



## Review Article

# Effectiveness of Pilates Exercise on Disability in Low Back Pain Patients: A Meta-Analysis Review Paper

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### ABSTRACT

**Background:** Low back pain (LBP) is one of the main problems resulting in pain and disability in society. The aim of this meta-analysis review study was to examine and summarize the benefits of Pilate's exercises on disability in patients with low back pain (LBP).

**Methods:** This is a meta-analysis review article. Research was conducted from March 2005 to December 2018. Patients with chronic low back pain formed the statistical population of this study. The keywords were Pilates together with low back pain, chronic low back pain, and back pain. The Medline, Embase, Pubmed, Google Scholar, Scopus, and SID databases were searched for relevant literature.

**Results:** Nineteen papers, including 15 high quality and 4 poor quality papers, were assessed. The results showed that Pilates exercises had a significant and high effect size ( $P=0.000$ ) on disability in comparison with the control group (Hedges  $g=1.183$ ) as well as a significant ( $P=0.000$ ) and medium effect size compared with the exercise group (Hedges  $g=0.526$ ). When the durability of the Pilates exercise effect was assessed in the follow-up period, a significant and low effect size ( $P=0.017$ ) was found in the Pilates group compared with the control group (Hedges  $g=0.488$ ).

**Conclusion:** Pilates exercises improved the stability of patients with LBP compared to the control group. The effect of Pilates exercises decreased during follow-up after 13 weeks of inactivity. Pilates exercises are more effective than other types of exercise. Equipment Pilates exercises have a greater effect than mat Pilates on disability improvement during the follow-up periods; thus, it is advisable for therapists to use Pilates-based equipment exercises to increase the stability of patients with LBP.

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## Introduction

Low back pain (LBP) is one of the main problems resulting in pain and disability in society. Approximately 84% of people experience it all through their lifetimes. LBP is a localized pain between the 12th rib and gluteal line, and 90% of the cases are idiopathic [1]. Six weeks after getting LBP, its effects disappear and the affected person recovers. If the pain is sustained during this period, the chance of recovery decreases and levels

of pain and disability appear. People who experience disability are restricted in activities of daily life and may receive inappropriate muscular neural adaptation to perform daily functions such as running and walking [2]. Biofeedback, relaxation, massage, spinal manipulation [3], and vertebral column stability [4] are effective treatments for LBP. The weakness of the transverse abdominal, multifidus and longissimus muscles decreases the stability of the lumbar vertebrae and leads to back pain in LBP patients [5]. Pilates exercises have the potential to increase the strength and endurance of the abdominal and lumbar muscles and can lead to reduced pain and disability in LBP patients [6].

Today, Pilates exercises have been widely used in the

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treatment of LBP. Several review articles have assessed the effects of Pilates exercises on LBP. Some studies have shown that Pilates exercises are more effective in improving the disability of LBP patients compared to other type of exercises [1-3]. Conversely, others have observed no difference between Pilates and other exercises [4, 5].

The results of previous research on the effectiveness of Pilates exercises on disability improvement in LBP patients are controversial [1-5]. Moreover, the number of studies reviewed in the meta-analysis article was low [6-12]. Certainly, the greater the number of studies involved in a meta-analysis, the more accurate the outcome of the results will be. In addition, the effectiveness of Pilates exercises on disability during follow-up periods has been ignored. Thus, the current study aimed to examine and summarize the benefits of Pilate's exercises on disability in patients with LBP in this meta-analysis review.

## Methods

### Study Design

In this meta-analysis study, the benefits of Pilates

exercises on the severity of disability in chronic LBP patients have been investigated.

### Search Strategy

Studies from March 2005 to September 2018 were assessed. The keywords Pilates with LBP, low back pain, and chronic low back pain were searched in the Medline, Embase, Pubmed, Google Scholar, Scopus, and SID databases.

### Participants

Participants with acute, subacute, or chronic idiopathic LBP who were over the age of 20 years were included in this study. Also, studies that compared the experimental group (Pilates exercise therapy) and the control group (without exercise, daily activity, and usual treatment) or other type of training group except Pilates were included.

