Bachelor's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Neuromedicine and Movement Science

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Effect of Exercise Therapy on Low Back Pain-Related Disability

Bachelor's Thesis
BEV2900 - Spring 2022

Bachelor's thesis in Human Movement Science
Supervisor: Paul Jarle Mork
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Abstract

Purpose: Non-specific, chronic low back pain (NSCLBP) is one of the major health challenges worldwide. Exercise therapy may be a cost-effective treatment approach. This study aims to examine the effect of exercise therapy on pain-related disability among adults with NSCLBP. **Method:** The studies included were found through PubMed, Web of Science, and Ovid Medline. Participants were adults with NSCLPB exclusively. Only Randomized Controlled Trials, published as of 2011, were included. Disability had to be evaluated through the Roland-Morris Disability Questionnaire and/or Oswestry Disability Index. **Results:** Eight studies were included, and all found that exercise, regardless of type, had a positive effect on NSCLBP to varying extents. **Conclusion:** Coinciding with existing evidence, the findings from this review suggests that exercise, regardless of type, will positively improve pain-related disability in adults with NSCLBP. Furthermore, exercise therapy is more effective than no intervention, while a multidisciplinary approach appears to provide greater improvements. Due to a variety of different exercise interventions, it is difficult to compare the results directly. Further research is needed to be able to recommend a specific type of exercise. In anticipation of this, the patient's and therapist's preferences can serve as a base.

Abstrakt

Bakgrunn: Uspesifiserte, kroniske korsryggsmerter er en av de største helseutfordringene på verdensbasis. Trening kan være en kosteffektiv behandling, og denne studien vil derfor undersøke effekten av trening på nedsatt funksjon relatert til smerte hos voksne med denne lidelsen. **Metode:** Inkluderte studier ble funnet gjennom databasene PubMed, Web of Science og Ovid Medline. Utvalget inkluderte utelukkende voksne med uspesifiserte, kroniske korsryggsmerter. Bare randomiserte, kontrollerte studier, utgitt fra og med 2011, ble inkludert, hvor funksjon var målt med Roland-Morris Disability Questionnaire og/eller Oswestry Disability Index. **Resultat:** Åtte studier ble inkludert. Samtlige viste at trening, uavhengig av type, hadde positiv effekt på uspesifiserte, kroniske korsryggsmerter i varierende grad. **Konklusjon:** I samsvar med eksisterende evidens, antyder funnene i denne studien at trening, uavhengig av type, reduserer smerter og bedrer funksjon hos voksne med uspesifiserte, kroniske korsryggsmerter. Treningsintervensjoner mer effektivt enn ingen behandling, og multidisiplinære behandlingstilnærminger virker å gi bedre effekt. Inkludering av ulike treningsintervensjoner gjør det vanskelig å sammenligne resultatene direkte. Det er behov for ytterligere forskning for å kunne anbefale en spesifikk type trening. I påvente av dette kan pasientens og behandlerens preferanser ligge til grunn for valg av type trening.

1. Introduction

Musculoskeletal conditions affect all age groups and are the leading cause of disability across cultures, in both low- and high-income countries, leading to a vast amount of sick leave (1,2). Chronic low back pain (LBP) constitutes a sizable part of these cases and is a major health problem accompanied by extensive economic and social costs. More than 70-80% of all people will experience an episode with LBP at least once during their life (3), and more than 80% of healthcare costs for back trouble are used on patients suffering from chronic LBP (4).

In approximately 90% of the cases (5), it is not possible to identify a specific nociceptive cause (1) among people suffering from chronic LBP. Non-specific chronic LBP (NSCLBP) is therefore the most common form (5). NSCLBP is defined as pain or discomfort localized above the inferior gluteal folds and below the costal margin, with no attribution to known or recognizable specific pathology (6), that lasts more than 12 weeks (4).

Treating NSCLBP is challenging, and the excessive use of imaging, opioids, and surgery remains a widespread problem (5). In order to find an effective, economic, and more sustainable method, exercise therapy should be evaluated as a method for treating pain-related disability in NSCLBP patients. It can potentially serve as a sustainable treatment option, allowing more accessibility through easy implementation and low cost (7). Additionally, exercise can provide better overall health, by contributing to the reduction of risk for multiple diseases (8). In the current study, exercise therapy is defined as physical activities prescribed for specific therapeutic goals, with the purpose of restoring normal musculoskeletal function and reducing pain (9). A Cochrane review examined exercise therapy (e.g., Pilates (10), motor control (11,12), strength training, aerobic exercise) for NSCLBP. There was moderate-certainty evidence that exercise is likely to be effective for reducing LBP compared to no treatment, usual care, or placebo (13), which is also reported in another study (14).

The aim of this study is to examine the effect of exercise therapy on LBP-related disability among adults with NSCLBP, by examining results from randomized controlled trials that evaluated the effect of exercise therapy versus other interventions (i.e., physical therapy and/or medication.

