Complementary Therapies in Clinical Practice 35 (2019) 102–108

Contents lists available at ScienceDirect

Complementary Therapies in Clinical Practice

journal homepage: www.elsevier.com/locate/ctcp

Stabilization exercise versus yoga exercise in non-specific low back pain: Pain, disability, quality of life, performance: a randomized controlled trial

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1. Introduction

Low back pain (LBP) is one of the major public health problems that today's society struggles with. Ongoing pain for more than 3 months is described as chronic low back pain (CLBP), which causes deterioration in functional status, quality of life (QoL), and social life. It also has socio-economic effects such as work force loss and increases in financial burden [1].

CLBP is complex phenomenon that interacts with many factors, including psycho-social factors. Therefore, the treatment for patients with CLBP should be selected according to these factors [2]. Due to the complex nature of CLBP, treatment methods have a wide range from medical treatments to surgery and exercise therapies. Exercise is known to be effective, evidence-based, and safe treatment options. Core or stabilization exercises (SE) are popular and effective exercises for pain reduction and functional restoration [3]. Core stability exercises are aimed at improving neuromuscular control, and endurance of the trunk muscles is necessitated to maintain spinal stability [4]. A meta-analysis study by Gomes-Neto showed that SE are as effective as manual therapy in terms of decreasing pain and improving disability and also highlighted that SE should be a part of musculoskeletal rehabilitation for LBP [5].

Recently, yoga have been commonly used as an alternative method for treating LBP since it is a kind of body-mind collaboration concept that has effect on pain relief, functional restoration, and improvements in psychosocial parameters [6,7]. Although yoga has insufficient evidence in acute LBP, it has been considered for use as an adjuvant and safe therapy option in CLBP [8–11]. Some yoga poses are known to facilitate the activation of hip and trunk stabilizer muscles [12], but comparison studies related to yoga and SE in patients with non-specific-CLBP (NLBP) are lacking. So, the aim of the study was to determine whether spinal stabilization or yoga has effects on pain, functional status, QoL, and performance.

2. Materials and methods

2.1. Ethics statement

This study examined patients with chronic NLBP who visited a physiotherapy unit. Necessary authorizations and permits for this study were secured from the Non-Entrepreneurial Clinical Studies Ethical Board of the university.

2.2. Study design, participants and raters

This randomized controlled study involved 77 patients diagnosed with chronic NLBP. Diagnostic criteria for NLBP were having pain at lumbar region and pain was not related to specific pathology. The eligibility criteria were ongoing pain for at least three months, and age between 20 and 65 years. Patients who had structural scoliosis, neurologic, metastatic, or metabolic diseases, had undergone spinal surgery were excluded.

Eligible patients were allocated randomly into two groups: a yoga group (YG) and a stabilization group (SG) by using a sealed envelope method at a ratio of 1:1. In YG, exercise sessions were performed under the supervision of the same physiotherapist, who had practiced yoga for more than 10 years. In SG, exercise was performed with another physiotherapist. The statistician did not know any personal data about the subjects to prevent bias. The statistician and patients were blinded, but the study was not double blinded since the outcome assessor already knew about the groups.

2.3. Outcomes

The demographic characteristics of patients were recorded before interventions, including age, sex, body mass index, and comorbidities.

Visual Analog Scale (VAS): The pain severity was rated on a 10-cm-long line, where the leftmost point was indicated as “pain free,” and the rightmost point was indicated as “unbearable pain”. Patients were separately asked about resting pain, night pain, and pain during activity. The Minimal Clinical Important Difference (MCID) for the VAS has been reported to be 1.5 cm [13].

