Pain Management Nursing 26 (2025) e448–e455

Contents lists available at ScienceDirect

Pain Management Nursing

journal homepage: www.painmanagementnursing.org

Original Research

Effects of External and Internal Focus of Attention Exercises in Chronic Low Back Pain: A Randomized Controlled Trial☆

Şafak Kuzu, P.T., Ph.D.[*,1], Anıl Özüdoğru, P.T., Ph.D.[*], Figen Tuncay, M.D., Ph.D.[†]

[*] School of Physical Therapy and Rehabilitation, Kırşehir Ahi Evran University, Kırşehir, Turkey
[†] Department of Physical Medicine and Rehabilitation Faculty of Medicine, Kırşehir Ahi Evran University, Kırşehir, Turkey

ARTICLE INFO

Article history:
Received 15 October 2024
Received in revised form 13 January 2025
Accepted 13 February 2025

Keywords:
External focus
Internal focus
Low back pain
Balance
Physical performance

ABSTRACT

Aim: Balance, physical performance, and functional parameters are adversely affected in individuals with chronic low back pain (CLBP). The focus of attention can affect balance and performance. Our aim is to compare the effects of focus of attention instructions given to dynamic balance exercises on balance, physical performance, and functional status in individuals with CLBP.
Design: A randomized controlled trial.
Methods: Of 53 individuals with CLBP, 44 individuals who met the inclusion criteria were divided into two groups: the external focus group (EFG) and the internal focus group (IFG). Traditional physiotherapy methods and dynamic balance exercises were applied to both groups. External focus (EF) instructions were given to the EFG, and internal focus (IF) instructions were given to the IFG during the dynamic balance exercises. Participants before and after the treatment were evaluated for pain, functional level, balance, physical performance, and posture.
Results: The results of the study showed greater improvement in EFG on dynamic balance, fall risk, stability limits, physical performance, posture, spinal mobility, and postural endurance ($p < .05$).
Conclusions: This study showed that external focusing was more effective than internal focusing on balance, performance, and posture in individuals with CLBP.

Key practice points

- The effects of dynamic balance exercises performed with external and internal attention focus instructions were compared on individuals with chronic low back pain. The effects were compared on physical performance, balance, fall risk, limit of stabilization, function, pain, posture and spinal mobility.
- Externally focused exercises were found to be more effective than internally focused exercises on function, balance, fall risk, limit of stabilization, and postural competence.

Introduction

Chronic low back pain (CLBP) is one of the most common disorders that results in functional loss in activities of daily living (Itz et al., 2013). In individuals with CLBP, problems are seen in the activation time and coordination of the muscles responsible for the stabilization of the trunk, as a result, the trunk muscles weaken. According to a systematic review, sensorimotor control is more impaired in CLBP patients than in healthy individuals (Tong et al., 2017). When sensorimotor control is impaired, the pain mechanism becomes chronic, and neuromuscular adaptations develop. These neuromuscular adaptations change the postural control strategies with the decrease in motor responses and cause the balance and performance of the person to be affected in daily living activities (Tsigkanos et al., 2016). Balance training is used in the therapeutic treatment of low back pain because postural control and balance disorders accompany low back pain. Balance training requires motor response at the brainstem level. Postural control, which is impaired due to CLBP, needs to be restructured and used with automatic reactions. For this purpose, it can be transformed into an automatic motor reaction by teaching

☆ **Trial Registration:** This clinical trial was registered at http://clinicaltrials.gov (registration number: NCT05722457).

[1] Address correspondence to: Şafak Kuzu, P.T., Ph.D., School of Physical Therapy and Rehabilitation, Kırşehir Ahi Evran University, Bagbasi Mah., Sehit Necdet Yagiz Street No. 143, 40100 Kırşehir, Turkey.
E-mail address: safak.yumusak@gmail.com (Ş. Kuzu).

