ijlpr 2023; doi 10.22376/ijlpr.2023.13.4.L88-L100

International Journal of Life science and Pharma Research

ISSN 2250-0480

Research Article

Physiotherapy

Combined Effect of Diaphragmatic Breathing Exercise and Pelvic Floor Exercise in Patients with Non-Specific Chronic Low Back Pain.

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Abstract: Low back pain (LBP) is more of a symptom than a disease that affects people of all ages and is the leading cause of disability worldwide. Up to 85% of people experience non-specific LBP with no diagnosable underlying pathology. Therefore, healthcare research has focused on understanding the mechanisms underlying the maintenance of pain in chronic non-specific LBP (CNSLBP). We aimed to determine the combined effect of diaphragmatic breathing exercises and pelvic floor exercises in patients with non-specific chronic low back pain. It was an experimental design study, where 30 subjects, both Male and Female, with a primary diagnosis of non-specific chronic low back pain by the physician were recruited into two groups or intervention sequences with 15 subjects in each group. Group-A (Experimental group) received the moist hot pack, diaphragmatic breathing exercise (DBEx), pelvic floor muscle (PFM) exercise, and conventional back exercise. In contrast, Group B (the Control group) received a moist hot pack and conventional back exercise for five sessions per week for a total of 6 weeks. The Outcome measures used were the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI). The paired 't'-test was used to analyse both groups' pre-test and post-test results. The study concluded that both Group-A (moist hot pack, diaphragmatic breathing exercise, pelvic floor exercise, and conventional back exercise) and Group-B (moist hot pack and conventional back exercise) showed improvement post-treatment and was found to be significant $p < 0.05$ in VAS in terms of pain and ODI in terms of disability. However, the mean score of VAS and ODI post-treatment decreased more in Group-A than in Group B. The Group-A treatment protocol resulted better in alleviating the pain and was effective in improving the disability. A suggestion to add DBEx and PFM exercises in physical therapy intervention to manage CNSLBP can be considered.

Keywords: Low back pain, non-specific LBP, breathing exercises, diaphragm, diaphragmatic breathing exercise, pelvic floor muscle exercise, VAS, ODI.

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Received On	**25 August, 2022**
Revised On	**3 February, 2023**
Accepted On	**14 February, 2023**
Published On	**1 July, 2023**

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

Citation Glory Dangmei, Abhijit Kalita and Abhijit Dutta , Combined Effect of Diaphragmatic Breathing Exercise and Pelvic Floor Exercise in Patients with Non-Specific Chronic Low Back Pain..(2023).Int. J. Life Sci. Pharma Res.13(4), L88-L100 http://dx.doi.org/10.22376/ijlpr.2023.13.4.L88-L100