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https://doi.org/10.1016/j.ctcp.2019.02.004
Received 24 December 2018; Received in revised form 1 February 2019; Accepted 3 February 2019
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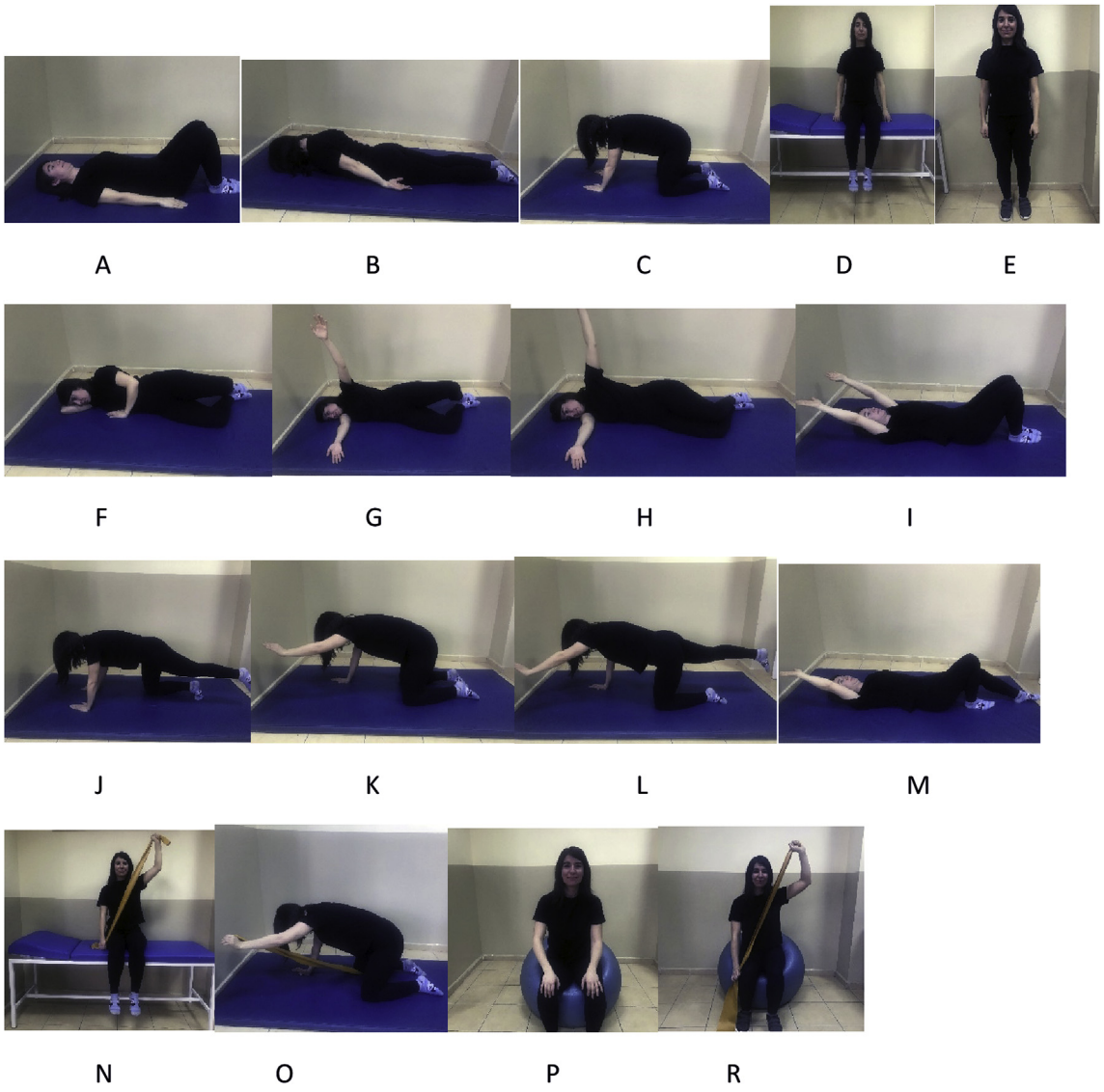

Fig. 1. Stabilization exercise A–E: First week, F–H: Second week, I-k: Third week, L–M: Fourth week, N–O: Fifth week, P–R: Sixth week.