https://doi.org/10.1016/j.pmn.2025.02.011
1524-9042/

correct movement by using attention-focus. Studies on balance-related attention-focus have shown that it may affect motor control (Chiviacowsky et al., 2010; McNevin & Wulf, 2002; Wulf & McNevin, 2003; Wulf et al., 2004). The focus of attention refers to the place where a person pays attention while performing a certain movement (Wulf et al., 1998; McNevin et al., 2003b). Focusing on the inside of the body while performing a movement is called "internal focus" (IF) while focusing on the outside of the body (e.g., the environment) is called "external focus" (EF). By promoting automatic motor control, EF provides muscle activation that is more sensitive to perturbation with the effective operation of reflex responses (McNevin & Wulf, 2002; Wulf, McNevin, et al., 2001; Wulf et al., 2003). The focus of attention is a situation that involves the psychological complexity of movement. It aims to manage the automatic and cognitive control processes of movement during exercise. Movement is efficient if it occurs at the correct speed, direction, and oscillation. When efficient movement becomes a habit through repetition, cognitive load decreases (Haith & Krakauer, 2018; Pacherie & Mylopoulos, 2021). EF was found to be superior to IF in increasing motor learning and motor performance in these ways (Calatayud et al., 2016; Park et al., 2015; Wulf, 2013; Wulf et al., 1998). Wulf et al. (1998) attribute this to the constrained action hypothesis. According to the constrained action hypothesis, when IF is used, automatic control processes that would normally regulate movement are constrained or may interfere with motor coordination. However, an EF is thought to allow the motor system to self-organize in a more natural way. Herrebrøden, on the other hand, argues that, unlike the limited action hypothesis, focus should be task-oriented. He thinks that EF or IF can be more effective not in all tasks, but rather in the harmony of task-related information (Herrebrøden, 2023). In some studies conducted in sports such as dance, gymnastics, and diving, the superiority of EF was not observed. IF has been shown to be effective in improving performance in activities with high power production and number of repetitions, such as rowing (Maurer & Munzert, 2013; Neumann et al., 2020).

The effects of attention-focus on balance control, performance, and motor learning have been investigated in healthy individuals, geriatric individuals, and special populations such as patients with neuromuscular and neurological disorders (Chiviacowsky et al., 2010; Laufer et al., 2007; Wulf et al., 2009). There is no study in the literature that compares the effects of externally and internally focused balance exercises on individuals with CLBP. Our aim is to compare the effects of attention-focus on pain, balance, and physical performance by applying EF and IF instructions in balance exercises.

Materials and Methods

Study Design

This study was designed as a single-blind randomized controlled study. It was divided into two: external focus group (EFG) and internal focus group (IFG). Evaluations before and after treatment were made by an evaluator who was not familiar with the groups. The randomization process of the groups was applied according to the order of the numbers using the Research Randomizer program on the www.randomizer.org website (https://www.randomizer.org/.).

Participants

In the study, 53 patients who were admitted to a hospital and diagnosed with CLBP were evaluated. The study was conducted with 44 patients who voluntarily participated in the study and met the inclusion criteria. Participants were randomly divided into two groups: EFG ($n = 22$) and IFG ($n = 22$). Inclusion criteria included having low back pain for at least 3 months, being between 18 and 65 years of age, having a visual analog scale (VAS) level of 3 or higher, and volunteering to participate in the study. Exclusion criteria were having an orthopedic neurological condition in the spine, having radicular or referred leg pain in addition to low back pain, having a musculoskeletal injury in the last year, having been treated for low back pain in the last 3 months, having regular sports activities in the last 3 months, and having poor cooperation.

Sample Size

In the study, the study of Mohammad Hosseinifar et al., which investigated the effects of stabilization training on balance in low back pain, was taken as a reference in determining the sample size (Hosseinifar et al., 2009). In the analysis performed with G*Power Software (Version 3.1.9.2, Düsseldorf University, Düsseldorf, Germany), it was determined that a total of 38 individuals, 19 individuals in each group, should be included in the 95% confidence interval and 80% power. Due to the 15% drop-out risk, a total of 44 people, 22 for each group, were included in the study.

Randomization

The randomization process of the groups was applied according to the order of the numbers using the Research Randomizer program on the www.randomizer.org website (https://www.randomizer.org/.).

Outcome Measurements

Demographic characteristics of participants

Before starting the study, demographic information such as age, height, weight, body mass index (BMI), and gender of the participants was recorded.

