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Effect of global postural reeducation on chronic low pain patients with lower cross syndrome

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Abstract

Background Today, low back pain is a serious global health issue. Currently, 85% of low back pain is caused by muscular imbalance and is a result of Lower cross syndrome (LCS), which are chronic postural defects. The physical therapy techniqueknown as Global Postural Re-education (GPR) was created in France and is based on the concept that muscle chains make up the entire muscular system.

Aim The purpose of this study was to investigate the effect of global postural re-education on low back pain patients with lower cross syndrome.

Design Prospective pre and post-test, single-blind randomized controlled trial.

Setting Outpatient physio therapy clinic at Damanhur teaching hospital.

Population Fifty participants (25 to 40 years old) suffer from low back pain with lower cross syndrome.

Methods Participants were randomly assigned to two equal groups: global posture re-education approach and conventional physiotherapy was given to study group "A" and conventional physiotherapy was given to control group "B" throughout the courseof 15 treatment sessions, twice sessions weekly. The patients' pre- and post-treatment progress was assessed using the clinometer digital smartphone application to measure anterior pelvic tilting, flexible ruler to measure lumbar lordosis, Modified Thomas test to measure hip flexor flexibility, Visual analogue scale (VAS) to measure pain and Oswestry Low Back Pain Disability Questionnaire Arabic version to measure function disability.

Results Comparing the study group and the control group after treatment showed that the study group had a significantly lower anterior pelvic tilting ($P = 0.001$), lower lumbar lordosis ($p = 0{,}024$), higher flexibility of hip flexor muscle ($p = 0{,}001$), lower VAS ($p = 0{,}001$) and improving in function disability ($p = 0{,}001$) compared to the control group.

Conclusion Adding a Global postural re-education approach is thought to be effective in treating low back pain patients with lower cross syndrome.

Clinical Rehabilitation Impact Global postural re-education approach decreases anterior pelvic tilting angle, lumbar lordotic angle, pain, and disability caused by low back pain and increase hip flexor flexibility.

Keywords Global postural re-education, low back pain, lower cross syndrome

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Introduction

One of the most frequent reasons for individuals to seek medical care in both primary care settings and emergency rooms is back pain [1]. Low back pain (LBP) is not considered to be an illness, but rather a symptom. The most typical type of "non-specific LBP" has mechanical causes as its primary factor, which accounts for 97% of cases. Nonspecific LBP is frequently characterized as a sensation of pain or discomfort persisting for a minimum duration of 1 day. This discomfort is localized in the posterior region of the body, extending from the inferior margin of the 12th rib to the lower gluteal folds [2].

Studies show that 30% of adolescents have LBP at least occasionally. LBP is particularly prevalent in adolescents, with a peak prevalence in the third decade of life, according to numerous studies [3]. According to Liebensons (2007), joint dysfunction, notably at the L4-L5 as well as L5-S1 segments of the spine, as well as tension on the lumbopelvic and abdominal muscles are associated with the lower cross syndrome, a specific type of muscle imbalance in the low back [4]. Lower cross syndrome (LCS), a condition characterized by long-term postural errors, accounts for 85% of low back pain [5].

The symptoms of LCS include weak abdominal and gluteal muscles crossed with tight hip flexors and lower back muscles [4]. The occurrence of LCS leads to an anterior pelvic tilt, increased lumbar lordosis, flexion of the hips, and hyperextension of the knees [6]. This condition is alternatively referred to as a distal or pelvic cross syndrome [7]. It is currently treated with physiotherapy, which includes postural training in which the patient is instructed to avoid any positions or actions that heighten lumbar lordosis [5], core stability exercise with kinesio taping [8], Brugger's exercise [9], stretching and strengthening exercise [5], and Pilate's exercises [10]. Treatment of lower crossed syndrome or lumbopelvic pain with a muscle energy approach is equally as effective as treatment with any other manual therapy approach [11].

A physical treatment method called global postural reeducation (GPR) was created in France. This technique is founded upon a comprehensive comprehension of the muscular system, which is made up of muscle chains that may shorten for causes related to the human constitution, behavior, and psychology. The goal of GPR is to correct the postural imbalance by utilizing the creep feature of viscoelastic tissue to elongate shortened muscles and enhance the muscular activity of the antagonist [12].

