RESEARCH PAPER

Effect of Pranayama on Pulmonary Functions and Exercise Tolerance in Burn Patients: A Randomized Controlled Study

Vaishnavi Jadhav[1], Ganesh B.R.[2*]

[1]Post Graduate, Department of CVTS Physiotherapy, Belagavi, Karnataka, India, Karnataka, India Email ID: vaishjadhav2621@gmail.com, ORCID ID- 0009-0001-2876-3590

[2]MPT, Ph.D, Professor and HOD, Department of CVTS Physiotherapy, KAHER Institute of Physiotherapy, Belagavi, Karnataka, India, Email ID: ganeshbr@klekipt.edu.in, ORCID ID- 0000-0002-5235-1764

Corresponding Author: Dr. Ganesh B.R.

*Professor and HOD, Department of CVTS Physiotherapy, KAHER Institute of Physiotherapy, Belagavi, Karnataka, India, Email: ganeshbr@klekipt.edu.in

Abstract

Background

Burn injuries can lead to various complications, including reduced pulmonary function and decreased exercise tolerance due to chest wall stiffness, pain, prolonged immobilization, and respiratory muscle weakness. These complications may affect the recovery and overall functional capacity of burn patients. Breathing exercises are commonly used in physiotherapy rehabilitation to improve lung function and enhance physical endurance. Pranayama, a yogic breathing technique, has been shown to improve respiratory efficiency and promote better oxygenation. Therefore, this study aimed to evaluate the effect of pranayama on pulmonary function and exercise tolerance in burn patients.

Objectives

To determine the effect of pranayama breathing exercises on pulmonary function and exercise tolerance in burn patients.

Materials and Methods

This randomized controlled study included 24 burn patients who met the inclusion criteria. The participants were randomly divided into two groups: Group A (Pranayama Breathing Exercises) and Group B (Conventional Breathing Exercises). Baseline assessment of pulmonary function was performed using spirometry to measure Forced Vital Capacity (FVC), FEV1/FVC ratio, and Peak Expiratory Flow Rate (PEFR). Exercise tolerance was assessed using the 2-Minute Walk Test (2MWT). Both groups performed their respective interventions for four weeks, five days per week, with each session lasting 30–45 minutes at moderate intensity. Post-intervention assessments were conducted using the same outcome measures.

Results

The results of the study showed significant improvement in pulmonary function and exercise tolerance following the intervention. Parameters such as FVC and PEFR demonstrated improvement, indicating enhanced lung capacity and respiratory muscle strength. Additionally, the distance covered during the 2-Minute Walk Test increased after the intervention, reflecting improved exercise tolerance and functional capacity in burn patients.

Conclusion

The study concludes that pranayama breathing exercises are effective in improving pulmonary function and exercise tolerance in burn patients. Incorporating pranayama as an adjunct to conventional physiotherapy may enhance respiratory efficiency and support better functional recovery during burn rehabilitation.

Keywords: Burn patients, Pranayama, Pulmonary function, Exercise tolerance, Breathing exercises, Physiotherapy rehabilitation.

How to cite this article: Jadhav V, Ganesh BR. Effect of Pranayama on Pulmonary Functions and Exercise Tolerance in Burn Patients: A Randomized Controlled Study. Int J Drug Deliv Technol. 2026;16(60s):1567-1578. DOI: 10.25258/ijddt.16.60s.140

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Burn injuries are among the most severe forms of trauma and contribute significantly to global morbidity and mortality. These injuries may result from thermal, electrical, chemical, or radiation exposure and can cause extensive damage to the skin and underlying tissues. In addition to local tissue destruction, severe burns produce systemic physiological responses that affect multiple organ systems including the respiratory, cardiovascular, and musculoskeletal systems.

Globally, burn injuries account for approximately 180,000 deaths each year, with the majority occurring in low- and middle-income countries. Survivors of burn injuries often experience long-term complications such as pulmonary dysfunction, muscle weakness, contractures, and reduced exercise tolerance. These complications significantly affect functional independence and overall quality of life.

Pulmonary complications are particularly common in patients with moderate to severe burns. Factors such as inhalation injury, chest wall restriction, pain, prolonged immobilization, and respiratory muscle weakness can impair ventilation and reduce lung volumes. Burn injuries involving the thoracic region may further limit

*Author for Correspondence: drganeshnssofficer@gmail.com

chest expansion due to eschar formation and scar contractures, resulting in restrictive ventilatory patterns. Reduced pulmonary function may lead to dyspnea, fatigue, and decreased tolerance to physical activity.