### Quality Assessment

The PEDro 11 checklist questionnaire, a scale for assessing the quality of the articles, was used to evaluate the studies. Each study meeting these criteria was carefully examined and adapted. If the article had enough

**Table 1:** Summary of reviewed articles

study	Study type	Subject	Study design	Control group	Pilates group	Frequency (weeks, session, min)	Results
Nezhad roomezi 2012	RCT	30 female	Core exercise 15 female Control 15 female	No modality	Did core exercise	4No3No30No45 min	Disability (oswestry)
Shahrokhi 2016	RCT	30 male/female	Pilates 15 Control 15	Usual treatment	Did Pilates exercise	6No3No60	Disability (oswestry)
Alizamani 2010	RCT	28 female	Pilates 13 Control 13	Usual treatment	Did Pilates exercise	6No3No60	Disability (oswestry)
Aminzadeh 2012	RCT	17male/female	Pilates 15 Control 15 Walking 15			14No3No60	
Da Luz 2014	RCT	86male/ female	44 Pilates 43 Control	Traditional exercise for LBP	Did Pilates exercise	6No2No60	Disability (NRPS)
Wajswelner 2011	RCT	87male/ female	Pilates Control		Did Pilates exercise	10No1No60	Disability (Quebec)
Rydeard 2006	RCT	39 male/ female	21 Pilates 18 Control	Usual treatment	Did Pilates exercise	4No3No60	Disability (RMDQNoHK)
Rajpal 2008	RCT	40 female	15 Pilates 14 Control	Postural alignment	Did Pilates exercise	4No?No?	Disability (RMDQ)
Quinn 2011	RCT	29 male/female	15 Pilates 14 Control	Usual treatment	Did Pilates exercise	8No?No?	Disability (RMDQ)
Natour 2014	RCT	29 male/female	Pilates Control	Usual treatment	Did Pilates exercise	?No?No?	Disability (RMDQ)
Miyamoto 2013	RCT	86 male/female	48 Pilates 43 Control	Learn anatomy of the body	Did Pilates exercise	6No2No60	Disability (RMDQ)
Gladwell 2006	RCT	34 male/female	20 Pilates 14 Control	Usual activity	Did Pilates exercise	6No1No60	Disability (VAS)
Fonseca 2009	RCT	17 male/female	8 Pilates 9 Control	Usual activity	Did Pilates exercise	8No2No60	Disability (VAS)
Mostagi 2015	RCT	22 male/female	11 Pilates 11 Control	Did standard exercise	Did Pilates exercise	8No2No60	Disability (VAS)
Lopes 2017	RCT	46 male/female	23 Pilates 23 Control	Sat on the chair at the same time	Did Pilates exercise	?No?No20	Disability (VAS)
Mazloun 2017	RCT	74 male/female	16 Pilates 15 traditional exercise 16 Control	Usual activity	Did Pilates exercise	6No3No?	Disability (VAS)
Esha 2017	RCT	44 male/female	12 Pilates 12 core stabilization 12 dynamic strengthening		Did Pilates exercise	12No2No40	Disability (VAS)
Silva 2018	RCT	16 male/female	8 Pilates 8 control	Did kinsiotape	Did Pilates exercise	12No2No40	Disability (VAS)

explanation for the particular item, it was given a positive rating (Yes), and if it was not, it was assigned a negative rating (No). The positive scores were added together and, after calculating the total points, scores higher than 5 were considered as high quality articles and scores below 5 were considered to be low quality articles. [13] The PEDro scale was used to evaluate the articles in a systematic review in physiotherapy (Table 1) [14].

#### Data Analysis

The disability severity was assessed by Oswestry questionnaire. The results were reported based on corrected standard differences (Hedges  $g$ ) with a 95% confidence interval, where the corrected standard differences between 0.5-0.2 were considered as a low effect size, between 0.8-0.5 were considered a medium effect size, and 0.8 and more were considered a high volume effect size [15]. Data was analyzed using a random model. Forest Plot summarized each study for each separated section.

#### Results

##### Study Selection

In this study, only clinical trial studies were used for analysis. The articles selected were in Persian and English. A total of 736 studies were selected from the

search. After removing duplicates, 547 studies were dropped, and a detailed study of the articles led to 189 studies being excluded due to a lack of relevance to the topic. Out of a total of 63 articles, 19 articles ultimately met the necessary meta-analysis criteria and were chosen.

##### Participants

A total number of 766 people participated in this meta-analysis study; the number of samples varied from 8 to 87 individuals.