1. INTRODUCTION

Low back pain (LBP) is a widespread symptom experienced by people of all ages. Low back pain is now the number one cause of disability globally.[1-3] It is defined by the location of pain, typically between the twelfth rib and the inferior gluteal folds, with or without leg pain, and about 90% of cases are nonspecific[4], having its source in the spinal joints, vertebrae, and discs, or soft tissues classified as mechanical in origin.[5] The most common form of low back pain is non-specific low back pain.[6] Chronic nonspecific LBP (CNSLBP) is generally defined as pain, muscle tension, or stiffness not attributed to specific pathology (e.g., infection, tumor, osteoporosis, arthritis, fracture, Cauda equina syndrome, etc.) and last longer than 12 weeks.[7] According to The World Health Organization reports, "Pain of the lower back is the most prevalent of musculoskeletal conditions;[8] it is the leading cause of disability globally, placing a high burden on healthcare services nine and socioeconomic costs.[10] Chronic nonspecific low back pain (CNSLBP) is considered the second leading cause of physician's visits, having a major impact on health and health-related quality of life, lost time at work diminishing the standing capacity, walking, and sitting.[7] LBP has a lifetime prevalence of 84% and peaks between the ages of 35 and 55. Prevalence was found to be greater in high-income countries (median 30·3%) than in middle-income (21·4%) or low-income (18·2%) countries.[4] A recent systematic literature review stated that the prevalence of LBP ranges from 1.4% to 20.0% and the incidence from 0.024% to 7.0%.[2] In the Indian population, prevalence varies between 6.2% (in the general population) to 92% (in construction workers),[11] higher in women (52.9%) compared to men (28.4%), highest (50%) in the age group (41-50 years) compared to other age groups and 30.8% in the younger age group (20-30 years).[12] CNSLBP is generally diagnosed or "ruled in" when red flags, magnetic resonance imaging, and x-ray results are negative for spine or nerve pathology, respectively.[7] Diaphragmatic (abdominal) breathing (DB) is defined as an outward motion of the abdominal wall while reducing movement of the upper rib cage during inspiration.[13] Along with respiration, the diaphragm also plays a role in swallowing and vocalization. The diaphragm modulates intra-abdominal pressure and regulates postural stability, urination, micturition, and parturition.[14] The basic functions of the pelvic floor include the support of the abdominal and pelvic organs, the production of IAP from the combined action of the diaphragm, TA, and OI, the regulation of bowel and bladder movements, the arousing of sexual desire, and the support of breathing and posture.[15] Pelvic floor muscles (PFM) work in synergy with other muscles surrounding the abdominal cavity, particularly with anterolateral abdominal muscles and thoracic diaphragm, to modulate and respond to changes in intra-abdominal pressure (IAP), to provide trunk stability, and to contribute to continence while breathing and coughing.[16] The transverse abdominis (TrA), multifidus, diaphragm, and pelvic floor muscles have traditionally been regarded as the primary stabilizers of the low back. By contracting together, the TrA, multifidus, pelvic floor muscles, and diaphragm raise the intra-abdominal pressure (IAP), thus offering postural and trunk stability.[5] During breathing, elevated IAP periods occur during inspiration and expiration.[16] According to Hodges (2007), raised intra-abdominal pressure (IAP) extends the lumbar spine and thus assists in the control of spinal orientation. This decreases the compressive load on the lumbar spine and reduces pain, thus helping effectively manage low back pain.[17] Numerous publications have documented changed breathing patterns, including variations in lung function and diaphragmatic mechanics, in people with persistent, non-specific low back pain.[5] People with CLBP have a higher position of the diaphragm, a smaller excursion, and a greater degree of diaphragm fatigability, which is compensated by a larger lung volume to produce a sufficient rise in intra-abdominal pressure.[18] The body's ventilatory demands may exacerbate diaphragm dysfunction and increase compressive loads on the lumbar spine.[5] The emergence of low back pain is correlated with dysfunction of the pelvic floor muscles. Pain, poor movement patterns, trauma, surgery, or childbirth can bring on pelvic floor muscle insufficiency. These muscular imbalances do not resolve independently and can cause hip, pelvic, and low back pain.[19] Additionally, it was demonstrated that the trunk stabilizers' kinematics are altered due to delayed contraction of the Transverse Abdominis. This modification can be the responsible factor for low back pain.[20] As Diaphragm and Pelvic floor muscles have an important role in lumbar spine stability, and lumbar instability was suggested to be one of the causes of LBP, it was hypothesized that Diaphragmatic breathing exercise (DBE)[5] and Pelvic floor muscle (PFM) exercise could be of benefit for patients with chronic LBP.[21] Recent research demonstrates that core stability along with diaphragmatic breathing exercise is more effective than core stability alone for the reduction of mechanical non-specific chronic low back pain. [5] There are also studies suggesting that pelvic floor exercises combined with routine treatment in chronic low back pain provide significant benefits in pain relief and disability over routine treatment alone. [4,19] However, there is a lack of literature showing the combined effect of diaphragmatic breathing and pelvic floor exercise in patients with non-specific chronic low back pain. So this study aimed to find out the combined effect of diaphragmatic breathing exercises and pelvic floor exercises in patients with non-specific chronic low back pain.

2. MATERIALS AND METHODS

2.1. *Study design*

The study was an Experimental Study approved by the Institutional Research and ethical committee (Adtu/Ethics/stdnt-lett/2022/33). Therefore, all the experimental procedures were in accordance with the University's guidelines.

2.2. *Participants*

A total number of 30 subjects, both Male and Female, with non-specific chronic low back pain fulfilling the inclusion criteria were allocated into Group-A and Group-B by random sampling method where Group-A (n=15) received Moist hot pack, Diaphragmatic breathing exercise, Pelvic floor exercise and Conventional back exercise and Group-B (n=15) received Moist hot pack and Conventional back exercise. This study was carried out in the Department of Physiotherapy, Down Town Hospital Guwahati, and Department of Physiotherapy, Down Town University Panikhaiti Guwahati.

2.3. *Inclusion criteria*

Patients in the age group of 18-60 years, both genders, patients with chronic non-specific LBP for > three months, with or without radiculopathy, patients with chronic LBP with/ without respiratory pathology, and individuals willing to participate in the study.

2.4. Exclusion criteria

Patients who underwent any abdominal and thoracic surgery, smokers, traumatic LBP, continuous pain >8 on a visual analog scale (VAS, where 0 represented no pain and 10 represented the worst pain possible), previous attendance at any structured pelvic floor muscle training program, previous spinal or pelvic surgery, progressive neurological deficit, structural anomaly, acute infection, ongoing back pain treatment by other health care providers, severe instability, severe osteoporosis, and severe cardiovascular or metabolic disease.