2. Methods

The literature search for this study was conducted on the 21st of February 2022, using the databases PubMed, Ovid Medline, and Web of Science. The following search terms were used: “non-specific low back pain”, “un-specific low back pain”, “chronic”, “exercise”, “exercise therapy”, “Roland-Morris Disability Questionnaire”, “Oswestry Disability Index”, and “randomized controlled trial”. These were combined using the Booleans AND & OR, to ensure the finding of as many relevant articles as possible. This search provided 25 different articles, whereas two were excluded for not having full text available. Furthermore, an additional 15 articles were excluded for not meeting the inclusion criteria and therefore being deemed irrelevant for this literature review, thus leaving eight relevant articles.

Only randomized controlled trials, which used exercise as therapy for otherwise healthy adults (aged 18-75 years old) with NSCLBP, were included. Additionally, they had to be published as of 2011, have full text available in English, and use the Roland-Morris Disability Questionnaire (RMDQ) and/or the Oswestry Disability Index (ODI) to assess LBP-related disability. Systematic reviews, meta-analysis, and prospective/retrospective cohort studies were excluded, along with studies conducted on children, adolescents, elders, and disabled people. Furthermore, studies that included other treatments for rehabilitation or prevention (i.e., back school programs, manipulation), as well as studies examining neck, shoulder, or upper back pain, were also excluded.

The RMDQ is a self-administered disability measurement. This is a point scale ranging from 0 to 24, where greater levels of disability are reflected by higher numbers (15). The ODI consists of ten questions assessing the degree of pain, personal care, pain alteration, social life, travel, and daily activities (such as walking, sitting, sleeping etc.), each scoring between 0 to 5 (16). Pain was evaluated through the Visual Analog Scale (VAS) or Numeric Rating Scale (NRS). The VAS consists of a straight line with the endpoints being “no pain at all” and “pain as bad as it could be”, where patients are asked to mark their level of pain on the line. The NRS asks the patients to circle the number between 0 to 10 that best fits their pain intensity (17).

3. Results

The eight included studies (18–25) have all evaluated the effect of exercise therapy (some along with other interventions) on pain and disability among the participants. The types of exercises investigated are Pilates (n=2), hip-strengthening exercises (n=1), sensorimotor training (n=1), movement control (MC) (n=2), and various stabilization exercises for the core and lumbopelvic region (n=2). Two studies included physical therapy in addition to general exercise. The studies have used the RMDQ and/or ODI for measuring disability. The intervention period ranged from 4 to 12 weeks, and the follow-up period ranged from 4 weeks to 12 months. The total number of participants evaluated is 613, aged 18-75 years. The results from the included articles are summarized in Table 1.

Table 1. *Descriptive information from the included studies and the main findings.*

First author, year, country	Objective	Number of participants	Follow-up period	Type of intervention	Main finding
Kendall, K.D., 2014, Canada	To compare the effectiveness of adding hip-strengthening exercises to a lumbopelvic exercise program in the treatment of NSCLBP.	n=80	6 weeks	E: Lumbopelvic stabilization program + kinetic chain hip-strengthening exercises. C: Lumbopelvic stabilization program.	Adding specific hip-strengthening exercises does not significantly improve the treatment outcomes of pain and disability for NSCLBP. Patients respond similarly to exercise regardless of type.
Saner, J., 2015, Switzerland	To compare the effectiveness of MC exercises versus general exercise on pain and disability.	n=106	12 months	E: MC treatment; active exercises addressing the pain-provoking postures and control of the impaired movements. C: Exercises for improving the muscular strength of the lumbar and pelvic region and legs.	No additional benefit of specific MC exercises versus general exercise was found. Both groups improved significantly ($p<0.001$) on all outcomes over time but differences between groups were non-significant at all follow-ups.
Valenza, M.C., 2016, Spain	To investigate the effects of a Pilates exercise program on treatment outcomes (pain, disability, lumbar mobility, balance, and flexibility) for NSCLBP patients.	n=54	8 weeks	E: Pilates exercise program twice a week. 45 minutes per session. C: Information and various advice on i.e., physical activity, sedentary behavior, and fear of movement.	Significant improvements in pain, disability, flexibility, and balance immediately after treatment in the experimental group compared to the control group.
Letafatkar, A., 2017, Iran	To investigate the effect of self-management therapeutic techniques and sensorimotor training to improve the proprioceptive system, MC, neuromuscular coordination,	n=53	5 weeks	E: Sensorimotor exercises using HUBER spine force rehabilitation machine. 10 sessions, 2 days a week. C: No information.	Significant improvements in the proprioceptive system, MC, and quality of life (pain + disability) in the sensorimotor training group compared to the control group ($p<0.001$).

