

ORIGINAL ARTICLE

EFFECT OF 90/90 HEMI BRIDGE BALL AND BALLOON EXERCISE ON PULMONARY FUNCTION AND POSTURAL ALIGNMENT IN PERSONS WITH HYPER LUMBAR LORDOSIS.

Kharwandikar Divya¹, Mahajan Aashirwad², Parihar Akshay², Ghosh Nisha³¹MPTTh (Neurophysiotherapy), ²Professor (Dept. of Cradiovascular and Respiratory PT), ³Intern, Rashtrasant Janardhan Swami College of Physiotherapy Ahilyanagar, Maharashtra.

ABSTRACT:

Background: Hyper-lumbar lordosis refers to an exaggeration of the normal lumbar anterior convexity. It is commonly associated with increased anterior pelvic tilt and hip flexion. Contributing factors may include impaired mobility of the lumbar extensors and hip flexors, along with weakness of the abdominal musculature. The 90/90 hemi-bridge with ball and balloon exercise is designed to enhance core stability, improve pelvic control, and restore the zone of apposition (ZOA).

Methodology: A single group pre-test and post-test experimental study was conducted on 33 individuals aged 18-25 years with hyper-lordotic lumbar posture were recruited according to predefined inclusion criteria. Individuals underwent a supervised 90/90 hemi-bridge with ball and balloon exercise program for 20 min/day, five days/week for four weeks. Pulmonary function parameters (FVC, FEV₁, FEV₁/FVC) and lumbar lordosis angle were analyzed pre- and post-intervention data were analyzed using paired t-tests.

Results: Significant improvements were observed in pulmonary function parameters following the intervention, with FVC and FEV₁ showing statistical significance ($p = 0.0001$) and the FEV₁/FVC ratio demonstrating improvement ($p = 0.0194$). However, no significant change was observed in lumbar lordosis angle ($p = 0.1008$).

Conclusion: The 90/90 hemi-bridge with ball and balloon exercise effectively improved pulmonary function in individuals with hyper-lumbar lordosis; however, short term intervention not show significant change was noted in lumbar curvature.

Keywords: Hyper-lumbar lordosis, Pulmonary function, 90/90 hemi-bridge ball and balloon exercise.

INTRODUCTION:

The lumbar spine plays a vital role in the vertebral column due to its unique anatomical position and direct articulation with the pelvis¹. Lumbar lordosis refers to the natural anterior curvature of the lumbar region, whereas hyper-lumbar lordosis denotes an exaggerated anterior convexity frequently observed in clinical practice^{2,3}. This abnormal curvature is characterized by increased anterior pelvic tilt and hip flexion, resulting in a greater lumbar Cobb's angle. While a Cobb's angle of 40°-60° is considered optimal, values exceeding 60° are indicative of hyper-lumbar lordosis^{3,4}. Such alterations may contribute to muscle impairments, including reduced

mobility of the lumbar extensors and hip flexors, along with abdominal muscle weakness. Contributing factors such as sustained faulty posture, pregnancy, and obesity can accentuate thoracolumbar curvature, which has also been associated with reduced pulmonary function, respiratory muscle strength, and muscle thickness^{2,4,5}. Thus, vertebral alignment directly influences respiratory health.

The diaphragm, a dome-shaped muscle with costal, lumbar, and sternal attachments, plays a dual role in respiration and postural stability. Its lumbar attachments extend between L1 and L3 on the right and between L2 and L3 on the left⁶.

*Corresponding author: Kharwandikar Divya

Email : kharwandikardivya1632@gmail.com

Rashtrasant Janardhan Swami College of Physiotherapy Ahilyanagar, Maharashtra

Loring et al. demonstrated that the optimal position of the diaphragm and the Zone of Apposition (ZOA) is critical, as it influences diaphragmatic tension, which is regulated by abdominal muscles. A reduced ZOA has been shown to compromise breathing efficiency and diminish transversus abdominis activation⁷. Suboptimal positioning of the diaphragm and ZOA may therefore result in postural deviations, limited rib cage expansion, and compensatory abdominal expansion. Over time, these adaptations can contribute to lumbar instability, impaired diaphragmatic activation, and the adoption of inefficient breathing patterns⁶.