2.5. Outcome Measures

Pain intensity was measured by VAS (Visual Analogue Scale), and functional status was measured by ODI (Oswestry Disability Index) at pre-intervention and after 30 sessions (5 sessions per week for six weeks) of intervention.

2.6. Pain

A VAS is generally a horizontal line measuring 100 mm in length, with the words "no pain" and "pain as bad as it could be" labeled at either end. The point the patient feels best captures their perception of their current condition is marked on the line. The distance between that mark and the origin is measured to determine the patient's score. [22,23]

2.7. Disability

The Oswestry Disability Index is a Low Back Pain Disability Questionnaire used by researchers to measure a subject's level of functional disability. The evaluation is regarded as the "gold standard" for measuring the low back functional outcome. The ODI is divided into ten sections (pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and traveling). The overall score for each section of six statements is 5. The level of disability is calculated by adding the points obtained from each section as follows: [24]

$$\frac{\text{Total scored}}{\text{Total possible score}} \times 100 = \%\text{ of disability}$$

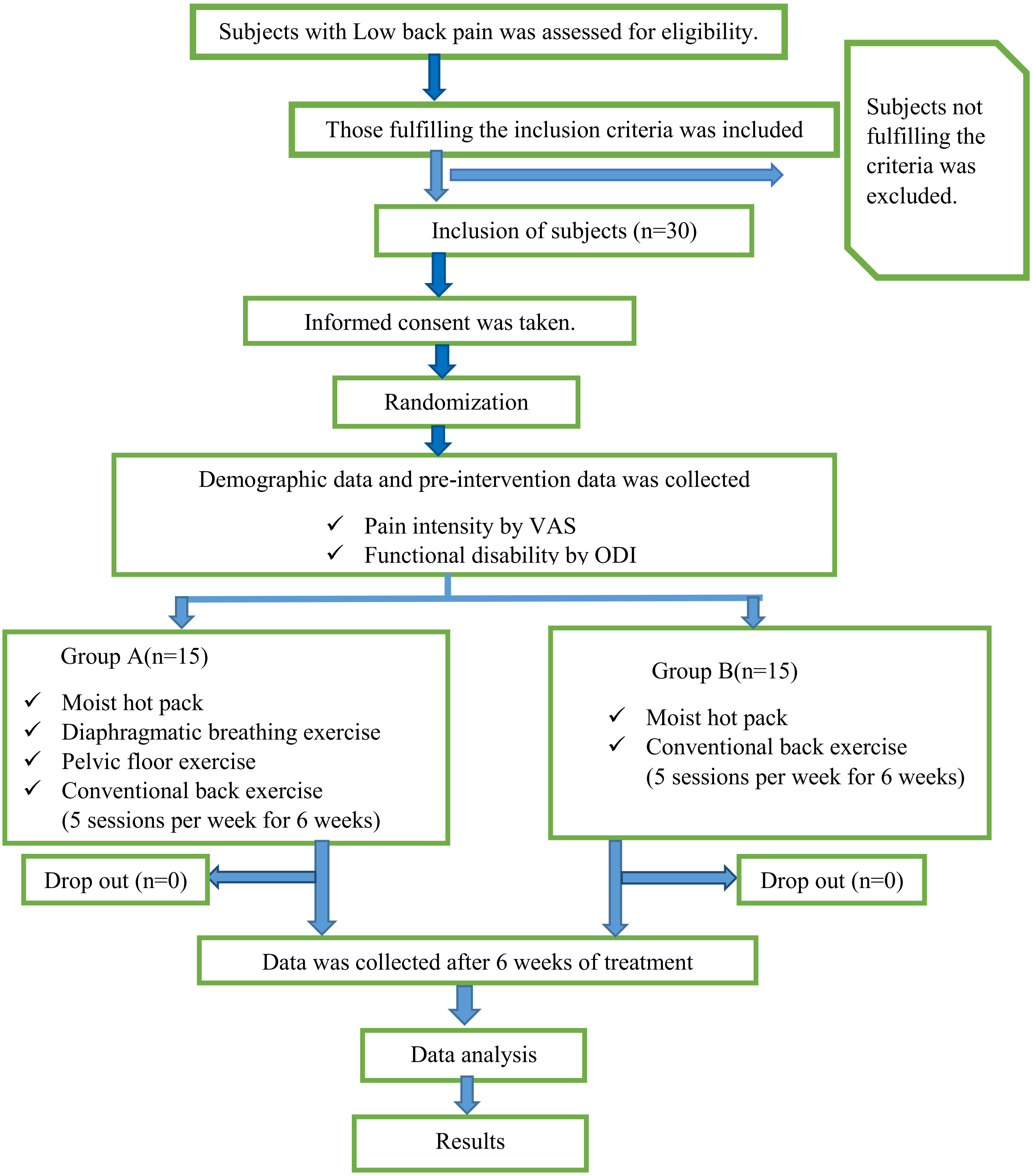

Fig 1: Study flow diagram.