##### Pilates Intervention

Training sessions lasted 20, 40, 60, and 66 minutes with a frequency of once, twice, and three times per week. The length of the training period was 4, 6, 8, 10, 12, and 14 weeks, with 6 weeks being the highest frequency among the studies, followed by 4 weeks as the second most frequent duration of training. The Pilates interventions are summarized in Table 2.

#### Results

In this study, the disability variable in the Pilates group was compared to the control group after treatment (15 out of 19 studies) and follow-up time (7 out of 19 studies) and compared to other types of exercise after treatment (7 out

**Table 2:** Quality assessment of the papers

	Eligibility criteria*	Random allocation	Concealed allocation	Baseline comparison	Subjects (blinding)	Therapist (blinding)	Assessor (blinding)	Adequate follow-up	Intention to treat	Between-group comparisons	Point estimation & variability	Score 0/10
Silva, 2018	Yes	No	Yes	No	No	No	No	No	Yes	Yes	Yes	4
Esha, 2017	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	6
Mazloum, 2017	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	7
Mostagi, 2015	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	7
Lopes, 2015	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
Fonseca, 2009	Yes	Yes	No	Yes	No	No	No	Yes	No	No	Yes	3
Gladwell, 2006	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	Yes	5
Miyamoto, 2013	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Natour, 2014	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Quinn, 2011	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	7
Rajpal, 2008	Yes	Yes	No	No	No	No	No	Yes	No	Yes	Yes	4
Wajswelner, 2011	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Rydeard, 2006	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7
Borges, 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	8
Da Luz, 2014	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Aminzadeh, 2012	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	6
Alizamani, 2010	Yes	No	No	No	No	No	No	Yes	Yes	Yes	Yes	4
Shahrokhi, 2016	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	5
Nezhad Roomezi, 2012	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	7

of 19 studies) and follow-up time (5 out of 19 studies). According to the PEDro scale [14], 16 and 3 papers ranked as high and low quality articles, respectively. The heterogeneity was assessed in this studies using the Cochran Q test. Considering the high heterogeneity, the random model effect was used to analyze the data.

*A) Effect of Pilates exercises on disability compared to control group (Figure 1)*

The effects of Pilates exercises on disability were assessed by 15 out of 19 studies (23-16) by comparison with the control groups. The results of the meta-analysis showed that Pilates exercises had a positive and significant effect (P=0.000) with a high effect size (Hedges g=1.183) on the improvement of disability in LBP patients. Disability improved in LBP patients after Pilates exercises compared to the control group.

Of the 15 papers reviewed, 6 showed no significant differences in post-test results compared with the control groups (6-11) (P>0.05) (Figure 1).

Rydzread et al. showed a significant (P=0.000) and moderate effect size (Hedges g=5.512) of Pilates exercises on disability compared to the control group [12]. Mazloun et al. (Hedges g=1.905) [13], Ali Zamani et al. (Hedges g=2.538), Nezhad Romezi et al. (Hedges g=3.120) [14], Llewellyn et al. (Hedges g=1.234) [15], Marshall et al. (Hedges g=0.997) [16], and Borges et al. (Hedges g=1.107) [17] showed a significant (P=0.000) and high effect size of Pilates exercises on disability improvement compared with the control group.

Myamoto et al. (Hedges g=0.573) [18] showed a significant (P=0.000) and moderate effect size of Pilates exercises on disability compared with the control group.

*B) Effectiveness of Pilates exercises on disability after follow-up period compared to control group (Figure 2)*

After follow-up, the durability of the effectiveness of Pilates exercises on disability improvement were assessed [6-8, 12, 13, 17]. The reviewed studies evaluated the durability effectiveness of Pilates exercises on disability compared with the control group after 13 weeks [6], 25 weeks [7, 8, 12], 6 weeks [13], and 30 weeks [17] follow-

up after the completion of Pilates exercises training. Meta-analysis results showed that Pilates exercises had a significant and positive (P=0.017) with low effect size (Hedges g=0.488) on disability improvement in patients with LBP. The results also showed that the effectiveness of Pilates exercises decreases over time. Disability was not significant between follow-up (30 weeks, 25 weeks, and 13 weeks) and baseline (P>0.05) [6-8, 12, 17]. After 6 weeks of Pilates exercises, the improvement of disability was significant (P=0.000) with a high effect size (Hedges g=1.906) compared to baseline.

