

Research Paper

Supervised Group Exercise Therapy Versus Home-based Exercise Therapy: The Effect of McGill Exercises on Pain, Disability and Trunk Stability in Middle-aged Women With Non-specific Chronic Low Back Pain



Parvin Baghani¹, Nader Naserpour², Hashem Piri^{2*}

1. Department of Department of Physical Education & Sport Sciences, Faculty of Literature, Humanities and Social Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran.

2. Department of Sports Injuries and Corrective Exercises, Faculty of physical Education and Sport Sciences, Allameh Tabataba'i University, Tehran, Iran.



Citation Baghani P, Naserpour N, Piri H. Supervised Group Exercise Therapy Versus Home-based Exercise Therapy: The Effect of McGill Exercises on Pain, Disability and Trunk Stability in Middle-aged Women With Non-specific Chronic Low Back Pain. *Physical Treatments*. 2023; 13(2):127-134. <http://dx.doi.org/10.32598/ptj.13.2.564.1>

doi: <http://dx.doi.org/10.32598/ptj.13.2.564.1>



Article info:

Received: 17 Apr 2022

Accepted: 09 May 2022

Available Online: 01 Apr 2023

Keywords:

Trunk stability exercises, Non-specific low back pain (LBP), Middle-aged women

ABSTRACT

Purpose: Chronic low back pain (LBP) is one of the spine disorders and musculoskeletal problems and is one of the most common causes of people's disability. This study aims to compare the effects of McGill trunk stability exercises performed at home or in a supervised group setting on pain, disability, and trunk stability in middle-aged women with non-specific chronic LBP.

Methods: The current study is a cross-sectional comparative, quasi-experimental research with a pre-test and post-test design. The statistical sample included 30 middle-aged women aged 35 to 50 years with non-specific chronic LBP in Tehran City, Iran. Based on the inclusion and exclusion criteria, they were selected and randomly assigned into two groups, home-based exercises, and supervised group exercises. The subjects performed McGill trunk stability exercises for six weeks, three 45-minute sessions per week. Pain, disability, and endurance of spinal flexor and extensor muscles were measured using pain and Quebec questionnaires, a sit-up test, and a Biering-Sorenson test, before and after 6 weeks of training. To analyze the data, descriptive statistics, paired-samples t-test, and one-way analysis of covariance (ANCOVA) tests were used at the significant level of ($P \leq 0.05$) using SPSS software, version 26.

Results: The results of the present study showed that the post-test scores compared to the pre-test in both groups have improved significantly ($P \geq 0.05$), and no significant difference was observed between the two groups with the control of the covariate variable ($P < 0.05$) in the intensity of pain and endurance of the spinal flexor muscles in the post-test scores. However, a significant difference was observed in the endurance of the spinal extensor muscles in the post-test scores of the two groups in favor of the home-based exercise group ($P \geq 0.05$). Additionally, in the post-test scores, a significant difference was observed in functional disability level between the two groups ($P \geq 0.05$) so that the degree of disability in the home-based exercise group was higher than in the supervised group.

Conclusion: It seems that performing McGill exercises, either in supervised group or home-based settings, can reduce pain and disability, and improve the endurance of the spinal flexor and extensor muscles in middle-aged women with non-specific chronic LBP.

* Corresponding Author:

Hashem Piri, Assistant Professor.

Address: Department of Sports Injuries and Corrective Exercises, Faculty of Physical Education and Sport Sciences, Allameh Tabataba'i University, Tehran, Iran.

Phone: +98 (21) 48394116

E-mail: hpiry63@gmail.com

Highlights

- Chronic low back pain (LBP) is one of the most common causes of people's disability.
- Performing the McGill stability exercises has a positive effect on the endurance of the trunk muscles.
- Performing the McGill stability exercises either in the supervised group or home-based setting, resulting in a reduction in pain and disability.