2.8. Procedure

The subjects were assigned into two groups – Group-A {Moist hot pack (MHP), Diaphragmatic breathing exercise (DBEx), Pelvic floor muscle exercise (PFM) & Conventional back exercise} and Group-B (Moist hot pack & Conventional back exercise) by random sampling, consisting of 15 subjects in each group. Those fulfilling the criteria were explained in detail about the purpose of the study, and a written consent form was obtained from each subject. In addition, demographic data were collected for each subject, and a Pre-test and Post-test were carried out for both Group A and Group B using a Visual Analogue Scale (VAS) for assessing pain and Oswestry Disability Index (ODI) for evaluating disability. The data about the outcome measure were collected on day 0 and week 6 of the intervention.

2.9. Intervention

Group-A received a Moist hot pack, Diaphragmatic breathing exercise, Pelvic floor exercise, and Conventional back exercise.
Group B received a moist hot pack and Conventional back exercise. All the subjects received the intervention for five therapy sessions per week (a total of 30 therapy sessions), lasting for six weeks.

- A moist hot pack to the lower back region was given to both groups for 15 minutes before starting the exercises to relieve pain.
- For Diaphragmatic breathing exercises, a comfortable position such as a semi-Fowler's (Figure 2) was given. The Therapist's hand was placed on the rectus abdominis below the anterior costal margin, and the patient was asked to breathe in slowly and deeply through the nose. The patient was then asked to relax, exhale slowly through the mouth, and to practice three to four times, and rest. The patient then was asked to keep his hand below the anterior costal margin and feel the movement. The patient's hand should rise slightly during inspiration and fall during expiration. When the patient has mastered the breathing pattern in the supine the protocol was progressed to the sitting position (Figure 3), standing (Figure 4), walking (Figure 5), and finally, stairs (Figure 6). 5 sets of 10 repetitions of Diaphragmatic breathing (DBEx) was performed per session.
- For Pelvic floor exercises, subjects were explained the anatomy and importance of pelvic floor muscle exercises. Subjects were asked to empty the bladder before beginning the pelvic floor exercises. Verbal cues such as "squeeze and lift" or tightening the pelvic floor as if attempting to stop urine flow or hold back gas were used. The patients were taught to contract their pelvic floor muscles by squeezing and lifting with maximum applied effort and hold for 6 seconds, followed by rest for 6 seconds, without holding the breath, resulting in 5 contraction cycles/min. The number of contraction cycles was increased over the 6-week treatment period:
  - week 1, 25 cycles/day (5 min total), the patients were advised to perform in crook lying positions for the first two weeks (Figure 7)
  - week 2, 50 cycles/day (10 min total)
  - week 3, 75 cycles/day (15 min total), the patients were advised to practice the session in two positions, i.e., sitting (Figure 8) and lying
  - weeks 4-6, 100 cycles/day (20 min total), the patients were advised to continue the exercises in lying, sitting, and standing (Figure 9).

The conventional back exercise program consists of Supine lying – Leg lifts, Abdominal crunches in the crook lying position, Prone lying – Leg lifts, and Prone lying – Trunk lifts. Each of these exercises were given for ten repetitions per session. At the same time, all the subjects in both groups were explained postural and back care advice.

Fig 2: Diaphragmatic breathing exercise in semi-fowler's position (first position). The patient was encouraged to practice diaphragmatic breathing to become aware of their breathing pattern.

Fig 3: The patient advances to the sitting position for breathing retraining. Note the relaxed position of the patient's shoulders and hands.

Fig 4: The third position in the sequence is standing.

Fig 5: Walking is the fourth stage of retraining. The patient was encouraged to relax, control their breathing, take long steps, and slow down.

Fig 6: The patient is instructed to pause slightly as they breathe in and to exhale as they climb one to two stairs.

Fig 7: Pelvic floor muscle exercise in crook lying position.

Fig 8: Pelvic floor muscle exercise in sitting.

Fig 9: Pelvic floor muscle exercise in standing.

3. DATA ANALYSIS

Statistical analysis was performed in SPSS version 25.0(SPSS Inc, Chicago, Illinois). A paired t-test was used to analyze the variables pre-intervention and post-intervention. The significance level with p-value was set at 0.005; less than this is considered statistically significant.