Another important challenge in burn rehabilitation is exercise intolerance. Burn injuries trigger a hypermetabolic state characterized by increased energy expenditure and muscle protein breakdown. Prolonged hospitalization and immobilization also contribute to skeletal muscle deconditioning and reduced cardiovascular endurance. Consequently, many burn survivors demonstrate reduced aerobic capacity and impaired functional mobility.

Physiotherapy plays a crucial role in burn rehabilitation by preventing complications, improving respiratory function, and restoring physical capacity. Conventional respiratory interventions include deep breathing exercises, chest physiotherapy, positioning, and graded exercise programs.

Pranayama, a yogic breathing technique, involves controlled regulation of inhalation, exhalation, and breath retention. Regular practice of pranayama has been shown to improve lung ventilation, respiratory muscle strength, and autonomic nervous system balance. Studies conducted in individuals with respiratory disorders have demonstrated significant improvements in pulmonary function following pranayama practice.

Despite these benefits, limited research has evaluated the effectiveness of pranayama specifically in burn patients. Therefore, the present study aims to evaluate the effect of pranayama on pulmonary function and exercise tolerance in burn patients.

MATERIALS AND METHODS

This randomized controlled study was conducted to evaluate the effect of pranayama on pulmonary function and exercise tolerance in burn patients. The study was carried out in the burn rehabilitation unit of a tertiary care hospital. A total of sixty burn patients were recruited for the study and randomly assigned into two groups: an experimental group and a control group. Each group consisted of thirty participants. The experimental group received pranayama exercises in addition to conventional physiotherapy, whereas the control group received only conventional physiotherapy.

Participants were selected according to predefined inclusion and exclusion criteria. Patients aged between 18 and 60 years with burn injuries involving 10–40% total body surface area and who were medically stable were included in the study. Participants were required to be able to understand and follow verbal instructions and capable of performing physical activity required for the exercise tests. Patients with severe inhalation injuries requiring mechanical ventilation, pre-existing chronic pulmonary diseases, unstable cardiovascular conditions, or neurological and musculoskeletal disorders affecting mobility were excluded from the study.

All procedures were conducted in accordance with ethical standards. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to their inclusion in the study. Participants were informed about the purpose and procedures of the study before the intervention began.

ASSESSMENT

Pulmonary function was assessed using spirometry, which is a widely used method to measure lung capacity and respiratory performance. The primary spirometry parameters measured in this study were Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1). Participants were instructed to sit comfortably and perform a maximal inhalation followed by a forceful exhalation into the spirometer according to standardized procedures. The highest value obtained from repeated trials was recorded for analysis.

Exercise tolerance was evaluated using the Two-Minute Walk Test (2MWT). The test was conducted on a flat corridor measuring thirty meters in length. Participants were instructed to walk at a comfortable pace for six minutes while covering as much distance as possible. Standardized verbal encouragement was provided during the test to maintain motivation. The total distance walked by the participant in six minutes was recorded in meters and used as an indicator of exercise tolerance and functional capacity.

PROCEDURE

Participants who met the inclusion criteria were recruited and randomly allocated into either the experimental group or the control group. Before the intervention began, baseline assessments of pulmonary function and exercise tolerance were performed for all participants. Spirometry measurements were taken to determine FVC and FEV1 values, and the Two-Minute Walk Test was conducted to measure the distance walked.

