The Effects of Yoga and Stabilization Exercises in Patients With Chronic Low Back Pain

A Randomized Crossover Study

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This study aimed to assess the effectiveness of yoga and stabilization exercises in patients with chronic low back pain. Thirty-five female patients were randomly assigned to the stabilization exercise group or the yoga group. Outcome measures were the visual analog scale (VAS), Oswestry Disability Index (ODI) and Back Performance Scale (BPS), 6-minute walk test (6MWT), Fear-Avoidance Beliefs Questionnaire (FABQ), and Pittsburgh Sleep Quality Index (PSQI). The scores of the VAS, ODI, BPS, 6MWT, and PSQI improved significantly after both interventions ($P < .05$). Improvements in the stabilization program were higher on the transversus abdominis activation ($P < .05$). Both interventions had no effect on kinesiophobia ($P > .05$). Both exercise approaches were found to be similarly effective on pain, function, metabolic capacity, and sleep quality. **KEY WORDS:** *exercise*, *low back pain*, *physiotherapy*, *yoga* *Holist Nurs Pract* 2023;37(4):E59–E68

INTRODUCTION

Low back pain, which is among the most important reasons of morbidity, causes serious physical, psychological, and economic problems in developed and developing countries. Low back pain lasting for more than 3 months is defined as "chronic low back pain (CLBP)" and this situation negatively affects the functional status, metabolic capacity, sleep, and quality of life of individuals.[1,2]

According to the perspective recently applied to the concept of pain, it is known that many factors such as stress, sleep quality, catastrophic thoughts about pain, fear-avoidance beliefs, and diet can simultaneously affect pain rather than a single dimension, and these factors trigger the chronicity of pain.[3,4] For this reason, in the treatment of low back pain, there is a trend toward approaches that evaluate and treat the individual from a biopsychosocial framework.[5]

In the management of CLBP, the first-line treatment includes conservative treatment approaches. Among these approaches, exercise is the most commonly used treatment with proven effectiveness in reducing pain and improving function.[6,7] Many exercise methods are used in the treatment of CLBP. In recent years, body-mind approaches that treat CLBP by taking into account its multidimensional nature have become more prominent. One of these exercise approaches is spinal stabilization exercise that uses the motor learning approach to optimize altered stability and control of the spine in individuals with CLBP by rehabilitating the posture, movement patterns, breathing, and the coordination of the deep trunk muscles of the spine. Also, it has been reported in the literature that spinal stabilization exercise improves the perception of neutral spine position, proprioception, kinesthetic, and body awareness in these individuals.[8,9] Yoga is another popular body-mind approach originating from India. It has several potential benefits including changes in physiological, behavioral, and psychological factors

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for individuals with CLBP. Potential benefits of yoga include improved flexibility and muscular strength through the practice of yoga postures (*asanas*), increased mental and physical relaxation with controlled breathing or meditation exercises, and improved body awareness gained with both the physical and mental aspects of yoga.[10,11]

Although exercise has been shown to be effective in the treatment of CLBP in the literature, there is no clear conclusion as to which exercise is superior to the other. Spinal stabilization exercises and yoga are widely used in patients with CLBP, and their positive effects on pain, disability, and quality of life have been demonstrated. However, the studies evaluating and comparing their effects on different factors that trigger pain are insufficient. Therefore, this study aimed to investigate the effects of spinal stabilization and yoga exercises on pain, functional status, metabolic capacity, kinesophobia, and sleep quality in individuals with CLBP.

MATERIAL METHODS

Study design

This study was conducted as a parallel randomized controlled crossover study in Back and Neck Health Unit of Hacettepe University, the Faculty of Physical Therapy and Rehabilitation. The crossover design was chosen to avoid changes in pain perception, physical and psychosocial characteristics among the participants. The ethical approval of the study was obtained from the clinical research ethics committee of the university (KA-20031). The study was carried out in accordance with the Helsinki Declaration. All participants signed an informed consent form before the investigation. The clinical trial number of the study was NCT04787094.