Back Performance Scale (BPS): Back-pain-related physical performance was assessed with the BPS, which includes five common dimensions: the sock, pick-up, roll-up, fingertip-to-floor, and lift test. It has Likert-type scoring on scale of 0–3, and a higher score indicates worsening back performance [14]. The MCID for BPS has been reported to be 1.5 points [15].

Nottingham Health Profile (NHP): The Turkish version of NHP was used to measure the changes in perceived health status. It has six subscale: pain, physical activity, energy, sleep, social isolation, and emotional reactions. Each sub-scale is scored between 0 and 100 points. A high NHP score indicates higher level of impairment in health status [16]. The MCID for the health-related questionnaires has been reported to be half of the standard deviation [17].

Oswestry Disability Index (ODI): Back-pain-related functional disability was measured with the Turkish version of the ODI [18]. The total ODI scores range from 0 (no disability) points to 100 points (severe disability). A higher score indicates higher level of disability [19]. The MCID for the ODI has been reported to be 13,67 points [20].

2.4. Interventions

All group exercises were performed three times per week for 6 weeks. Both programs lasted almost 60 min per session.

2.5. Stabilization group (SG)

The program's main step started with diaphragm respiration and the co-contraction of core muscles, including the transversus abdominis (TA) and multifidus muscles. After all patients learned to keep contracting the TA and multifidus muscles for ten seconds, the program was started. The progress in SG for each week is described below and is shown in Fig. 1.

First week: The TA and multifidus muscles were contracted together with diaphragm respiration appropriately in basic positions (supine, prone, standing, sitting and crawling positions).

Second week: Exercises were done in different positions, which included side-lying exercises such as side-lying hip abduction and adduction.

Third week: Bilateral and ipsilateral movements, closed-chain exercises were added in basic positions.

Fourth week: Alternative movements and open-chain exercises in basic positions.

Fifth week: Resistive bands were used for the strengthening phase. The resistive band was chosen according to the patient's strength.

Sixth week: For the balance phase, exercise balls were used to complicate the movements.