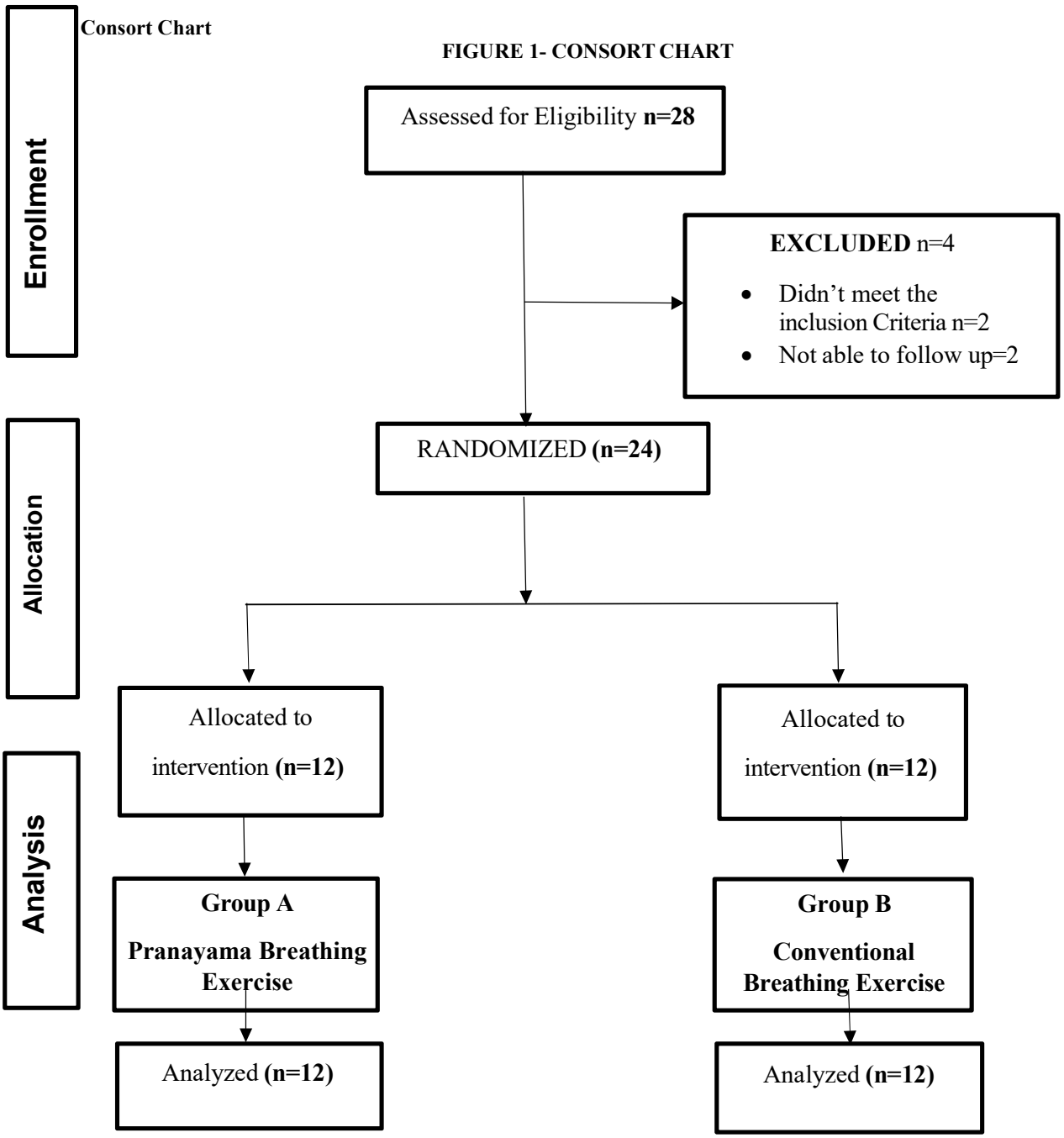
Participants in the experimental group underwent pranayama training in addition to conventional physiotherapy exercises. The pranayama program included diaphragmatic breathing, Anulom Vilom breathing, and Bhramari breathing techniques. Each session lasted approximately twenty minutes and was performed five days per week for a duration of four weeks. Participants were guided by a trained physiotherapist to ensure correct breathing technique and proper execution of the exercises.

The control group received conventional physiotherapy treatment, which included deep breathing exercises, incentive spirometry, active limb exercises, and gradual mobilization. These interventions were performed according to the standard burn rehabilitation protocol used in the hospital

After completion of the four-week intervention period, pulmonary function tests and the Six-Minute Walk Test were repeated for all participants to assess changes in pulmonary function and exercise tolerance.

Consort Chart

FIGURE 1- CONSORT CHART



Statistical Analysis

Statistical analysis for the present study was carried out using Statistical Package for Social Sciences (SPSS) software. The collected data were entered into Microsoft Excel, organized, and subjected to statistical evaluation. Descriptive statistics such as mean and standard deviation were calculated for all outcome measures.