Participants

Twenty-eight female patients were included in the study. The inclusion criteria for the study were the presence of CLBP for at least 3 months, and the age range of 25 to 65 years. The individuals were excluded if they: had signs of nerve root compromise defined as decreased tendon reflexes, sensory loss, and motor deficits; were diagnosed as having a tumor, infection, or inflammatory diseases affecting the spine; had spinal fractures or structural deformities such as spondylolisthesis and spondylolysis; had a history of spinal or lower-limb surgery; had any contraindications to exercise therapy (eg, uncontrolled hypertension, previous myocardial infarction, cerebrovascular disease, peripheral vascular disease, and respiratory disorders); were receiving concurrent treatments from another practitioner for their low back pain.

Outcome measures

Sociodemographic characteristics of the participants such as age, occupation, body weight, height, and medical history were recorded.

Primary outcome measures

Pain intensity

The pain intensity of the patients was evaluated with a visual analog scale (VAS). The participants were told that the leftmost of the 10-cm-long line indicates the absence of pain and the rightmost indicates unbearable pain, and they were asked to mark their pain levels in the last 24 hours on the line.[12]

Functional status and performance

The Oswestry Disability Index (ODI) was used to assess functional disability associated with low back pain.[13,14] The questionnaire consists of 10 questions evaluating the effects of low back pain on daily life activities such as sitting, walking, and dressing. Each question is scored between 0 and 5. The total score to be obtained from the questionnaire ranges between 0 and 100. The higher the score, the higher the functional disability.

The Back Performance Scale (BPS), which was performed by the observation of the physiotherapist, was used to determine the impact of low back pain on the performance of the patient. The scale includes 5 questions, each scoring between 0 and 3. The total score was recorded.[15,16]

Secondary outcome measures

Deep muscle activation

The stabilizer biofeedback device was used to evaluate the transversus abdominis (TrA) muscle activation. It is placed under the abdomen, just below the spina iliaca anterior superior, while the patient is in the prone position. The cuff of the device is inflated to 70 mm Hg, and the patient is instructed to take a deep breath, pull the abdomen up and in while exhaling, avoiding pelvis and spine movements. In the meantime, the pressure change is read from the stabilizer device. In the test, the average of 3 repetitions was recorded.[17]

Fear-avoidance beliefs (kinesiophobia)

Fear of movement related to low back pain was evaluated with the Fear-Avoidance Beliefs Questionnaire (FABQ). This questionnaire has 2 subsections, namely physical activity with 4 questions and work sections with 7 questions. Each question is scored on a scale of 0 to 6 points. The higher the score, the higher the kinesophobia. The total score of participants were recorded. Due to the fact that the individuals participated in the study were retired or housewives, only the physical activity section was taken into consideration.[18,19]

Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality. This questionnaire measures sleep quality and disturbance over the past 1 month. The scale consists of 7 subcomponents: Subjective Sleep Quality, Sleep Latency, Sleep Duration, Habitual Sleep Efficiency, Sleep Disturbances, Use of Sleeping Medication and Daytime Dysfunction. Each component is scored between 0 and 3 points. The total score of the PSQI ranges from 0 to 21. A score greater than 5 indicates "poor sleep quality."[20,21]

Metabolic capacity

The metabolic capacity of the patients was determined with the 6-minute walk test (6MWT).[22] Before the test, the individuals were informed about the procedure, and their heart rate, blood pressure, oxygen saturation, and respiratory frequency were measured. The individuals were then instructed to walk as fast as possible along the 30-m-long corridor for 6 minutes without running. The test was initiated and the number of laps was recorded while the patient was walking. Shortness of breath, quadriceps fatigue, and general fatigue were evaluated according to the modified Borg Scale. After waiting for 1 minute at the end of the test, the parameters determined at the beginning were reevaluated and recorded. In this study, the 6-minute walking distance of the individuals was taken into account.

