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RESEARCH

The effect of exercıse program on exercıse perceptıon and fear of movement ın low back paın

Mine ARĞALI DENİZ[1] · Burcu Özüberk[2] · Feray Soyupek[3]

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Abstract

Purpose This study aimed to investigate the effects of a home exercise program on trunk flexibility, exercise benefits/barriers perceptions, and fear of movement in individuals with nonspecific low back pain (NLBP).

Methods In this randomized controlled trial, 65 individuals with NLBP were allocated by the closed-envelope method into either a home exercise group or a control group. The home exercise group received a four-week exercise intervention, while the control group received no intervention. Assessments included a demographic data form (gender, height, weight), the Visual Analog Scale (VAS) for pain intensity, the Exercise Benefits/Barriers Scale (EBBS) for exercise perceptions, the Tampa Scale of Kinesiophobia (TSK) for fear of movement, and trunk flexibility measurements. This trial was registered at ClinicalTrials.gov (NCT05433311).

Results Significant differences were observed between groups in VAS and TSK scores before and after treatment ($p < 0.05$). No significant differences were found in trunk flexibility ($p > 0.05$). Post-intervention EBBS scores in the exercise group demonstrated a non-significant numerical improvement in the total score and subscales.

Conclusions The findings suggest that a home exercise program positively influences perceptions of exercise benefits/barriers and reduces fear of movement in individuals with NLBP. Incorporating home exercise into rehabilitation programs may therefore add value to treatment.

Keywords Low back pain · Exercise barriers · Exercise benefits · Fear of movement · Flexibility

Introduction

Low back pain is one of the leading causes of disability worldwide, limiting functionality and daily activities through complex biopsychosocial mechanisms and imposing a considerable economic burden. Although etiologies may vary, approximately 80–85% of cases are classified as nonspecific, with no identifiable pathoanatomical source [1, 2]. As no specific treatment is available, management primarily targets pain reduction and functional improvement [3]. Among conservative approaches, exercise therapy is widely implemented, with particular emphasis on spinal alignment, core stabilization, strengthening, stretching, and flexibility training [4–6].

When exposed to injury, individuals may respond with either avoidance or confrontation as a result of increased pain perception. In the context of chronic musculoskeletal pain, kinesiophobia plays a central role, as movement avoidance behaviors contribute to muscle weakness, joint stiffness, and the persistence of chronic pain. Moreover, avoidance reinforces increased pain perception, which is closely linked to anxiety and depression. In combination with maladaptive pain behaviors, false beliefs, and fear-avoidance patterns, these factors may reduce functionality,

✉ Burcu Özüberk
burcuozuberk@klu.edu.tr

Mine ARĞALI DENİZ
ftrmine@hotmail.com

Feray Soyupek
feraysoyupek@yahoo.com

[1] Süleyman Demirel University Research and Application Hospital, Department of Physical Therapy and Rehabilitation, Süleyman Demirel University, Isparta, Turkey

[2] Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Kırklareli University, Kırklareli, Turkey

[3] Faculty of Medicine, Department of Physical Therapy and Rehabilitation, Süleyman Demirel University, Isparta, Turkey

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intensify pain, and negatively influence treatment outcomes as well as patient adherence [7, 8].

Exercise benefit/barrier perception refers to how individuals interpret exercise, defined as a planned, structured, and repetitive activity designed to improve or maintain physical health [9]. A positive perception of exercise promotes preventive health behaviors and lowers the risk of disease, whereas exercise barrier perception encompasses internal and external obstacles that hinder engagement in health-promoting activities. Recent studies have identified the most common barriers to physical activity as lack of time, low motivation, environmental constraints (e.g., unsafe neighborhoods, limited access to sports facilities), and pain or fatigue associated with chronic conditions [10, 11]. Furthermore, accumulating evidence demonstrates that regular physical activity enhances mobility [12, 13].

In light of the aforementioned literature, the present study aimed to evaluate and compare the effectiveness of a home exercise program on trunk flexibility, exercise perception, and kinesiophobia in individuals with nonspecific low back pain (NLBP).

Methods

The study was designed as a prospective, randomized, controlled clinical trial. Ethical approval was obtained from the Clinical Research Ethics Committee of Süleyman Demirel University Faculty of Medicine (decision no. 16/262, dated 03.08.2021). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All participants were informed about the study both verbally and in writing, and only volunteers were enrolled. The trial was registered in the clinical trial registry under identifier NCT05433311.