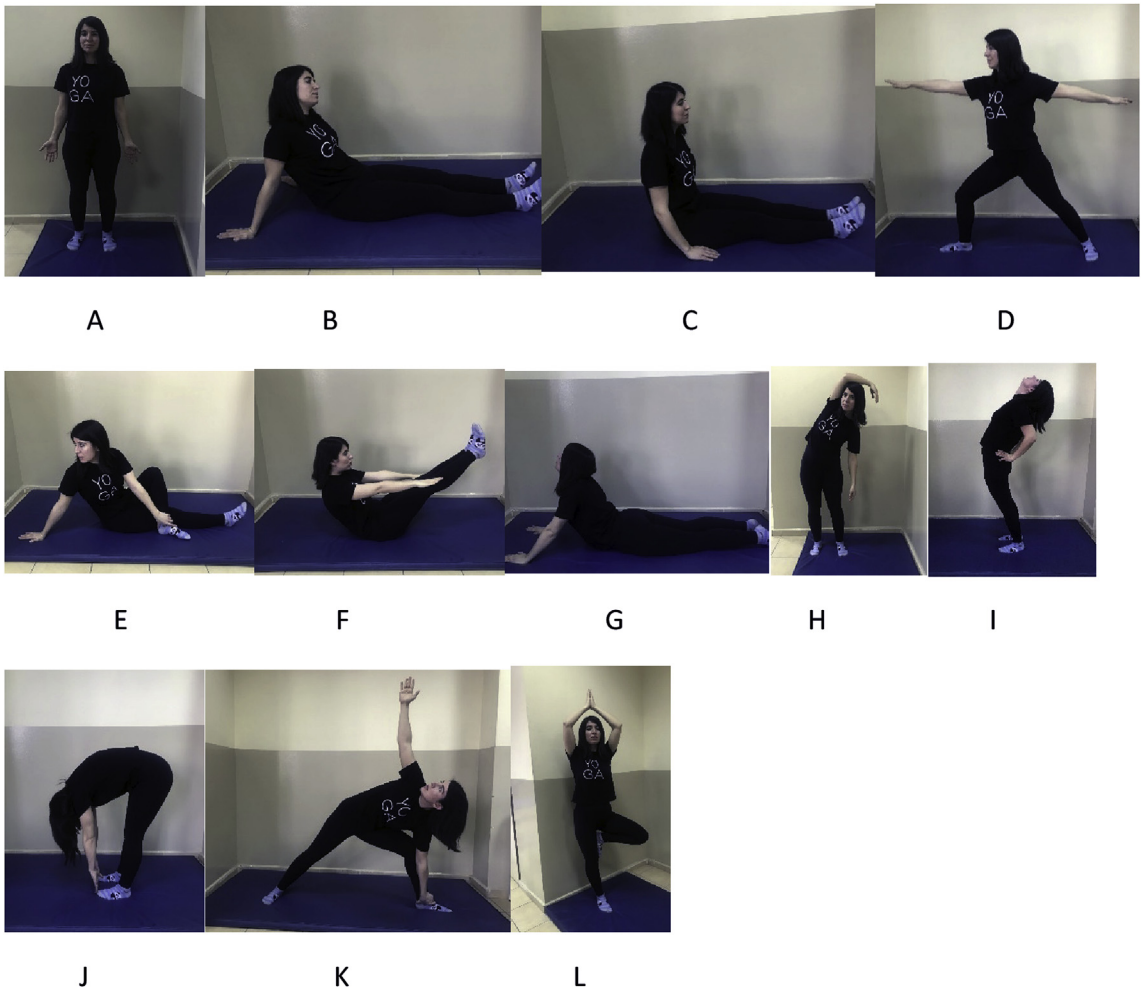

Fig. 2. Yoga exercise, A–E: First-second week, E–H: Third-fourth week, H–L: Fifth-Sixth week.

2.6. Yoga group (YG)

The program's main step started with talking about the philosophy of yoga, its purpose, and the exercises in different phases. Additionally, diaphragmatic respiration was taught to each participant. The progress in YG is described below and shown in Fig. 2.

First and second weeks: Mountain (tadasana), warrior-II (virabhadrasana), staff (dandasana), and twisted pose (vakrasana) were performed.

Third and fourth weeks: Twisted (vakrasana), cobra (bhujangasana), boat (naukasana), and half-waist-wheel pose (ardhakatichakrasana) were performed.

Fifth and sixth weeks: Tree (vrksasana), extended-side-angle (utthita parsvakonasana), hand-under-foot (padahastasana), half-waist-wheel (ardhakatichakrasana), and standing-backward-bend (ardhachakrasana) were performed.

2.7. Statistical methods

The IBM SPSS statistical 23.0 software was used for the statistical analysis. The compatibility of the data with normal distribution was reviewed visually (probability plots and histograms) and through analytical methods (Kolmogorov-Simirnov/Shapiro-Wilk's test). The student-t test was conducted to identify the difference between the groups, while the paired sample-t test was conducted to determine the changes within groups. Changes from baseline to after interventions were computed for each outcome. The difference outcome is shown as "Δ" in Table 3. Cohen's d effect size for each outcome was calculated for student *t*-test and paired sample *t*-test, separately. Effect sizes were shown in Tables 2 and 3. The "Δ" values compared with each outcome's literally reported MCID values. The statistical significance level was acknowledged as $p < 0.05$.

2.8. Sample size

Sample size was calculated from the GPower 3.0 analyses program. Sample size estimations were done according to a study in terms of pain severity [21]. To obtain 90% power at an alpha level of 0.05, sample size was estimated as 31 patients in each group and total 62 patients. Considering the possible drop out risks, 80 subjects were decided to admit to the study.

3. Results

Although 80 patients participated to the study, 77 patients were analyzed. In SG three patients could not complete the study due to pregnancy, fracture and vertigo (Fig. 3). All participants had similar data in terms of age, sex, and body mass index ($p > 0.05$, Table 1). Pain intensity during activity, back-pain-related disability, and the pain sub-scale of NHP were higher in SG at baseline. Within group analyses showed that all outcome measures were improved after any exercise program in comparison to the baseline except for the social isolation sub-scale of NHP ($p < 0.05$) (Table 2).