Statistical analysis

The a priori sample size was calculated using a G*Power statistical program. After examining the studies in the literature, we selected partial η^2 of 0.06 (moderate) for the primary study variable (pain intensity). To achieve 80% power at an α level of .05, the minimum total sample size was estimated to be 28 patients.

The data were analyzed using a statistical software package (NCSS version 23.0; SPSS version 25.0). The quantitative data were expressed as means $\pm$ SDs or as percentages for qualitative variables, unless otherwise specified. A crossover analysis was applied in the NCSS 23.0 software by using the values measured after the first and second periods of 7 different variables in the data set. However, carryover effect on the FABQ, BPS, and VAS variables was found to be statistically significant ($P < .05$); therefore, they could not be evaluated by the crossover analysis. Using the values of these 3 variables at the beginning and after the first period, the repeated-measures analysis of variance method was applied with the SPSS 25.0 software to statistically analyze the significance of time effect, group effect, and group-time interaction. In both analyses, the α value (type 1 error) of .05 was compared to the calculated P value, and $P < .05$ was considered statistically significant.

Interventions

The present study was designed as a randomized controlled crossover trial. The individuals were randomly assigned to either the spinal stabilization exercise group or the yoga group using sealed opaque envelopes. The individuals were treated 2 days a week, 1 hour each day for a total of 16 weeks (8 weeks $\times$ 2). The first protocol started with an 8-week spinal stabilization exercise program and after a 2-week washout period continued with an 8-week yoga program. In the second protocol, the 8-week yoga program, 2-week washout period, and 8-week spinal stabilization exercise program were applied, respectively. The flowchart of the study is shown in Figure 1.

Yoga intervention

The 8-week hatha yoga program was performed for 1 hour, 2 times a week. It was led by a physical therapist who was a certified yoga instructor with 5 years of teaching experience. The yoga program