The study sample comprised 65 patients aged 18–65 years who had been diagnosed with nonspecific low back pain (NLBP) and applied to the outpatient clinic of the Department of Physical Therapy and Rehabilitation at Süleyman Demirel University between 06.09.2021 and 06.12.2021. Eligible participants volunteered to take part in the study and met the inclusion criteria (Fig. 1, CONSORT diagram). Patients with NLBP were enrolled after consideration of red and yellow flags and medical evaluation by a physician. Inclusion criteria were: diagnosis of NLBP for at least 3 months, no history of spine or lower extremity surgery within the previous 6 months, absence of orthopedic injuries or neurological deficits. and adherence to exercises without interruption. Participants who did not adhere to the exercise program were excluded.

All participants completed a self-administered questionnaire that included demographic and health-related information, such as age, gender, body mass index, marital status, education level, presence of comorbidities, pain duration, and prior pain treatments. The primary outcome measures were the Visual Analog Scale (VAS) for pain intensity, the Exercise Benefits/Barriers Scale (EBBS) for exercise perception, the Tampa Scale of Kinesiophobia (TSK), and trunk flexibility measurements to assess trunk mobility. Alloutcome parameters were assessed by the same physiotherapist at baseline and following completion of the four-week exercise program.

VAS was used to assess pain intensity, with participants rating their pain on a scale from 0 to 10, where 0 indicated no pain and 10 indicated the most severe pain. Scores of 1–3 were classified as mild pain, 4–6 as moderate pain, and 7–10 as severe pain [14].

Trunk flexibility (flexion, extension, lateral flexion) was evaluated as follows:

- Flexion: The participant sat on a firm surface with knees extended and feet fixed, then reached toward the feet without bending the knees. The distance between the fingertips and the target was measured in centimeters (cm), with negative values indicating a distance short of the target and positive values indicating beyond the target.

- Extension: The participant stood with the pelvis and trunk fully in contact with a wall. The initial distance between the sternal notch and the wall was measured. The participant then extended the trunk backward, and the distance was remeasured; the difference represented the range of motion in cm.

- Lateral Flexion: The participant stood with feet apart and arms at the sides. The starting position of the middle finger on the thigh was marked. After bending the trunk laterally, the new position was marked, and the distance between the two points was measured in cm.

Each test was performed twice for both sides, and the highest value was recorded as the participant's score [15]. Trunk flexibility measurements were used to compare treatment effectiveness rather than to determine absolute flexibility values, consistent with clinical practice in nonspecific low back pain [16].

The Exercise Benefits/Barriers Scale (EBBS) comprises two subscales—benefit and barrier. The scale is in Likert format (1: strongly disagree, 2: disagree, 3: agree, 4: strongly agree) and consists of a total of 43 items. The total score for the Benefits Scale ranges from 29 to 116, while the total score for the Barriers Scale ranges from 14 to 56. Each subscale can be evaluated independently from one another. A high total score on the Exercise Benefits Scale indicates a strong perception of the benefits of exercise. Conversely, a higher total score on the Exercise Barriers Scale reflects a higher perceived level of barriers to exercise. The Turkish