*C) Effects of Pilates exercises on disability compared to other therapeutic exercises (Figure 3)*

Five studies compared the effects of Pilates exercises with those of other therapeutic exercises on improvement of stability [6, 13, 19-21]. The results showed that Pilates exercises had a significant positive effect (P=0.000) with a moderate effect size (Hedges g=1.906) of the Pilates group on improvement of disability compared to other types of exercise.

Of the 6 papers reviewed, 4 studies did not show any significant differences on improvement of disability between Pilates and other therapeutic exercises [6, 13, 19, 22] (P>0.05).

Da Luz et al. (Hedges g=0.237) [19], Bhadauria et al. (Hedges g=0.638) [22], Mostagi et al. (Hedges g=0.641) [6], and Mazloun et al. (Hedges g=0.641) [13] showed no significant differences in the effectiveness of Pilates exercises compared to other therapeutic exercises on improvement of disability.

*D) Effects of Pilates training on improvement of disability during the follow-up period compared to other exercises (Figure 4)*

Five studies investigated the effects of Pilates exercises and other exercises on improvement of disability in the follow-up period [6, 13, 19, 20, 23]. These studies tracked the durability of improvement of stability after Pilates exercise compared to other types of exercise after 4 weeks [19], 6 weeks [13, 20], and 8 weeks [6, 23]. The results of the meta-analysis indicated that there was no significant