The normality of the data was assessed prior to analysis, and since the data followed a normal distribution, parametric statistical tests were applied. The independent sample t-test was used to compare baseline characteristics between Group A and Group B. The paired sample t-test was used to analyse differences within each group by comparing pre-test and post-test values. A p-value less than 0.05 was considered statistically significant

Results

The present study aimed to evaluate the effect of the intervention on pulmonary function and functional capacity among participants. A total of 24 participants who met the inclusion criteria were recruited for the study and were randomly allocated into two groups, with 12 participants assigned to Group A and 12 participants assigned to Group B. Randomization was performed to ensure equal distribution of participants and to minimize selection bias between the groups.

Participants in Group A received the experimental intervention, while Group B served as the comparison group and followed the conventional protocol. All outcome measures were assessed both before the commencement of the intervention (pre-test) and after completion of the intervention period (post-test) to determine the effectiveness of the intervention.

The primary outcome measures used to evaluate the effects of the intervention included Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), FEV1/FVC ratio, Peak Expiratory Flow Rate (PEFR), and Two-Minute Walk Test (2MWT). These outcome measures provided a comprehensive evaluation of pulmonary function and functional capacity following the intervention.

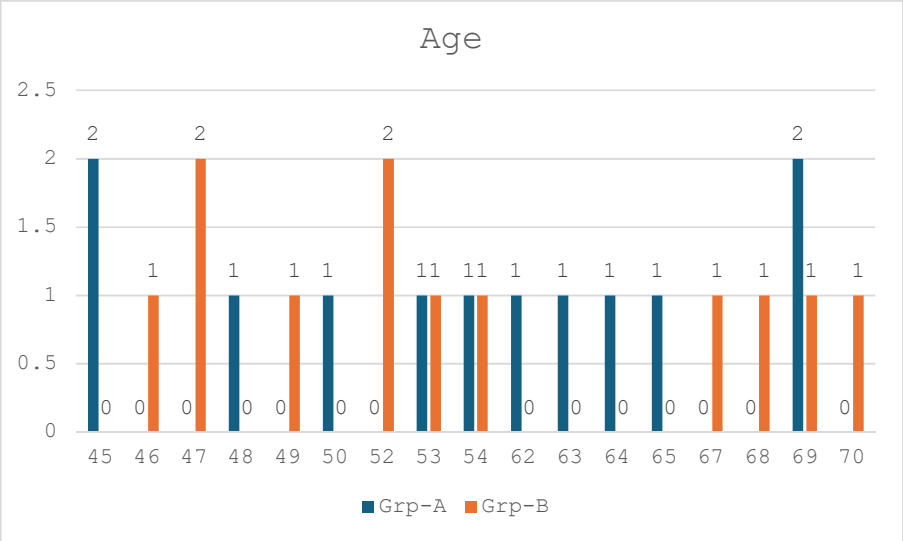
Age Distribution

The age of the participants included in the study represented the adult population. The mean age in Group A was 57.88 ± 8.25 years, whereas in Group B it was 58.00 ± 8.76 years. Statistical analysis revealed no significant difference between the groups (p = 0.967).

Inference: Both groups were age matched at baseline, indicating homogeneity and minimizing the influence of age as a confounding factor.

		Group		Total
		Grp-A	Grp-B	
	45.00	2	0	2
	46.00	0	1	1
	47.00	0	2	2
	48.00	1	0	1
	49.00	0	1	1
	50.00	1	0	1
	52.00	0	2	2
	53.00	1	1	2
	54.00	1	1	2
	62.00	1	0	1
	63.00	1	0	1
	64.00	1	0	1
	65.00	1	0	1
	67.00	0	1	1
	68.00	0	1	1
	69.00	2	1	3
	70.00	0	1	1
Total		12	12	24