Plain Language Summary

Chronic LBP is one of the spine disorders and musculoskeletal problems and is one of the most common causes of people's disability. The strength and endurance of the trunk muscles have a positive effect on reducing pain and increasing the stability and function of the spine. Several clinical studies have suggested movement therapy for the control of non-specific chronic LBP and stated that exercise therapy has a significant effect on relieving pain and improving disability. McGill's stability exercises with a simultaneous focus on local and global muscles in the abdominal-lumbar region can be effective in improving the performance of these muscles. Many women with non-specific chronic LBP find it difficult to attend sports clubs due to lack of time and busy work. It is possible to help control and treat this type of back pain in such people by providing a suitable exercise program at home and following up on the correct implementation of exercise programs. The findings of this study indicated that executing McGill exercises, either in a supervised group or in home-based settings, can reduce pain and disability and improve the endurance of the spinal flexor and extensor muscles in middle-aged women with non-specific chronic LBP.

1. Introduction

Back pain is defined as localized pain below the lower edge of the last rib and above the gluteal line with or without lower limb pain [1]. The high prevalence of back pain has been recorded among people and different occupational groups. It is estimated that at any point in time, about 11.9% of the world's population suffers from back pain. The prevalence of chronic back pain in the world between the ages of 20 and 59 is estimated to be 19.6% [2]. Back pain is divided into two types, specific and non-specific. If the existence of a specific pathological problem in the spinal structures is not observed and the pain continues for more than three months, it is referred to as non-specific chronic back pain [3]. This type of back pain harms people's performance and life so that in some cases, people have to change their daily routine to eliminate or reduce the pain [4]. Back pain is one of the most prevalent causes of the limitation of daily activities and functional disability in individuals. Disability is a main issue in back pain that affects physical performance and as a result, the work productivity of people. The limitation or inability to perform an activity in the way or within the range considered for a normal person is called disability [5]. Consequences of back pain include balance disorders, postural disorders, lack of coordination in movements,

movement weakness, and as a result, lack of independence in performing daily activities [6].

The proper strength and endurance of the trunk muscles have a special place in reducing pain and increasing the stability and normal function of the spine, especially in the lumbar region [7, 8]. Disturbance in the functioning of the abdominal and core body muscles leads to a decrease in muscle power in this area, and in the long run, it can lead to the loss of stability in the core part of the body and, as a result, an increase in unnecessary movements in the lumbopelvic and sacral-iliac joints. As a result, it causes pain in the lumbopelvic region and spine and leads to chronic back pain [9-10]. Fatigue is one of the crucial factors in creating instability in the spine, which ultimately leads to back pain. Due to fatigue, the endurance of the paraspinal muscles is reduced and the vertebrae are exposed to pressure, thus causing back pain. Lack of trunk endurance has been mentioned as a predictor of the onset of back pain in men [11]. Previous studies have shown that patients with non-specific chronic back pain suffer from mechanical disorders, such as the imbalance of strength and length of the spinal column muscles, the reduction in the endurance of the spinal column muscles, the asymmetry between the internal-external rotation range of motion in the hip joint and the flat foot [12].

In patients suffering from chronic low back pain (LBP), the goal of rehabilitation interventions is to recover the normal muscle function and increase spine stability to reduce pain and disorders in these patients so that the person can engage in his or her daily life activities [13]. Several clinical studies have suggested movement therapy for the control of chronic LBP and stated that exercise therapy has a significant effect on relieving pain and improving disability [14]. Considering that exercise therapy is a non-invasive, effective, and low-risk approach, various exercise programs have been used to improve back pain for many years [15]. More studies are needed to investigate the effect of common specialized training programs on spine stability. McGill's stability exercises with a simultaneous focus on local and global muscles in the abdominal/lumbar region can be effective in improving the performance of these muscles. The more favorable the activation in the muscles of the lumbopelvic region, the greater the stiffness. As a result, the stability of the lumbar-pelvic vertebrae is provided and leads to the reduction of back pain and improvement of performance [16]. Although many studies have been conducted regarding local stability exercises, not much clinical evidence exists about stability exercises based on McGill's point of view. Therefore, it seems necessary to conduct more research in this field.