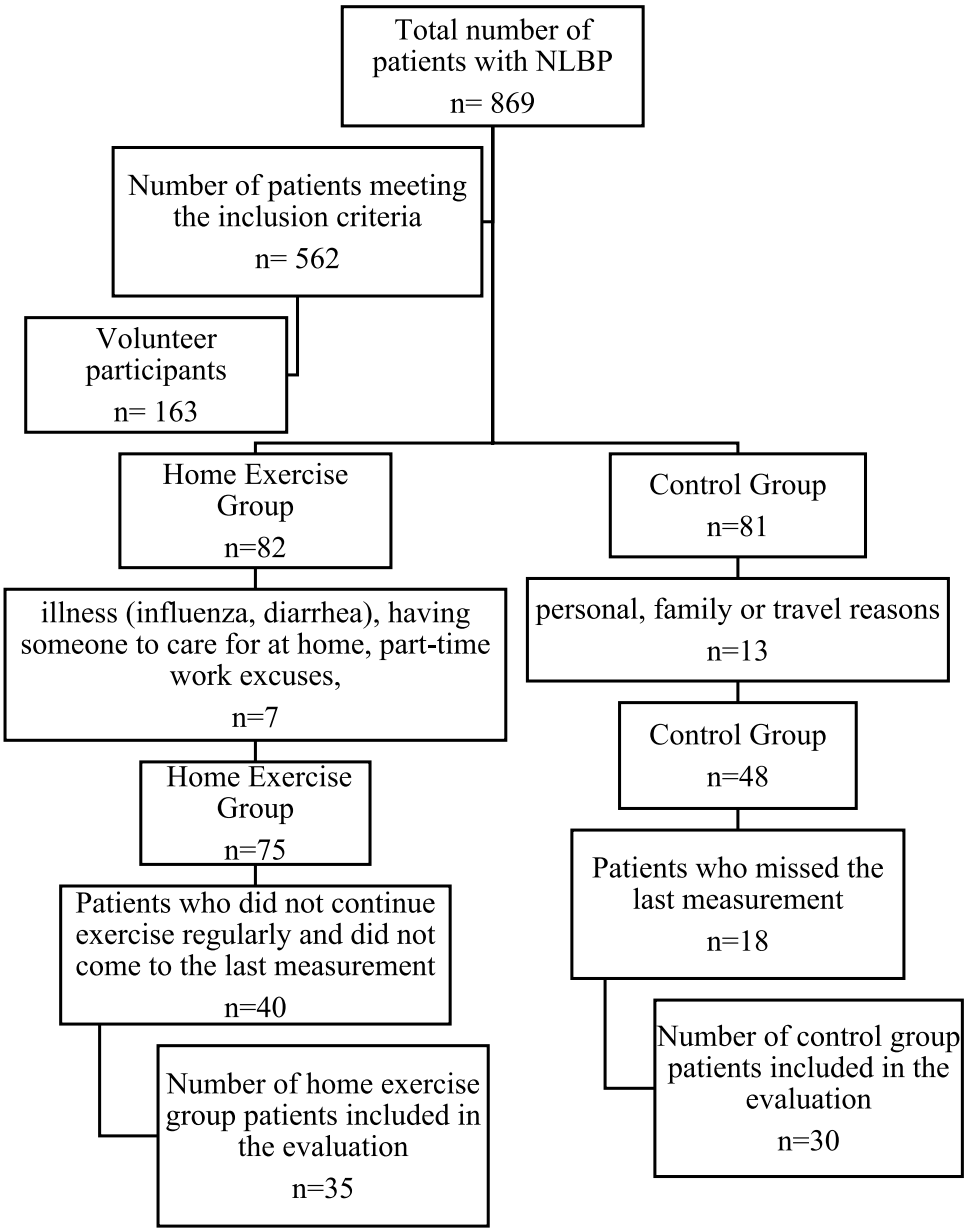


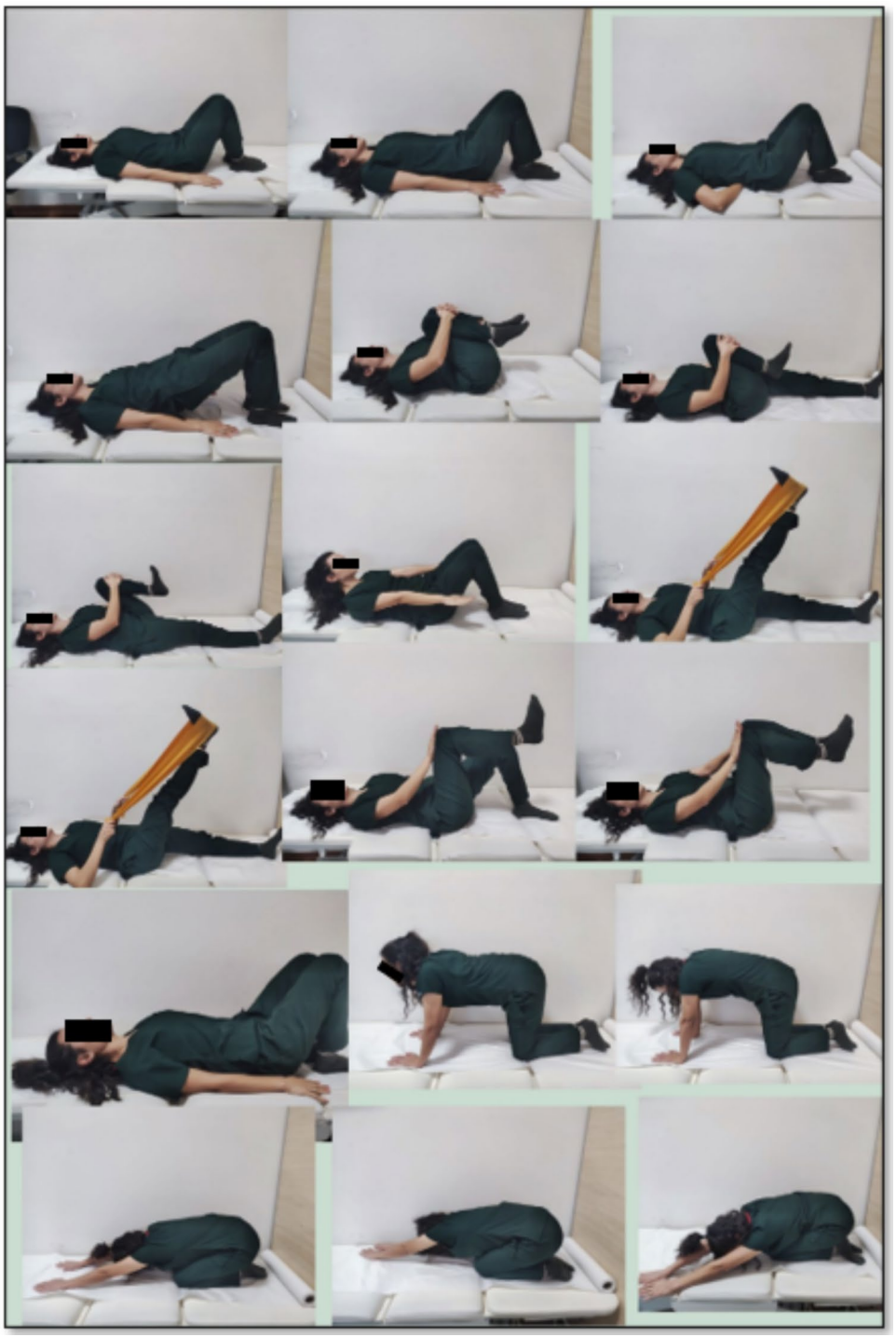
Fig. 1 Consort diagram

reliability and validity of the scale were established by Ortabağ et al. [17, 18].

Fear of pain or reinjury can result in restricted movement even after recovery, leading to persistent kinesiophobia. The Tampa Scale of Kinesiophobia (TSK) is a 17-item questionnaire designed to assess fear of physical movement and activity. Scores range from 17 to 68, with values of 37 and above indicating the presence of kinesiophobia. The Turkish validity and reliability of the scale were established by Yılmaz et al. [19, 20].

Participants were randomized using the closed-envelope method into either a control group or a home exercise group. The home exercise group received a four-week program that included exercises in a neutral position, core strengthening targeting the transversus abdominis and multifidus muscles, isometric abdominal and back extensor exercises, stretching of the lumbar extensors, hamstrings, gastrocnemius-soleus, latissimus dorsi, and gluteal muscles, as well as bridge and cat-camel exercises (Fig. 2). Participants were provided with visual instructional materials (brochures) and instructed to perform 10 repetitions of each exercise in 3 sets daily. After four weeks, participants returned to the clinic and adherence was assessed. Those who skipped exercises for three consecutive days or discontinued during the first week, as recorded in the exercise follow-up form included with the brochure, were excluded. The control group received no intervention other than an informational booklet describing factors that could affect low back health and recommendations for daily

Fig. 2 Exercise fotographs



behaviors. The booklet included information on low back anatomy, strategies to perform daily activities without overloading the low back, and appropriate sleeping positions.