4. RESULTS

All the subjects (n=30) received 30 treatment sessions (5 sessions per week), where Group-A (Experimental Group) received a Moist hot pack, Diaphragmatic breathing exercise, Pelvic floor exercise, and Conventional back exercise, and Group B (Control Group) was set at a treatment protocol of Moist hot pack and Conventional back exercise.

4.1. Demographic Representation of data

Thirty subjects (17 females and 13 males) were evaluated for the study by random sampling and then allocated to Group A and B.

Table 1: Descriptive Statistics of demographic information of subject

	Group A (n=15)	Group B (n=15)
Minimum age	20	20
Maximum age	50	47
Age (Mean ± SD)	29.73 ± 7.3889	32.13 ± 7.6408
Height (Mean ± SD)	163.017 ± 7.187	161.913 ± 8.118
Weight (Mean ± SD)	60.4 ± 9.721	62.267 ± 9.205
Gender (M:F), n	6:9	7:8

In Group A, the mean age was 29.73 years (ranging from 20 to 50 years), the mean height was 163.01 cm (152.4 to 176.7 cm), and the mean weight was 60.4 Kg (45 to 75 Kg) & in Group B, the mean age was 32.13 years (20 to 47 years), mean height was 161.91 cm (149.3 to 176.7 cm) and mean weight was 62.26 Kg (50 to 76 Kg).

4.2. Effect of intervention

Table 2: Comparison of PRE & POST Data of VAS score for Group – A and Group – B.

Group	VAS	Mean ± SD	N	t	df	p	Remarks
Group A	Before Treatment (Pre-Test)	6.20 ± 0.98	15	3.542	28	0.001	S
	After Treatment (Post-Test)	4.53 ± 0.88	15				
Group B	Before Treatment (Pre-Test)	6.53 ± 1.02	15	2.949	28	0.003	S
	After Treatment (Post-Test)	5.47 ± 0.88	15				

****S =Significant***

4.3. Pain intensity

It is seen that in group A (Experimental Group), the pre-test and post-test for the VAS scale are significant since $p < 0.05$, and the protocol (Moist hot pack, Diaphragmatic breathing exercise, Pelvic floor exercise, Conventional back exercise) is effective since mean VAS score decreases from 6.20 to 4.53. On the other hand, in group B (Control Group), the pre-test and post-test of the VAS scale are significant since $p < 0.05$, and the protocol (Moist hot pack and conventional back exercise) is effective since the mean VAS score decreases from 6.53 to 5.47. The above discussion is depicted in Table 2 and follows Figure 10 and Figure 11.

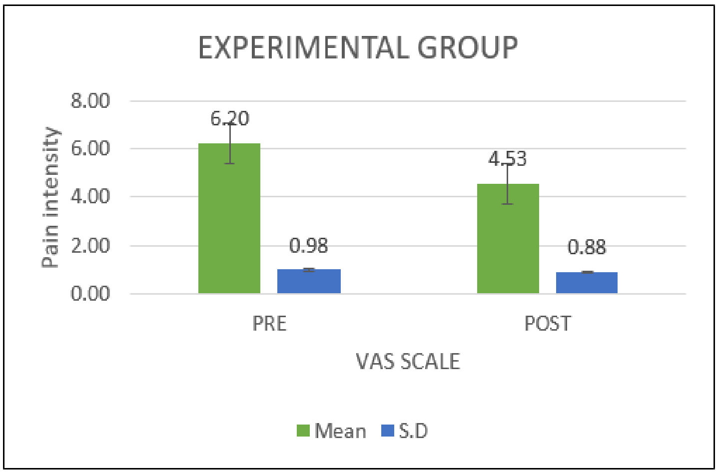

Fig 10: Comparison of PRE & POST Data of VAS scale of Experimental Group

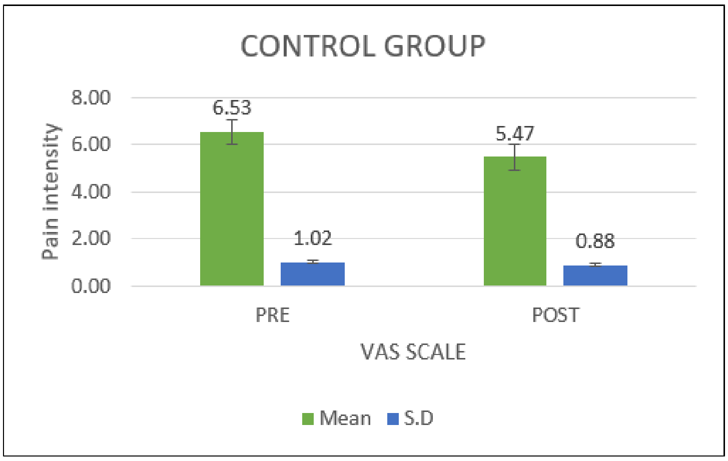

Fig 11: Comparison of PRE & POST Data of VAS scale of Control Group

Table 3: Comparison of PRE & POST Data of ODI score for Group – A and Group – B.