There were no significant improvements in NHP sub-scale except for

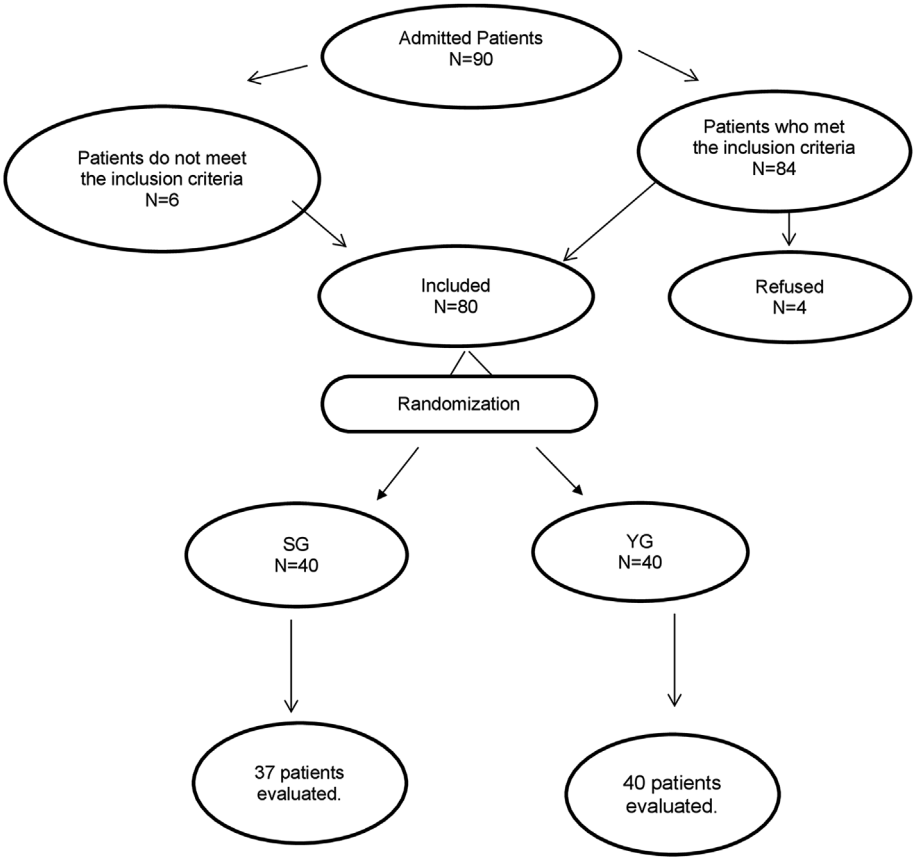

Fig. 3. Flow diagram.

Table 1
Baseline characteristics of participants according to yoga and stabilization groups.

	Yoga (n = 40)	Stabilization (n = 37)	p[a]
Age	44.25 ± 8.71	45.59 ± 12.32	0.28
BMI	26.57 ± 4.52	27.95 ± 5.72	0.33
Sex (n/%)			
Female	33 (82.5)	29 (78.4)	.64
Male	7 (17.5)	8 (21.6)	

BMI: Body Mass Index, p[a]: Independent Sample T-Test for continuous variables and the X^2 test for categorical variables. Statistical significance level was assumed at $p < 0.05$.

pain levels after treatment ($p > 0.05$). Between group analyses showed that pain during activity improved in favor of YG, and disability improved in favor of SG. The change between baseline and after treatment is shown in Table 3. Pain during activity and performance had higher effect size values in YG. The NHP sub-scales and total scores had similar effect sizes for both groups (Table 3).

SG reached the MCID for ODI and pain intensity during the activity. YG reached the MCID for both pain during activity and resting pain. Both YG and SG reached the MCID for performance (Table 3).