	pain, and disability by using the HUBER machine.				
Salamat, S., 2017, Iran	To compare the short-term effects of trunk stabilization exercises versus MC exercises on pain, disability, and flexion relaxation ratio in NSCLBP patients.	n=32	4 weeks	E: Trunk stabilization exercises involving coordinated training and independent activity of the deep trunk muscles. C: MC exercises aiming for normalizing abnormal movement patterns and postures and relaxing the trunk muscles. Both groups received 8 sessions of 45 min supervised exercise, with two sessions per week.	Significant improvement in pain and disability for both groups ($p<0.05$), but no difference between groups. A significant improvement in the flexion relaxation rate in the MC group compared to the stabilization group.
Cruz-Díaz, D., 2018, Spain	To assess the effectiveness of a Pilates intervention on pain, function, kinesiophobia, and deep trunk muscle thickness in NSCLBP patients.	n= 64	12 weeks	E: Pilates exercise program twice a week. 50 minutes per session. C: Booklet with NSCLBP information.	The Pilates group improved significantly ($p<0.001$) in disability and function, pain, and deep trunk muscle thickness. There were no changes in the control group, and the between-group difference was statistically significant.
Şahin, N., 2018, Turkey	To investigate the effectiveness of physical therapy modalities for pain and functional status in NSCLBP patients.	n=104	12 months	E: Physical therapy modalities in addition to medical and exercise therapy. 10 sessions, five days a week. C: Exercise and medical therapy alone, focusing on strengthening abdominal and leg muscles. Two	Both groups improved significantly ($p<0.05$) in pain and disability from baseline to three months. There was also a statistical difference in favor of the physical therapy group at two weeks, three months, and one year follow-up.

				exercises a day with a minimum of 10 repetitions, five days per week.	
Waseem, M., 2019, Pakistan	To compare the effects of core stabilization exercises and routine physical therapy exercises in terms of mean reduction in disability due to NSCLPB.	n=120	6 weeks	E: Core stabilization exercises C: Exercises targeting superficial muscles of the spine and routine PT exercises. Both groups were advised to exercise twice a week at home, in addition to one session a week supervised by a physical therapist.	Both groups improved significantly ($p<0.05$) in disability score, with a greater improvement for the experimental group. It is not reported whether the between-group difference is significant or not. Furthermore, male subjects responded better to core stabilization exercises than female subjects, and both genders responded equally to physical therapy.

3.1 Pilates interventions

Valenza et al. (18) and **Cruz-Díaz et al.** (19) investigated the effects of a Pilates exercise program on disability and pain among NSCLBP patients. Both studies used the Roland-Morris Disability Questionnaire (RMDQ) and the visual analog scale (VAS) to assess disability and pain, respectively. In addition, Valenza et al. included measures of lumbar mobility, flexibility, and balance, while Cruz-Díaz et al. included kinesiophobia (fear of movement) and trunk muscle thickness. Both studies found significant between-group differences in favor of the Pilates group compared to the control group in all variables after treatment, indicating that Pilates is more effective than no treatment or information.

Cruz-Díaz et al. reported a change in RMDQ score of 5 points after 12 weeks of Pilates intervention and a change of 2.8 points in improved VAS score. Additionally, the improvement in kinesiophobia was greater for the Pilates group compared to the control group (6-point change versus 1.5-point change on the Tampa Scale of Kinesiophobia). These findings are similar to those reported by Valenza et al., who found a statistically significant mean change in RMDQ score of 5.3 points, Furthermore, they found a mean change of 2.3±1.9 points in current pain (VAS score) in the experimental group after 8 weeks of Pilates intervention. Both balance and flexibility also improved in the Pilates group, while the control group showed no statistical difference.

3.2 Movement control

Three studies investigated the effect of specific movement control (MC) intervention. However, the approaches are somewhat different. **Letafatkar et al.** (20) evaluated the efficacy of a HUBER exercise system (spine force sensorimotor training) and found a significant between-group improvement in the proprioceptive system, lumbar MC, and quality of life ($p<0.001$). They reported a reduction of 2.3 points on the RMDQ, and a reduction of 2.9 points in the VAS score in the experimental group (both significant, $p<0.001$). Based on this they concluded that sensorimotor training significantly improves pain and disability in NSCLBP patients.

Saner et al. (21) assessed the effectiveness of a specific exercise treatment to improve MC and compared this to general strengthening exercises. They focused on patient-specific LBP-

related activity limitations measured with the Patient Specific Functional Scale as their primary outcome and used the RMDQ as concurrent validity. Activity limitation results indicated that both groups improved significantly ($p<0.001$) over time, with a slight non-significant (estimated mean difference of -0.4 points, -1.4 to 0.6, 95%CI) post-treatment trend in favor of the MC group, which leveled off at six months. The same findings were reported by the concurrent RMDQ results. In addition, both pain and disability (RMDQ score) improved significantly in both groups and were sustained for up to 12 months. In this study, the findings indicated no additional benefit of MC exercise compared to general strengthening exercise for patients with NSCLBP.