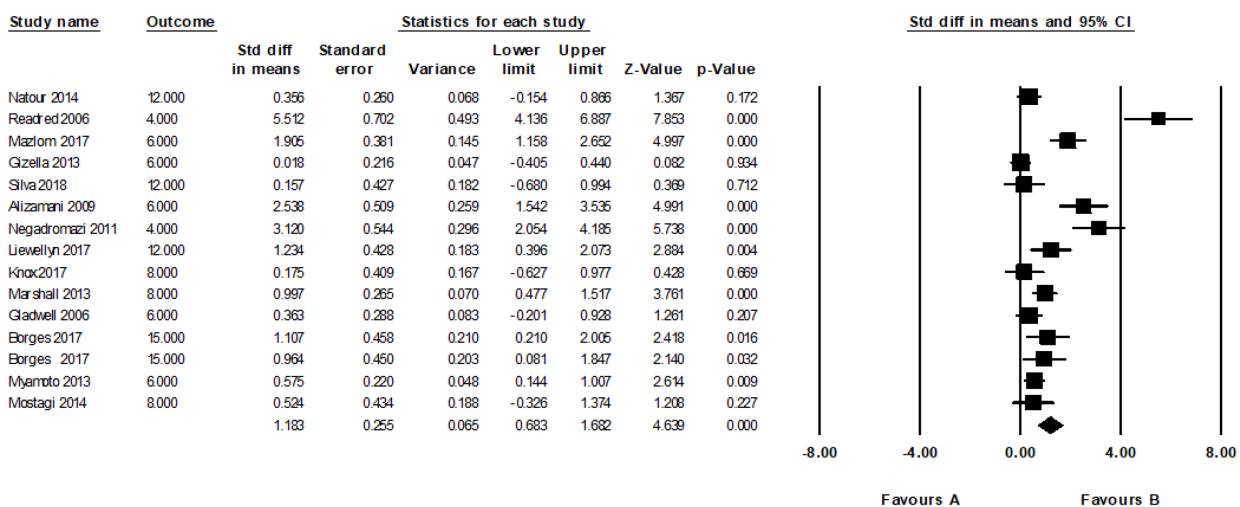


Figure 1: Effects of Pilates exercises on disability compared to control group

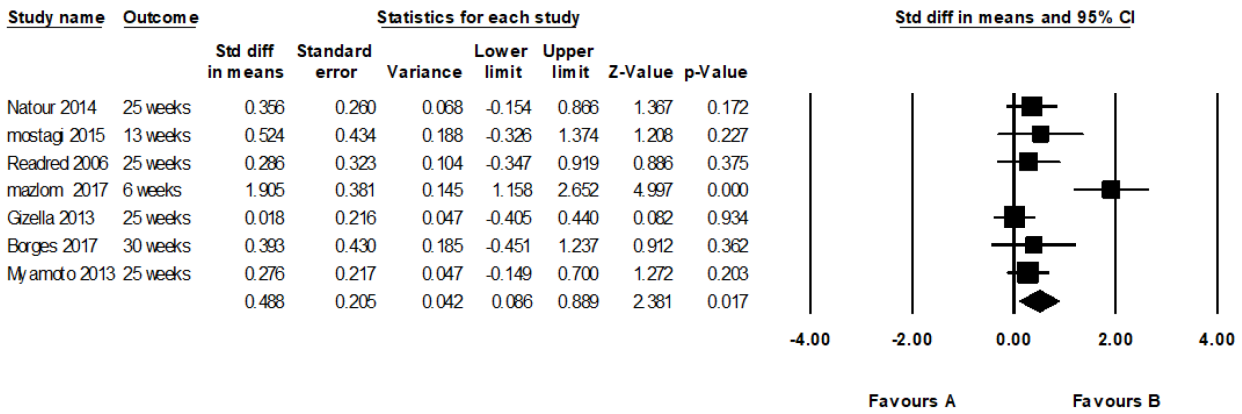


Figure 2: Effectiveness of Pilates exercises on disability after follow-up period compared to control group

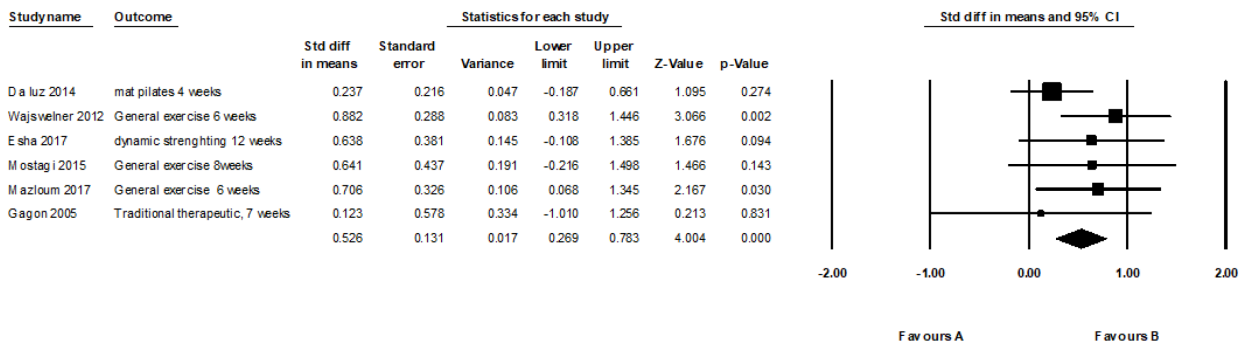


Figure 3: Effects of Pilates exercises on disability compared to other therapeutic exercises

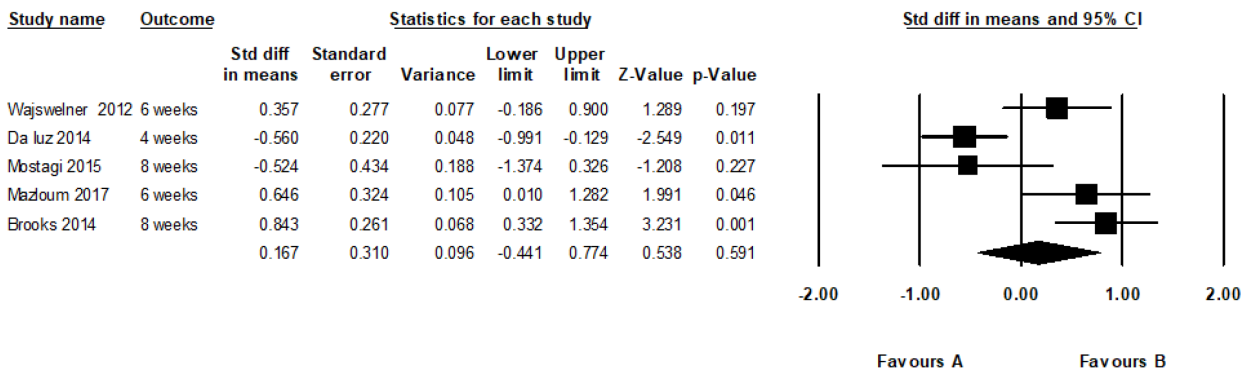


Figure 4: Effects of Pilates exercises on disability compared to other therapeutic exercises at follow-up

difference in durability of stability improvement between the Pilates group and other exercises groups (P=0.59).