Group	ODI	Mean ± SD	N	t	df	p	Remarks
Group A	Before Treatment (Pre-Test)	0.29 ± 0.05	15	3.618	28	0.0005	S
	After Treatment (Post-Test)	0.22 ± 0.05	15				
Group B	Before Treatment (Pre-Test)	0.34 ± 0.05	15	3.136	28	0.002	S
	After Treatment (Post-Test)	0.28 ± 0.05	15				

S =Significant

4.4. Disability

It is seen that in group A (Experimental Group), the pre-test and post-test for ODI score are significant since p < 0.05, and the protocol (Moist hot pack, Diaphragmatic breathing exercise, Pelvic floor exercise, Conventional back exercise) is effective since mean ODI score decreases from 0.29 to 0.22.

On the other hand, in group B (Control Group), the pre-test and post-test of ODI score are significant since p < 0.05, and the protocol (Moist hot pack and conventional back exercise) is effective since the mean ODI score decreases from 0.34 to 0.28. The above discussion is depicted from the above Table 3 and following Figure 12 and Figure 13.

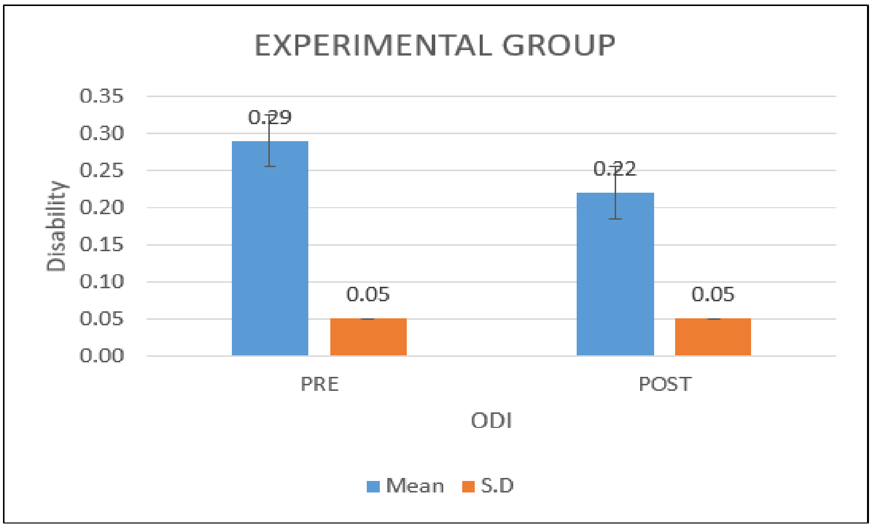

Fig 12: Comparison of PRE & POST Data of ODI score of Experimental Group.

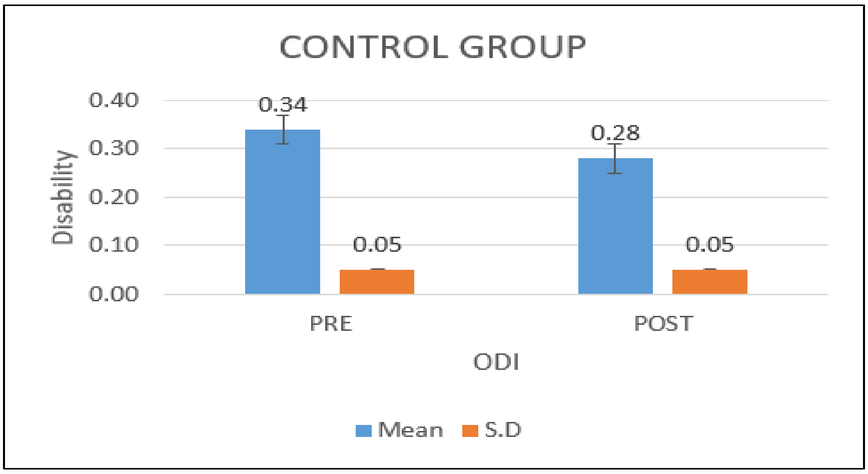

Fig 13: Comparison of PRE & POST Data of ODI score of Control Group

Table 4: Inter-group analysis between Group A and Group B to compare and find the effectiveness of interventions on pain intensity and functional status in patients with non-specific chronic low back pain.

