 2013).

Post-treatment exercises can reduce both the rate and the number of recurrences of back pain, but healthcare providers and patients need to understand their options in relation to what works and what is cost-efficient to make a confident and well-educated decision regarding their choice of a rehabilitation program (Choi et al., 2010; Privett et al., 2012).

Hypothesis

This study aimed to investigate the effectiveness of physical activity and exercise in the prevention of non-specific chronic low back pain. Our primary hypothesis was that PA and ET can be beneficial in NSCLBP. Our secondary hypothesis was that the risk of relapse would be lower after ET than after primary care management.

Leisure time physical activity

Leisure time physical activity (LTPA) is any bodily movement produced by the contraction of skeletal muscles that requires energy expenditure, such as walking or climbing stairs (Booth et al., 2012). Exercise is a specific form of LTPA, which is a purposeful, planned and repetitive activity often with the purpose of improving or maintaining physical fitness, or even for losing weight. Obesity is a lifestyle risk factor associated with CLBP, a condition that can be treated with PA or ET combined with health education and diet (Shiri et al., 2017). Muscle imbalance and vicious posture are also modifiable risk factors that can be reduced with interventions such as postural control or muscle endurance exercises (Steiger et al., 2012).

Although it is well known that PA can reduce all-cause mortality and risk factors of a wide variety of chronic diseases such as cardiovascular and respiratory diseases, diabetes, obesity and musculoskeletal diseases, unfortunately, there is a lack of evidence linking the effects of exercise to changes in the musculoskeletal system for CLBP patients (Steiger et al., 2012; Alzahrani et al., 2019).

However, there is an intense association between physical activity and LBP. A recent meta-analysis reported that medium to high level of leisure-time physical activity (LTPA) reduces the risk of developing chronic LBP by 11–16% (Alzahrani et al., 2019). Also, another study showed that high-intensity physical activity is a feasible, well tolerated, and effective therapy choice in CNSLBP. Moreover, it has shown a greater improvement of disability and exercise capacity than a similar ET performed at moderate intensity (Verbrugghe et al., 2019).

Measuring physical activity (PA) levels in CLBP is known to have important clinical implications, but is constrained by time or resources. Regarding clinical presentation, patients with chronic symptoms and high disability are more likely to have a low PA level (Carvalho et al., 2017). Clinicians can assume that patients with CLBP have low levels of physical activity and can design treatment accordingly, but direct monitoring of physical activity using an instrument of movement registration, such as a pedometer or accelerometer, can be used to provide patient feedback or set quotas for activity progression, and may be a useful treatment adjunct (Lin et al., 2011).

Also, it is equally important to search for the "yellow flags", which are risk factors for the chronification of acute LBP and are often found in psychosocial limitations such as fear, depression, excessive demands on oneself, self-esteem deficits, fear-avoidance-beliefs, dissatisfying employment and mobbing. Targeting the yellow flags and risk factors in CLBP patients should allow a prescription of the most appropriate treatment, maximizing the likelihood of a favorable clinical outcome (Macedo et al., 2013; Niederer et al., 2018; Underwood et al., 2000).

The multifactorial genesis of LBP indicates that PA alone may not be enough for the prevention of CLBP, although a relation between the amount and characteristics of PA/ET and LBP exists. Individualization of the treatment seems to be crucial. More specifically, the fastest possible early onset of PA after the non-specificity diagnosis of pain may be helpful; in fact, this was demonstrated in some studies where early ET showed improvements in comparison with the usual care (Niederer et al., 2018). Resumption of normal activities shortens the duration of acute and subacute episodes of LBP, leading to the assumption that chronic disability will also be reduced. As regular PA is thought to reduce the proportion of LBP patients that progress to disability, it is plausible that regular PA before the onset of pain would have a similar effect. If combined with educational aspects, as described above, PA may be efficient in preventing recurrent NSLBP, but evidence at this moment is yet inconclusive (Niederer et al., 2018; Underwood et al., 2000).

Understanding the links between physical activity and LBP will allow future multi-component interventions aimed at LBP prevention. Examining each domain of physical activity separately will enable easier translation of the knowledge generated in observational studies into real-life prevention (Alzahrani et al., 2019).

Although the evidence for PA preventing LBP is weak, patients should be encouraged to stay as active as possible and progressively increase their physical activity levels (Koes et al., 2010). The other potential benefits of exercising mean that it is reasonable to encourage regular physical activity as part of a strategy to reduce the overall impact of back pain disability, on both the individuals and society (Underwood et al., 2000).