Salamat et al. (22) investigated the effect of MC compared to stabilization exercises on pain, disability, and flexion relaxation ratio of lumbar muscles (multifidus and iliocostalis). Similar to Saner et al., they found a significant improvement in pain (NRS score) and disability (ODI score) for both groups, but no difference between groups post-intervention during the short-term follow-up. The MC group had a mean reduction of 3.5 points in pain, and 8.2 points in disability, compared to a reduction of 2.3 points and 5.8 points in the control group, which indicates a greater improvement for the MC group. Additionally, the flexion relaxation ratio of iliocostalis lumborum pars thoracic was significantly higher ($p<0.001$) in the MC group than in the stabilization group, suggesting focusing on MC may improve dynamic trunk muscle control more than specific stabilization exercises.

3.3 Stabilization exercises

Similar to Salamat et al., **Kendall et al.** (23) examined the effect of adding hip-strengthening and stabilization exercises to a lumbopelvic exercise program. Using VAS and ODI, they found congruous results indicating that there was no statistical difference in pain (estimated mean difference of -4.0mm, -11.5 to 3.5, 95%CI) and disability (estimated mean difference of -0.3%, -3.5 to 2.8, 95%CI) between the groups after 6 weeks of follow-up. The mean improvement in pain and disability for the intervention group was 25 and 8 points, and for the control group 21 and 8, respectively. These results show a minor between-group difference in experienced pain.

Waseem et al. (24) also investigated the effect of stabilization exercises on disability. However, they focused on core rather than hip stabilization and compared this to routine

physical therapy. They too found a statistically significant difference in ODI score in both treatment groups after 6 weeks ($p<0.01$). However, the reduction was greater for the core stabilization group (mean change: 39.4±14.6 points) than for the physical therapy group (mean change: 31.9±12.3 points), leading to a conclusion stating that core stabilization exercises prominently decrease disability compared to routine physical therapy.

3.4 Physical therapy

Şahin et al. (25) assessed the effect of combining physical therapy, exercise therapy, and medication compared to exercise therapy and medication alone on pain and functional status. VAS and ODI, in addition to Istanbul Low Back Disability Index (ILBP), were used to evaluate pain and disability, respectively. In contrast to Waseem et al., they found that combining physical therapy, exercise, and medication significantly ($p<0.05$) improved the VAS, ODI, and ILBP scores at all follow-up measures between the groups, thus in favor of the physical therapy group. From baseline to the 3-month follow-up, the physical therapy group had a significant improvement with a mean change of 1.7, 6.9, and 8.1 points on VAS, ODI, and ILBP scores respectively, compared to the mean change of 1, 11.4, and 7.2 points in the control group.

4. Discussion

The aim of this study was to evaluate the effect of exercise therapy on LBP-related disability among adults with NSCLBP. Based on the results from the eight studies, exercise therapy seems to have a positive effect on NSCLBP compared to no treatment. Furthermore, the effect is not associated with a specific type of exercise. All studies found an improvement in both pain and disability post-treatment. Four of the studies found no significant difference between the intervention and the control group. However, Valenza et al. (18), Cruz-Díaz et al. (19), Letafatkar et al. (20), and Şahin et al. (25) found significant results in favor of the intervention group.

4.1 Effect of different exercise therapies

The majority of the included studies (n=6) compared different exercise programs or examined

exercise therapy compared to no treatment. Nevertheless, regardless of type, exercise interventions reduced pain and disability to a larger extent than no exercise. These findings correspond to those reported in the Cochrane review by Hayden et al. (13), who reported moderate-certainty evidence that exercise therapy reduces pain and improves disability compared to no treatment, usual care, or placebo for pain. In the same review, Hayden et al. found that those receiving exercise therapy on average rated their pain 15 points lower and disability 7 points lower at three months post-treatment on a scale from 0-100, compared to those who received no treatment, placebo, or usual care. The results from the included articles in the current study show a similar tendency, though to a smaller extent.

Both Valenza et al. and Cruz-Díaz et al. (18, 19) examined the effect of Pilates compared to no exercise. There were significant improvements in pain and disability in the Pilates intervention group compared to the control group in both studies after 8- and 12-weeks of follow-up, respectively. In addition, flexibility, balance, and kinesiophobia significantly improved in the intervention group. These findings align with Yamato et al. (10), reporting low to moderate-quality evidence that Pilates is more effective than minimal interventions for pain and disability. Although the findings by Yamato et al. pointed in the same direction as the conclusions drawn in Valenza et al., and Cruz-Díaz et al., they suggest that the use of Pilates in the treatment of NSCLBP should be included if it is enjoyable for the patient - not based on it being more effective than other treatment methods.