Pain assessment

The VAS was used to determine the presence and severity of low back pain in the participants participating in the study. VAS is a practical test with high validity and reliability in pain assessment. The VAS is numbered from 0 to 10, with "0" denoting no pain and "10" an assessment method denoting the presence of the most severe pain. Participants were asked to mark the degree of pain they had on this scale, and it was recorded (Reed & Van Nostran, 2014).

Functional level

Oswestry Disability Index (ODI) is a questionnaire developed in 1980 to assess the level of disability in individuals with low back pain (Roland & Fairbank, 2000). The Turkish version of the questionnaire was found to be valid and reliable in patients with low back pain by Yakut et al. (2004). The questionnaire consists of 10 questions assessing activities of daily living such as pain intensity, self-care, weight lifting, walking, sitting, standing, sleeping, social life, and travel information. Each question is scored between 0 and 5 on a Likert scale. The total score obtained is calculated as a percentage. An increase in the score obtained from the questionnaire indicates an increase in disability (Yakut et al., 2004).

The physical performance level

The physical performance test battery (PPTB) was used to determine the physical performance level. To evaluate the physical performance of individuals with low back pain, Novy et al. (1999) used this battery, which contains tests similar to activities of daily living. Battery: It consists of lumbar flexion range of motion, walking 50 steps, walking for 5 min, sitting and standing with 5 repetitions, trunk flexion with 10 repetitions, and reaching forward with weight (Özüdoğru et al., 2023).

Balance

The Biodex stability system (Biodex Medical System Inc., NY, USA, Model SW4530DE6N, SD 950304) was used to assess static and dynamic balance, fall risk, and the limit of stability (Arifin et al., 2014). This device creates stability indices by evaluating movements in the overall, anterior-posterior, and medial-lateral directions. Its validity and reliability in this area have been established (Pickerill & Harter, 2011). In the “Limit of Stability” test, there are 9 balls on the screen of the device, 1 in the middle and 8 on the sides. When these balls are burned, the person should move the center of gravity to the burning ball and keep it here for 0.25 s. The test is applied three times, and the deflating time of all balls is recorded by the device. The dynamic balance test is used for fall risk assessment. It consists of 3 tests lasting 20 s. The dynamic level is in the range 6-3 (Arnold & Schmitz, 1998; Hosseinifar et al., 2009).

Assessment of posture, spinal mobility, and postural endurance

Spinal posture, spinal mobility, and postural competence were measured with a computer-assisted wireless Spinal Mouse device (the Spinal Mouse System, Idiag, Fehraltorf, Switzerland). By moving the Spinal Mouse device on the spine with its wheel, it measures the length of the spine, posture, and joint movements and transfers this sequence to the computer environment. Trunk flexion posture was recorded for spinal mobility. Upright posture was measured for the postural endurance (competence) values, and then, after holding a weight of 5% of the person’s body weight between the hands parallel to the shoulder level for 30 s, the upright posture was re-measured while the weight was still in the person’s hand (Mannion et al., 2004).

Interventions

All of the participants received a total of 24 sessions of treatment, 2 days a week, for 8 weeks. Each session consists of 60 min of training, including 5 min of warm-up and 5 min of cool-down exercises. Warm agents (a hot pack for 10 min) and conventional transcutaneous electrical nerve stimulation (TENS for 10 min, 50-100 Hz, pulse duration 150 s) were applied to both groups throughout the treatment period. Spinal mobility, lumbopelvic stabilization exercises, and dynamic balance exercises were applied to both groups. Different attentional focus instructions were given to the groups during dynamic balance exercises. EF instructions were given to EFG during balance exercises. IF instructions were given to IFG during balance exercises. First-level exercises 1-3 weeks, second-level exercises 4-5 weeks, and third-level exercises 6-8 weeks. The dynamic balance exercise program is shown in the Supplementary File and, Figure 1 (Supplementary 1).

EF Group

Tens-Hotpack, warm-up-cooling exercises, spinal mobilization, and lumbopelvic stabilization exercises, dynamic balance exercises, and EF instructions.

IF Group

Tens-Hotpack, warm-up-cooling exercises, spinal mobilization, and lumbopelvic stabilization exercises, dynamic balance exercises, and IF instructions.