The sample size was calculated a priori using G*Power 3.1 software. For a repeated measures ANOVA design with two groups and three measurement time points, an effect size (Cohen's *f*) of 0.25, a significance level (α) of 0.05, and a power (1–β) of 0.80 were assumed. The correlation among repeated measures was set at 0.5, and the nonsphericity correction (ε) was set at 1. Based on these parameters, the minimum total sample size required to detect a significant difference between groups was 30 participants (15 per group). This study exceeded that requirement, enrolling a total of 65 participants, thereby ensuring adequate statistical power. For comparison of demographic characteristics between the exercise and control groups, the chi-square

Table 1 Comparisons of demographic and health related status

Parameters	Exercise group (n=35) M±SD	Control group (n=30) M±SD	P value
Gender			
Female	23	22	0.595
Male	12	8	
Marital status			
Married	24	14	0.074
Single	11	16	
Education			
Graduate	4	6	**0.001**
Undergraduate	7	11	
High School and below	24	13	
Work			
Employee	19	17	**0.001**
Student	15	3	
Housewife	1	10	
Tabacco			
Smoking	9	1	**0.016**
Not smoking	26	29	
Age (years)	48.14±13.49	34.40±11.94	**0.000**
BMI (kg/cm^2)	28.62±4.94	28.37±5.04	0.839
Chronic disease			
Yes	20	11	0.136
No	15	19	
Family History			
Yes	28	17	0.060
No	7	13	
Previously treated for pain			
Treated	10	24	**0.006**
Not treated	20	11	
When did your pain first occur (years ago)	10.88±10.46	8.07±7.31	0.234
Pain duration (hours)	68.82±14.92	26.12±30.20	**0.000**

BMI: body mass index

test was used for categorical variables, and the independent *t*-test was applied for continuous variables, depending on normality. Changes in dependent variables over repeated measurements and between-group comparisons over time were analyzed using repeated measures ANOVA. To control for baseline differences and potential confounding effects, analysis of covariance (ANCOVA) was performed with baseline scores included as covariates.

