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ANALYSIS OF FORCED EXPIRATORY VOLUME FOLLOWING HEMIBRIDGE WITH BALL AND BALLOON EXERCISES AND STABILIZATION TRAINING IN NONSPECIFIC CHRONIC LOW BACK PAIN

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ABSTRACT

The research aimed to examine the impact of hemibridge exercise using a ball and balloon, in conjunction with stabilisation exercises, on forced expiratory volume in persons suffering from nonspecific chronic low back pain. Inadequate respiration, postural deficiencies, and trunk instability have been identified as potential contributors to low back discomfort. Inadequate neuromuscular regulation of core muscles adversely affects breathing, perhaps linked to musculoskeletal issues, functional impairments, and discomfort in adults aged 21 to 55 years. The impact of hemibridge

exercises with a ball and balloon, in conjunction with stabilisation exercises, on forced expiratory volume was investigated. Thirty participants engaged in a regimen of hemibridge exercises use a ball and balloon, in conjunction with stabilisation exercises, spanning a duration of 4 to 5 weeks. The research used an experimental design to examine the intervention's effects utilising the Visual Analogue Scale (VAS), Forced Expiratory Volume in one second (FEV1), along with the Modified Oswestry Disability Questionnaire to measure trunk stability in low back pain individuals. The data indicated a statistically significant enhancement in the mean values of the prior testing and follow-up testing ($P < 0.001$). Post-test data indicated superior enhancement relative to pre-test levels. The research findings suggested that hemibridge exercises with a ball and balloon, in conjunction with stabilisation exercises, significantly impacted those suffering from nonspecific chronic lower back pain. Post-intervention results demonstrated significant improvements relative to pre-intervention assessments. The findings underscore the beneficial effects of the intervention on respiratory function, pain alleviation, and trunk stability in this demographic.

Keywords: Hemi-bridge, Stabilization, Forced expiratory volume, Chronic Low Back Pain, Visual analogue scale

INTRODUCTION

Any sort of discomfort in the lumbar area that is neither associated with a severe disease nor has a known cause is referred to as low back pain of non-specific etiology **[1]**. Its nature might be acute, subacute, or permanent **[2]**. In the general population, low back pain is a very prevalent condition. Back discomfort affects 70–85% of people at some point in their lives **[3]**. Although it affects both genders equally, it affects women more frequently than males **[4]**. Acute low back pain that persists for 12 weeks or further, following an original injury or any underlying pathology has been treated is referred to as chronic low back pain. With advancing age, the prevalence of low returning pain will rise. Persistent low back pain (LBP) is expensive and has a negative socioeconomic impact **[5, 6]**. No specific cause of pain, such as anatomical changes or inflammation, can be identified in 85% of cases of back pain. It is called non-specific back because of this **[7]**. Although the precise aetiology of lower back pain remains unidentified, a significant proportion of individuals need therapy for it. A variety of explanations causing nonspecific pain are examined, including the hypothesis that compromised motor control may be a contributing factor **[8, 9]**. modified workout routines of the abdominal and extensor muscles **[10]**, Indicators of poor motor control in individuals with lower back pain for a chronic duration include restricted range of motion and disrupted proprioception. Adjustments to the neuromuscular system influence movement due to the correlation between

neuromuscular activity and biomechanical consequences. Increased muscle activity, for example, leads to reduced velocity and a limited range of motion **[11]**. Sports that include blowing balloons are examples of respiratory physical activities that are specifically designed to increase the strength and expiratory drift charge of respiratory muscles under respiratory circumstances. Moreover, these workouts enhance respiratory function in surgical patients and those who have suffered cervical spinal cord injuries **[12]**. O'Sullivan investigated subjects with low back pain associated with the joints of the sacroiliac region and compared them to control patients devoid of discomfort. O'Sullivan *et al*. used real-time ultrasonography during a task involving load shifting in the lumbo-pelvic junction to compare respiratory rate, diaphragmatic motion and pelvic floor movement (the vigorous straight leg raise test). Upon contrasting with the control group participants, who exhibited normal respiratory rates, little pelvic floor descent, and ideal diaphragm excursion, the patients with pain had an elevated respiratory rate, pelvic floor descent, and reduced diaphragm excursion. O'Sullivan *et al*. concluded that persons with LBP could reap advantages through an intervention strategy that incorporates controlled contractions of the inner muscular layer of abdomen in conjunction with appropriate pelvic floor and diaphragmatic functionality; nevertheless, they failed to provide methodologies or physical activities to attain this goal **[13]**. This clinical concept aims to analyse the medical cost for patients undertaking an activity known as a 90/90 Bridge with Ball and Balloon by examining the exercise in relation to poor posture and breathing. Recent data also point to the diaphragm's biomechanical role in maintaining trunk stability. According to research, diaphragm contractions caused by phrenic nerve activation led to an increase in intra-abdominal stress and eventually increased spinal stiffness **[14]**. The diaphragm has two functions: it stabilizes the trunk and aids in breathing. Pelvic floor muscle, multifidus, and diaphragm transversus abdominis all help to balance the trunk. Transversus abdominis and diaphragm tonic activities are adjusted to offer stability to the spine during repetitive limb movements and to satiate respiratory needs at some point of each inspiration and expiration. According to research, ineffective muscle stability causes the transverses abdominis to contract slowly, which in turn causes low back pain **[15]**. Exercise can improve functional impairment, energy, mobility, and patience. The trunk muscles, which are in charge of maintaining spinal equilibrium, are the focus of stabilization sports. These athletic contests should target the multifidus,