4. Discussion

The aim of this study was to investigate and compare the short-term effects of SE and yoga on disability, pain, performance, and QoL in patients with NLBP. This study showed the following short-term benefits at 6 weeks: both exercises improved outcome measures after treatment compared to baseline according to the MCID, but YG had a superior reduction in pain during the activity and improved performance, while SG had superior improvements in disability.

A review article presented strong evidence that exercise therapy is equally effective as conventional therapies, which include traction, mobilization, hot-packs, massage, electrotherapy, ultrasound [22]. However, it is still unclear whether any exercise is better than the others or which exercise is the best for subgroups of LBP. According to LBP guidelines from Denmark, the UK, and the USA, exercise therapy is prescribed for limited circumstances in acute LBP and it must be applied in a routine rehabilitation setting as a first step of therapy in CLBP [8–10]. The European guideline for chronic NLBP states that individualized supervised exercise therapy is not superior to supervised group exercise therapy [22]. With this background, exercises applied as group intervention rather than individual sessions.

A review article suggests that in patients with chronic or recurring LBP, motor control exercises are superior to general exercise, manual therapy, and minimal intervention with regard to disability and pain [23]. The management of lumbar segmental clinical instability is based on motor control retraining and re-education programs involving postural control retraining and multifidus co-activation with segmental SE [24]. The findings of a study indicated that SE provided therapeutic benefits by increasing the muscle thickness and the function of the TA. In another study, a 10-week exercise program provided significant improvements in pain intensity, functional disability, and QoL in patients with clinical lumbar instability [3]. Similarly, disability levels were decreased in favor of SE in the current study.

Yoga consists of breathing and relaxing exercises, but the treatment mechanism has not been explained with certainty. It has been explained to have both physical and psychological benefits that are gained through breathing control and mental focusing. By improving proprioceptive skills and body awareness for correct alignment and correct posture, it decreases maladaptive stress and loading. By increasing flexibility and strength, it relaxes paravertebral muscle spasms. It is

Table 2
Changes in outcome measures between and within groups.

	Groups	Before treatment	After treatment	p[b]
$VAS_{resting}$	Yoga	2.92 ± 2.65	1.06 ± 1.44	< **0.001**
	Stabilization	2.62 ± 2.23	1.76 ± 2.24	**0.01**
	Effect size	0.12	0.37	
	p[a] value	0.79	0.24	
$VAS_{activity}$	Yoga	5.76 ± 1.96	2.36 ± 2.09	< **0.001**
	Stabilization	6.72 ± 2.02	3.78 ± 2.44	< **0.001**
	Effect size	0.48	0.62	
	p[a] value	**0.03**	**0.008**	
ODI	Yoga	30.94 ± 16.74	18.41 ± 12.65	< **0.001**
	Stabilization	39.67 ± 15.90	23.66 ± 16.56	< **0.001**
	Effect size	0.53	0.35	
	p[a] value	**0.01**	0.23	
Performance	Yoga	4.39 ± 2.65	1.54 ± 1.84	< **0.001**
	Stabilization	4.67 ± 3.46	2.60 ± 2.75	< **0.001**
	Effect size	0.09	0.45	
	p[a] value	0.97	0.13	
Nottingham Health Profile *PA*	Yoga	24.26 ± 18.28	13.09 ± 13.97	< **0.001**
	Stabilization	30.84 ± 18.45	19.47 ± 16.08	< **0.001**
	Effect size	0.35	0.42	
	p[a] value	0.15	0.06	
P	Yoga	37.45 ± 32.75	16.38 ± 21.54	< **0.001**
	Stabilization	52.42 ± 32.78	30.68 ± 28.37	**0.001**
	Effect size	0.45	0.56	
	p[a] value	**0.04**	**0.01**	
S	Yoga	23.03 ± 28.36	13.92 ± 19.61	**0.005**
	Stabilization	35.11 ± 34.29	21.71 ± 25.81	**0.005**
	Effect size	0.38	0.33	
	p[a] value	0.15	0.18	
SI	Yoga	13.53 ± 21.37	9.66 ± 20.60	0.59
	Stabilization	15.13 ± 26.69	6.01 ± 14.99	**0.01**
	Effect size	0.06	0.20	
	p[a] value	0.84	0.45	
ER	Yoga	25.59 ± 24.18	16.60 ± 22.41	**0.002**
	Stabilization	26.13 ± 27.36	14.33 ± 20.89	**0.002**
	Effect size	0.02	0.10	
	p[a] value	0.94	0.74	
ES	Yoga	40.96 ± 36.30	26.56 ± 31.42	< **0.001**
	Stabilization	52.77 ± 38.53	30.97 ± 34.25	**0.001**
	Effect size	0.31	0.34	
	p[a] value	0.15	0.55	
Total score	Yoga	164.85 ± 116.72	95.63 ± 102.15	< **0.001**
	Stabilization	212.31 ± 133.34	123.31 ± 111.87	< **0.001**
	Effect size	0.37	0.25	
	p[a] value	0.10	0.32	