Regarding MC, both Saner et al. and Salamat et al. (21, 22) found significant improvement in pain in both the intervention and control group, but no significant difference between groups. In contrast, Letafatkar et al. (20) reported a significant improvement for the MC group compared to the control group. To compare, a Cochrane review by Saragiotto et al. (11) concluded that MC exercise is not superior to other forms of exercise for NSCLBP, supporting the findings of Saner et. al., and Salamat et al. It should also be noted that the interventions in the studies are quite different, and therefore one should be cautious as to compare the results - especially regarding the findings in Letafatkar et al.. The findings of the three studies are compared in this literature review due to all examining MC exercise. However, this is the only similarity between them. In addition, Letafatkar et al. fail to report whether the control group received any treatment or not. This is a major limitation of the study, as it will be almost impossible to replicate, resulting in their findings being less trustworthy.

As for the effect of stabilization exercises, neither Salamat et al., Kendall et al. nor Waseem et al. (22–24) found significant evidence supporting the use of additional hip, core, or trunk stabilization, compared to general exercise programs and physical therapy. They all indicated that subjects would respond similarly to exercise regardless of type. The stabilization exercises prescribed in the intervention groups followed the physiological principle of progressive loading during the treatment. Waseem et al. and Kendall et al. found a larger reduction in disability and pain in the intervention group compared to the controls, indicating that both core- and hip stabilization do seem to be an efficient add-on. However, in Salamat et al. the stabilization intervention showed less improvement in both pain and disability when compared to MC.

The overall findings from the three studies mentioned above align with the conclusion in the systematic review of Macedo et al. (12), suggesting that graded activity (such as stabilization exercises) is marginally more effective than other forms of activity in the short and medium term. It should be noted that there is limited evidence on this type of exercise in relation to NSCLBP, and therefore one should be careful of over-emphasizing the conclusions. Kendall et al. are, to the best of our knowledge, currently the only study that has examined the effect of adding hip-strengthening exercises to a lumbopelvic exercise program, and therefore the findings need to be replicated by other studies.

4.2 Exercise therapy compared to other treatment interventions

Waseem et al. (24) and Şahin et al. (25) included other interventions in addition to exercise therapy in their studies and found contradicting results. Waseem et al. compared core stabilization exercises to routine physical therapy exercises and found significant improvement in both groups, thus a greater improvement was observed in the experimental group (stabilization exercises). It should be noted that Waseem et al. does not report whether the between-group difference is statistically significant or not. In contrast, Şahin et al. combined physical therapy, exercise therapy, and medication, and compared this to exercise therapy and medication only. They found significant improvements for both groups; however, the results were in favor of the physical therapy group. It is important to notice that the two physical therapy interventions are relatively different. Waseem et al. used routine physical therapy exercises, consisting of e.g., hamstring and calf stretching and exercises for

hip and back extensors. On the other hand, Şahin et al. had physical therapy modalities including hot packs, ultrasound, and transcutaneous electrical nerve stimulation (TENS) for reducing inflammation and relieving musculoskeletal symptoms and joint stiffness.

Given the fact that the control group in Waseem et al. received traditional physical therapy exercises, one can argue that they ultimately compared two different exercise programs, and not exercise therapy versus physical therapy (with different modalities). Findings reported in the Cochrane Review by Saragiotto et al. indicate that no single form of exercise is proven superior to another (11). Given that both groups improved significantly, these findings are consistent with existing evidence.

Şahin et al. found improvement in both pain and functional status for the physical therapy group. However, it is difficult to attribute the effect to a single intervention, given that the experimental group received both exercise therapy, physical therapy modalities, and medication if necessary (1.5 grams/day of Paracetamol). Evidence from the Cochrane review by Hayden et al. suggests that exercise treatment is probably more effective than non-exercise physical therapy (13). In addition, a former study provides evidence stating that the effects of non-exercise physical therapy and treatments such as ultrasound and TENS are of unknown value or ineffective, and should therefore not be over-emphasized (4). However, other studies report evidence that supports the effectiveness of multidisciplinary rehabilitation and non-pharmacological therapies, as there are moderate short-term effects on pain and small effects on function (14). Given the increased cost of adding a multidisciplinary treatment approach for patients with NSCLPB, one should consider this mainly for those who do not respond to less expensive options such as exercise therapy alone (4).