Aerobic exercises

Aerobic exercises are a form of low intensity physical activity (PA) that maintains a 60% maximal heart rate for at least 30 minutes. They are more commonly known for improving cardiovascular endurance, but benefits to muscular endurance and flexibility are seen as well (Privett et al., 2012). Aerobic exercises increase the blood flow and nutrients to the soft tissues in the back, improving

the healing process, but also increase the production of endorphins known as "natural pain killers", which is a natural alternative for pain relief for the body, and can reduce CLBP (Gomes-Neto et al., 2017). Additional benefits are provided, such as improving the functional status of patients and reducing the fear of movement, which is a predictor for functional limitation associated with disability (Gordon et al., 2016; Gasibat et al., 2017).

Most of the studies evaluating ET for NSLBP patients, measuring pain, function, recurrence, global improvement outcomes, demonstrated that regular aerobic exercises may be helpful in alleviating pain, disability and psychological strain and appear to improve the mood states and the work status (Chatzitheodorou et al., 2007; Murtezani et al., 2011).

Studies on pain, physical and psychosocial disability of CLPB showed that psychologists play essential roles, but unfortunately most of individuals with chronic pain never receive behavioral therapy. Behavioral therapy is effective in reducing pain, distress, pain interference with activities, disability, and also lacks the risks associated with chronic pain medications, surgeries or other interventional procedures (Ehde et al., 2014). This suggests that behavioral therapy can be applicable to CLBP patients as an alternative treatment method, and combined with aerobic exercises offers promising outcomes.

Regarding the intensity of aerobic exercise programs, studies indicate that similar outcomes can be achieved despite differences of intensity. However, the most prescribed aerobic exercises for CLBP are moderate intensity programs, used to reduce risks, enhance compliance and have an optimal impact (Murtezani et al., 2011; Gordon et al., 2016).

Many researchers in the field who compared the effectiveness of aerobic programs with different types of exercises or even with active physiotherapy in CLBP patients found a similar effectiveness between the different therapeutic methods applied (Shnayderman et al., 2013; Mannion et al., 2001; Kell & Asmundson, 2009). In a randomized clinical trial on subjects treated for CLBP, three different types of therapy were compared (active physiotherapy, muscle reconditioning on training devices and low impact aerobics), and the authors reported that the therapies were equally efficacious and significantly reduced pain intensity and frequency for up to 1 year after therapy. For the physiotherapy group, disability increased again during the first six months of follow-up, whilst the other two groups showed a further decline. Also, in all groups the values then remained stable up to the 12-month of follow-up, which shows that aerobic exercise programs for patients with CLBP may reduce the enormous costs associated with its treatment (Mannion et al., 2001). Prophylactic rehabilitation involving moderate intensity aerobic exercise should be prescribed more often for NSCLBP, but the key to success in having the best outcomes is to individualize ET for each patient depending on functional status or other medical conditions. A multidisciplinary program which includes aerobic fitness and behavioral therapy may be more efficient in reducing CLBP recurrence, but further research is needed.

Stretching exercises

LBP is a common cause of decrease in physical activity (PA), creating a vicious cycle that is difficult to change. Restoring muscle balance and improving the mobility of the spine are the most important tasks of kinetotherapy in lumbar pain syndrome.

Stretching is a therapeutic method included in medical rehabilitation, used to increase muscle length and also to strengthen the collagen fibers. Details on stretching exercises are rarely supplied. The isometric technique seems to be the most widely used method, but static stretches, proprioceptive or ballistic neuromuscular facilitation could also be performed. Stretching exercises focus not only on the back, but also on other muscle groups in the legs, thighs, hips, or trunk (Niederer et al., 2018).

The difficulty of determining the effectiveness of stretching comes from the fact that the rehabilitation events are supplemented by other means of impact on the muscles. The most effective types of exercises for CLBP are still controversial, but ET is one of the most widely used conservative treatments around the world (Lizier et al., 2012). Modern studies show that the good condition of the lumbar spine depends on many factors, one being muscle elasticity. Static stretching of muscles can lead to greater improvements in flexibility in people's spine (Feland & Marin, 2004).

Patients with chronic musculoskeletal pain who follow a stretching program for three weeks have an increased tolerance to stretching the muscles. Muscle relaxation and stretching exercises are useful, allowing patients to participate in an active exercise program (Fleckenstein et al., 2010). The stretching programs for CLBP patients that have been reported in the literature show that they are effective in reducing pain, improving functional condition and quality of life (emotional, limitations in physical functioning, vitality and mental health), accelerating the return to normal daily activity or even to work (Lawand et al., 2015; Gawda et al., 2015). A systemic stretching program focused on the back, trunk, thighs, hips and legs is effective in CLBP patients, and can be performed before and after other exercises, as part of prevention (Johnson, 2012; Niederer et al., 2018).