VAS: Visual Analog Scale, ODI: Oswestry Disability Index, PA: Physical abilities, P: Pain, S: Sleep, SI: Social isolation, ER: Emotional reaction, ES: Energy.
*p < 0.05.
[a] p value between group difference in scores using Independent Sample T-test.
[b] p value within group difference in baseline and after treatment scores using Paired Sample T-test.

emphasized that functional restoration and pain relief are gained by performing body movements safely with sufficient flexibility and relaxation of the spinal muscles [25,26]. Higher pain relief during activity was observed in YG in the current study. It is thought that maintaining the right posture helped with relaxation of the lumbar muscles and helps with daily activities. A reduction in pain during activity could decreases disability levels and improves functioning by supporting pain-free movement.

Studies on the effect of yoga on QoL are lacking. Goode et al. found evidence that yoga is effective for both short and long-term pain in patients with NCLBP, but there was uncertain evidence related to the benefits on QoL and the effectiveness for acute LBP [27]. Nambi et al. researched the effects of four weeks of yoga on QoL and found that yoga improved health parameters related to QoL following six months after the exercise was over [28]. They also reported improvement in QoL related to pain relief and a reduction of days with limited activity. Patil et al. researched the effects of yoga in nurses with CLBP and found positive effects on physical, psychological, and social sub-scales of health-related QoL [29]. They explained the reduction in pain and disability by increases in flexibility of the spine in terms of the physical activity item. They explained the reductions in stress, anxiety, and depression by yoga acting like cognitive behavioral therapy that effects social isolation in terms of psychological measures. In the current study, pain -the sub-scale of NHP— was improved in favor of YG. It is thought that yoga's breathing and relaxation exercises might have another mechanism for changing pain perception. Yoga have been known to help pain control and improve pain management by decreasing stress, anxiety, and depression levels [21,30]. Yoga has an increasing effect on the release of some hormones, such as serotonin, cortisol, dehydroepiandrosterone, and brain-derived neurotrophic factor, which is necessary for physical health and the energy cycle and contributes to the reduction of pain [31]. Patients with chronic pain had a good capability of managing pain conditions or managing pain relief cognitively after receiving a yoga intervention [32]. Yoga is known as a body-mind collaboration and has a direct relationship between relaxing tense muscles and meditation [33]. A review study suggested that patients with CLBP will benefit from exercise therapy by changing behaviors and beliefs related to LBP [34]. Although there was no assessment related to beliefs and behaviors, both exercise therapies facilitate patient movement and might decrease fear avoidance beliefs. However, there was no evidence regarding whether motor control exercises improved QoL, and exercise studies that focus on frequency, dosage, or subgroups of LBP are still lacking [31]. In contrast to this study, SE was previously found to be more effective than yoga and hot-packs in terms of general health status in patients with postural LBP [32]. They suggested that SE focused on strengthening helped physical and mental health. Because of the study targeted postural LBP conditions such as hypermobility syndromes, the patients benefited more from SE than other exercises. Different sample populations might have caused a difference between this study and the current study. To date, no MCID has been reported for QoL, which assessed with NHP. Previous studies including different exercise therapies reached lower NHP levels after therapy in comparison to baseline. Although no superiority was detected between yoga and SE, the current study's results are similar to others in terms of improving QoL.