Two studies have been reported in the literature to demonstrate the benefits of GPR for patients with LBP. They demonstrated that GPR intervention led to a larger reduction in function disability and pain intensity in patients with persistent LBP [12, 13]. Additionally, recent systematic reviews and meta-analyses have shown that GPR intervention improved functional disability and pain perception in individuals with chronic nonspecific low back pain [13]. Up to the authors' knowledge, there is no available randomized control study investigating the effect of GPR on anterior pelvic tilt, lumbar lordosis, hip flexor flexibility, pain, and function in patients with LBP in LCS, so this trial was conducted to evaluate the effect of a GPR program as compared to standard treatment in patients with LBP in LCS.

Materials and methods

Sample size

Prior to the trial's start, the sample size was determined using G*Power (version 3.1.9.2). Calculation based on *F* test: repeated measures, between factors. Type I error rate set at 5% (alpha-level 0.05), type II error rate at 0.8, and the effect size = 0.38 of the main outcome variables (The Oswestry Low Back Pain Disability Questionnaire) obtained from previously published research [7]. The appropriate minimum sample size for this study was 42 subjects. To account for the drop-off, a 20% increase in the calculated sample size, so the study sample was 50 patients.

In order to allocate the participants into two groups in a random manner, a computer-generated randomization block was applied. The block sizes were four and eight to avoid bias and ensure a balance between groups. To ensure the concealment of the allocation, opaque sealed envelopes containing sequential numbers were utilized for storing the randomization codes. The blinded researcher, upon opening the opaque sealed envelope, administered the treatment. The blinded researcher, who did not participate in the data-collecting process, implemented a randomized procedure. The blinded researcher collected the data while remaining unaware of the allocation step. Lastly, the blinded researcher conducted data analysis and interpretation. Figure 1 depicts the flow chart for this research trial. Sixty participants were enrolled but 10 participants were excluded because they did not meet the inclusion criteria. Fifty participants were allocated randomly to two groups with 25 participants within each group. One participant lost to follow-up in both groups due to a busy schedule.

Participants

Prospective pre- and post-test single-blinded (assessor) parallel randomized controlled trial. This trial was conducted on 50 patients, of both genders, aged 25–40 from January 1, 2023, to June 10, 2023, in the physical therapy clinic at Damanhur Teaching Hospital. The Research Ethics Committee at the Faculty of Physical Therapy, Cairo University, assigned a special ethical number (P.T.REC/012/003923) to this study. Another distinct

number is derived from the Clinical Trials Registry, specifically identified as the Registry ID: NCT05664022.

This study exclusively enrolled participants who met the criteria for lower crossed syndrome, which encompassed the presence of tight hip flexors and erector spinae muscles, as well as weakness in the glutei and abdominal muscles. Additionally, participants were required to have experienced LBP for a duration of 3 months or more. Patients were excluded from the study if they were undergoing concurrent treatments that could potentially affect the outcomes, such as alternative forms of physical therapy or medication specifically targeting LBP. Additionally, individuals who were participating in another interventional clinical research trial, experiencing nerve entrapment, exhibiting bowel or bladder dysfunction, suffering from kidney disease, pregnant, or had undergone surgery on the back, pelvis, or sacrum were also excluded.

Assessment of tightness hip flexors via the modified Thomas test

The patient was placed in a supine position with their thigh resting over the edge of the examination table for this test. The untested limb's thigh was to be grasped by the patient and pushed towards the chest. If the tested limb's hip continued to flex against gravity, the test was considered successful. To determine if the tested limb had a tight rectus femoris or iliopsoas muscle, more testing was required if the tested limb also showed knee extension. In order to counteract the influence of the rectus femoris and determine if hip flexion remained unchanged, this was accomplished by passively extending the knee of the tested limb [9].

Assessment of tightness erector spinae by means of the visual assessment of shortness in lumbar erector spinae muscles

Seated on the examination table, the patient's legs were spread out and their pelvis was upright. In order to raise their forehead to their knees, the patient was instructed to actively flex their front. The erector spinae should exhibit an even "C" shaped curvature and a distance of 10 cm between the forehead and the knees in normal functioning. Additionally, there should not be any knee flexion or pelvic tilting. Any departure from this suggested that the erector spine muscles were short [9].

Assessment of weakness gluteus maximus by prone hip extension coordination\strength test

With the knee held extended and the patient in a prone posture, the tested thigh was elevated into extension. Feel the gluteus maximus and lumbar erector spinae. Next, the hamstring and gluteus maximus muscles, the contralateral lumbar erector spinal muscles, and finally the ipsilateral lumbar erector spinal muscles were palpated and evaluated as part of the abnormal activation sequence. If the gluteus maximus muscles contracted before the lumbar erector spinae, the test was considered positive [9].