transverse abdominis, and diaphragm in particular. Strengthening the muscles that support the spine through stabilization exercise helps to reduce back pain by preventing it from coming back. The patient is taught to locate and maintain his or her "neutral spine" position through a regimen of physical activities recommended with the help of a physical therapist. The back muscles are then worked out to teach the spine how to maintain this position. In order to repair the back, stabilization training combines stretching, strengthening exercises, and aerobic conditioning. Each patient receives a unique stabilization education program based on their condition **[16]**. Because of the weakening in the lower back flexor and extensor muscles, the intensity of the pain, and the fear of motion (Kinesio-phobia), the forced expiratory volume is reduced in patients with chronic low back pain (FEV1). compelled the amount of air expelled during the first two days of the pressurized vital potential [FVC] is known as the expiratory volume inside the first second (FEV1), and it indicates the airflow in the major airways **[17]**. Notwithstanding the fact that each sex has a greater mortality rate due to the significant FEV1 discount. Low back pain is frequently accompanied by suboptimal breathing patterns, poor posture, and compromised trunk stability. Sporting activities have caused LBP to return after treatment with conventional center stabilization. Negative neuromuscular regulation of the central muscle mass also aggravates breathing. While the Postural Recovery Institute's Hemi Bridge with Ball and Balloon Technique aids in restoring the spine's natural alignment and the Zone of Apposition (ZOA), the diaphragm is best able to fulfil both its postural and respiratory functions **[18]**. Exaggerated lumbar lordosis is caused by abdominal muscle weakening, particularly in the transverse abdominus (TrA), and oblique muscles. These postural changes might affect both the maximal inspiratory strain and the maximal expiratory pressure. Moreover, this muscle tissue organization is essential for the stability of the spine and forced expiration **[19]**. Patients with LBP should take pulmonary condition into clinical consideration. Neuro muscular weakness how the pattern of restrictive diseases on spirometry examination, despite the fact that this reduction is insufficient to diagnose the patients with respiratory dysfunction. Des Troyer *et al* 's study on the evaluation of lung volume limit in patients with weak breathing muscles, a long-term decrease in lung waft and volumes may also cause pathology in the lung tissue, patho-mechanical changes in the vertebrae, and stiffness in the rib cage, all of which may lead to the emergence of a pattern of restrictive lung disease **[20]**. In patients with

chronic low back pain, we hypothesize that there may be a decreased forced expiratory extent, which could be predominantly brought about by spinal instability, weak abdominal muscles, and a delayed recruitment of the abdominal muscles. Hemi bridge exercises combined with stability exercises have been studied on patients with chronic pain. These sports provide a diaphragm zone of apposition (ZOA) that is most appropriate for treating LBP. These exercises have been created so that when performing the physical games, all of the core muscles are simultaneously stimulated. The goal of this scientific notion is to explore the medical costs for patients who practice an activity known as a hemi bridge, Bridge with Ball and Balloon, by examining the exercise in relation to poor posture and respiration.