Results

Analysis of demographic data revealed significant differences between the groups in age, pain duration, marital status, education level, occupation, smoking status, and prior attempts to receive treatment for pain ($p<0.05$) (Table 1).

The mean±standard deviation (SD) values of the baseline and post-intervention trunk flexibility test are shown in Table 2. A repeated evaluation of ANOVA with a Greenhouse–Geisser correction revealed statistically significant difference in mean flexion assessment between time points ($F=23.723$, $p=<0..01$).

The mean±standard deviation (SD) values of the baseline and post-intervention VAS, TSK, EBBS total and subscale scores are shown in Table 2. There was a statistically significant difference between the groups in the VAS scale and TSK before treatment ($p<0.05$). VAS score decreased from 7.11 to 4.77 in the EG after intervention, however no statistically significant change was recorded in the control group. In the analyses of variances for repeated measures, VAS scores differed significantly between time points ($F=31.871$ $p<0.001$) (Table 3).

In the analysis of the EBBS total score, no significant differences were found between the exercise and control groups from baseline to post-intervention ($p>0.05$). However, in the exercise group, the EBBS benefit subscore increased while the EBSS barrier subscore decreased after the intervention. The EBBS subscale scores showed improvements after the exercise intervention. In the analyses of variances for repeated measures, EBSS total and benefit subscale scores differed significantly between time points ($F=7.349$ $p=0.009$, $F=6.070$ $p=0.016$, respectively).

In the exercise group, the TSK score decreased from 44.09 to 39.57, whereas it remained stable in the control group (Fig. 3). A statistically significant change in TSK scores was observed over time. In covariance analysis, no significant interaction was found over TSK change related

Table 2 Changes in trunk flexibility tests in groups over time

Parameter	Group	Mean±SD		p^1 value	p^2 value	η^2
		Baseline	Postintervention			
Flexion (cm)	EG	9.83±8.09	14.29±6.42	<0.001	**<0.001**	0.274
	CG	9.97±8.92	10.17±9.28	0.604		
Extension (cm)	EG	14.09±5.15	15.77±5.63	0.001	0.711	0.139
	CG	16.20±5.06	18.20±5.77	0.009		
Right lateral flexion (cm)	EG	15.91±3.68	17.09±3.88	<0.001	0.064	0.053
	CG	17.07±6.17	17.47±5.92	0.149		
Left lateral flexion (cm)	EG	14.89±4.24	16.17±4.09	<0.001	0.082	0.047
	CG	17.07±5.27	17.57±5.38	0.169		

Table 3 Changes in scales in groups over time

Parameter	Group	Mean±SD		p^1 value	p^2 value	η^2
		Baseline	Postintervention			
VAS	EG	7.11±2.27	4.77±3.03	<0.001	**<0.001**	0.262
	CG	4.40±2.78	4.17±2.64	0.229		
EBBS	EG	77.89±14.22	81.23±16.21	0.058	0.009	0.104
	CG	77±15.13	76.63±15.09	0.281		
EBBS Benefit	EG	50.17±13.77	55±16.14	<0.001	0.016	0.88
	CG	50.83±11.99	50.50±11.93	0.310		
EBBS Barier	EG	27.71±6.86	26.26±7.31	0.007	0.009	0.104
	CG	26.80±5.35	26.83±5.46	0.662		
TSK	EG	44.09±8.93	39.57±9.21	0.001	0.002	0.137
	CG	33.43±9.90	33.53±10.06	0.501		

VAS: Visuel Analog Scale; EBBS: Exercise Benefit/Barrier Scale; EBBS Benefit: Exercise Benefit Subscale; EBBS Barrier: Exercise Barrier Subscale; TSK: Tampa Kinesiophobia Scale

P^1 value for repeated measures ANOVA test comparing changes in EG from baseline to post-intervention and in CG from baseline to post-intervention

P^2 value for repeated measures ANOVA test comparing changes between the exercise and control group from baseline to post-interv