Assessment of weakness abdominals using the trunk flexion coordination and strength test

The patient was lying supine, with the legs bent and the arms bent either front across the body or behind the neck. then place your hand beneath the patient's lower back. After that, the patient was instructed to elevate their trunk until their scapulae cleared the table and performed a posterior pelvic tilt. This was the position that was held for 2 s. After that, the patient was told to do 10 repeats, holding each one for 30 s. If the patient was unable to complete 10 repetitions without their heels or lumbar spine lifting off the table, the test was considered positive [9].

Outcome measures

Before the start of the treatment program and after 15 sessions of study, the measurements of the study's findings were conducted. Outcome measures were anterior pelvic tilting by the clinometer digital smartphone application, lumbar lordosis using a flexible ruler, hip flexor flexibility was measured by a modified Thomas test, pain assessed using the visual analog scale (VAS), as well as the function disability by the ODI Arabic Version,

Assessment of anterior pelvic tilting

A software application (iHandy Soft, Inc., New York, USA) is used to measure anterior pelvic tilting. Using a sensitive mechanism that is already there on the phone, this application may turn it into an inclinometer [14]. Using the iHandy Level app on a smartphone, one can assess the range of motion with good construct and criterion validity [15]. The anterior and posterior iliac spines were felt. The iHandy's angle was set to 0 while the patient was lying prone, and a semi-permanent pen was used to mark the skin at levels L5–S1. The patient was lying in a long sitting position with his or her feet flat against a wall. The examiner instructed the patient to move their ischial tuberosities into a more posterior position and to raise their chest towards the wall. Try to stay at the same height while you move forward from the hips. Proceed as far as you are able to. Stop when you feel you can no longer go or when your knees start to lift under your hands. Instead of bouncing, hold as tightly as you can. There were only 10 s in this pose. The active range was the only thing evaluated. The mobile device was then positioned so that the skin marker covered the L5-S1 intervertebral space when the software was accessed. The

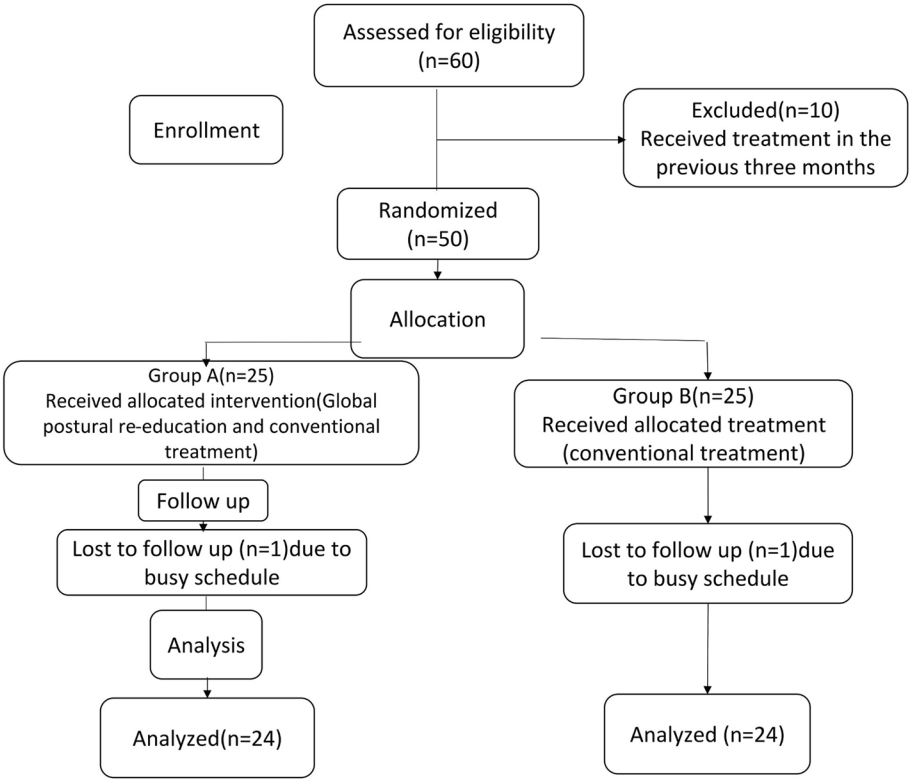

Fig. 1 Consort flow diagram of this study

hold button was used to lock the angle once the mobile device was in place. Using the supplied measuring tool, the angle that matched the range of the highest anterior pelvic tilt was determined. The examiner performed the process three times, and during those three trials, the best view was acquired [16] (Fig. 2). The normal average anterior pelvic tilt angle is 9.6 ± 3.5 and 11.7 ± 3.8° in males and females, respectively [17].