Statistical Methods

The IBM SPSS version 23 statistical package program was used to analyze the data. The conformity of the variables to the normal distribution was evaluated with the help of visual and analytical methods. Shapiro-Wilk and Kolmogorov-Smirnov tests from analytical methods were used. Mean and standard deviation values were given in descriptive analyses, and numbers and percentages were given in nominal variables. Independent sample t-test was used to compare the pretreatment values and evaluate the differences between the groups in the study. Chi-square test was used for categorical variables (gender). Two-way mixed design repeated measures ANOVA was used to examine the changes in the 2 group data over time and the group × time interaction. The effect size was recorded as 0.10: small effect, 0.25: medium effect, and 0.40: large effect (Maher et al., 2013). The level of statistical significance was evaluated as $p < .05$.

Results

53 patients who volunteered to participate in the study were evaluated. Five patients were excluded because they did not meet the inclusion criteria. The treatment process started with 48 people. Four of the patients could not complete the treatment process and left the study. The study was completed with a total of 44 patients, 22 of whom were in both groups. The working flow chart is shown in Figure 2.

The demographic and physical characteristics of the individuals participating in the research are given in Table 1. There was no statistically significant difference between the groups in terms of demographic and physical characteristics ($p > .05$). There was no statistically significant difference in pain, functional level, balance, PPTB, or posture values between the groups before treatment ($p > .05$).

The values of VAS, ODI, static and dynamic balance, limit of stability, fall risk, PPTB, and posture before and after treatment are given in Table 2. Significant improvement was observed in all parameters after the treatment except posture ($p < .05$). Considering the changes after treatment, there was no difference between the groups in VAS rest, VAS activity, ODI, static balance values, (PPTB) five sit-stand test ($p > .05$). According to the post-treatment changes, there was a statistically significant difference between the groups in dynamic balance overall, balance dynamic AP, stability limit, fall risk, PPTB, posture, spinal mobility, and postural competence values in favor of EF ($p < .05$).

Discussion

Working on the perception of pain, Sharpe et al. (2010) stated that attention training was effective in increasing the pain threshold, but the intensity of pain was not affected. Looking at the literature, Zamani et al. (2022) who provided a focus on attention training in conservative treatment of low back pain, investigated the effects of EF training on pain in patients with recurrent low back pain. They added motor control training to one group and EF exercises in addition to motor control training to the other group. They found the reduction in pain intensity to be superior in the EF group compared to the other group. Pouradeli et al. (2021) investigated the effects of exercises performed with attention-focused instructions on balance and pain in elderly male patients with knee osteoarthritis. While both focuses were effective in reducing the level of pain, no difference was observed between them. In this study, the effect of focus of attention on the reduction of pain level was found to be similar. It was seen that traditional pain-reducing

Figure 1. Treatment balance exercise.

Table 1
Comparison of Demographic Information and Physical Characteristics of the Groups.

		EFG ($n = 22$) $X \pm SD$		IFG ($n = 22$) $X \pm SD$		t	p
Age (years)		47.55 ± 14.097		48.64 ± 11.069		−0.285	.777
BMI (kg/m^2)		27.42 ± 4.19		27.72 ± 3.37		−0.257	.768
		n	(%)	n	(%)	X^2	p^1
	Female	12	54.5	11	50		
Gender	**Male**	10	45.5	11	50	0.091	.763

EFG = external focus group; IFG = internal focus group; BMI = body mass index; t = Student t test; p^1: Chi-square analysis X^2 = Coefficient of Chi-square analysis; X = mean; SD = standard deviation.

physiotherapy methods and balance exercises that we applied were effective in reducing pain.

Zamani et al. (2022) investigated the effects of EO training on the functional level in patients with recurrent low back pain. They stated that functional level improvements were similar in the EO and control groups. In a review study examining the effects of the focus of attention on musculoskeletal injuries, it was stated that there was no difference in functional level between the focus of attention groups (Sturmberg et al., 2013). In this study, in accordance with the previous literature, improvement was observed in both groups after the treatment, but there was no difference between the groups at the functional level.