Outcome measures	GROUP	Mean ± SD	t	df	p	Remarks
VAS	Group A	4.53 ± 0.88	-2.792	28	0.004	S
	Group B	5.47 ± 0.88				
ODI	Group A	0.22 ± 0.05	-3.077	28	0.002	S
	Group B	0.28 ± 0.05				

S =Significant

In inter-group comparison, Group-A (Experimental Group) showed significant improvement over Group B concerning pain intensity (VAS) and functional status (ODI) as p-value <0.05 (post-treatment) with a mean VAS score of 4.53 and mean ODI score of 0.22 as compared to Group-B (Control Group) where the mean VAS score is 5.47 and mean ODI score is 0.28 (Table- 4).

5. DISCUSSION

The emergence of low back pain is correlated with dysfunction of the main stabilizers of the trunk, which are the transverse abdominis, multifidus, diaphragm, and pelvic floor muscles. These muscles work together by contracting synergistically to increase intra-abdominal pressure (IAP), offering postural and trunk stability.[5] The present study was conducted for a total of 6 weeks program where 30 participants were randomly allocated into two groups (15 each) to receive a physiotherapy intervention consisting of a moist hot pack, Diaphragmatic breathing exercise, Pelvic floor exercise, Conventional back exercise as Group A and Group B to receive Moist hot pack and Conventional back exercise program. Parameters like the visual Analog Scale (VAS) and Oswestry Disability Index (ODI) were used to study the efficacy of pain intensity and functional status in patients with non-specific chronic low back pain. Every single subject completed their therapy session. Therefore, no drop-outs were recorded. The present study confirms that after six weeks of treatment, group A, who received a physiotherapy regimen of a Moist hot pack, Diaphragmatic breathing exercise, Pelvic floor exercise, and Conventional back exercise showed significant improvement in pain intensity on VAS and disability status on ODI as compared to group B who received Moist hot pack and Conventional back exercise program. The subjects in group A were made to perform the diaphragmatic breathing exercise (DBEx) at five sets of 10 repetitions per session,[5] 25 to 100 contraction cycles of 6 seconds hold followed by 6 seconds rest for the pelvic floor exercise[19] and conventional back exercise after receiving moist hot pack for 15 minutes.[25,26] Hence supporting the study of Peter Ronai (2013) that says exercise is beneficial to improve health-related quality of life for persons with CNSLBP and that a slower rate of exercise program progression, volume, and intensity must be warranted in such individuals.[7] The pelvic floor provides hammock-like support at the base of the pelvis[27] and is the foundation for all movement, balance, stability, and flexibility.[19] The PFM exercise was designed to co-activate abdominal and superficial deep core muscles, improve pain, and improve ODI scores. The present study also supports the findings of Bhatnagar et al. 2017 where they evaluate the comparison of pelvic floor exercises and conventional regimens in patients with chronic low back pain. Thirty chronic low back pain patients aged 25-50 were randomized to two groups. Group-A received a conventional regimen, while Group B was subjected to the pelvic floor exercise. The study concluded that pain intensity (NPRS) and ODI scores were significantly lower in Group B at the end of 6 weeks. [4] The results of the present study are also consistent with the findings of others, who demonstrated the superiority of pelvic floor muscle exercises to conventional treatment. [19,28] Pelvic floor muscle exercises strengthen long-lasting structural support of the pelvis by raising the levator plate to a higher location in the pelvis and enhancing hypertrophy and stiffness of the pelvic floor muscle and connective tissues. Studies show that pelvic floor muscle exercises could prevent perineal descent during increased intra-abdominal pressure and facilitate automatic motor unit firing.[27] Sapsford et al., 2001; Neumann and Gill, 2002 reveal that the EMG activity of the PFM and abdominal muscles during voluntary PFM activity shows that all abdominal muscles were recruited at different levels. The PFM contributes to urinary and fecal continence and is integral to trunk and lumbopelvic stability.[4,29] According to research, co-activation of the primary low back stabilizers is necessary for building sufficient IAP and thereby supporting the spine.