Assessment of lumbar lordosis

To get an accurate reading of lumbar lordosis, a flexible ruler is employed. The flexible ruler demonstrates high reliability and validity as a portable and non-invasive tool for measuring lumbar lordosis. Specifically, the validity of lumbar lordosis measures obtained using the flexible ruler, when compared to those obtained using X-ray imaging, is reported to be 0.91 [18]. An angel's theta can be calculated using the formula [theta] = 4 × [arctan(2H/L)], where theta stands for the magnitude of the lordotic curve. The lumbar lordotic angle typically ranges from 6.50 to 17.80° [19] (Fig. 3).

Assessment of hip flexor flexibility

The modified Thomas test has been used to evaluate hip flexor flexibility. The patient was lying on their back during this test, and their thigh was hanging over the side of the examination table. The patient firmly held the thigh of the unexamined limb and brought it closer to their chest. The pelvis was rotated posteriorly, and the lumbar spine was flat on the plinth [20]. Using a goniometer to measure the angle of hip flexion, the length of the iliopsoas muscle was determined. The femur's greater trochanter and fulcrum were in line. Using the pelvis as a reference point, the measurement was performed by positioning the goniometer's fixed arm along the lateral midline of the abdomen and its moving arm along the lateral midline of the femur [21].

Assessment of pain

VAS is employed as a quantitative tool to assess the subjective intensity of pain experienced by an individual. The VAS is a reliable and valid method for assessing low back pain clinically [22]. It consists of a single handwritten mark down the length of a 10-cm line, with "no pain" at one end of the scale (0 cm) and "worst pain" at the other (10 cm) [23].

Assessment of disability

The Arabic version of the Oswestry Disability Index (ODI) has been applied to evaluate the disability brought

on by LBP. It is a scale with validity, applicability, and reliability. The questionnaire was filled out by the patient in about 5 min, and the doctor scored it in around 1 min. Each component is given a score between 0 and 5, with 5 being the most severe disability. The index is determined through the division of the total score by the range of scores, and then its numerical representation as a percentage is derived by multiplying the result by 100. As a result, the denominator drops by 5 for each query that is unanswered [5].

Interventions

Study group received a global postural re-education approach and conventional physiotherapy treatment of low back pain, and the control group received the conventional physiotherapy treatment in the form of an exercise program (strengthening the abdominal as well as pelvic floor muscles) in addition (to stretching exercises for the back as well as hip flexor muscles). Each group received these treatments two times per week for a total of fifteen sessions.

The GPR involves a sequence of active, moderate postures as well as exercises that are designed to realign joints, stretch shortened muscles, in addition, strengthen the contraction of the antagonist's muscles to prevent postural asymmetry. There are eight different therapeutic postures in the GPR approach that should be held for 15 to 20 min while lying, sitting, or standing. Only two or three postures have been proposed to encourage treatment standardization [12]. Lying posture with progression by leg extension, lying posture with progression by hip joint flexion, as well as standing posture with progression by trunk flexion have been included in this study. The diaphragm muscle is intended to be released, and the anterior muscular chain (diaphragm, pectoralis minor, scalene, sternocleidomastoid, intercostalis, iliopsoas, arm, forearm, as well as hand flexors) is intended to be stretched.

The first posture: The patient was lying supine, while their forearms extended to the side along with their upper limbs slightly abducted at an angle of 30°. The foot soles touched, and the hips were flexed, abducted, as well as laterally rotated (Fig. 4). The therapist applied manual traction to the lumbar spine to straighten it, and then sacral traction to the neck's dorsal and cervical curvature. The patient was instructed to keep his feet together, adduct his upper limb, and extend his lower leg from the beginning. Lower limb extension and upper limb adduction were the directions in which the process occurred [24].

The second posture: In the lying position with the legs bent, the posterior chain (upper trapezius, levator scapulae, suboccipital, erector spine, gluteus maximus, ischiotibial, triceps surae, as well as foot intrinsic muscles) was stretched. The patient was lying while upper limbs were abducted at a 30° angle in addition hip flexed. Hip flexion, knee extension, as well as ankle dorsiflexion all increased during progression (Fig. 5) [23].