Prevention of recurrent NSLBP is an important part of rehabilitation, and stretching exercises are an affordable, easily workable method with a good therapeutic effect on the pain of the musculoskeletal system. Muscle spasm and muscle imbalance are positively influenced by the administration of stretching exercises, which may prevent recurrent CLBP. The studied publications advocate that stretching exercises should be recommended in the management of LBP, but the modalities of implementation and the results remain controversial due to some discrepancies in terms of duration and frequency of stretching therapy. More evidence should be gathered to allow conclusions to be drawn about the prevention of NSCLBP involving stretching exercises (Angelova et al., 2019).

Core strength and stability exercises

Core strength and stability exercises have become a major focus in the prophylactic care of LBP. The difference between them is that core stability refers to the ability of

stabilizing the spine as a result of muscle activity, whereas core strength refers to the ability of the musculature to produce force through contractile forces and intra-abdominal pressure (Gomes-Neto et al., 2017; Hibbs et al., 2008).

When the core muscles function normally, they can maintain segmental stability, protect the spine, and reduce stress impacting the lumbar vertebrae and intervertebral discs. In order to function normally every day, our body needs to have enough strength and stability, but after a low back pain episode, muscles do not regain their full strength and endurance (Shiju Majeed et al., 2019; Hibbs et al., 2008).

A core program which incorporates both core stability and core muscular strength, emphasizing spinal mobility, back muscle strength, muscular endurance, coordination and proprioception, is more effective for NSCLBP patients than muscular strength exercises alone. These training programs should be directed against adjusting deficits and imbalances, which can be predictors of increased low back pain recurrences (Gordon et al., 2016; George et al., 2007).

A poor sitting posture determines a lower activation of the core muscles; consequently, they become weaker, having a negative impact upon the ability to maintain an upright posture. The increase in the number of sick leave days also increases the risk for chronic LBP, and ET alone might be unable to help patients with many days of sick leave. A core program combined with education on the correct techniques for maintaining an upright sitting posture and for lifting can be more effective in reducing LBP, and these techniques should be prescribed together more often (Gordon et al., 2016).

Some studies compared the efficiency of core exercises to that of conventional spine exercises, and core stabilization exercises were found to be more effective in reducing pain, improving functional status by decreasing disability of NSCLBP patients (Inani et al., 2013), but also more effective than muscular strength exercises (Alhakami et al., 2019). The conclusion of a systematic review was that lumbar low load specific stabilization exercises would be more efficient than muscle strengthening in the improvement of CLBP, but strengthening exercises are considered more valuable in effectively 'pre-habilitating' and in reducing the injury risk (Hadala & Gryckiewicz, 2014).

Many studies highlighted the importance of these programs for CLBP disability. In comparison with standard medical care treatment, core stabilization programs emphasizing activation of the transversus abdominis and multifidi cause fewer recurrences of LBP 3 years after treatment (George et al., 2007). This motor control exercises can be effective for some patients, but most of them are unable to voluntarily contract their muscles and may be inhibited from doing so due to arthrogenic muscle inhibition. In combination with restorative neurostimulation, a new approach for NSCLBP patients can be promised (Russo et al., 2018). Motor control of the trunk comprises modulation of intrinsic stiffness through tonic muscle activity, anticipatory control, and feedback control. Moreover, individuals with LBP may show more noticeable changes when they perceive the task that they perform as threatening in terms of pain provocation or re-injury (Van Dieen et al., 2019). There is also evidence suggesting that exercises designed to condition the lumbar extensors may also result in significant activation of this musculature during their performance (Steele et al., 2015).

However, other studies showed that some stabilization exercises were not more effective than others, suggesting that there is no evidence to support the superiority of one form of exercises over another. A more general program as opposed to focus on one particular area of fitness may be more effective to reduce NSCLBP (Gomes-Neto et al., 2017; Gordon et al., 2016; Van Middelkoop et al., 2010). Nevertheless, multiple studies have shown that not all subjects with LBP benefit equally from stabilization exercise (Hicks et al., 2005).

Core exercises can be encouraged for recurrent NSCLBP, but it is difficult to make a definitive and pragmatic recommendation, because of the variation in the duration of exercise programs, progression criteria, muscle activation, and type of feedback used during the interventions (Gomes-Neto et al., 2017). A clearer understanding of the roles that specific muscles have during core stability and core strength exercises would enable more functional training programs to be implemented in rehabilitation.