Many women with non-specific chronic LBP find it difficult to attend sports clubs due to lack of time and travel expenses or busy work. Therefore, it is possible to help control and treat this type of back pain in such people by providing a suitable exercise program at home and following up on the correct implementation of exercise programs. Therefore, this study was conducted to compare the effect of performing McGill trunk stability exercises in two different settings, namely, home-based and supervised, on pain, disability, and endurance of flexor and extensor muscles of the spinal column in middle-aged women with non-specific chronic LBP.

2. Materials and Methods

This study is quasi-experimental research that was conducted in a cross-sectional comparative way, with a pre and post-test design. This study was conducted in 2022 and its statistical sample included 30 middle-aged women aged 35 to 50 years with chronic non-specific LBP in Tehran City, Iran. The sample size was estimated using G*Power software, version 3.0.1 considering $\alpha=0.05$ and, β (statistical power=0.8) and effect size=0.5. The inclusion criteria included being a woman, being in the age range of 30 to 50 years, and suffering from non-specific chronic back pain and the exclusion criteria in-

cluded history of surgery in the neck, back, and middle part of the body, cardiovascular and respiratory disease, the history of high blood pressure, diabetes, history of debilitating diseases, history of acute diseases related to the back (such as disc herniation) and two sessions of absence from training. The participants were selected by convenience sampling method and randomly assigned into two groups, home-based exercise and supervised group exercise equally. The subjects were selected after completing the forms of personal profile, consent to take part in the study, and the physical activity readiness questionnaire (PAR-Q). Moreover, the participants were given information about the objectives of the research before starting the research. The home-based exercise group performed the McGill trunk stability exercises (including curl up, bird dog, and side plank exercises) at home and the other group performed the same exercises in a gym as a supervised group. Both groups performed the McGill trunk stability exercises for 6 weeks, 3 sessions per week, 45–50 minutes each session. Before and after 6 weeks of training, the subjects' pain, disability, and muscular endurance were measured.

The level of pain intensity and functional disability of the subjects were measured by the visual analogue scale (VAS) and Quebec questionnaire, and the endurance of trunk flexor and extensor muscles were measured by sit-up and Biering-Sorenson tests, respectively. The Quebec questionnaire is designed based on a five-point Likert scale so that a score of zero implies no problem and a score of five indicates the inability to perform the activity. The score obtained from the total of twenty questionnaire items was considered the final score. To investigate the endurance of the abdominal muscles (trunk flexors), the sit-up test was used. In this test, the subject was asked to lie down on a mat and cross her arms on her chest and lift her head and chest from the mat. As long as she can stay in the same position, during the test, the subject's legs are held by another person. The Biering-Sorenson test was used to evaluate the isometric endurance of the hip and back extensor muscles. To perform this test, an examination table, a chronometer, and three to four straps are needed. In the starting position, subject is lying horizontally, the superior edge of the iliac crest is on the edge of the table and the arms are crossed over the chest. The lower limbs are stabilized with straps. The subject is asked to keep the upper body in a horizontal position and the chronometer begins. As soon as the person leaves the horizontal state, the test is stopped, and the period that the subject was in the horizontal state without error is measured using the chronometer and recorded as a personal record.

Considering the number of each group which was less than 50 people, the Shapiro-Wilk test was applied to examine the normal distribution of the data. To test the research hypotheses, paired-samples t-test and one-way analysis of covariance (ANCOVA) test were utilized (at the significant level of $P \leq 0.05$) using SPSS software, version 26.

3. Results

Table 1 presents demographic information (age, height, weight, and (body mass index) BMI) of the subjects for each research group. The results of Shapiro-Wilk's normality test showed that the demographic data are normal except for the BMI ($P < 0.05$) variable. Besides, the results of Shapiro-Wilk's normality test showed that the main research variables were approximately normal. As a result, t-test and ANCOVA were used for within and between-group comparisons.

The results of the paired-samples t-test (Table 2) showed that both home-based and supervised group exercises have a significant effect on pain intensity, functional disability, and endurance of flexor and extensor muscles of the trunk ($P \leq 0.05$).