Several studies have attempted to restore pulmonary function by modifying thoracolumbar curvature. Corrective approaches such as lumbar extension traction combined with stretching and infrared therapy have been shown to improve the sagittal lumbar curve and reduce mechanical low back pain in individuals with hyper-lumbar lordosis^{8,9}. Similarly, core stability-based corrective exercise programs have demonstrated positive outcomes in reducing exaggerated curvature¹⁰.

The Postural Restoration Institute™ developed the balloon-blowing exercise in a 90/90 hemi-bridge position, involving hip and knee flexion at 90° and a ball positioned between the knees. This technique aims to restore the ZOA and spinal alignment, thereby facilitating optimal diaphragmatic function for both respiratory and postural roles through core muscle activation⁶. Based on this principle, it was hypothesized that the 90/90 hemi-bridge with ball and balloon exercise would improve pulmonary function and postural alignment in individuals with hyper-lumbar lordosis.

METHODOLOGY:

The study design was a single group pre-test and post-test experimental study. This study was selected to assess within- subject changes in

pulmonary function and postural alignment following the intervention. Ethical approval for the study was obtained from the institutional ethics committee.

Sample size was calculated using G*Power software based on effect sizes reported in previous studies evaluating balloon blowing exercise.. Therefore, a total of fifty-two individuals were screened, of whom 19 were excluded for not meeting the inclusion criteria. The final sample consisted of thirty-three individuals s aged 18-25 years presenting with hyper-lumbar lordosis, defined by a Cobb's angle greater than 60°. This age group was chosen to minimize the influence of age related degenerative spinal changes and variability in pulmonary function, ensuring sample homogeneity. Pulmonary function testing was performed at baseline to record respiratory parameters. Exclusion criteria included individuals with a history of chronic respiratory disease, prior spinal surgery, chronic smoking, congenital spinal deformities, pregnancy, spinal cord injury, pulmonary nerve injury, ankylosing spondylitis, and Pott's spine.

Lumbar lordosis was assessed using a 40-cm flexible ruler device where the individuals were instructed to stand in a relaxed posture with the lumbar region and upper buttocks exposed, maintaining equal weight distribution on both feet positioned 15 cm apart. Arms were placed by the sides, and individuals s were asked to gaze forward to ensure a standardized position.

Anatomical landmarks were identified by palpation. The spinous process of T12 was located by tracing medially from the inferior borders of the 12th ribs, while the spinous process of S2 was identified at the midpoint between the inferior aspects of the posterior superior iliac spines (PSIS). These points were marked as the superior (A) and inferior (B) reference points, respectively.

The flexible ruler was then molded along the contour of the lumbar spinous processes between T12 and S2. The traced curve was transferred onto paper, and a straight vertical reference line (L) was drawn connecting points A and B. The deepest point of the lumbar curve was identified, from which a perpendicular line (H) was extended to intersect line L. These measurements were subsequently applied to the formula for calculating the lumbar lordosis angle:

$$\text{Lumbar lordosis angle} = 4\text{Arctan } 2H/L$$

where L represents the straight-line distance between the superior endplate of the first lumbar vertebra and the inferior endplate of the last lumbar vertebra, and H denotes the maximum perpendicular distance from the midpoint of line L to the deepest point of the lumbar curve (in centimeters)¹¹.

Pulmonary function testing was performed with individuals seated in a comfortable upright position. Each individual was instructed to inhale maximally and then exhale into the spirometer (Helios 401, RMS, India) as forcefully and completely as possible for a duration of six seconds. The maneuver was repeated three times, and the best effort was considered for analysis. Nose clips were applied to prevent air leakage. The following indices were recorded and interpreted: Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV₁) in one second, and the FEV₁/FVC ratio¹².