4.3 Methodological limitations:

There are some methodological limitations to consider when evaluating the results. These limitations affect both the evidence in the included articles, as well as the findings in this literature review. Some of them are related to the research on NSCLBP in general, while others affect the article in question only. Several of the included studies in the current study points out that a potential limitation may be a risk of bias due to difficulties of sufficiently blinding exercise treatments in NSCLPB research. This limitation is also pointed out in Hayden et al. (13) as a major limitation one should take into consideration when evaluating

findings within this field. The general consensus seems to be that it is challenging to sufficiently blind the physiotherapists and other exercise therapy providers, as they are critical for overseeing and customizing the exercise program. This also applies to patients, as they in many cases will understand whether they are receiving a tailored or general exercise program, or in some cases no treatment (e.g., a booklet with information). The problem regarding exercise treatment blinding is prominent in the Cochrane meta-analysis, where 79% of the included studies were judged to be at risk of performance bias (13).

Another considerable limitation in the included articles is the relatively small sample sizes. Combined, the eight studies have a mean of 77 included participants, divided into two groups. These small sample sizes provide limited power to detect a difference between groups, or the results might be false-positive (Type II error). Only Kendall et al. have reported this as a limitation in their study, which is concerning given the fact that four of the included articles have a sample size of less than 77 (Letafatkar, Salamat, Valenza, Cruz-Díaz).

Furthermore, when considering the study population, several of the studies, as well as Hayden et al. (13), mention heterogeneity in the included population as a possible limitation. Including only one particular group of patients makes it difficult to assess if other groups would experience the same effects and thus if the same treatment is applicable. Most of the included studies do not describe the details regarding this heterogeneity, which makes it harder to compare the different studies sufficiently. Saner et al. (21) mentions that their population may reflect individuals with low psychosocial influence and high self-management competence and that this must be considered when selecting exercise treatment for future research. Additionally, it is specified that their inclusion criteria for MC impairment were designed to select patients with the best chance of experiencing improvement with specific exercises. This must be viewed as a considerable limitation when evaluating their results.

Waseem et al. (24) brought up lacking proof of patients' compliance to at-home exercise programs as problematic. One can assume that patients with a higher degree of self-management will have a stronger adherence to home exercises compared to those with low self-management. The different adherence within or between groups can affect the results, and not measuring this makes it harder to replicate the study. Moreover, Valenza et al. added

that one should also evaluate patient satisfaction when investigating exercise therapy as treatment. A higher degree of patient satisfaction can positively affect the patient's adherence to the prescribed exercise program. Furthermore, Waseem et al. also recognized that failing to consider the patients' jobs may influence the results of the study. Work type is a factor one should implement in research regarding treatment and symptom improvement, as patients with physically active jobs may experience different effects of the exercise therapy compared to those with more sedentary work. Failing to include this information weakens the evidence as different workgroups may experience various effects of the same exercise therapy. This will further make it difficult to develop recommendations for different patient groups.

Another limitation to consider is that the follow-up periods in the included studies are relatively short. All but two studies had a follow-up period of 12 weeks or shorter. The two studies, by Şahin et al. and Saner et al., had a follow-up of 12 months, providing the possibility of examining the long-term effects of the exercise therapy. Knowing the long-term effects of exercise therapy on NSCLBP will strengthen the basis for recommending this as the preferred treatment option, which can be especially helpful for low-income countries and patients with low socioeconomic status. It should be noted that the studies with a short follow-up period acknowledge this as a limitation and recommends extending this further in future research.

Additionally, a potential limitation of this literature review is the exclusion of studies using other measurement methods than RMDQ and ODI. This may lead to excluding appropriate studies that may provide supporting or contradicting evidence to the NSCLBP research that should be evaluated. However, the requirement of using RMDQ and ODI as measurements was set due to these being the most commonly used outcome measures in the Cochrane meta-analysis by Hayden et al. (13). Furthermore, exclusively including studies using the same measurement methods might lead to stronger validity as a result of reduced risk of drawing erroneous conclusions due to different measurement methods.

5. Conclusion

This literature review examined the effect of exercise therapy on LBP-related disability among adults with NSCLBP, based on the existing evidence found in randomized controlled

trials. All of the included studies found improvement in both pain and disability (i.e., within-group improvement). Exercise therapy had a significantly greater effect than no treatment in the studies by Cruz-Díaz et al. and Valenza et al. The studies by Letafatkar et al. and Şahin et al. found a significant between-group difference in favor of the intervention group suffer from methodological limitations which weakens their credibility. The remaining four studies (Saner et al., Salamat et al., Kendall et al., and Waseem et al.) all found significant within-group improvement, but no difference between the two groups. These findings coincide with existing evidence indicating that exercise, regardless of type, will positively improve both pain and function in adults suffering from NSCLBP but the effect is not necessarily different from other types of treatment. Further research is needed to strengthen the evidence, due to limitations in blinding and population heterogeneity, and to be able to give specific exercise therapy recommendations. Given the results, one can safely recommend a variety of exercise therapies and thus concentrate on finding the one which the patient enjoys the most.