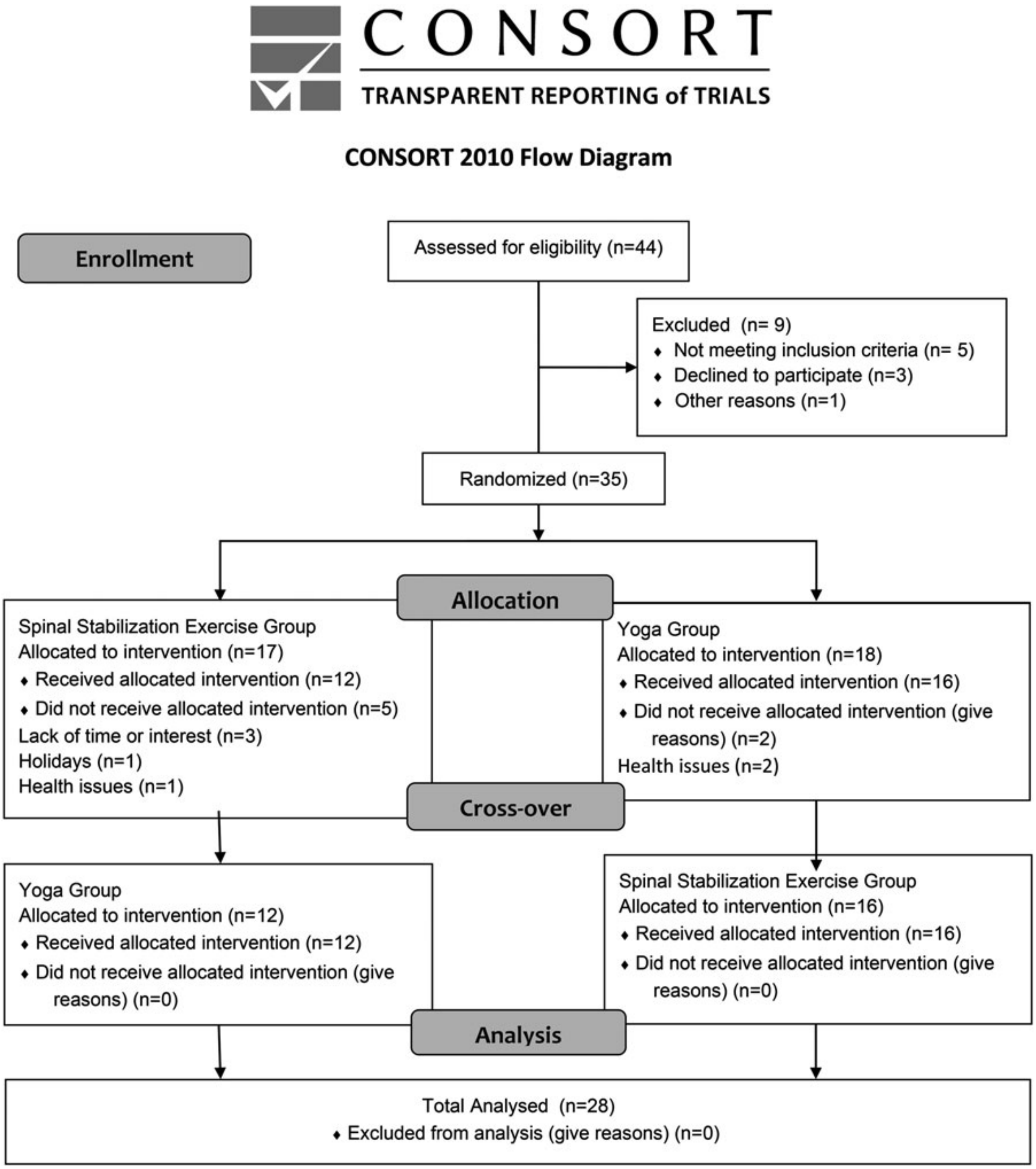

FIGURE 1. CONSORT flow diagram.

consisted of breathing, warm-up, yoga postures (*asanas*), and relaxation practices. The detailed contents of the yoga program are shown in Table 1. The *asanas* (yoga postures) were selected by a physiotherapist experienced in the field of spinal health, specifically for individuals with CLBP. The procedure was performed gently, and the yoga postures were adapted to the capabilities of each individual to prevent injury. The difficulty of the postures (*asanas*) was gradually increased from simple to more challenging postures over the duration of the 8 weeks. The detailed information about the *asanas* is in Table 2.

Spinal stabilization exercise intervention

The stabilization exercises were applied in 3 stages as beginning, intermediate, and advanced levels. At the beginning level, it was aimed that the patient activated the core muscles in various positions. Then, while the superficial muscles were activated, it was aimed to continue the activation of the core muscles. At the intermediate level the aim was to maintain

TABLE 1. Content of Yoga Sessions

Curriculum (Sessions) Elements	Time, min
Breathing exercises	10
Instant relaxation techniques	2-3
Warm-ups	10
Quick relaxation techniques	3-5
Sun salutation (*suryanamaskar*)	10
Yoga postures (*asanas*)	20
Deep relaxation techniques	10-15
Total time	*≅60*

spine stabilization during more complex movements such as contralateral activities, while at the advanced level the aim was to maintain spine stabilization during high-level activities such as resistance and unstable ground (Figure 2).[23,24]

Beginning level (0-2 weeks)

The patient was first taught to activate the core muscles including the TrA and multifidus muscles with diaphragmatic breathing in supine, side-lying, crawling, prone, sitting, and standing positions. The patient was instructed to maintain the contraction of the muscles for 8 seconds for each position. Subsequently, the patient was taught to maintain the contraction of deep core muscles during movements in which superficial muscles were activated, such as shoulder flexion and hip abduction.

Intermediate level (2-5 weeks)

At this level positions, more complex movements such as ipsilateral and contralateral extremity movements and bridge exercises were initiated, respectively, in addition to core muscle activation.

Advanced level (5-8 weeks)

At this level, the exercises with resistance bands were applied according to the strength of the patient. Then, the patients performed the exercise on the exercise ball. Finally, resistance exercises were started on the exercise ball.