The 90/90 hemi-bridge with ball and balloon exercise program was implemented for 20 minutes per day, five days per week, over a four-week period. Individuals were positioned supine with their hips and knees flexed at 90° and feet placed flat against a wall. A 4-inch ball was positioned between the knees, with the right arm extended overhead and the left hand holding an uninflated balloon. During the exercise, individuals performed a posterior pelvic tilt, gently elevating the tailbone off the mat while maintaining lumbar contact with the surface. The

heels were engaged to apply downward force against the wall without forward pressure. (Fig -01) The left knee was lowered below the right and pressed into the ball to facilitate core engagement and pelvic stability. (Fig -02) The breathing component involved nasal inhalation followed by controlled exhalation into the balloon followed in both positions. Each inhalation was performed at approximately 75% of maximal capacity for 3-4 seconds, followed by exhalation lasting 5-8 seconds with a 2-3 second pause. Tongue placement on the palate was maintained to minimize air leakage. Individuals continued the cycle of inhalation and balloon exhalation without excessive recruitment of the neck or facial muscles. After the final exhalation, the balloon was released to allow air escape. Each trial consisted of six repetitions, with one-minute rest intervals between repetitions. All exercise sessions were supervised by an examiner to ensure adherence to the protocol and proper execution of the technique. Following the four-week intervention, post-intervention assessments of pulmonary function and lumbar lordosis were performed.



90/90 hemi bridge ball and balloon exercise

Figure 1



90/90 hemi bridge ball and balloon with hip shift exercise

Figure 2

RESULTS

Data were analyzed using GraphPad Instat software. Descriptive statistics for all outcome measures were expressed as mean \pm standard deviation. Pre- and post-intervention differences were evaluated using paired t-tests, with statistical significance set at $p < 0.05$. Significant improvements were observed in pulmonary function parameters following the intervention. FVC and FEV₁ in one second demonstrated highly significant improvements ($p = 0.0001$), while the FEV₁/FVC ratio also showed a statistically significant increase ($p = 0.0194$). In contrast, no statistically significant change was noted in postural alignment as measured by lumbar lordosis angle ($p = 0.1008$).

The detailed findings are summarized in below Table

Table 1: Pre- and Post-Intervention Comparison of Lumbar Lordosis Angle and Pulmonary Function Parameters

Outcome Measure	Pre (Mean \pm SD)	Post (Mean \pm SD)	p-value	t-value
Lumbar Lordosis Angle (°)	53.45 \pm 6.09	53.42 \pm 6.12	0.1008 (ns)	1.69
FVC	67.45 \pm 7.55	85.48 \pm 9.61	0.0001**	14.11
FEV1	79.12 \pm 8.95	98.48 \pm 10.78	0.0001**	11.18
FEV1/FVC Ratio	116.67 \pm 4.84	112.52 \pm 10.29	0.0019**	2.46

The findings of the present study demonstrated that performing balloon-blowing exercises in the 90/90 hemi-bridge position with a ball placed between the knees was effective in improving pulmonary function parameters in individuals with hyper-lumbar lordosis. Significant improvements were observed in FVC, FEV₁ in one second, and the FEV₁/FVC ratio following the four-week intervention, indicating enhanced respiratory efficiency and pulmonary mechanics. Despite these favorable outcomes in pulmonary function, the intervention did not result in a statistically significant change in lumbar curvature as assessed by Cobb's angle. This

suggests that while the balloon-blowing exercise protocol facilitated measurable improvements in respiratory function, it was not sufficient to induce structural or postural changes in the lumbar spine within the given study duration.

The results highlight the potential role of targeted breathing exercises, particularly when combined with specific postural positions such as the 90/90 hemi-bridge, in enhancing pulmonary function among individuals with postural deviations. However, addressing structural spinal alignment may require longer intervention periods, additional corrective exercises, or a multimodal rehabilitation approach.

DISCUSSION

The present study investigated the effects of the 90/90 hemi-bridge with ball and balloon-blowing exercise on pulmonary function and lumbar curvature in young adults with hyper-lumbar lordosis. The results demonstrated significant improvements in pulmonary function parameters, including FVC, FEV₁, and the FEV₁/FVC ratio, following the intervention, whereas no significant change was observed in lumbar curvature as assessed by Cobb's angle. These findings indicate that targeted breathing exercises can effectively enhance respiratory function, but structural postural adaptations may require more prolonged or multimodal interventions.