6. Reference list

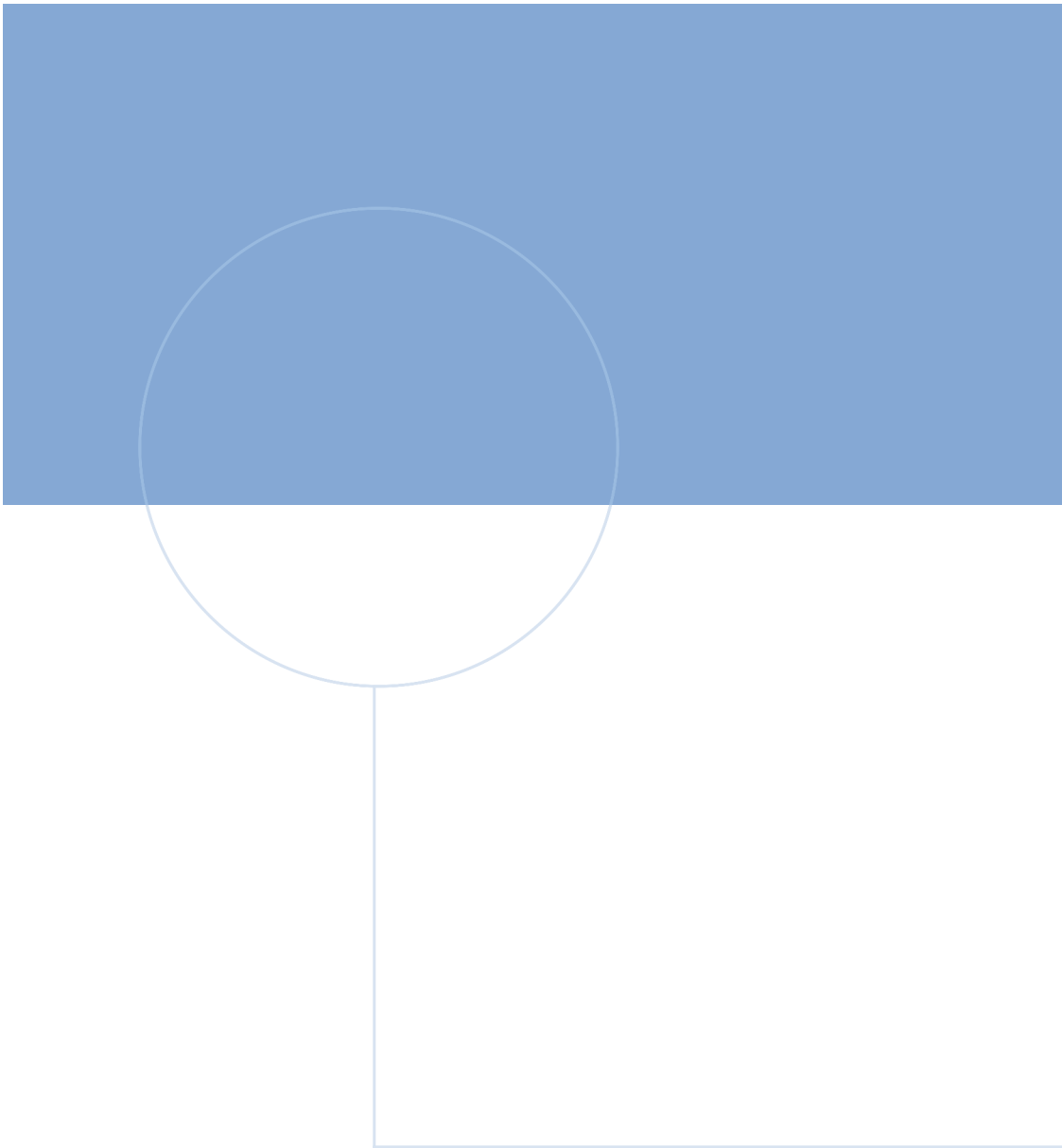
1. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. What low back pain is and why we need to pay attention. Lancet Lond Engl. 2018 Jun 9;391(10137):2356–67.
2. Du Bois M, Szpalski M, Donceel P. Patients at risk for long-term sick leave because of low back pain. Spine J Off J North Am Spine Soc. 2009 May;9(5):350–9.
3. Mattila VM, Sahi T, Jormanainen V, Pihlajamäki H. Low back pain and its risk indicators: a survey of 7,040 Finnish male conscripts. Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc. 2008 Jan;17(1):64–9.
4. Maher CG. Effective physical treatment for chronic low back pain. Orthop Clin North Am. 2004 Jan 1;35(1):57–64.
5. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. Lancet Lond Engl. 2017 Feb 18;389(10070):736–47.
6. Balagué F, Mannion AF, Pellisé F, Cedraschi C. Non-specific low back pain. The Lancet. 2012 Feb 4;379(9814):482–91.
7. Becker A, Held H, Redaelli M, Chenot JF, Leonhardt C, Keller S, et al. Implementation of a Guideline for Low Back Pain Management in Primary Care: A Cost-Effectiveness Analysis. Spine. 2012 Apr 15;37(8):701–10.
8. Lavie CJ, Ozemek C, Carbone S, Katzmarzyk PT, Blair SN. Sedentary Behavior, Exercise, and Cardiovascular Health. Circ Res. 2019 Mar;124(5):799–815.
9. American Psychological Assosiation. APA Dictionary of Psychology: exercise therapy [Internet]. APA Dictionary of Psychology. [cited 2022 Mar 18]. Available from: https://dictionary.apa.org/
10. Yamato TP, Maher CG, Saragiotto BT, Hancock MJ, Ostelo RW, Cabral CM, et al. Pilates for low back pain. Cochrane Database Syst Rev [Internet]. 2015 [cited 2022 Mar 10];(7). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD010265.pub2/full
11. Saragiotto BT, Maher CG, Yamato TP, Costa LOP, Menezes Costa LC, Ostelo RWJG, et al. Motor control exercise for chronic non-specific low-back pain. Cochrane Database Syst Rev. 2016 Jan 8;(1):CD012004.
12. Macedo LG, Maher CG, Latimer J, McAuley JH. Motor Control Exercise for Persistent, Nonspecific Low Back Pain: A Systematic Review. Phys Ther. 2009 Jan 1;89(1):9–25.
13. Hayden JA, Ellis J, Ogilvie R, Malmivaara A, Tulder MW van. Exercise therapy for