The results of the ANCOVA test (Table 3) revealed that, after controlling the impact of the pre-test (covariate), no significant difference was observed ($P < 0.05$) in the intensity of pain and endurance of trunk flexor muscles between the two groups. However, a significant difference was observed in the endurance of the spinal extensor muscles, between the two groups, in favor of the home-based exercise group ($P \geq 0.05$). Moreover, a significant difference was observed in the level of functional disability between the two groups ($P \geq 0.05$).

4. Discussion

This study was conducted to examine the impact of McGill trunk stability exercises using two methods of home-based exercise and supervised group exercise on the intensity of pain, functional disability, and stability of the core region in middle-aged women with non-specific LBP. The results revealed that performing McGill exercises in both methods namely, home-based exercise and supervised group exercise have a significant effect on the intensity of pain, functional disability, and stability of the core region. These results substantiate the results of Ghorbanpour et al (2018) [17], Ko et al (2018) [18], Haag et al (2018) [19], Mazloun et al (2018) [20], Zahedpour et al (2017) [10], Hemmati et al (2011) [13], Hurwitz et al (2005) [21] who used McGill exercises and core stability exercises.

Table 1. The results of the normality test about the distribution of demographic characteristics of participants

Groups	Variables	Mean±SD		P
		Supervised Group Exercise (n=15)	Home-based Exercise (n=15)	
	Age (y)	47.73±6.64	44.87±7.56	0.28
	Weight (kg)	68.27±6.78	63.40±11.18	0.16
	Height (cm)	161.8±4.61	163.20±6.33	0.49
	BMI (kg/m ²)	26.05±2.12	23.70±3.44	0.035

Abbreviations: BM: Body mass index.

Table 2. The results of the t-test about the comparison of pre-intervention and post-intervention values in two groups

Variables	Supervised Group Exercise (n=15)				Home-based Exercise (n=15)			
	Pre-test	Post-test	t	P	Pre-test	Post-test	t	P
Pain intensity	6.33±0.31	4.27±0.42	11.37	0.001	5.87±0.55	3.60±0.43	7.98	0.001
Functional disability	38.13±2.56	21.26±2.18	15.52	0.001	31.66±3.18	19.66±2.47	11.61	0.001
Endurance of trunk flexor muscles	23.67±1.95	39.20±3.25	-6.47	0.001	21.33±2.62	32.73±3.58	-7.30	0.001
Endurance of trunk extensor muscles	52.33±6.88	109.87±12.23	-7.74	0.001	75.67±17.7	156.33±15.42	-14.04	0.001

Table 3. The results of the analysis of variance (ANCOVA) test about the between-group comparisons

Variables	Group	Mean	F	df	P	Eta Squared
Pain intensity	Supervised group	4.27	1.862	1	0.184	0.065
	Home-based	3.60				
Functional disability	Supervised group	21.26	7.586	1	0.01	0.219
	Home-based	19.66				
Endurance of flexor trunk muscles	Supervised group	39.20	1.634	1	0.212	0.057
	Home-based	32.73				
Endurance of extensor trunk muscles	Supervised group	109.87	4.834	1	0.037	0.152
	Home-based	156.33				

PHYSICAL TREATMENTS

Regarding the comparison of the effects of performing McGill exercises in supervised and home-based groups, no study was found by the researchers. This study's results showed that after performing McGill exercises, the endurance of spinal extensors increased more in the home exercise group compared to the supervised group. On the other hand, no significant difference was observed in the endurance of the spinal flexor muscles between the two groups.

The trunk muscles are designed to be active continuously throughout the day, but pain and immobility cause weakness, and atrophy of these muscles, and these changes result in early fatigue even in normal conditions. The endurance of trunk muscles is a crucial factor in back pain [22]. Since these muscles guide the lumbopelvic joints in different movement patterns, and functions resulting from these patterns, when LBP occurs, they are the first muscles that are dysfunctional, and their weakness causes injury and movement control defects. On the other hand, empowering these muscles improves proprioception and kinesthesia, and as a result, improves physical performance [23].