TABLE 2. Yoga Postures (*Asanas*) in the Yoga Sessions

Yoga Postures (*Asanas*)	wk 1	wk 2	wk 3	wk 4	wk 5	wk 6	wk 7	wk 8
Ardha kati çakrasana	X	X	X	X	X	X	X	X
Ardha çakrasana	X	X	X	X			X	X
Padahastasana	X	X	X	X			X	X
Vrikşasana	X	X	X	X	X	X	X	X
Natarajasana					X	X	X	X
Vrabhadrasana I	X	X	X	X				
Vrabhadrasana II			X	X			X	X
Parşva konasana							X	X
Parivritta parşvakonasana								X
Parivritta trikonasana			X	X				
Vakrasana	X	X	X	X	X	X		
Ardha matsyendrasana					X	X		
Matsyendrasana					X	X		
Gomukasana					X	X		
Uştrasana					X	X		
Şaşankasana					X	X		
Supta udarakarshanasana	X	X	X	X				
Shavaudarakarshanasana					X	X		
Setubandasana				X	X	X	X	X
Navasana								
Pavanamuktasana							X	X
Tiryaka bujangasana					X	X		
Bujangasana							X	X
Ardha şalabasana					X	X		
Şalabasana							X	X
Sarpasana							X	X

FIGURE 2. Spinal stabilization exercise examples.

RESULTS

Twenty-eight female patients with CLBP were included in the study. There were 12 participants in the first group, which started with stabilization exercises and continued with yoga. On the other hand, 16 participants were included in the second group who started with yoga and continued with stabilization exercises. The age, height, weight, body mass index, and VAS values for all participants according to groups are shown in Table 3. The crossover analysis was performed for variables with no carryover effects (ODI, TrA muscle activation, PSQI, and 6MWT distance), and the significant difference between the groups was detected only in terms of TrA muscle activation. The crossover analysis was not applied for the variables with a significant carryover effect (FABQ, BPS, and VAS).

TABLE 3. Clinical Features of Participants

	Group 1 (n = 12) Mean (SD)	Group 2 (n = 16) Mean (SD)	All Participants (n = 28) Mean (SD)
Age, y	55.08 (2.67)	47.12 (7.07)	50.53 (6.84)
Height, cm	157.41 (6.45)	162.68 (3.45)	160.42 (5.54)
Weight, kg	81.91 (10.69)	69.86 (10.61)	75.22 (12.09)
BMI, kg/m^2	33.27 (5.05)	25.37 (4.51)	28.73 (6.11)
VAS, cm	7.28 (2.01)	6.28 (1.77)	6.74 (1.91)

Abbreviations: BMI, body mass index; VAS, visual analog scale.

It was determined that the stabilization exercise program increased TrA muscle activation more than yoga ($P < .05$). In other parameters, improvements were significant both after the stabilization and yoga exercises. However, the difference between the effects of yoga and stabilization treatments was not statistically significant ($P > .05$) (Table 4).

It was determined that both stabilization and yoga interventions reduced pain intensity and increased functional performance level. However, there was no statistically significant difference between the effectiveness of the 2 interventions ($P > .05$). Both interventions had no effect on kinesiophobia ($P > .05$) (Table 5).

Adverse events

Short-term muscle pain and tension were observed in some participants when they started the exercise programs. This was expected as the individuals participating in the study had a sedentary lifestyle. No serious adverse events were observed.