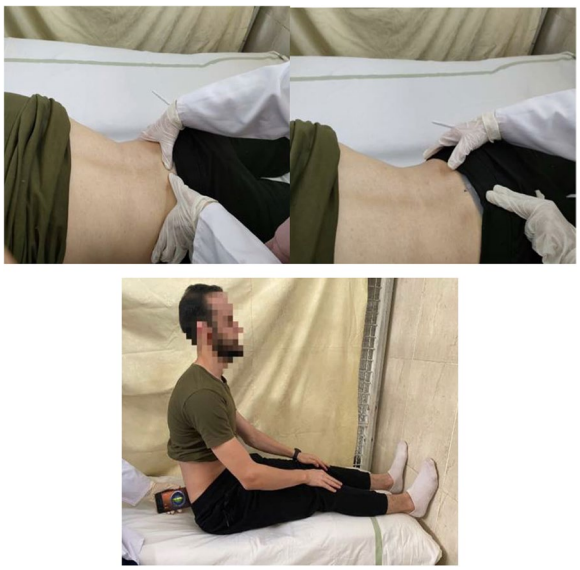

Fig. 2 Measurement of anterior pelvic tilting by software application

The third posture: The individual transitioned from an erect stance with flexion of the trunk to a position of forward bending, while maintaining proper alignment in the occiput, thoracic spine, as well as sacrum. Stretching the posterior chain was required in this position. Each session lasted the same amount of time overall. Patients are instructed to engage in the prescribed exercises at home, either during the morning or evening hours, as determined by their individual capabilities [12] (Fig. 6).

Conventional physiotherapy

Each patient in this group has been asked to perform an exercise program of (abdominal and pelvic floor strengthening) and (stretching exercises of back and hip flexor muscles) to improve pain and function in chronic low back pain patients [25]. The exercise program has lasted 60 min for 15 sessions and is performed 2 days per week.

Bridging exercise

The muscles surrounding hips and lower body are worked during the bridging exercise. The patient performed 8–12 repetitions. If he experienced pain while performing this exercise, stop. With both knees bent, he lay on his back. He should have a 90° bend in his knees. Pulling in his belly button towards his spine will help in tightening the abdominal muscles. Once his shoulders,

Fig. 3 Measurement of lumbar lordosis by flexible ruler

Fig. 4 Lying posture with leg extension progression, anterior muscle chain stretching

hips, and knees are all in a straight line, he presses his heels into the floor, clenches his buttocks, and raises his hips off the ground. Breathe normally throughout the 6 s of holding, then slowly return his hips to the floor to rest for a maximum of 10 s [25].

Double knee-to-chest

The patient lay on the back with his feet flat on the ground and his knees bent. He stepped up to his chest with one leg, then the other. Avoid lifting his legs together. For 15 to 30 s, hold. Let his legs drop to the floor, one at a time, while he relaxed. Take a 30-s break. He did it two or four times [25].

Backward bend

The patient positions his feet hip-width apart and points his toes forward. Avoid locking his knees. He placed his hands on his back with his palms at the waist. He Bent backward over his hands without bending the neck; and kept his legs straight. He kept the position for 1 or 2 s. Get back to his feet. Repeat 3 to 10 times [25].

Curl-ups

The patient lay flat on his back on the floor, his knees bent 90°. Place his feet level on the floor, about 12 inches (32 cm) away from the rear end. He folded his arms over his chest. Exert his core muscles gradually and lift his shoulder blades off the ground. Do not bring his chin up to his chest; instead, keep his head in alignment with his body. After maintaining this posture for 1 or 2 s, he carefully returned to the floor. Eight to 12 times, repeated [25].

Alternate arm and leg

The patient made an effort to maintain a straight posture at all times and avoided letting one hip drop more than the other. He began on his hands and knees on the ground. His stomach muscles should be taught. He Stretched one leg straight out after lifting it off the ground. After holding for roughly 6 s, he dropped his leg and replaced it with the other. On each leg, he repeated 8 to 12 times. Hold for 10 to 30 s at a time. He Tried lifting the opposite arm straight out at the same time as the leg he raised if it felt stable and comfortable [25].

Hip flexor stretch

The patient bent one knee and placed one leg behind him while kneeling on the ground. He placed his front knee over his arch. He kept the other knee in contact with the ground. Then pushed his hips forward gradually until his back leg's upper thigh stretched. For at least 15 to 30 s, hold the stretch. He continued with his opposite leg. He Did each side two to four times [25].