The significant improvements in FVC and FEV₁, with highly significant p-values ($p = 0.0001$), suggest that the intervention enhanced respiratory mechanics through increased activation of abdominal and intercostal muscles. The improvement in the FEV₁/FVC ratio ($p = 0.0194$) further highlights a positive influence on ventilatory efficiency, which is particularly relevant in individuals with altered spinal alignment who often demonstrate compromised pulmonary performance^{2,4,5}.

These outcomes are consistent with previous studies by Seo and Mi-Suk et al. who reported significant gains in pulmonary function, including FVC, FEV₁, and peak expiratory flow, after balloon-blowing exercises in the 90/90 bridge position in young females¹³, while Rose et al. observed similar improvements in pulmonary parameters among asymptomatic individuals following the same protocol¹⁴. Together, these findings reinforce the idea that balloon-blowing in the hemi-bridge position restores diaphragmatic efficiency, promotes rib cage mobility, and strengthens the expiratory muscles. The underlying mechanism may be explained by the restoration of the Zone of Apposition (ZOA), which optimizes diaphragmatic alignment and function^{6,7}. Balloon resistance during exhalation increases expiratory resistance, thereby facilitating greater activation of the abdominal musculature and improving diaphragmatic efficiency. Restoration of the zone of apposition optimizes the diaphragm's length-tension relationship, allowing more effective force generation during inspiration and expiration. Additionally, slow controlled breathing against resistance promotes neuromuscular relaxation and improved ventilatory efficiency, explaining the gains observed in FVC and FEV₁ in this study.

In contrast, no significant change was observed in lumbar curvature as measured by Cobb's angle ($p = 0.1008$). This finding suggests that although respiratory efficiency improved, structural postural deviations such as hyper-lumbar lordosis may not be sufficiently responsive to short-term interventions focusing primarily on breathing mechanics. Exaggerated lumbar curvature is influenced by multiple musculo-skeletal adaptations, including shortened hip flexors, weakened abdominals, and increased anterior pelvic tilt^{2,3,4}. Correcting such structural alterations often requires prolonged

interventions incorporating targeted stretching, strengthening, and postural retraining. Previous studies employing lumbar extension traction with adjunctive therapy^{8,9} or core stability-based corrective exercise programs¹⁰ have demonstrated significant reductions in excessive lumbar lordosis, in contrast to the present findings where spinal alignment remained unchanged. The discrepancy can be explained by the intervention's focus on respiratory rather than structural correction and the relatively short duration of four weeks. It is therefore reasonable to suggest that combining balloon-blowing exercises with corrective postural training may provide greater benefits for both spinal alignment and pulmonary outcomes.

The demonstrated improvements in FVC and FEV₁ indicate that balloon-blowing in the 90/90 hemi-bridge position is an accessible, cost-effective, and non-invasive strategy to enhance pulmonary function in this population. Nevertheless, since no significant change in lumbar curvature was observed, clinicians are advised to integrate such breathing interventions with corrective postural strategies, such as hip flexor stretching, core strengthening, and spinal mobility training, to achieve comprehensive rehabilitative outcomes.

The present study has certain limitations, including a relatively small sample size, restriction of individuals to those below the age of 25 years, limited specifications regarding individual characteristics, and a short intervention duration. Despite these constraints, the 90/90 hemi-bridge ball and balloon exercise demonstrated notable strengths, particularly in enhancing and facilitating improvements in pulmonary expansion and overall respiratory function. Future research with larger sample sizes, broader age groups, and longer intervention periods is warranted to validate and extend these findings.

CONCLUSION

The present study demonstrated that the 90/90 hemi-bridge ball and balloon exercise is effective in improving pulmonary function parameters, including FVC, FEV₁, and the FEV₁/FVC ratio, in individuals with hyper-lumbar lordosis. These improvements highlight the role of breathing re-education in enhancing respiratory efficiency. However, the intervention did not produce significant changes in lumbar curvature as measured by Cobb's angle, suggesting that postural alignment may require a longer intervention duration or the integration of additional corrective strategies.