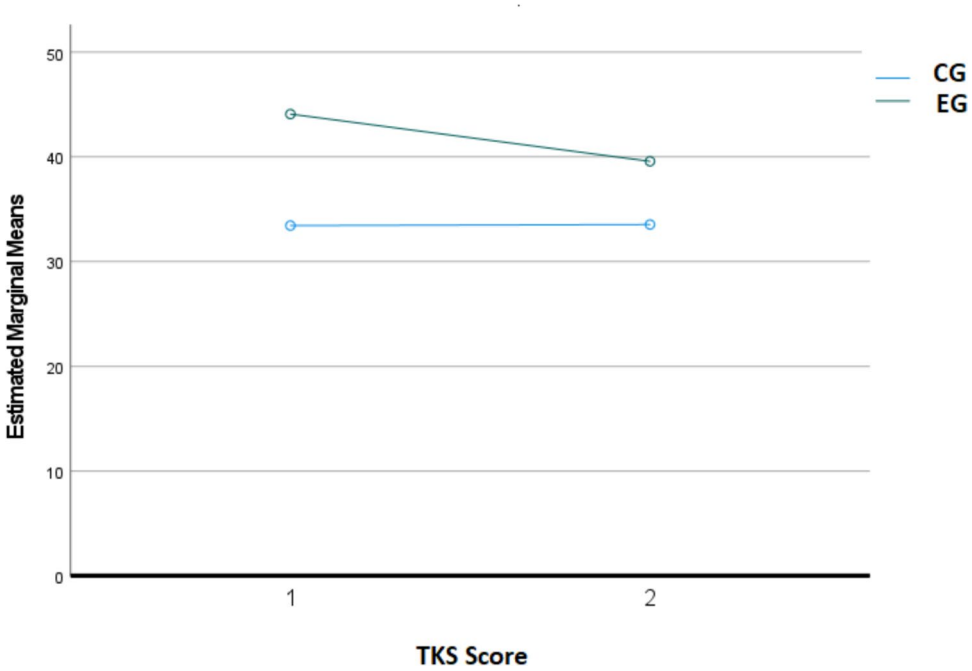


Fig. 3 Changes in TKS scores over time in the groups 1. CG:Control Group; EG:Exercises Group; TKS Score: Tampa Scale of Kinesiophobia Score

with intervention and baseline VAS (p=0.761, η^2=0.001). (p=0.761). As confounding variables, age were analyzed and no statistically significant interactions was found (p=0.703). Furthermore, no significant correlation was detected between age and baseline VAS scores and baseline TSK scores (r=0.097 p=0.440 for age r=0.072, p=0.568 for VAS).

Although no statistically significant difference was found in the EBBS total and subscale scores, a trend toward improvement was observed in the post-treatment scores of the exercise group. The ANCOVA analysis results showed that the group variable had a statistically significant effect on the TSK scores after treatment (p=0.002, partial η^2=0.140). Pre-treatment VAS value showed (in ancova tests) an effect on the border of significance as a control variable (p=0.060, partial η^2=0.056) (Table 4). According to the results of another ANCOVA analysis, when the pre-treatment VAS covariate was controlled, no significant effect of the group variable on the post-treatment EBBS scores was found (p=0.623, η^2=0.004). Table 5 presents the ANCOVA results comparing post-treatment EBBS scores between groups while controlling for pre-treatment pain levels (VAS scores), examining both the group effect and the covariate effect of pain on balance outcomes (p=0.263, η^2=0.020) (Table 5).

Table 4 ANCOVA results on post-treatment TSK scores, controlling for pre-treatment VAS

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	915,382[a]	2	457,691	5,160	,008	,143	10,320	,808
Intercept	17,751,619	1	17,751,619	200,124	,000	,763	200,124	1,000
Pre-treatment VAS	326,435	1	326,435	3,680	,060	,056	3,680	,472
GRUP	897,302	1	897,302	10,116	,002	,140	10,116	,879
Error	5499,603	62	88,703					
Total	94,367,000	65						
Corrected Total	6414,985	64						

[a]R Squared = ,143 (Adjusted R Squared = ,115)

[b]Computed using alpha = ,05

Table 5 ANCOVA results comparing post-treatment EBBS scores between groups while controlling for pre-treatment pain

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	654,676[a]	2	327,338	1,333	,271	,041	2,666	,277
Intercept	55,529,247	1	55,529,247	226,091	,000	,785	226,091	1,000
Pre-treatment VAS	313,568	1	313,568	1,277	,263	,020	1,277	,199
Goup	59,968	1	59,968	,244	,623	,004	,244	,078
Error	15,227,570	62	245,606					
Total	422,654,000	65						
Corrected Total	15,882,246	64						

[a]R Squared = ,041 (Adjusted R Squared = ,010)

[b]Computed using alpha = ,05

Discussion

In this study, in which we evaluated the effects of a home exercise program for non-specific low back pain on kinesiophobia, trunk flexibility, and exercise perception, we found that the exercise program reduced patients' fear of physical movement and activity, improved their exercise perception, and increased trunk flexibility. In addition, their pain levels also showed significant improvement.

The likelihood of experiencing NLBP at some point in one's life is as high as 60–80% in the general population [21]. The prevalence of NLBP, which is generally more common between the ages of 30–50 years, tends to increase with age [22]. In our study, the mean ages of the exercise and control groups were 48 and 34 years, respectively. Similar to the literature, it was observed that the mean age of both groups was observed in the 3rd and 4th decades of life.