Pelvic tilt exercise

The patient bent his knees and lay on his back. He braced his stomach by drawing in and contracting his muscles while visualizing his belly button going in the direction of his spine. He felt like his hips and pelvis were moving back and his back was pressing into the floor. He breathed naturally for approximately 6 s while holding. Eight to 12 times, repeated [25].

Fig. 5 Lying posture with hip joints flexion progression, posterior muscle chain stretching

Fig. 6 Standing posture with trunk flexion progression, posterior muscle chain loading stretching

Statistical analysis

The data had a normal distribution as indicated by the results of the Shapiro–Wilk as well as Kolmogorov–Smirnov normality tests. The data analysis of this research involved the utilization of the unpaired *t*-test as well as the chi-square test. MANOVA was conducted on the parametric variables. The Wilcoxon as well as Mann–Whitney tests are commonly used statistical methods for analyzing non-parametric variables.

Results

There was no substantial difference among the mean value of age, weight, height, as well as low back pain chronicity for both groups ($p > 0.05$), in addition, there was no substantial difference regarding sex distribution, among both groups ($p = 0.571$) (Table 1).

Using a two-way mixed design MANOVA, the difference between the two groups' scores on the combined parametric variables was determined. There was a substantial multivariate effect for the groups, Wilk's A = 0.003; F (3,39) = 22.94, $P = 0.001$, η2 = 0.638; for time, Wilk's $A = 0.03$; F (3,39) = 421, $P < 0.001$, η2 = 0.97; in addition, for the interaction of groups as well as time, Wilk's A = 0.145; F (3, 39) = 76.61, $P < 0.001$, η2 = 0.85.

Regarding between groups comparison, there was a statistically significant difference in the mean values of anterior pelvic tilting ($p = 0.001$), lumbar lordosis ($p = 0.024$), hip flexor flexibility ($p = 0.001$), pain ($p = 0.001$), and functional disability ($p = 0.001$) after 8 weeks between both groups in favor to study group (Table 2).

Regarding within-group comparison, there was a statistically significant decrease in anterior pelvic tilting in the study group after 8 weeks compared with that of baseline ($p = 0.001$) by 46.9% and a significant decrease in lumbar lordosis ($p = 0.001$) by 17.4%, also there was a significant decrease in pain ($p = 0.001$) by 66% and a significant decrease in functional disability ($p = 0.001$) by 50%. There was a statistically significant increase in hip flexor flexibility ($p = 0.004$) by 49.8%.

There was a statistically significant decrease in anterior pelvic tilting in the control group after 8 weeks compared with that of baseline ($p = 0.001$) by 22%., and a significant decrease in lumbar lordosis ($p = 0.001$) by 6.5%, also there was a significant decrease in pain ($p = 0.001$) by 28.6% and a significant decrease in functional disability ($p = 0.001$) by 21%. There was a statistically significant increase in hip flexor flexibility ($p = 0.001$) by 19.6% (p 0.001) (Table 2).

Discussion

The GPR approach is accounted as an effective treatment method that improves and enhances chronic LBP [12, 13, 26]. One of the most important risk factors for developing LBP is a muscle imbalance. LCS is a muscular imbalance that can cause chronic LBP by modifying the distribution of biomechanical forces in the lumbar region. It is characterized by tight hip flexors and lower back muscles, while abdominal muscle weakness [27].

This research was designed to examine the impact of GBR on anterior pelvic tilting, lumbar lordosis, hip flexor flexibility, pain, as well as function disability in

chronic LBP patients having LCS. The outcomes of this study reported statistically substantial differences among groups in anterior pelvic tilting, lumbar lordosis, hip flexor flexibility, pain, as well as function disability after 15 sessions of the GBR approach with more favor to the study group.

The findings of this research reported a notable decrease in anterior pelvic tilting and lumbar lordosis which suggests an improvement in chronic LBP with LCS after 15 sessions twice a week of treatment with a mean difference of 4.3–5.2° respectively between the two experimental groups. The minimal clinical important difference (MCID) for anterior pelvic tilting and lumbar lordosis among patients suffering from LBP is 3.5–11° respectively [28, 29]. So, the difference among groups regarding anterior pelvic tilting was statistical and clinical, and lumbar lordosis was statistical but not clinical. GPR approach seems to improve anterior pelvic tilting and lumbar lordosis by lengthening hip flexors, and lower back muscles in addition to strengthening the contraction of abdominals, and gluteus maximus muscles hence it improved postural asymmetry. It is consistent with Barroqueiro and Morais, (2014) who studied the effects of GPR on a spondylolisthetic adolescent handball player. Lumbar lordosis, sacral slope, and anterior pelvic tilting were decreased following the GPR period [30].