Table 1- Age and Group cross tabulation



Graph 1

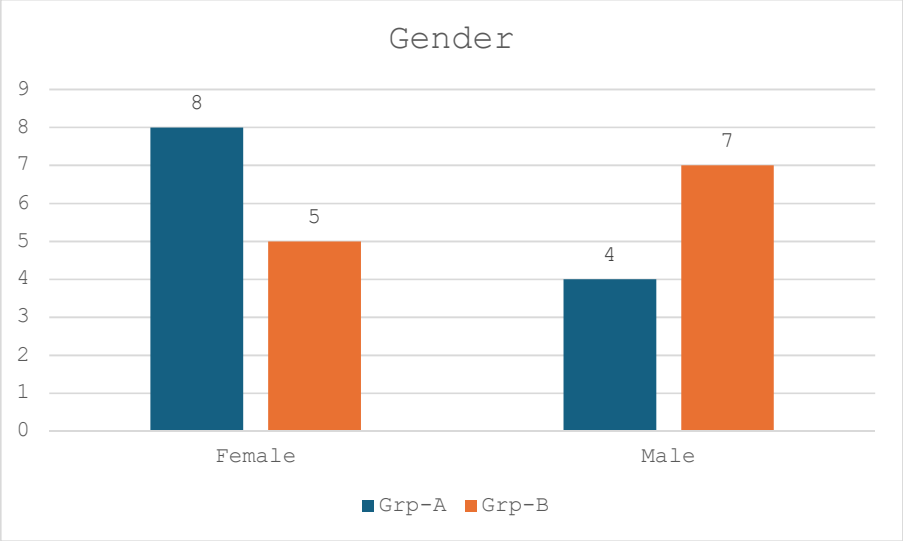
Gender Distribution (Table 2) (Graph 2)

A total of 36 participants were included in the study. In Group A, there were 10 females and 7 males, while Group B consisted of 8 females and 11 males. The gender distribution was similar between the two groups.

Inference: Both groups were comparable in terms of gender distribution, ensuring that gender did not influence the study outcomes.

		Group		Total
		Grp-A	Grp-B	
Gender	Female	8	5	13
	Male	4	7	11
Total		12	12	24

Table 2-Gender Group cross tabulation



Graph 2

Normality Test

The normality of the collected data was assessed using the Shapiro–Wilk test, as the sample size was less than 2000. The results showed that p-values for all variables were greater than 0.05, indicating that the data were normally distributed. Since the assumption of normality was satisfied, parametric tests were used for further analysis.

Within Group Analysis

Forced Vital Capacity (FVC) (Table 3) (Graph 3)

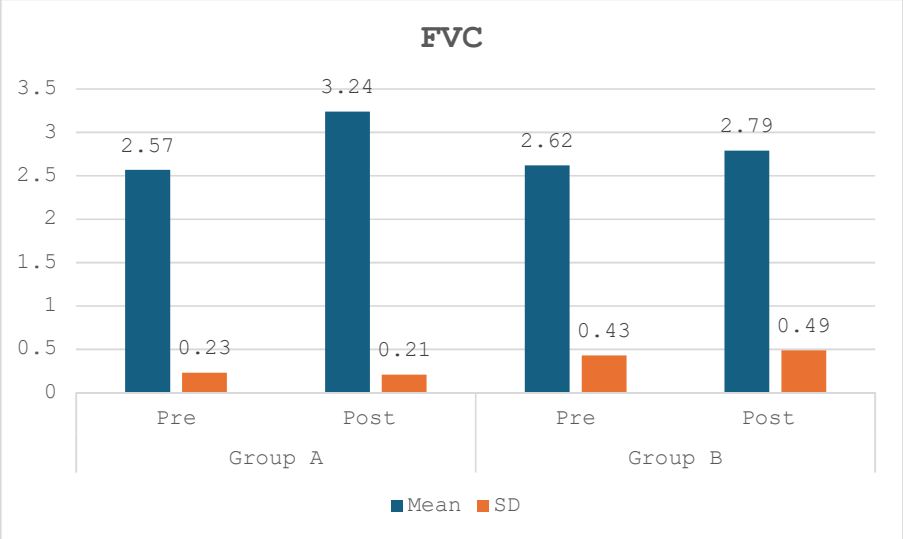
In Group A, the mean pre-test value of FVC was 2.61 ± 0.25, which increased to 3.27 ± 0.24 following the intervention. The improvement was statistically highly significant (p = 0.001) with a very high effect size (7.41).

In Group B, the mean pre-test value was 2.61 ± 0.37, which increased to 2.76 ± 0.41 after the intervention. The improvement was also statistically significant (p = 0.001) with an effect size of 1.25.

Inference: Both groups showed improvement; however, Group A demonstrated greater improvement in FVC compared to Group B.