DISCUSSION

The aim of the present study was to evaluate the effects of yoga and stabilization exercises on pain, functional level, and performance in female patients with CLBP. A secondary goal was to investigate the

TABLE 4. Changes in Variables Analyzed With the Crossover Analysis at the 8th and 18th Weeks[a]

	Baseline		Values After First Period		Values After Second Period			
	Group 1 Mean (SD)	Group 2 Mean (SD)	Group 1 Mean (SD)	Group 2 Mean (SD)	Group 1 Mean (SD)	Group 2 Mean (SD)	Effect Size (95% CI)	*P*
ODI	31.5 (17.85)	27.00 (9.57)	24.17 (14.41)	20.57 (10.80)	23.50 (18.45)	14 (12.23)	−3.62 (−8.39 to 1.15)	.21
TrA muscle activation	2.00 (1.61)	1.07 (1.38)	5.90 (1.37)	4.47 (2.13)	4.80 (1.32)	5.53 (1.92)	−1.08 (−1.82 to −0.36)	.005
PSQI	7.63 (3.17)	8.20 (1.89)	6.88 (2.17)	5.25 (2.30)	5.63 (3.38)	5.25 (1.82)	−0.63 (−1.67 to 0.42)	.22
6MWT distance	460.90 (59.77)	461.18 (50.60)	479.55 (47.29)	488.25 (48.78)	505.09 (37.79)	506.25 (51.63)	21.77 (3.84 to 39.70)	.66

Abbreviations: CI, confidence interval; ODI, Oswestry Disability Index; PSQI, Pittsburgh Sleep Quality Index; 6MWT, 6-minute walk test; TrA, transversus abdominis.
[a]Group 1, the group that starts with stabilization exercises and continues with yoga; group 2, the group that starts with yoga and continues with stabilization exercises.

effects of these exercises on TrA activation, metabolic capacity, kinesiophobia, and sleep quality.

Effects of yoga and stabilization exercises on pain and function

In the present study, it was found that both yoga and stabilization exercises had positive effects on pain, functional status, and performance, but they were not superior to each other. In the literature, there are very few studies comparing the effectiveness of yoga and stabilization exercises, while there are many studies comparing the effects of these 2 exercises with traditional therapeutic exercises; however, no clear findings were obtained in those studies. It was reported in some studies that they had similar effects,[25-27] while some other studies indicated that yoga and stabilization exercises were more effective.[28-30] In addition, the results of recent systematic reviews and meta-analyses examining the effects of exercises on CLBP indicate that exercises are not superior to each other.[7,8] Considering these findings, the results of the present study are compatible with the literature. But in our previous study, it was found that yoga exercises were more effective on pain, while stabilization exercises were more effective on function.[31] Our current study was designed in a different type of research (crossover design) to avoid changes in pain perception and physical and psychosocial characteristics among the participants. For this reason, it is necessary to interpret the results of the present study with caution. In the statistical analysis, the carryover effect was found to be significant for pain (VAS) and function (BPS) variables. Although a clear washout period was not stated in the literature, a longer period could have different effects on the results. We think that this situation may have an effect on these parameters.

Effects of yoga and stabilization exercises on TrA activation, metabolic capacity, sleep quality, and kinesiophobia

According to our results, both interventions had positive effects on TrA muscle activation, but stabilization exercises further increased this activation. The studies show that spinal stabilization exercises are effective in reducing low back pain by increasing TrA muscle strength and activation.[32,33] Our study has similar results with the literature in this respect. To the best of our knowledge, there is no study in the

TABLE 5. Changes in Variables Analyzed With Repeated Variance Analysis at the Baseline and After 8 Weeks

	Baseline Values		Change From Baseline to 8 wk				
	Stabilization Mean (SD)	Yoga Mean (SD)	Stabilization Mean (SD)	Yoga Mean (SD)	Effect Size	P[a]	P[b]
VAS	7.21 (2.09)	6.28 (1.77)	3.78 (2.08)	2.12 (2.66)	0.137	*.00*	.06
BPS	4.50 (3.74)	2.75 (1.48)	2.90 (2.37)	0.62 (0.51)	0.173	*.00*	.08
FABQ	12.91 (5.77)	12.07 (5.70)	14.50 (6.02)	10.76 (5.15)	0.051	.88	.27

Abbreviations: BPS, Back Performance Scale; FABQ, Fear-Avoidance Beliefs Questionnaire; VAS, visual analog scale.
[a]Time difference.
[b]Difference between groups.