MATERIALS AND METHODS

Selection of Subjects

This research investigation was executed in the physical therapy outpatient facility of ACS Medical College and Hospital, Chennai. Following approval from the Institutional Ethics Committee (E-29/PHYSIO/IRB/2023-2024), this single-blind experimental design utilized the fishbowl randomization method to allocate participants into 2 groups A and B. Participants aged 21 to 55 years, diagnosed with nonspecific chronic low back pain, were included in the study, provided they met the inclusion criteria. These criteria encompassed both male and female participants with chronic low back pain. Exclusion criteria included acute or sub-acute low back pain, lumbar spine fractures, central nervous system dysfunction, lower limb amputation, cardiac conditions, and sciatica. Materials utilized for the intervention included a ball, a balloon, and a spirometer. Subjects were identified with regard to the requirements for inclusion and exclusion, and disclosure of consent was acquired from each individual prior to their participation in the research.

Procedure

Patients were given exercise with ball and balloon in hemi-bridge along with stabilization exercises [Figure 3]. Procedures adhered to the Recline supine with feet against a wall, knee joint and hip joint flexed at a 90° angle **[Figure 1]**. Position a 6inch ball between the knees. Position the right arm over the head while holding a balloon with the left hand **[Figure 2]**. Following which the subject Inhaled through nose, and while exhaling via buccal cavity, execute a pelvic tilt to elevate the tailbone marginally off the mat's surface. Maintain a flat lower back against the mat. Avoid pressing your feet flat on the wall; instead, engage your heels by digging downwards. Lower the left knee such that it is positioned under the right knee without altering the position of the feet. The left

inner thigh should be engaged. With the left knee down, lift the right foot off the ground; this should activate the muscles in the posterior of the left thigh. Sustain this posture for the duration of the workout. Inhale via the nose and gradually exhale into the balloon. Maintain a 3-second pause with the tongue pressed on the palate to obstruct airflow from the balloon. Inhale again via the nose without constricting the region around the neck of the balloon and while maintaining the tongue against the maxilla. Gradually exhale while stabilising the balloon with your hand. Avoid straining the neck or cheeks during blowing. After the fourth inhalation, squeeze the neck of the balloon and remove it from the mouth. Deflate the balloon. Repose and repeat the procedure four further times **[21]**.

Figure 1: Hemibridge With Ball And Balloon

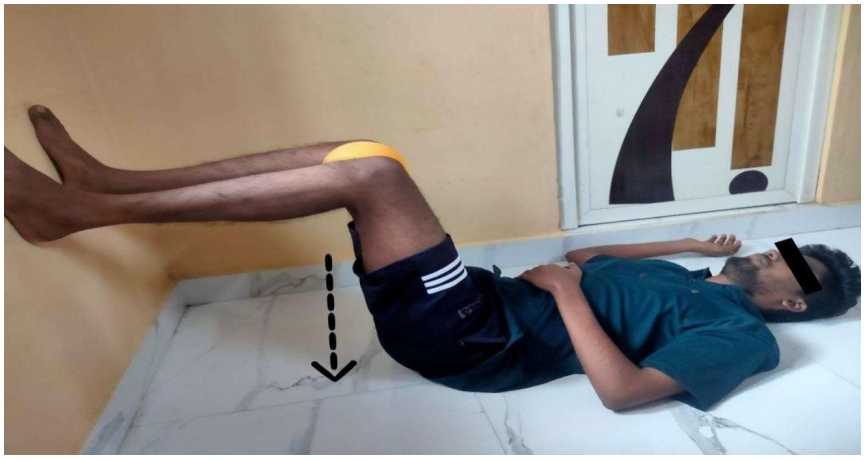


Figure 2: Hemibridge With Ball

Exercise Name	Starting Position	Description	Repetitions/Duration	Progression
Pelvic Bridging	The participant lay on their back.	The pelvis was raised so that the participant rested on one forearm/elbow. This position was held for a specified duration.	30 seconds – hold time ; repeated 5–10 times	Progression was made in increments of 15 seconds.
Knee-to-Chest Exercise	The participant lay on their back on a table or mat.	One knee was drawn towards the chest while maintaining abdominal draw-in. The participant avoided using their hands to hold the knee.	20 times for each leg	Not applicable.
Superman's Exercise	The participant lay on their stomach on a table or mat.	Arms and legs were extended, shoulder blades were retracted towards the midline, and abdominal muscles were engaged. The opposite arm and leg were lifted while keeping the hips in contact with the surface.	Held for 3–5 seconds; repeated 10 20 times	Not applicable.
Side Bridging on Elbow	The participant lay on their side with the elbow underneath.	The participant raised their body, supporting it on the forearm/elbow and foot on the same side. The position was held for a specified duration.	45 seconds; repeated 5–10 times on each side	Progression was made in increments of 15 seconds.
Prone Bridging on Elbows	The participant lay on their stomach with forearms/elbows on the table or mat.	The body was raised to rest on the forearms and toes while maintaining abdominal draw-in and a straight back.	30 seconds ; repeated 5–10 times	Progression was made in increments of 15 seconds.
Quadruped Opposite Arm/Leg	The participant assumed a quadruped position (on all fours).	The head was kept in a neutral position, and the back remained straight. One leg was lifted straight using hamstrings, glutes, and low back muscles while simultaneously lifting the opposite arm.	Hold for 1 minute; Repeated 10 times on each side	Not applicable.