In the first experiment examining the effect of attention-focus instructions on balance, Wulf et al. (1998) examined balance times in healthy individuals using a ski simulator and EF and IF instructions. They stated that the EF group was superior at balancing. Afterward, many researchers contributed to this issue with soft ground, dynamic balance, and suprapostural tasks in different populations and obtain findings similar to the first experiment in the direction of EF (Laufer et al., 2007; McNevin & Wulf, 2002; Rotem-Lehrer & Laufer, 2007). Examining the effect of focusing attention on gaining and maintaining postural control after an ankle sprain, Laufer et al. (2007) worked with two groups by giving IF and EF instructions during dynamic balance training. As in our study, the dynamic balance assessment of the platform was used, and they stated that there was improvement in dynamic total and dynamic anterior-posterior parameters in both groups and that the improvement in the EF group was superior. In a study, they examined the effects of EF and IF exercises applied to knee osteoarthritis on balance and pain. While improvement was observed in both groups in terms of dynamic and static balance, there was no difference between the groups (Pouradeli et al., 2021). de Bruin et al. (2009) examined the effect of focusing attention on balance in elderly individuals. They applied EF and IF instructions during dynamic balance training for 5 weeks. As a result, while there was a significant improvement in dynamic balance, stability limits, and fall risk values in the IF and EF groups after treatment, there was no difference between the groups. In our current results, we found that EF instructions are more effective than IF instructions on dynamic balance, stability limits, and fall risk, consistent with the literature.

Balance training requires motor control at the brainstem level. Controlling appropriate movement requires reflexive responses at