This study's findings corroborated those of Dimitrova and Rohleva, (2014) who investigated the effect of GPR in the treatment of postural impairments. The study's findings indicated that treating postural abnormalities with the GPR treatment approach might be more successful than treating them with a traditional physiotherapy program [31]. Also, in the study conducted by Rahmani et al. (2020), a comparison was made between the impact of GPR and lumbar stabilization exercises on movement control, pain, as well as disability in male individuals experiencing lumbar movement control dysfunction. Compared to the lumbar stabilization exercise, the GPR approach had a greater impact on disability [32].

The findings of this research reported a notable increase in hip flexor flexibility which suggests an improvement in chronic LBP with LCS after 15 sessions twice a week of treatment with a mean difference of 8° between the two experimental groups. The minimal clinical important difference (MCID) for hip flexor flexibility in patients who have low back pain is 19° [33]. So, the difference between groups in hip flexor flexibility was statistical but not clinical. The GPR approach appears to enhance hip flexor flexibility through the utilization of the creep characteristic of viscoelastic tissue, which involves stretching the iliopsoas muscle. Additionally, this approach enhances the activity of the antagonist muscles. It is agreed with the study of Rahmani et al. (2022) that examined the impact of GPR on the flexibility of hip muscles following 6 weeks of intervention in men with motor control dysfunction. Based on the results of the study, it was observed that the GPR approach showed a greater capacity to enhance the flexibility of shortened muscles [34]. Individuals suffering from non-specific LBP and/or neck pain for a duration beyond 6 weeks were subjected to a GPR evaluation by Cavalcanti et al. (2020), who discovered that GPR had favorable benefits on pain and flexibility but did not significantly affect posture [33]. The research conducted by Guastala et al. (2016), investigated the impact of GPR and isostretching among patients having nonspecific chronic LBP. In patients having constant LBP, it was discovered that the GPR and iso-stretching approaches yielded positive outcomes in terms of pain reduction, improvement in functional capacity, increased flexibility, and enhanced muscle strength. There were no statistically significant variations [35].

The findings of this research reported a notable decrease in pain and function disability which suggests an improvement in chronic low back pain with LCS after 15 sessions twice a week of treatment with a mean difference of 1.8–11.5 points respectively between the two experimental groups. The minimal clinical important difference (MCID) for pain as well as functional disability in individuals who suffer from persistent LBP are 2–10 points respectively [36]. So, the difference between groups in

Table 1 Demographic data of subjects of both groups

Demographic data	Study group	Control group	*t* value	*p* value
Age (years)	25 ± 1.7	24.7 ± 1	1.14	0.256
Weight (kg)	70.4 ± 8.1	71 ± 8.9	− 0.216	0.830
Height (cm)	167.2 ± 9.4	168.8 ± 9.7	− 0.603	0.549
Chronicity (month)	10.5 ± 3.4	10.9 ± 3.7	− 0.397	0.693
Occupation	*N* (%)	*N* (%)	$\chi^2 = 4.76$	0.942
Doctor	3	3		
Nurse	4	4		
Carpenter	2	2		
Housewife	4	3		
Teacher	4	3		
Plumber	2	2		
Bus driver	1	2		
Taxi driver	0	1		
Electrician	1	2		
Baker	0	1		
Farmer	3	4		
Dentist	1	0		
Sex	N (%)	N (%)	$\chi^2 = 0.321$	0.571
Males	12 (48%)	14 (56%)		
Females	13 (52%)	11 (44%)		

Data was expressed as mean ± standard deviation, χ^2 chi-square, *p* value significance

Table 2 Clinical characteristics of subjects for anterior pelvic tilting, lumbar lordosis, and hip flexor flexibility in both groups