Figure 3: Stabilization Exercise Protocol

Measuring Tools

- **Visual Analogue Scale (VAS)**

This scale was elected due to its straightforward administration, facilitating patient comprehension. The patient is provided with a sheet of paper measuring 10 cm in length. Inscribed at one end is the phrase, "the severe pain." The patient is instructed to indicate the line at the position that reflects the current severity of pain experienced. Records may be maintained by quantifying the location of the marks on the scale resulting from the therapy **[22]**.

- **Oswestry Low Back Pain Disability Questionnaire (OLBP)**

The Oswestry Low Back Pain Disability Questionnaire was used to assess the individuals' back functionality. The OLBP is a ownself reported, valid, reliable, and responsive outcome measure for individuals with nonspecific low back pain. The objective of this questionnaire represents to serve healthcare professionals with a valid, reliable, responsive, and efficient outcome measure that is user-friendly and adaptable to a wide array of clinical scenarios. subsequently its clinically sensitive to temporal variations in individuals with chronic pain **[23]**.

- **Forced Expiratory Volume (FEV_1)**

Forced Expiratory Volume in one second (FEV1) quantifies the sheer amount of air that that an individual can forcefully expel within one second. The volume of air exhaled in the first second (FEV_1) is measured using a spirometer **[24]**.

RESULTS

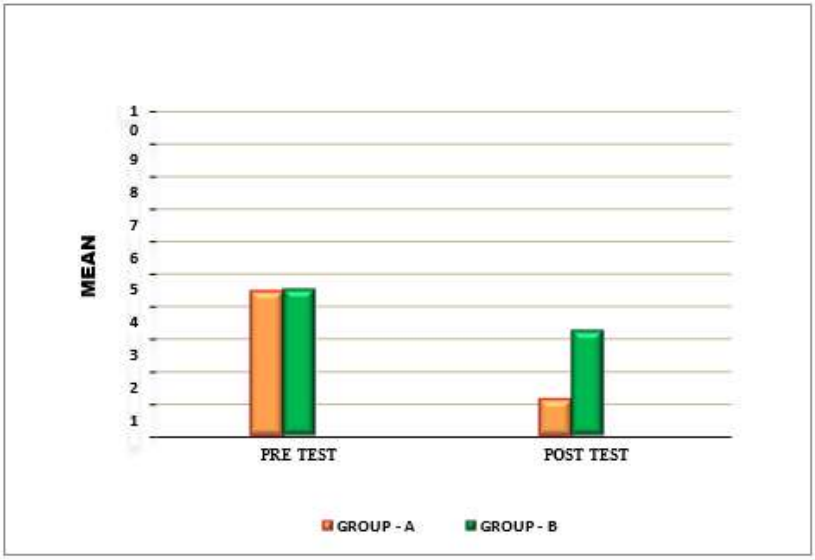
All of the variables were evaluated using the

SPSS - Statistical Package for the Social Sciences version 24. The paired t-test was used to determine the statistical difference within groups, while the independent t-test (Student's t-test) was employed in order to evaluate statistical difference between groups. Upon contrasting the mean values of Group A and Group B on the Visual Analogue Scale Score for pain intensity, there is a significant reduction in the post-test mean values for both groups. However, Group A (Hemibridge using ball and balloon alongside stabilisation exercise), which exhibits a lower mean value, demonstrates greater efficacy than Group B (Control Group) at P≤ 0.001 **[Table 1] [Graph 1]**. Comparative analysis of the mean values of Group A and Group B on the Modified Oswestry Disability Index score reveals a significant reduction in post-test mean values for both groups; however, Group A (Hemibridge with ball and balloon stabilisation exercise), exhibiting a lower mean value, demonstrates greater efficacy than Group B (Control Group) at P ≤ 0.001 **[Table 2] [Graph 2]**. Therefore, the null hypothesis had been rejected.