**Discussion**

Studies have shown that exercises lead to improved stability in patients with LBP [8, 12, 13, 16, 24]. However, the effectiveness and durability of exercises on disability are not yet known; therefore, the current study investigated the effects of Pilates exercises on disability in patients with LBP compared to other types of exercise and control groups. The results of this study

showed that Pilates exercises improved disability more than that of the control group. Disability improvement decreased after the follow-up period as the duration of inactivity increased. Pilates exercises have a greater effect on disability improvement compared to other types of exercise.

Disability improvement after Pilates exercises in patients with LBP was compared to control groups. The amount of improvement was dependent on the duration of the training sessions and the duration of the course. The longer the training period was, the greater was the improvement observed in patients with LBP.



The rate of disability improvement in follow-up conditions was also examined in Pilates groups compared to control groups. The results after the follow-up period were compared with the results of the baseline in both groups; it was seen that disability improvement during follow-up in the Pilates group decreased based on the interval between the end of training and the end of the follow-up period. As the inactivity gap at the end of the exercise period increased, the disability improvement decreased, such that after 13, 25, and 30 weeks of inactivity, the evidence of disability improvement disappeared, and there was no difference between the Pilates and control groups at the end of follow-up [6-8, 12, 17].

Natour et al. [7], Miyamoto et al. [8], Mazloun et al. [13], Borges et al. [17], and Rydeard et al. [12] showed that after 13, 25, and 30 weeks of Pilates exercises, there was no significant differences in disability between the Pilates and the control groups; disability was the same in both the Pilates and the control group. After 6 weeks of follow-up, however, a significant difference with a high effect size was observed between the two groups in favor of the Pilates group, indicating that Pilates training has a significant effect on disability in LBP patients, but if the training stops, the effects will disappear as the inactivity gap increases. Thus, it is important to keep in mind that, in order to favor the advantages of Pilates exercise, patients should continue the exercises all through their lives.

It has been accepted that exercise has the potential to improve disability in LBP patients, and a variety of exercises have been used to improve disability in these patients, including Pilates, equipment-based, and general exercises as well as aquatic therapy are the most popular treatment methods used for these patients. Regarding the wide range of exercises, the use of a program with the greatest effectiveness will get better results compared to other types of exercise.

The meta-analysis results showed that Pilates exercises had a significant positive effect on disability improvement in the Pilates group compared with other types of exercise methods. Wajswelner et al. [20] and Mazloun et al. [13] showed that Pilates exercises have a significant and positive effect on disability improvement in comparison with other types of exercise, which is consistent with the current results. Bhadauria et al. [22], Mostagi et al. [6], and Gagnon et al. [21], however, concluded that Pilates exercises have the same effect on disability in patients with LBP as other types of exercise.

The results showed that Pilates exercises were not superior in improving the durability of stability in the follow-up period compared to other types of exercises. Wajswelner et al. and Mostagi et al. found no differences between Pilates and other types of exercises on the durability of disability improvement [6, 20]. These results are consistent with the results of the current study. Da Luz et al. [19] assessed the effects of mat Pilates exercises and equipment Pilates exercises on disability in patients with LBP. Although they found no differences between mat and equipment Pilates exercises on the improvement of disability in patients with LBP, they did show that equipment Pilates exercises have longer durability in the follow-up period compared to the mat

Pilates group.

Many factors contribute to the stability of the lumbar column. Since vertebral column stability is obtained through active and passive structures, the most important factor contributing to the stability of the spinal column is the endurance and strength of muscles. The diaphragm, pelvic, abdominal and back muscles are the main supporting structures of the spine [25], and through contraction, they can increase intra-abdominal pressure and vertebrate stability. Muscle weakness is accompanied by a reduction in the stability of the vertebral column and leads to back pain [5], so strengthening these muscles increases stability [6]. After Pilates exercises, spinal column stability increased because of the strengthening and increased endurance of the supporting muscle [6]. When the exercises were stopped, muscle strength and endurance were reduced, and thus, the stability of the vertebral column decreased to the same level as in the control group. Therefore, it is important to keep in mind that these exercises should be done continually throughout one's life in order to benefit from Pilates exercises.

## Conclusion

Pilates exercises improved the stability of patients with LBP compared to the control group. The effect of Pilates exercises decreased during follow-up after 13 weeks of inactivity. Pilates exercises are more effective than other types of exercises. Equipment Pilates exercises have a greater effect on stability improvement during follow-up periods than mat Pilates, so it is advisable for therapists to use Pilates-based equipment exercises to increase the stability of patients with LBP.

**Conflict of Interests:** None declared.

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