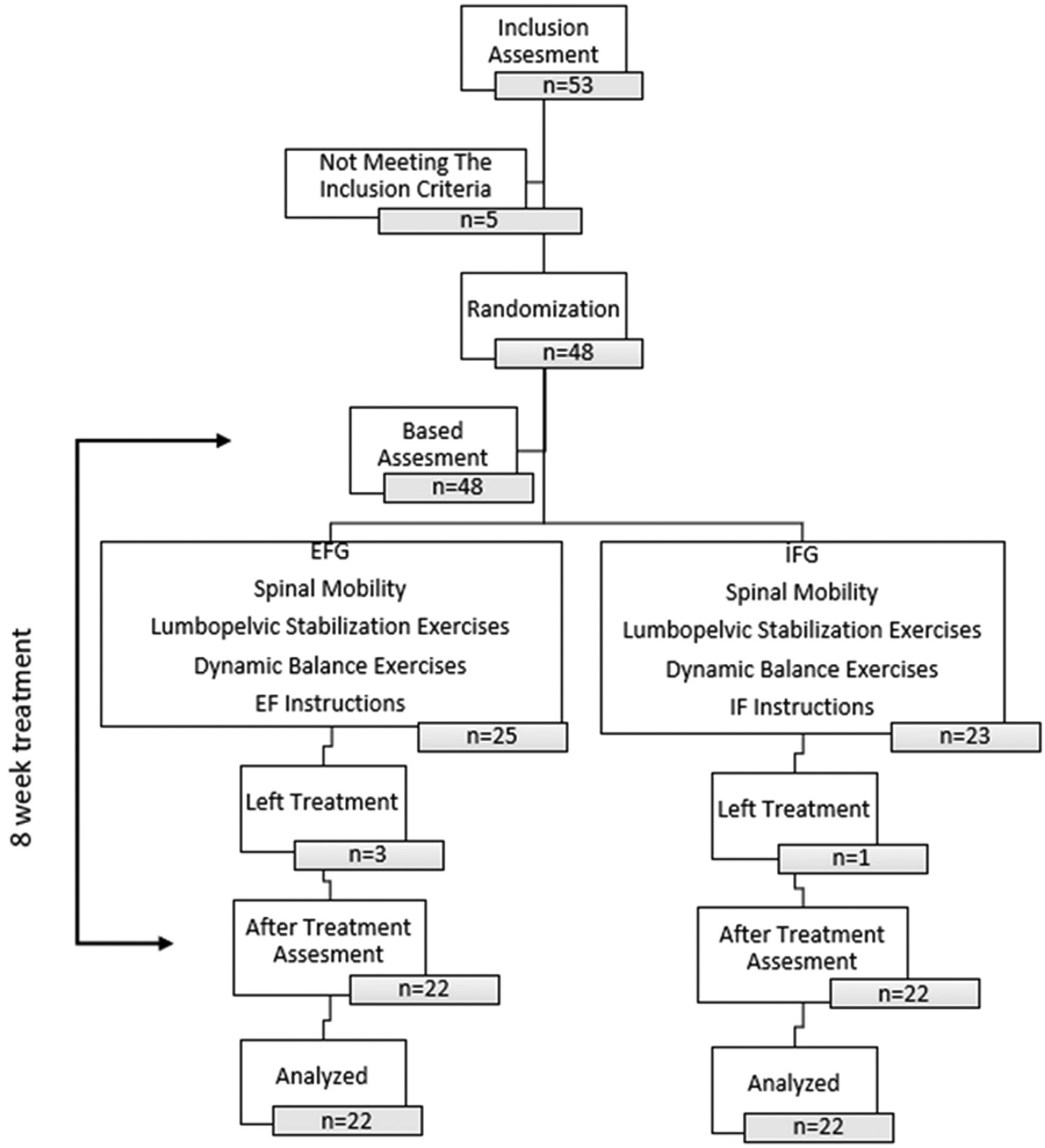

Figure 2. Study flow chart.

the spinal cord level, positional responses at the brainstem level, and automatic balance and conscious responses at the cortex level (Rozzi et al., 1999). As expressed in the restricted movement hypothesis, EF activates reflexive responses, while IF directs them to conscious control. Automatic motor control is affected as a result of neuromuscular adaptations that occur with impaired sensorimotor control in CLBP. At this point, based on the restricted movement hypothesis, it contributes to the creation of automatic reflexive responses without conscious intervention in the motor control process of the person with EF instructions. Previous studies suggests that when people use an IF, they may restrict the automatic control processes that would normally regulate movement or interfere with motor coordination, whereas an EF allows the motor system to self-organize in a more natural way (Wulf, McNevin, et al., 2001). Since conscious intervention in motor coordination increases with IF, movement requires more attention, and activities that require more attention develop more slowly. With EF, reflex responses suitable for perturbation and speed positively affect motor performance and balance in movement. According to studies, EF has been shown to be more effective than IF in the development of a movement's performance and balance ability (McNevin et al., 2003a,b; Wulf et al., 2009; Wulf & McNevin, 2003; Wulf, Shea, et al., 2001).

When the literature is examined, there are studies examining the effects of focus of attention on different sports activities, muscle tests, and disease-specific performance values, but there is no study examining the effects of focus of attention exercises on the physical performance of individuals with CLBP (Bredin et al., 2013; Halperin et al., 2016; Nadzalan et al., 2019). In a review study on musculoskeletal disorders, they stated that EF instructions had a superior and permanent effect on motor performance and motor learning compared to IF instructions (Hunt et al., 2017). One of the important parameters of physical performance is the number of repetitions and the speed of movement. In studies examining

Table 2
Comparison of All Values Between Groups.