Skikić and Suad (2003) in a study showed that in patients suffering from back pain, due to the wrong position, the muscles that extend the trunk and ligaments are overstretched and become weak, and this problem can cause back pain. Exercising the muscles that extend the trunk and strengthening these muscles can be useful in the treatment of back pain [24]. Hurwitz et al (2005) concluded in a study that stabilization exercises are useful in strengthening transversus abdominis and multifidus muscles as postural muscles [21]. In addition, it is likely that the core stabilization exercises not only improve the strength and stability of the deep muscles of the trunk but also increase the dynamic stability through improved neuromuscular control [13].

Ko et al (2018), Roh et al (2016), in two separate studies investigated the effect of slings (anterior and posterior oblique system) and back stabilization exercises on back pain. Both studies reported a significant and impressive pain reduction [18, 25]. Besides, Mazloum (2016) evaluated the effect of pilates and back extension exercises in two experimental groups compared to the control group and concluded that the core muscle activity increased in both groups, lumbar lordosis decreased, pain and disabilities caused by low back pain improved significantly compared to the control group [20]. Some studies have shown that the diameter of type II muscle fibers decreases in athletes suffering from back pain, and performing stabilization exercises can probably reverse the atrophy of type II fibers in the multifidus muscle and influence the diameter of these fibers [26]. One of the possible mechanisms regarding the effect of McGill and core stability exercises on improving the physical performance of back pain patients is that these exercises affect the multifidus and abdominal muscles (transversus abdominis, rectus abdominis, and oblique muscles) and by correcting the timing and level of activation of these muscles, improvement in physical performance of patients is plausible [27].

The present study's results clarified that the intensity of pain decreased in both exercise groups and the reduction rate was almost similar. In previous studies, it has been reported that lowering the pain threshold level in patients with LBP is related to pain intensity and destruction of physical performance [28, 29]. The weakness of the muscles around the vertebral column plays a considerable role in back pain. The weakness of these muscles (superficial and deep) leads to a decrease in the support provided by the active structures against the additional load, which puts a lot of pressure on the inactive structures, which eventually causes pain through the destruction of the structures that are sensitive to pain [30].

Moreover, the results of this study implied that executing McGill stability exercises reduced the functional disability in two groups, but the disability level in the home-based group was higher than the supervised group. Disability is the vital factor preventing success in the treatment of chronic back pain. Some studies have revealed that therapeutic exercises improve pain and reduce disability in chronic back pain patients [31]. One of the possible mechanisms to reduce functional disability following the intervention of core stability exercises is that these exercises improve the activity of the trunk muscles and reduce muscle atrophy, resulting in improvement of postural alignment and reduction of shear forces, which diminishes the sensitivity of pain receptors in this area [17, 32].

By reviewing 17 crucial studies between 2000 and 2017, Hagg et al (2018) investigated the impact of therapeutic and sensory-motor exercises on the pain and performance of patients with chronic LBP and reported no specific exercise therapy protocol. However, exercises aimed at improving core stability and developing motor control appear to be more effective in reducing pain and disability in patients with chronic LBP [19].

Based on the discussed topics and the results of this study, it appears that McGill's stability exercises by reinforcing the abdominal-lumbar muscles increase the stability and endurance of the core region, and through the stabilizing mechanisms and correcting the muscles recruitment time reduce the pressure on the vertebrae, and as a result, reduce pain and disability in people with non-specific chronic LBP.

5. Conclusion

According to the obtained results, it can be stated that performing McGill stability exercises is effective as an easy and low-cost intervention in the treatment of non-specific chronic LBP. Although the results of this study may only be generalized to middle-aged women with non-specific chronic back pain in the age range of 35 to 50 years.

Limitations

Finally, it is necessary to point out that the current study had some limitations. First, the sample size of this study was small. Second, this study studied the effects of McGill's stability exercises on women with non-specific chronic LBP; thus, the findings may not be generalized to men.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed of the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them. A written consent has been obtained from the subjects. principles of the Helsinki Convention was also observed.

Funding

This research received no grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

Conceptualization, investigation and resources: All authors; Methodology: Parvin Baghani and Hashem Piri; Writing original draft: Nader Naserpour; Reviewing and editing: Nader Naserpour and Hashem Piri; Supervision: Hashem Piri.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

We hereby thank all the participants who participated in this research and other loved ones who helped us in conducting this study.

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