Overall, this exercise can be considered a beneficial adjunct for improving pulmonary outcomes in individuals with hyper-lumbar lordosis, while further research is recommended to investigate its long-term effects on spinal alignment and to explore combined approaches that target both respiratory and musculoskeletal health.

Acknowledgement: We would like to express our gratefulness to RJS College of Physiotherapy for granting authorization and institutional support to conduct and publish this work.

Funding: None

Conflict of Interest: No Conflict of Interest

REFERENCES

- Rahmani M, Zandi S, Minoonejad H. Effect of a core stability-based corrective exercise program on posture and functional movement patterns in male adults with lumbar hyper-lordosis. *International Journal of Sports Science and Coaching*. 2022.
- Barron BA. Review of Rehabilitation of the Spine: A Practitioner's Manual, edited by C Liebenson. *Journal of Occupational Rehabilitation*. 2007;17(1):167–168. doi:10.1007/s10926-006-9063-y.
- Kisner C, Colby LA, Borstad J. *Therapeutic exercise: foundations and techniques*. 7th ed. Philadelphia (PA): F.A. Davis Company; 2020.
- Anim-Sampong S, Baddoo H, Naaeder S, Nuamah MA. Cobb angle measurements on lateral lumbar radiographs obtained in the lateral recumbent position: a Ghanaian study. *PLOS One*. 2022;17(6):e0269932. doi:10.1371/journal.pone.0269932.
- Rahman NN, Singh D, Lee RY. Correlation between thoracolumbar curvatures and respiratory function in older adults. *Clinical Interventions in Aging*. 2017;12:523–529. doi:10.2147/CIA.S110329.
- Boyle KL, Olinick J, Lewis C. The value of blowing up a balloon. *North American Journal of Sports Physical Therapy*. 2010;5(3):179–188.
- Loring SH, Mead J. Action of the diaphragm on the rib cage inferred from a force-balance analysis. *Journal of Applied Physiology*. 1982;53(3):756–760. doi:10.1152/jappl.1982.53.3.756.
- Dimitrijević V, Jevtić B, Nikolić M, Madić D. Effects of corrective exercises on lumbar lordotic angle correction: a systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*. 2022;19(8):4906. doi:10.3390/ijerph19084906.
- Diab AA, Moustafa IM. The efficacy of lumbar extension traction for sagittal alignment in mechanical low back pain: a randomized trial. *Journal of Back and Musculoskeletal Rehabilitation*. 2013;26(2):213–220. doi:10.3233/BMR-130372.
- Thangasheela GJ, Selvan S, Deepika A, Rajeshkumar MP, Subramaniyan A. Different types of corrective exercises on correction of hyper-lumbar lordosis in females: a narrative review. *Journal of Advanced Zoology*. 2023;44(Suppl 3):1359–1368. doi:10.17762/jaz.v44is-3.1663.

11. Reshma R, Sirajudeen MS, Chinnakalai T, Suhail M, Al-Hussinani NM, Pillai PS. Reliability of the flexible ruler in measuring lumbar lordosis among children. *Journal of Clinical and Diagnostic Research*. 2020;14(9):YC01–YC04. doi:10.7860/JCDR/2020/45472.14239.
12. Ponce MC, Sankari A, Sharma S. Pulmonary function tests. InStatPearls [internet] 2023 Aug 28. StatPearls Publishing..
13. Seo K, Cho M. Effects of a balloon-blowing exercise in a 90/90 bridge position using a ball on pulmonary function of females in their twenties. *Journal of Physical Therapy Science*. 2018;30(10):1267–1270. doi:10.1589/jpts.30.1267.
14. Rose S, Dhakal A. Effect of 90/90 bridge with ball and balloon exercise in asymptomatic subjects with suboptimal breathing: a randomized controlled trial. *Indian Journal of Physiotherapy and Occupational Therapy*. 2017;11(2):100–104. doi:10.5958/0973-5674.2017.00020.x.