		EFG (n = 22)			IFG (n = 22)			Time	Group × Time	
		BA	ATA	p^a		TS	p^a	p^b	F/p^b	η^2
Pain	**VAS rest**	4.63 ± 1.83	1.22 ± 1.26	<.001*	4.59 ± 1.40	1.36 ± 1.39	<.001**	<.001**	0.215/0.646	0.05
	VAS activity	7.63 ± 1.49	2.36 ± 1.49	<.001**	7.04 ± 1.04	2.45 ± 1.05	<.001**	<.001**	2.91/0.950	0.65
FS	**ODI**	32.72 ± 9.24	18.86 ± 8.10	<.001	37.13 ± 11.09	25.54 ± 8.41	<.001**	<.001**	0.215/0.646	0.05
Balance	**St-Overall**	1.73 ± 1.01	1.09 ± 0.70	.001*	2.43 ± 0.51	1.43 ± 0.65	.002*	<.001**	3.08/0.86	0.68
	Statik A-P	1.18 ± 0.92	0.66 ± 0.45	.001*	1.85 ± 0.83	1.49 ± 0.66	.043*	<.001**	4.65/0.37	0.10
	Statik M-L	1.04 ± 0.63	0.71 ± 0.57	.002*	1.22 ± 0.72	1.04 ± 0.56	.020*	<.001**	0.761/0.388	0.18
	Din-Overall	2.01 ± 0.84	1.44 ± 0.63	<.001**	1.20 ± 074	0.99 ± 0.54	.005*	<.001**	4.535/**0.039***	0.097
	Dinamik A-P	1.45 ± 0.54	1.07 ± 0.47	<.001**	1.52 ± 0.55	1.37 ± 0.48	.013*	<.001**	6.263/**0.016***	0.130
	Dinamik M-L	1.24 ± 0.81	0.93 ± 0.64	.001*	1.12 ± 0.52	1.01 ± 0.37	.026*	.002	2.518/0.120	0.57
	SST	24.63 ± 5.77	36.45 ± 10.45	<.001**	22.45 ± 4.28	29.63 ± 4.99	<.001**	<.001**	6.031/**0.018***	0.126
	Fall Risk	1.82 ± 0.67	1.20 ± 0.49	<.001**	1.96 ± 0.59	1.62 ± 0.39	<.001**	<.001**	5.732/**0.021***	0.120
Physical Performance	**LF-ROM**	71.13 ± 16.15	83.68 ± 10.48	<.001**	70.90 ± 9.1	78.86 ± 7.6	<.001**	<.001**	4.49/**0.041***	0.096
	50/step	28.97 ± 4.97	25.87 ± 4.29	<.001**	30.88 ± 3.56	29.34 ± 3.32	<.001**	<.001**	5.18/**0.028***	0.110
	5 min. W	419.91 ± 75.18	474.38 ± 95.71	<.001**	382.49 ± 60.01	383.17 ± 63.77	<.001**	<.001**	7.43/**0.009***	0.150
	5 STS	18.46 ± 5.10	13.46 ± 3.73	.001*	22.39 ± 9.77	19.02 ± 7.08	.003*	<.001**	1.61/0.211	0.037
	10 Fleks	26.94 ± 8.12	20.74 ± 4.95	.002*	27.70 ± 9.24	24.46 ± 6.83	<.001**	<.001**	5.35/**0.026***	0.113
	RFW	20.40 ± 8.79	26.12 ± 7.10	<.004*	20.59 ± 9.76	23.67 ± 8.8	<.001**	<.001**	6.91/**0.012***	0.141
Posture	**Posture**	25.40 ± 5.15	30.50 ± 7.94	<.001**	24.18 ± 4.86	24.45 ± 4.72	.618	.001**	14.22/**0.001***	0.25
	Mobility	21.27 ± 5.26	30.90 ± 5.78	<.001**	20.40 ± 7.48	23.58 ± 5.54	<.001	<.001**	14.02/**0.001***	0.250
	P. competence	21.59 ± 11.3	33.40 ± 14.91	<.001**	22.13 ± 6.08	24.77 ± 6.55	<.001**	<.001**	15.46/**0.000****	0.269

EFG = external focus group; IFG = internal focus group; BA = baseline assessment; ATA = after treatment assessment; VAS = visual analog scale; FS = functional status; LF-ROM = Lumbal Fleksion Range of Motion; 50/step = 50 step walk test; 5 min W = 5 min walk; 5 STS = 5 sit to stand; 10 Fleks = 10 repat lumbal fleksion test; RFW = reaching forward with weight; p^a: paired sample t test; p^b: 2-way mixed design repeated-measures analysis of variance; SD = standard deviation; η^2 = effect size; bold and *: p< 0.05; **: p<0.001.

motion analysis, the effects of IF and EF were investigated. It has been found that the number and speed of repetitions of the movement are higher with an EF compared to an IF (McNevin et al., 2003a,b; Wulf, McNevin, et al., 2001). Higher repetitions require faster reflex cycles and more automatic functional task execution (Vereijken et al., 1992). While the movement slows down due to conscious control in IF instructions, it accelerates in EF due to reflex mechanisms. The superiority of the EF group in the evaluation tests for the number of repetitions (10-repetition trunk flexion test, 50-step walking test) we used to determine physical performance may have been improved by the automatic reflex control mechanism of EF.