However, many articles in the literature promote core strength and stabilization programs in the rehabilitation sector, but additional research to determine the optimal approaches for recurrence prevention should be conducted, testing different type of exercises to determine their essential attributes, such as mode, intensity, frequency, duration, and timing, and also to match the prescription to the clinical characteristics of patients (Gomes-Neto et al., 2017).

Discussions

Until now, based on what we know from the literature, prevention of NSCLBP using ET is complex, difficult and remains unclear (Gomes-Neto et al., 2017). Overall, there is limited evidence for many aspects of prevention in LBP, yet there is evidence that prevention of various consequences of LBP is feasible (Foster et al., 2018). However, there are many clinical guidelines with similar recommendations for the prevention of NSCLBP, but the most promising approaches seem to involve PA, ET and appropriate education (Hasenbring et al., 2012; Burton et al., 2005). One of the reasons for the similarity of the guidelines might be that guideline committees are usually aware of the content of other guidelines and are motivated to produce similar recommendations that are deemed sensible and relevant (Koes et al., 2010).

The findings from this review indicate that ET was significantly better for relieving pain, functional outcomes, recurrence, disability, or psychological strain, and may have a positive effect in CLBP management (Gordon et al., 2016). Given that there is no strong evidence that one particular type of exercise is clearly more effective than others (general versus specific exercises, individualized versus group programs, supervised versus home exercises), it remains unclear which patients can benefit most from a specific exercise program (Henchoz et al., 2008). A

specific program focusing on one area of fitness may not be appropriate, but a multimodal prevention training program integrating major PA contents (muscular endurance, strength, stretching and aerobic fitness) seems promising and can be beneficial for NSCLBP (Gordon et al., 2016; Macedo et al., 2013).

Within rehabilitation approaches to CLBP, it is known that the behavioral or bio-psycho-social approach offers the foundation for a better insight into persistent pain, and that combined with ET it may reduce the risk of occurrence (Niederer et al., 2018; Paolucci et al., 2019). However, ET is not optimal in all patients because the physiological, psychological and social effects of exercise vary across patients (Gordon et al., 2016). Anecdotally, individuals might report that various strategies work for them, but in the absence of scientific evidence they cannot be generally recommended for prevention. It is not known whether some of these strategies have disadvantageous long-term effects (Burton et al., 2005). Also, it has been generally observed that patients may have an exacerbation of symptoms after starting the exercise and that they drop out of the exercise therapy. Hence, it is important to train patients in the correct way of performing the exercise. The exercises should be easy to train and perform with minimum resources (Shiju Majeed et al., 2019).

However, most clinicians prescribe a combination of these exercises, because they seem to be more effective than other alternatives, but the effects need to be balanced with their costs in terms of money, resources and time. A multidisciplinary prevention program is intensive, expensive, and may be appropriate for NSCLBP patients with a high rate of recurrence (Kamper et al., 2014; Shiju Majeed et al., 2019).

We think that the best prescription of ET in NSCLBP needs to be determined by innovative studies with increased reliability and validity to identify the modalities of implementation and the patient subsets that are likely to benefit from specific exercises (Burton et al., 2005; Privett et al., 2015; George et al., 2007; Paolucci et al., 2019).

Conclusions

1. Prevention of recurrent NSLBP with exercise therapy is an important part of rehabilitation programs to avoid complications, worsening and lesions of the structures of the spine.

2. Physical activity is significantly better: for relieving pain and for functional outcomes, for reducing recurrence and disability, for improving the quality of life and for accelerating the return to normal daily activities and work, in patients with chronic low back pain.

3. Other potential benefits of exercise mean that it is reasonable to encourage regular physical activity as part of a strategy to reduce the overall impact of back pain disability, on both the individuals and society.

4. Exercise therapy is not optimal in all patients because the physiological, psychological and social effect of exercise varies amongst patients, but combined with behavioral therapy it can be more effective in reducing the risk of recurrence.

5. Healthcare providers and patients need to understand their options in relation to what works and what is cost-efficient to make a confident and well-educated decision regarding their choice of a rehabilitation program.

6. A multimodal prevention training program aimed at adjusting the deficits or imbalance by integrating major physical activity contents (muscular endurance, strength, stretching and aerobic fitness) can be beneficial in the prevention of NSCLBP.

7. The best prescription of ET needs to be determined by additional research on the optimal approaches for recurrence prevention, by testing different types of exercises to establish their essential attributes (mode, intensity, frequency, duration and timing) and to match the prescription to the clinical characteristics of patients.

Conflicts of interest

Nothing to declare.

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