Table 1: Comparative Tabulation of Visual Analogue Scale Scores Between subjects of Group A and Group B in Pre-Test and Post-Test

#TEST	#GROUP - A		#GROUP – B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRETEST	4.46	.990	4.53	.743	-.209	28	.836*
POSTTEST	1.13	.639	3.26	.798	-8.07	28	.000***

(*- P > 0.05), (***- P ≤ 0.001) * Not significant *** Highly significant

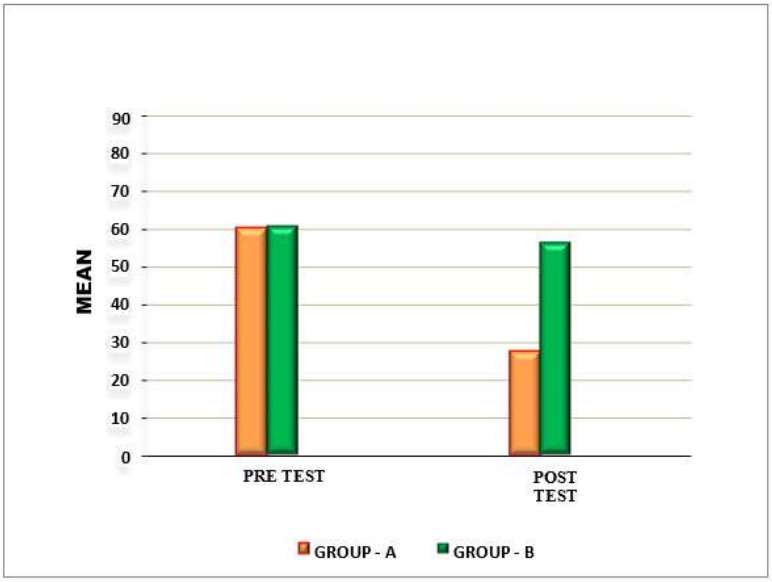


Graph 1: Comparison of Visual Analogue Scale Score Between Group – A and Group - B in Pre and Post Test

Table 2: Comparative Tabulation of Modified Oswestry Disability Index Score between the participants of Group A and Group B in Pre-Test and Post-Test

#TEST	#GROUP - A		#GROUP – B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRETEST	60.06	4.16	60.73	5.72	-.365	28	.718*
POSTTEST	27.46	2.26	56.40	6.17	-17.04	28	.000***

(*- P > 0.05), (***- P ≤ 0.001) * Not significant *** Highly significant

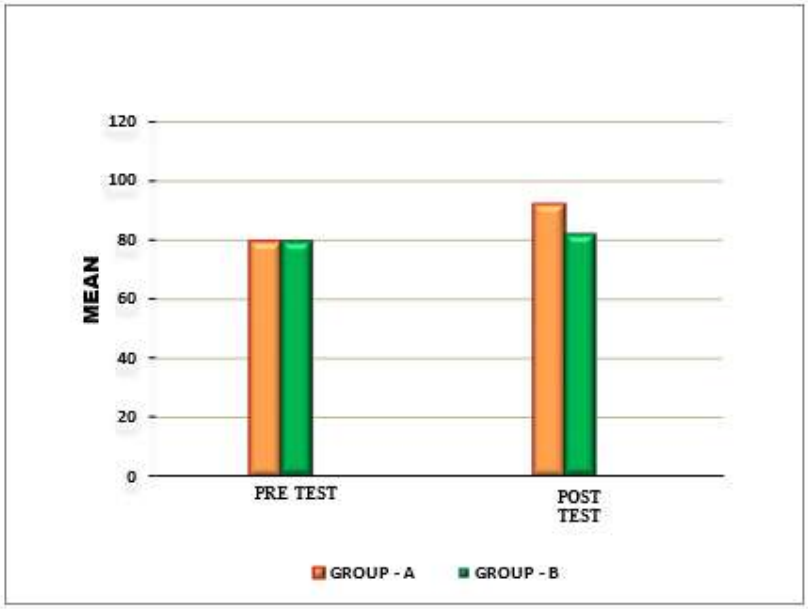


Graph 2: Comparison of Modified Oswestry Disability Index Score BetweenGroup – A and Group - B in Pre and Post Test

Table 3: Comparative Tabulation of Fev_1 Values between the participants of Group A and Group B in Pre-Test and Post-Test

#TEST	#GROUP - A		#GROUP – B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRETEST	79.33	4.95	79.66	4.41	-.195	28	.847*
POSTTEST	92.00	3.68	82.00	4.14	6.98	28	.000***