The exercise program we applied positively impacted participants' pain levels and reduced their kinesiophobia. In the literature, kinesiophobia is considered a key factor in the chronicity and disability of low back pain [23]. We believe the reduction in pain levels in the exercise group contributed to this decrease, as catastrophic thoughts following pain onset often heighten kinesiophobia and sensitivity to pain symptoms [24]. Especially in the exercise group, we think that the positive change in the trunk flexibility test results compared to the control group may have decreased the pain level and kinesiophobia. In the last two decades, the prevalence of non-specific low back pain (NLBP) has increased significantly [25–30]. While mechanical factors such as limited lower extremity flexibility, poor trunk stabilization, and difficulties in maintaining lumbar lordosis are important contributors, psychosocial, internal (e.g., psychological stress, fear-avoidance behaviors), and external factors (e.g., occupational hazards, lifestyle changes) also play a critical role in this increase. These multidimensional influences should be considered when interpreting the development and management of NLBP [31]. Moreover, the exercise group showed a longer duration of pain persistence, previous exposure to pain in earlier years, and higher treatment history compared to the control group, which may have initially placed them at a disadvantage. Nevertheless, based on the findings of Hayden et al. [32], we believe that these baseline differences did not significantly affect the positive outcomes observed, as a well-planned and regular exercise program can still be effective. Regarding the control group, while the statistical change was not significant, the trend appeared to favor improvement, which may be further clarified with a larger sample in future studies.

On the other hand, we can say that the reason for the difference between the pre-treatment kinesiophobia results is that randomization may have caused a significant difference in scores in small samples or at the beginning by chance. The exercise application may have reduced kinesiophobia by increasing the self-confidence of the participants. This psychological effect may not have been observed in the control group for this reason. The kinesiophobia scale used may have been sensitive enough to capture the change in the

exercise group, but it may not have been able to detect the small changes in the control group. The change in the control group may have been statistically insignificant (because the sample was small). Statistical significance may have been achieved because the effect in the exercise group was large.

We observed that there was a positive change in exercise benefit/barrier perceptions, especially in the participants in the exercise intervention group compared to the control group. According to Pender's 'Health Promotion Model', "How a person perceives and feels about illness and health" is important. This perception determines how psychologically compatible the individual is with practicing health behaviors. Perceiving a behavior positively accelerates the acquisition or acquisition of the behavior [33]. The main reason that reduces the possibility of activating and maintaining positive health behaviors is the difference between perception of barrier and perception of benefit. As the perception of benefit is higher than the perception of barrier, the likelihood of performing positive behaviors increases [34, 35]. The decrease in the level of pain may have contributed to the decrease in the negative health status that would create an obstacle to exercise by supporting the decrease in the kinesiophobia. Because in the literature, especially inhibitory factors in exercise benefit/barrier perception are listed as physical (Joint pain, muscle weakness) and environmental characteristics (distance of gyms, extreme hot/cold weather, long working hours, family responsibilities), health status of the individual (chronic diseases, acute health problems, psychological factors, fear of pain) and personal reasons (lack of motivation, low self-efficacy, lack of social support, cultural factors) [36, 37]. In other words, 'joint pain', which is one of the physical reasons that would prevent exercise in our study, may have been reduced by regular exercise. Environmental reasons such as 'distance to gyms' and 'extreme hot/cold weather' were eliminated by the home exercise programme. We think that doing the exercise at the time of the person's choice (convenient) did not prevent him/her from fulfilling his/her family responsibilities. we did not include those who had a chronic disease or acute health problem that could prevent exercise in terms of participation in the home exercise programme. finally, regarding the lack of motivation, which is one of the personal reasons, we can say that the decrease in pain as a counter effect.

Prevention strategies should be developed to prevent the development of kinesiophobia in people with NLBP [38]. We believe that this can be achieved by explaining the principles of protection of spinal health to the patients and an exercise program that the patients can adapt to and perform without difficulty. Because it should be kept in mind that the development of kinesiophobia may also affect the perception of exercise and prolong inactivity and lead to the observation of other comorbidities exercise [39]. Exercise in low back pain is beneficial in performing movements in a rapid and coordinated manner. Therefore, it positively affects movement perception and reduces the risk of injury during exercise [40]. Since kinesiophobia affects mobility in individuals with low back pain, obstacles that may affect patients' compliance with the treatment program should be frequently evaluated and mobilization and therapeutic exercises should be recommended before kinesiophobia occurs. Wood et al. (2023) reported in their randomized controlled trial that the improvements achieved in chronic low back pain were partially explained by reductions in pain catastrophizing and kinesiophobia (fear of movement). Our findings are consistent with these results. This situation highlights the importance of integrating approaches such as education or psychological support targeting patients' fears and negative beliefs into exercise programs for the treatment of chronic low back pain [41].