When PFM strengthens, the load on the lumbar spine decreases. This may be the cause for relieving LBP in the present study.[29] Diaphragmatic breathing exercises aim to restore a proper respiratory pattern and stabilize the lumbar spine by increasing intra-abdominal pressure and activating the core structures to transfer force from the body's center to the lower extremities. According to Davies, the primary and secondary muscles involved in breathing are distributed throughout the trunk and work in unison under mutually controlling neuromuscular control to keep the trunk stable in response to ongoing static/dynamic and internal/external environments. Thus, it was proposed that the transversus abdominis, external oblique, internal oblique, and multifidus muscles are more easily activated by the abdominal contraction that occurs during respiration. Sun Ja Park, in his study, reports that the application of segmental stabilization exercise accompanied by respiratory exercise improves the respiratory function and respiratory muscle strength of patients with chronic low back pain with the help of the mobilization of deep muscle.[30] Shruti Shah et al.,2020 evaluated the effectiveness of Diaphragmatic breathing (DBEx) on the improvement of pain and function and abdominal holding time as measured by NPRS, Modified Oswestry disability index, and PBU pressure holding time. Forty-six eligible patients aged between 35-55 years with non-specific mechanical low back pain were recruited and randomly allocated to Core stability (6 progressive levels) and DBEx (5 sets of 10 repetitions) and Core stability treatment groups for four weeks at home. The study concluded that core stability and diaphragmatic breathing exercises are more effective for reducing mechanical non-specific chronic low back pain. Evidence also points to a lack of active spinal control as a potential contributor to LBP since lifting and balancing increase the spine's susceptibility to loading and disc pressure. Hagins M (2011) demonstrates that individuals with LBP compensate for a higher diaphragm position and greater fatigability during a lifting task by increasing their lung volume to provide adequate intra-abdominal pressure. Kolar et al. (2012) found that people with LBP had a smaller diaphragm excursion and a higher diaphragm position. Furthermore, the crural fibers of the diaphragm form a direct anatomical connection with the spine. Therefore, DBEx retrained the breathing pattern. Additionally, an increase in intra-abdominal pressure is known to stiffen the spine and thus the control required for functional tasks. Interestingly, spinal control has been demonstrated to be positively influenced by isolated diaphragm contraction, even in the absence of abdominal and back muscle activity. As a result, frequent DBEx sessions could raise intra-abdominal pressure and reduce diaphragm fatigue. [5] According to Kim and Lee, after practicing deep breathing exercises once a day for four weeks, healthy participants with reduced tidal volume and limited rib cage excursion showed improved respiratory function and core stability. The breathing exercises consisted of five sets of 10 deep breaths each, followed by a 10-second breath hold. The findings revealed significant alterations in breathing patterns and the activation of the core muscles.[31] When the intra-abdominal pressure increases through the action of the diaphragm, the pelvic floor muscle is activated. It can contract simultaneously, thus allowing the transversus abdominis muscle to be activated easily by the contraction of the abdomen during respiration. These results suggest that the activation of the pelvic floor muscle and the transversus abdominis muscle facilitate the stabilization of the thoracic cage and lower back, leading to enhanced respiratory function.[30] Thus, from the above literature, it can be stated that the reduction of pain and disability of this study in group A is probably due to the enhanced activity of the trunk stabilizers through DBEx and PFM exercise, leading to improve stability, protecting the spine as well as reducing the load on the lumbar vertebrae and inter-vertebral discs, proper modulation of IAP, minimizing diaphragm fatigue and enhancing breathing, thus lowering the risk of lower back pain. So, in the current study, the experimental group (Group A) mean VAS score had significantly decreased from 6.20 to 4.53, ODI mean score decreased from 0.29 to 0.22, and the intergroup analysis showed improvement in both the groups, the experimental group being superior to the control group. Through this measure, we can state that the treatment protocol for group A had a significant improvement in pain and disability in patients with non-specific chronic low back pain.

6. CONCLUSION

All the interventions have brought about some improvement in each group following the treatment program. Noting the decreased mean value of VAS and ODI scores following a physiotherapy treatment in the experimental group (Group A) from 6.20 to 4.53 and 0.29 to 0.22 with a significant $p< 0.05$, the study proved that the reduction of pain and disability was probably due to the enhanced activity of the trunk stabilizers through DBEx and PFM exercise, leading to improve stability, protecting the spine as well as reducing the load on the lumbar vertebrae and inter-vertebral discs, proper modulation of IAP, minimizing diaphragm fatigue and enhancing breathing, improving the overall performance of the trunk stabilizers such as the transverse abdominis, the multifidus, the diaphragm and the muscles of the pelvic floor, thus minimizing the risk of lower back pain. Through this measure, we can state that the treatment protocol for group A, i.e., the experimental group, significantly improved pain and disability in patients with non-specific chronic low back pain.

7. LIMITATION

The sample size was small (Group A, n = 15; Group B, n = 15). In addition, there needed to be follow-up for the interventions. The strength of the lumbopelvic complex musculature was not considered due to—the lack of an objective outcome measure, such as measuring muscle activity and thickness using EMG or ultrasound.

8. AUTHORS CONTRIBUTION STATEMENT

Glory Dangmei, MPT Scholar, carried out the research work in data collection and review of the literature and prepared the thesis as a part of the curriculum of Masters in Physiotherapy. Dr. Abhijit Kalita PT, Assistant Professor, Department of Physiotherapy, guided as the primary supervisor in the study along with methodology, result analysis, and discussion of the study. Dr. Abhijit Dutta, Associate Professor, Assam Down Town University, helped review the literature and the methodology of the research work. Finally, all the authors read and approved the final version.

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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