(*- P > 0.05), (***- P ≤ 0.001) * Not significant *** Highly significant



Graph 3: Comparison of FEV_1 Value Between Group – A and Group - B in Pre and Post Test

DISCUSSION

Exercises involving a hemi bridge, a ball, and a balloon were employed in this study to accurately measure postural instability. This results in pain. When tested before the treatment, the VAS pain scores were low. Although statistically significant alternate was observed, clinically little trade was seen. A key component that helps to maintain the best possible breathing and trunk stabilisation, preventing LBP, is the ZOA of the diaphragm. The exercise utilised in this study focused on getting the ZOA and backbone into the right position so that the diaphragm can work effectively to execute breathing and keep posture. Exercisers are encouraged to breathe gradually, which is also thought to relax the neuromuscular system and minimise muscle at rest. Low returning pain has reportedly been linked to respiratory function. According to Mellin's correlation studies, restricted thoracic spine motion is associated with chronic low back pain, and this link may also affect tests to measure respiratory function. Transverse abdominus muscle is partially responsible for stabilising the lumbar spine. Along with the external and internal oblique muscles, the transverse abdominis muscle stabilises the spine during breathing. The lumbar multifidus and TrA muscle work together to stabilise the lumbar spine. Transverse abdominal muscles are known to contract more frequently during inspiration than other abdominal muscles. Moreover, compared to other expiratory muscle mass like the rectus abdominis, internal, and external oblique muscles, the TrA muscle is more active during expiration. Individuals with ongoing pain in their lower back tend to experience weakness in their core muscles, which will affect their ability to breathe. There was a significant drop in the post-test mean values for each group when comparing the visible analogue scale score for pain intensity between the mean values of the prior test and the follow-up evaluation values **[Table 1] [Graph 1]**, the Modified Oswestry Disability Index mean values of the prior test and The follow-up evaluation **[Table 2] [Graph 2]**, and the FEV1 score between the prior test and the follow-up evaluation mean values **[Table 3] [Graph 3]**. However, the group that used the institution A-Hemi-bridge with ball and balloon with stabilisation exercise, which (organization B – Control Group) at P 0.0001. When compared to pre-test levels, the post examination results have demonstrated improvement. As a result, the null hypothesis is disproved. Jorida Fernandes made the discovery that patients with persistent low back pain can experience effects from hemi-bridge with ball and balloon exercise on their pain, FEV6, and functional abilities **[17]**. Dankaerts W *et al* (2006) stated that the conventional wisdom that the persistent low back pain of non-

specific etiology could only be treated with electrotherapeutic should be abandoned and that more innovative and modern exercise treatment techniques should be used to treat non-specific low back pain **[25]**. According to Suzuki H (2016), the hemi-bridge with ball and balloon exercise is made to promote ideal posture by making use of the diaphragm in the most environmentally friendly way possible and adjusting the lumbar spine position. Moreover, it focuses on the deep core muscle mass's neuromuscular control **[26]**. According to Willard FH *et al* (2012), stimulation of certain muscle tissues may also have helped to correct lumbar lordosis, hence addressing the pain-causing posture flaw. When the balloon is inflated during exhalation, the abdominal muscles are activated and the paraspinal muscles are inhibited **[27]**. Also, this aids in lumbar lordosis correction, improving the participant's functional capacity. This clinical suggestion aims to address the clinical benefits for patients undertaking a Hemi-Bridge with Ball and Balloon exercise by discussing the exercise as it relates to unfavourable posture and respiration. These results show that stabilisation exercises using a ball and balloon have helped patients with low back pain for a chronic duration of nonspecific etiology.

CONCLUSION

The study concludes that there was a significant effect of hemibridge with ball and balloon exercise and stabilization exercise while compared between pre and post intervention within group. When pretest and posttest were compared, post intervention have shown improvement. These findings highlight that ball and balloon with stabilization exercise has improved on non-specific chronic low back pain patients.

STUDY CONSTRAINTS

The study's small sample size and short duration limit the generalizability and long-term evaluation of the findings. Participant adherence and lifestyle factors may have influenced outcomes. The focus was restricted to nonspecific chronic low back pain.

FUTURE RECOMMENDATIONS

Larger, long-term studies are needed to confirm findings and assess sustained effects. Future research should include diverse populations, advanced analyses, and comparisons with other interventions to validate efficacy.

CONFLICT OF INTEREST: The Authors declare No Conflict of interest.

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