Group	Time Frame	Mean	SD	Mean Diff.	SD Diff.	Effect size	t-value	p-value
Group A	Pre	2.57	0.23	0.66	0.09	7.38	25.568	0.001
	Post	3.24	0.21					
Group B	Pre	2.62	0.43	0.17	0.14	1.20	4.174	0.002
	Post	2.79	0.49					

Table 3- Within Group pre and post test for FVC by paired sample test



Graph 3

Forced Expiratory Volume in One Second (FEV1) (Table 4) (Graph 4)

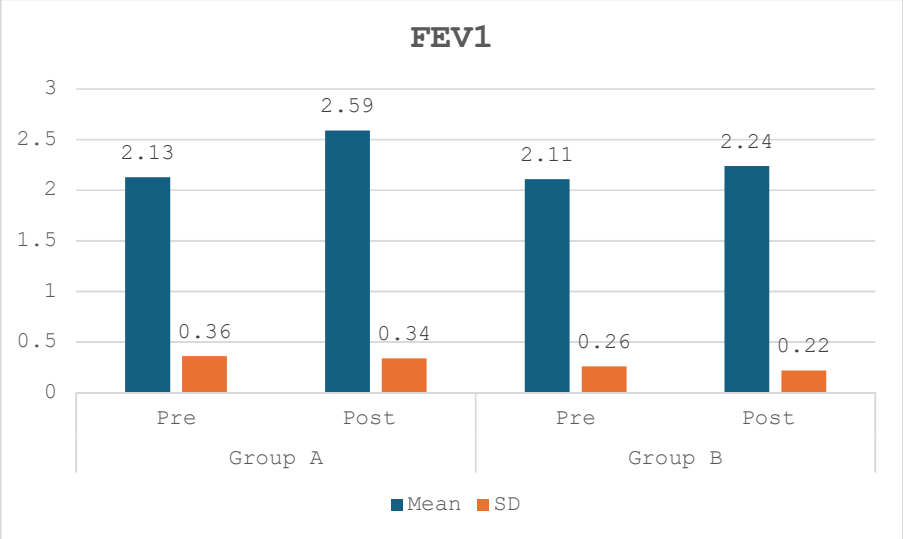
In Group A, the mean pre-test value of FEV1 was 2.08 ± 0.36, which increased to 2.57 ± 0.34 after the intervention. This improvement was statistically highly significant (p = 0.001) with a very high effect size (5.09).

In Group B, the mean pre-test value was 2.07 ± 0.29, which increased to 2.20 ± 0.27. The improvement was statistically significant (p = 0.001) with an effect size of 1.32.

Inference: Both groups showed improvement; however, Group A demonstrated greater improvement in FEV1.

Group	Time Frame	Mean	SD	Mean Diff.	SD Diff.	Effect size	t-value	p-value
Group A	Pre	2.13	0.36	0.46	0.09	4.87	16.882	0.001
	Post	2.59	0.34					
Group B	Pre	2.11	0.26	0.14	0.11	1.22	4.232	0.001
	Post	2.24	0.22					

Table 4- Within group Pre and Post Test for FEV1 by paired sample test



Graph 4

FEV1/FVC Ratio (Table 5) (Graph 5)

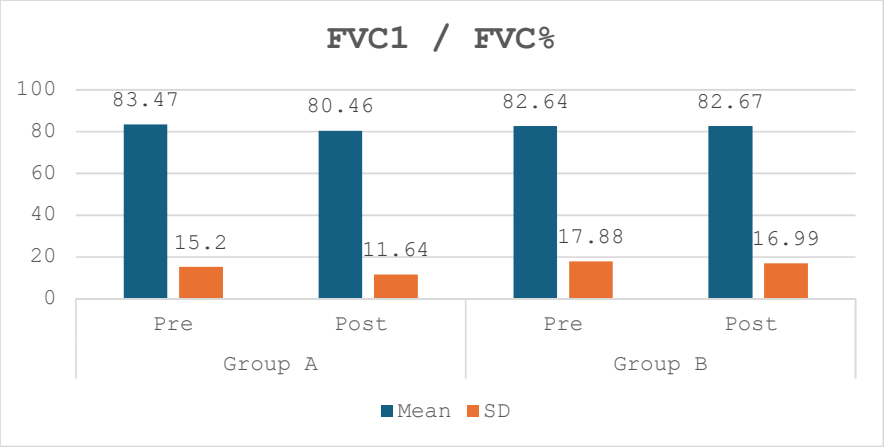
In Group A, the mean pre-test value was 80.32 ± 15.58, which slightly decreased to 79.02 ± 11.66 post-intervention. This change was not statistically significant (p = 0.330) with a low effect size (0.24).