literature examining the direct effect of yoga on TrA muscle activation. However, very few studies have reported that yoga may have effects on core stabilization z.[34,35] Omkar and Vishwas[35] stated that yoga techniques such as *uddhayana bandha* and *nouli* can increase core stabilization. Our results also support the literature that yoga increases TrA muscle activation. We think that the reason why stabilization exercises are more effective on TrA muscle activation is due to the fact that each exercise in this program is aimed at activation of this muscle. Although there is a need for experimental work on this subject, we believe that it might be beneficial to add *bandha* techniques to the yoga program, especially for the groups where the increase in TrA activation is targeted. Similar results were reported by Ahmadi et al,[36] who compared stabilization exercises and the Feldenkrais approach, a mind-body therapy method. They found that both interventions increased TrA muscle diameter, but this increase was higher in the group performing stabilization exercises. Also, in line with our results, they showed that despite this different level of improvement in the TrA muscle activation, pain and function improved similarly.[36] This situation suggests that the increase in TrA muscle strength may not be the only determinant for the functional development in individuals with CLBP.

According to our results, both interventions had a similar positive effect on both sleep quality and metabolic capacity. The PSQI mean score of 5 and above was regarded as poor sleep quality.[20] The baseline values of the patients in our study indicated that both groups had poor sleep quality. Roseen et al[37] showed that both yoga and traditional physiotherapy approaches had positive effects on sleep quality in a group with poor sleep quality, and improvements in pain intensity could affect sleep quality. We also think that the reduction in pain intensity after both yoga and stabilization exercises improves sleep quality. In addition, relaxation techniques in yoga may have contributed to this improvement.

It was reported in the literature that the walking speed of individuals with CLBP was significantly lower than healthy aged-matched controls.[38] Stabilization exercises, strengthening exercises, and walking training have been shown to increase walking distance and speed in individuals with CLBP.[38,39] Al-Obaidi et al[38] stated that yoga increased the 6MWT distance by improving cardiovascular efficiency in individuals with musculoskeletal problems. In line with the literature, our results show that both yoga and stabilization exercises increase the 6MWT distance. Both cardiopulmonary endurance and trunk deep and superficial muscle activations are determinants for gait performance.[40,41] In this context, we consider that yoga primarily increases walking distance through breathing exercises, cardiopulmonary development, trunk and lower extremity muscle endurance improvement, and that stabilization exercises also support deep muscle activation and trunk stability.

It was found in the present study that there was no significant effect of either group on fear-avoidance beliefs. It is regarded that the score of 0 to 13 points obtained from the FABQ defines low fear, and 14 points and above define high fear level in individuals with CLBP.[42] Considering the baseline values of the individuals who participated in our study, it can be said that both groups had a low level of kinesiophobia. Klaber Moffet et al[42] stated that the positive effects of the exercise program were more pronounced in the patients with CLBP with a high level of kinesiophobia. The reason that our patients did not have a significant improvement in kinesophobia levels may be attributed to their low baseline kinesiophobia level.

Limitations

Our study had several notable limitations. Some patients were lost during follow-up due to the long treatment period of the crossover study. In addition, although low back pain is more common in women, the fact that the present study consisted only of women may constitute a limitation in terms of generalization of the results. An exact washout period has not been specified in the literature for removing the effects of these exercises, and a carryover effect was found to be statistically significant on FABQ, BPS and VAS variables in the study. For this reason, a 2-week washout period might be considered as one of the limitations of the study.

CONCLUSION

Both yoga and stabilization exercises, which are body-mind approaches, were found to be effective on pain, functional level, metabolic capacity, and sleep quality in individuals with CLBP. The exercises were not superior to each other. On the other hand, it was determined that stabilization exercises were more effective than yoga on TrA muscle activation. Stabilization exercises may be preferred in treatment programs targeting isolated TrA muscle reactivation.

Health professionals such as medical doctors, nurses, and physiotherapists, who are part of the multidisciplinary team in pain management, can direct individuals with CLBP to both exercise approaches depending on their needs or interests.

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