One of the reasons why exercise perception did not change as a result of the study may be that exercise perception was assessed only with a patient-reported outcomes and the participants' perceptions were not questioned in depth [42]. In addition, since our study is a short-term study of four weeks, longer motivational interviews may be required to change exercise perception [43]. Cultural beliefs of the individuals may also be the reason for the lack of change in exercise perception. At the beginning of the study, it was seen that the high pain level in the exercise group had a limited effect on kinesiophobia. Kinesiophobia is associated with fear of pain rather than pain intensity [44]. This is explained by the fear-avoidance model of chronic pain. Therefore, high pain values may not directly explain kinesiophobia. This may explain the reason for the limited effect. In terms of methodological improvement of the study, in-depth examination of exercise perception (e.g. semi-structured interviews), long-term follow-up (6–12 months follow-up), motivational strategies (cognitive behavioural therapy) can be applied. Pain education (pain neuroscience education) and graded exposure techniques can be used to reduce kinesiophobia in clinical practice. Furthermore, to positively change patients' perception of exercise, education should be provided during the initial evaluation to explain that movement is safe and that exercise is beneficial, rather than harmful. Physiotherapists should actively assess each patient's specific beliefs, fears, and misconceptions. Addressing these issues through tailored education and cognitive restructuring can lead to improved adherence, reduced fear, and better rehabilitation outcomes.

Decreased flexibility in the lower back and lower extremities may lead to mechanical loading, decreased mobility, poor posture and low back pain. Exercise therapy in the

treatment of low back pain may help to reduce pain and improve general function due to reduced stress on the spine [25, 45–48]. In our study, core strengthening and flexibility exercises that we applied to our patients with low back pain significantly improved the pain level compared to the other group. Dysfunction of multifidus, transversus abdominis and gluteus maximus muscles with decreased lumbar and lower extremity flexibility in chronic low back pain is remarkable [49]. As a result of this effective exercise program applied in accordance with the literature, we think that the load on the waist is mechanically supported and therefore it is effective in reducing pain.

As an innovative aspect of our study, we can say that a four-week home exercise program can positively change the perception of exercise and reduce the kinesiophobia.

When we look at the strengths of the study, the study provides a holistic approach by examining not only physical parameters (trunk flexion flexibility) but also psychological factors (kinesiophobia, exercise perception). This makes an important contribution to understanding both the physical and mental effects of treatment. The study found that exercise perception was not affected by treatment. This result suggests that patients' preconceptions towards exercise take time to change or require longer-term interventions. This finding may contribute to the formulation of new hypotheses for future research. By comparing between different groups, the study clearly demonstrated the effectiveness and limitations of the intervention.

The limitation of our study is that the long-term follow-up of the groups was not performed, preventing us from determining whether the positive change in exercise benefit/barrier perception and kinesiophobia is permanent or temporary. Additionally, the fact that current exercise routines were not assessed at baseline could have potentially affected the homogeneity between groups. Due to various constraints, data were collected from 65 participants instead of the initially planned 123. This reduction may have lowered statistical power, potentially limiting the detection of small to medium effects. The limited sample size also restricts generalizability. Thus, findings should be interpreted cautiously and validated in future studies with larger samples. One limitation of this study is that adherence to home exercises was assessed only by patient self-reports. In future studies, the use of objective measures such as wearable activity trackers or video recordings will improve data reliability.

The findings of this study are consistent with the literature in terms of physical improvement and kinesiophobia, but the lack of change in exercise perception is a contrary result. This inconsistency may be explained by measurement methods, intervention duration or psychological factors. Qualitative approaches and long-term follow-up are recommended for future studies. Additionally, in future studies, we recommend that the participants' psychological moods, professional lives (occupational characteristics, job stress, working hours, economic factors) and social roles be analyzed in detail.

Clinical massages

- A home exercise program of at least four weeks can positively change the perception of exercise and kinesiophobia.
- Long-term follow-up can help determine whether improvements have been sustained over time.
- In addition, a detailed analysis of psychological status, professional life and social roles can guide the development of individualised intervention strategies to support the long-term maintenance of positive clinical outcomes (e.g. increased flexibility, reduction in kinesiophobia) after treatment.

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Author contributions M.A.D. did the evaluation and follow-up of the patients. B.Ö. obtained ethics committee approval and undertook the writing and publication process of the study. F.S. performed the examination of the patients in the study.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Conflict of Interest The authors declare no competing interests.

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