In Group B, the mean pre-test value was 81.28 ± 17.23, which slightly increased to 81.44 ± 16.49. This change was also not statistically significant (p = 0.731) with an effect size of 0.08.

Inference: Neither group showed significant improvement in FEV1/FVC ratio.

Group	Time Frame	Mean	SD	Mean Diff.	SD Diff.	Effect size	t-value	p-value
Group A	Pre	83.47	15.20	3.01	4.85	0.62	2.148	0.550
	Post	80.46	11.64					
Group B	Pre	82.64	17.88	0.03	2.09	0.01	0.041	0.968
	Post	82.67	16.99					

Table 5- Within group Pre and Post Test for FVC / FVC by paired sample test



Graph 5

Peak Expiratory Flow Rate (PEFR) (Table 6) (Graph)

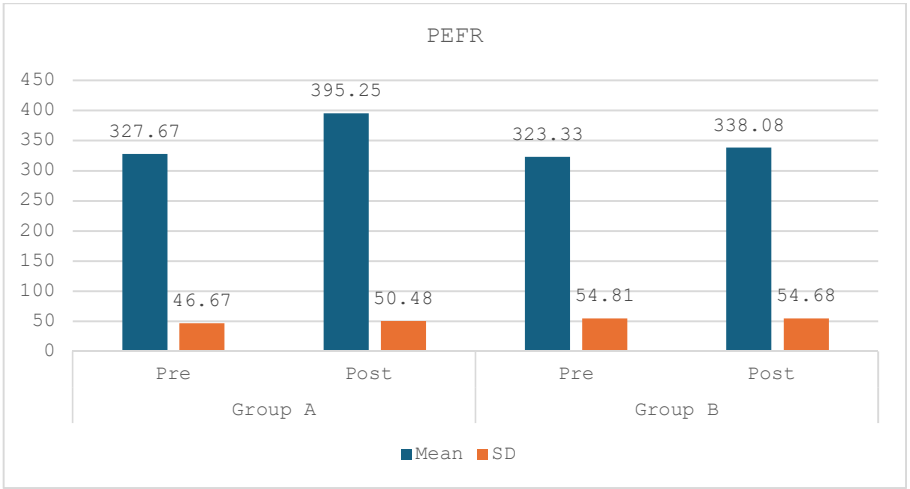
In Group A, the mean pre-test value of PEFR was 342.71 ± 48.13, which increased to 405.88 ± 46.94 after the intervention. This improvement was statistically highly significant (p = 0.001) with a very high effect size (3.58).

In Group B, the mean pre-test value was 326.42 ± 51.91, which increased to 341.32 ± 51.14. The improvement was statistically significant (p = 0.001) with an effect size of 1.66.

Inference: Group A demonstrated greater improvement in PEFR compared to Group B.

Group	Time Frame	Mean	SD	Mean Diff.	SD Diff.	Effect size	t-value	p-value
Group A	Pre	327.67	46.67	67.58	18.19	3.72	12.872	0.001
	Post	395.25	50.48					
Group B	Pre	323.33	54.81	14.75	10.90	1.35	4.689	0.001
	Post	338.08	54.68					