chronic low back pain. Cochrane Database Syst Rev [Internet]. 2021 [cited 2022 Mar 9];(9). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD009790.pub2/full

14. Chou R, Deyo R, Friedly J, Skelly A, Hashimoto R, Weimer M, et al. Nonpharmacologic Therapies for Low Back Pain: A Systematic Review for an American College of Physicians Clinical Practice Guideline. Ann Intern Med. 2017 Apr 4;166(7):493–505.
15. Pw S. Roland Morris Low Back Pain and Disability Questionnaire (RMQ). :2.
16. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine. 2000 Nov 15;25(22):2940–52; discussion 2952.
17. Stratford PW, Binkley J, Solomon P, Finch E, Gill C, Moreland J. Defining the Minimum Level of Detectable Change for the Roland-Morris Questionnaire. Phys Ther. 1996 Apr 1;76(4):359–65.
18. Valenza M, Rodríguez-Torres J, Cabrera-Martos I, Díaz-Pelegrina A, Aguilar-Ferrándiz M, Castellote-Caballero Y. Results of a Pilates exercise program in patients with chronic non-specific low back pain: a randomized controlled trial. Clin Rehabil. 2017 Jun 1;31(6):753–60.
19. Cruz-Díaz D, Romeu M, Velasco-González C, Martínez-Amat A, Hita-Contreras F. The effectiveness of 12 weeks of Pilates intervention on disability, pain and kinesiophobia in patients with chronic low back pain: a randomized controlled trial. Clin Rehabil. 2018 Sep 1;32(9):1249–57.
20. Letafatkar A, Nazarzadeh M, Hadadnezhad M, Farivar N. The efficacy of a HUBER exercise system mediated sensorimotor training protocol on proprioceptive system, lumbar movement control and quality of life in patients with chronic non-specific low back pain. J Back Musculoskelet Rehabil. 2017 Oct;30(4):767–78.
21. Saner J, Kool J, Sieben JM, Luomajoki H, Bastiaenen CHG, de Bie RA. A tailored exercise program versus general exercise for a subgroup of patients with low back pain and movement control impairment: A randomised controlled trial with one-year follow-up. Man Ther. 2015 Oct 1;20(5):672–9.
22. Salamat S, Talebian S, Bagheri H, Maroufi N, Jafar Shaterzadeh M, Kalbasi G, et al. Effect of movement control and stabilization exercises in people with extension related non -specific low back pain- a pilot study. J Bodyw Mov Ther. 2017 Oct 1;21(4):860–5.
23. Kendall KD, Emery CA, Wiley JP, Ferber R. The effect of the addition of hip strengthening exercises to a lumbopelvic exercise programme for the treatment of non-specific low back pain: A randomized controlled trial. J Sci Med Sport. 2015 Nov

1;18(6):626–31.

24. Waseem M, Karimi H, Gilani SA, Hassan D. Treatment of disability associated with chronic non-specific low back pain using core stabilization exercises in Pakistani population. J Back Musculoskelet Rehabil. 2019 Jan;32(1):149–54.
25. Şahin N, Karahan AY, Albayrak İ. Effectiveness of physical therapy and exercise on pain and functional status in patients with chronic low back pain: a randomized-controlled trial. Turk J Phys Med Rehabil. 2018 Mar;64(1):52–8.



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