A Characteristics	Study group (*n* = 25)	Control group (*n* = 25)	MD (95% CI)	*P* value[1]	η[2]
Anterior pelvic tilt (degrees)					
Baseline	17.7 ± 1.6	17.6 ± 1.4	0.103 (− 0.83, 1.04)	0.825	0.001
8 weeks	9.4 ± 1.5	13.7 ± 1	− 4.2 (− 5.04, − 3.4)	0.001*	0.747
P value	0.001*	0.001*			
Lumbar lordosis (degrees)					
Baseline	56.9 ± 7.9	55.8 ± 7	1.13 (− 3.49, 5.76)	0.623	0.006
8 weeks	47 ± 8	52.2 ± 6.5	− 5.2 (− 9.75, − 0.74)	0.024*	0.119
P value	0.001*	0.001*			
Hip flexor flexibility (degrees)					
Baseline	29.7 ± 3	28.5 ± 2.3	1.2 (− 0.44, 2.84)	0.147	0.051
8 weeks	14.9 ± 1.2	22.9 ± 2.3	− 7.97 (− 9.19, − 6.75)	0.001*	0.809
P value	0.004*	0.001*			
Pain (cm)			*z* value		
Baseline	5 ± 0.8	4.9 ± 0.8	− 0.362	0.717	
8 weeks	1.7 ± 0.6	3.5 ± 0.9	− 5.54	0.001*	
P value	0.001*	0.001*			
Functional disability (%)			*z* value		
Baseline	36.7 ± 5.4	37.7 ± 5.2	− 0.672	0.501	
8 weeks	18.3 ± 2	29.8 ± 4.5	− 6.05	0.001*	
P value	0.001*	0.001*			

P value significance within groups, *P* value[1] significance between groups, η^2 partial eta square

* Significant

pain was statistical but not clinical, and function disability was statistical and clinical. GBR approach appears to enhance pain reduction as well as disability by employing soft tissue stretching techniques to promote increased flexibility, balanced muscular tonus, and reduced tension. These results agreed with Bonetti et al. (2010) who determined the effectiveness of the GPR program for persistent LBP. The findings of this study showed that, in comparison to a stabilization exercise program, the use of GPR intervention in individuals experiencing persistent LBP led to a more significant enhancement in both pain reduction and functional impairment [12].

It is agreed with the research conducted by Lawand et al. (2015) that examined the impact of a muscle stretching program utilizing the GPR approach on individuals suffering from persistent LBP [36]. The present study's results corroborated the thorough review and meta-analysis conducted by Gonzalez-Medina et al. in 2021. The aforementioned research provided substantial evidence suggesting that GPR may serve as an effective intervention for those suffering from LBP. Specifically, GPR was found to be associated with pain reduction and improved functional outcomes [26].

In a study conducted by Castagnoli et al. (2015), the researchers examined the comparative effects of GPR and standard physiotherapy treatment, which involved active exercise, stretching, as well as massaging, on the improvement of pain as well as function in individuals suffering from persistent LBP. The findings of the study indicated that while the observed difference between the two treatment groups was not statistically significant, a greater number of participants in the GPR group reported positive outcomes in terms of both pain reduction and improved functionality, as compared to the group receiving standard physiotherapy treatment [13]. Guastala et al. (2016) discovered that both groups showed improvements in functional capacity and a statistically substantial decline in pain intensity, in favor of the GPR group [37]. When Kumar, A. (2022) compared GPR and motor control exercise (MCE) among patients suffering from non-specific LBP, the researcher found that those in the GPR group had a substantially greater enhancement in functional status, disability, as well as pain severity compared to those in the MCE group [38].

Limitation

There are some limitations to the current study, despite revealing objective data with statistically significant differences. The time of the study is short. The sample size is small, the generalizability of the study is limited to one hospital and there are other assessment tools that measure the variables in the study. Further study should be applied to investigate the long-term effect of global postural re-education on chronic low back patients with lower cross syndrome.

Conclusions

Adding a global postural re-education approach significantly decreases anterior pelvic tilting, lumbar lordosis, and pain, and increases flexibility of hip flexor muscle and function disability in chronic low back patients with lower cross syndrome.

Abbreviations

CLBP	Chronic low back pain
GPR	Global postural reeducation
LBP	Low back pain
LCS	Lower cross syndrome
VAS	Visual analog scale
ODI	Oswestry Disability Index

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Authors' contributions

EAK contributed to the concept or design of the article. EAK, AAY, SSD, and ASA contributed to the acquisition, analysis, or interpretation of the data for the article. EAK, AAY, SSD, and ASA drafted the article or revised it critically for important intellectual content. The authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This was approved by the Ethics Committee of the Faculty of Physical Therapy at Cairo University (P.T.REC/012/003923). Another distinct number is derived from the Clinical Trials Registry, specifically identified as the Registry ID: NCT05664022.

Consent for publication

Consent for the publication of pictures is obtained from the participants.

Competing interests

The authors declare that they have no competing interests.

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