Park et al. compared yoga and a combined exercise program of yoga and stabilization [35]. They found that the yoga-stabilization exercise program was superior in terms of lumbar strength and postural control ability. It is accepted that strengthening one's stabilizing muscles improves spinal function and strength and decreases back pain [36]. A review article also stated that unloaded movement-facilitation exercise is superior to treatment without exercise in terms of pain relief and functional restoration [37]. Both the yoga and SE used in the current study are kinds of unloaded movement-facilitation exercises that use only body weight. Core activation is provided during some yoga poses [12], so in the current study, there was no group combining yoga and SE.

Tekur et al. compared one week of intensive yoga therapy and a control group and found that spinal mobility and disability increased in favor of the yoga group [30]. Another study by same researcher showed that seven days of yoga was superior to conventional physiotherapy exercise in terms of pain, anxiety, depression, and spinal mobility [21]. Although both groups reached the MCID in pain and performance, only the yoga group reached the MCID in resting pain, and only stabilization group reached the MCID in functional restoration. This could be explained by the SE aiming to improve core muscles, which are actively used during all daily living activities and directly affect function. Due to the nature of yoga exercises, which aim to relax superficial and deep muscles, it is not surprising that pain relief is obtained in resting and activity.

A number of limitations were noted for this study. The major study limitation is the assessor was not blinded to the groups. Some of the patients did not want to join yoga classes because of religious concerns.

Table 3
Computed changes of outcomes and effect size values according to groups.

Δ	Yoga (n = 40)	Stabilization (n = 37)
$VAS_{resting}$	1.85 ± 2.19 [0.84]	0.88 ± 2.89 [0.31]
$VAS_{activity}$	3.40 ± 1.88 [1.80]	2.89 ± 2.28 [1.27]
ODI	−12.31 ± 16.44 [0.75]	−15.83 ± 14.61 [1.08]
Performance	−2.76 ± 2.07 [1.33]	−2.29 ± 2.18 [1.05]
Nottingham Health Profile	−10.88 ± 15.71 [0.69]	−11.66 ± 16.16 [0.72]
PA		
P	−20.77 ± 31.49 [0.66]	−20.82 ± 33.70 [0.62]
S	−9.01 ± 19.38 [0.47]	−12.05 ± 22.63 [0.53]
SI	−2.50 ± 16.99 [0.15]	−10.02 ± 21.89 [0.46]
ER	−8.52 ± 14.06 [0.61]	−13.08 ± 22.71 [0.58]
ES	−14.14 ± 22.54 [0.63]	−23.29 ± 36.19 [0.59]
Total score	−66.49 ± 71.51 [0.93]	−90.68 ± 102.0 [0.64]

VAS: Visual Analog Scale, ODI: Oswestry Disability Index, PA: Physical abilities, P: Pain, S: Sleep, SI: Social isolation, ER: Emotional reaction, ES: Energy, Cohen's d effect size values was shown in "[ ]" brackets.

The assessed outcome measures were planned to determine only the effectiveness or superiority of the treatments in terms of pain, disability, QoL, and performance. If the present study had set up interval assessments about which treatment was more effective in a shorter time frame, we could have had more discussion and richer results in terms of the uncertainty of the results for the different exercise types.

5. Conclusion

Our findings indicate that yoga and stabilization exercise has superior aspects on each other in terms of pain, disability, performance and health related life quality. It is strongly advised to choose the best exercise by addressing to patients' most prominent problem.

Conflicts of interest

The authors declare that they do not have a conflict of interest.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

The authors would like to thank Erkan Sümer MD, for referral to participants to the physiotherapy.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctcp.2019.02.004.

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