Muscle strength and endurance are important for physical performance. Vance et al. (2004) evaluated the biceps and triceps muscles with EMG by applying IF and EF instructions. As a result, they stated that EF reduced muscle activation, which would contribute to the quality of movement. Decreased muscle activity is also beneficial in activities that require endurance, where the level of physical activity must be sustained over a period of time (Zachry et al., 2005). There are studies that underline important improvements in EF conditions in studies examining muscle strength and endurance with physical performance tests (Bredin et al., 2013; Halperin et al., 2016; Nadzalan et al., 2019). In a study examining the effects of focusing attention on health-related physical performance in healthy individuals was observed that the EF group significantly better in physical performance than the IF group (Bredin et al., 2013). Cavaggioni et al. (2022) emphasized that IF and EF-instructed exercises made significant improvements in the functional performance of the EF group compared to the IF group in obese individuals. This study is in parallel with ours due to similar performance tests and focus applications in addition to the treatment program and study results. In the exercises we apply by creating EF, we can create permanent functional movement behaviors that fully adapt to the life experiences of the patients by developing neurocognitive participation in the motor learning process and placing the right movement. In the modeling of motor learning to which EF contributes, the creation and placement of the movement and the increase of reflex automatic control can increase physical performance.

There is a relationship between posture, and spinal mobility and postural endurance in individuals with CLBP (Kripa & Kaur, 2021). Bredin et al. (2013) found that EF instructions were superior to IF instructions in tests in which they evaluated spinal mobility in healthy individuals. Bourdon et al. (2018) examined the effects of focus-of-attention exercises on repetitive trunk flexion movements in individuals with low back pain. They stated that creating an EF of attention had no effect on trunk mobility during movement. According to the results of our current study, the EF group was found to be superior to the IF group in improvements in posture, spinal mobility, and postural endurance. We can attribute this situation to the management of postural tasks through automatic functional tasks, such as balance performance. When we focus on our body to change our posture, we create conscious posture control with the IF effect. When consciously applied motor control is combined with other activities, coordination, and timing disorders occur. Consciously corrected posture is lost during other functions. The smooth postural activity generated through the exercises is sustained by the activation of automatic reflex control by the EF exercises.

Limitations

The limitation of this study is that since the study was planned for 8 weeks, pain and functional level decreased effectively in both groups. It was not seen which group's pain level decreased earlier. The study was planned for three groups, but the same exercises can be applied to a third group by adding a control group without focus instruction. The presence of the third group may provide more evidence of the effectiveness of the focus of attention. Patients' perception and implementation of attention-focus instructions cannot be controlled.

Conclusions

This is the first study to compare the conditions of focusing attention during balance exercises in individuals with CLBP. In this study in which we applied balance exercise with focus of attention instructions in patients with CLBP, EF of attention was found to be superior to IF of attention in improving dynamic balance, fall risk, stability limit, physical performance, posture, spinal mobility, and postural competence values. On the other hand, the effects of balance exercises with EF and IF instructions were similar in terms of pain, functional level, and static balance parameters. We think that exercises with an EF of attention contribute to the reflex placement of the corrected neuromuscular control. It makes an important contribution to improving physical performance, balance, and posture in the treatment of people with CLBP. We think that exercises that focus external attention on the treatment program of individuals with CLBP may increase the effectiveness of the treatment. Pain management in CLBP is an issue frequently addressed by multidisciplinary health professionals (physiotherapists, rehabilitation nurses, occupational therapists, etc.). This study will guide researchers and clinicians on how IF and EF instructions can be used in pain and function management in CLBP.

Ethics Approval and Consent to Participate

The ethics committee approval of the study was approved by Kırşehir Ahi Evran University Scientific Research and Publication Ethics Committee (No: 2022-18/163). Written informed consent was obtained from all patients who were given detailed information about the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Funding

No funding was obtained for this study.

Declaration of competing interest

The authors declare no conflict of interest.

CRediT authorship contribution statement

Şafak Kuzu: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Anıl Özüdoğru:** Writing – review & editing, Writing – original draft, Supervision, Software, Methodology. **Figen Tuncay:** Writing – review & editing, Writing – original draft, Software, Resources, Conceptualization.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.pmn.2025.02.011.

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