Table 6- Within group Pre and Post Test for PEFR by paired sample test

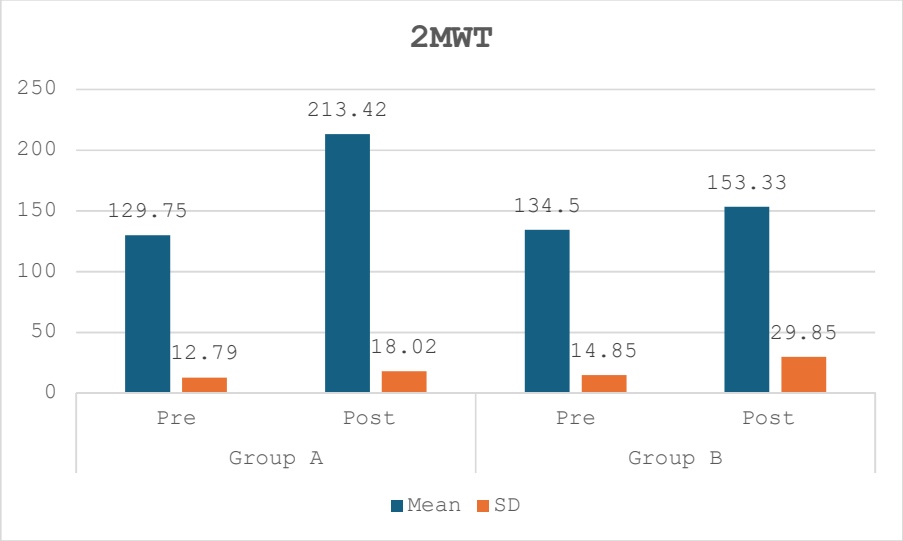


Graph 6

Two-Minute Walk Test (2MWT) (Table 7) (Graph 7)
In Group A, the mean pre-test value was 132.47 ± 14.87 meters, which increased to 216.41 ± 19.90 meters following the intervention. This improvement was statistically highly significant (p = 0.001) with a very high effect size (7.39).
In Group B, the mean pre-test value was 134.42 ± 15.60 meters, which increased to 151.05 ± 24.91 meters. The improvement was statistically significant (p = 0.001) with an effect size of 0.73.
Inference: Both groups improved, but Group A demonstrated significantly greater improvement in functional capacity.

Group	Time Frame	Mean	SD	Mean Diff.	SD Diff.	Effect size	t-value	p-value
Group A	Pre	129.75	12.79	83.67	11.99	6.98	24.163	0.001
	Post	213.42	18.02					
Group B	Pre	134.50	14.85	18.83	28.36	0.66	2.300	0.042
	Post	153.33	29.85					

Table 7- Within group Pre and Post Test for 20MWT by paired sample test

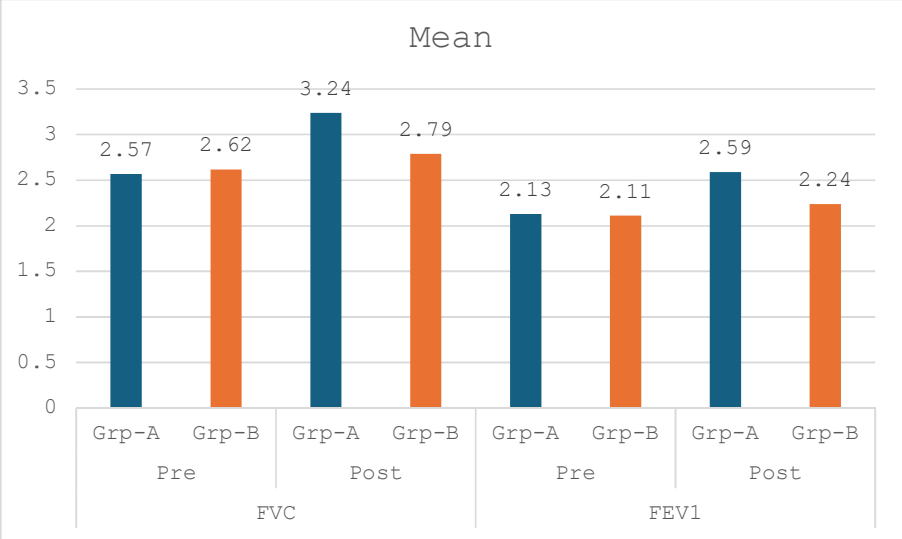


Graph7

Between Group Analysis(Table 8) (Graph 8)
The pre-test comparison between Group A and Group B showed no statistically significant difference for all variables, indicating that both groups were comparable at baseline.
However, the post-test comparison showed statistically significant differences in FVC, FEV1, PEFR, and 2MWT, favoring Group A.
For the FEV1/FVC ratio, no statistically significant difference was observed between the groups in both pre-test and post-test comparisons.
Inference: These findings indicate that Group A demonstrated greater improvement compared to Group B.

Variable	Time Frame	Group	Mean	SD	t-value	p-value
FVC	Pre	Grp-A	2.57	0.23	0.336	0.740
		Grp-B	2.62	0.43		
	Post	Grp-A	3.24	0.21	**2.872**	**0.009**
		Grp-B	2.79	0.49		
FEV1	Pre	Grp-A	2.13	0.36	0.223	0.826
		Grp-B	2.11	0.26		
	Post	Grp-A	2.59	0.34	**2.979**	**0.007**
		Grp-B	2.24	0.22		

Table 8- Between groups independent samples test



Graph 8

Clinical Significance (Effect Size Analysis)

Clinical significance was assessed using Cohen's d effect size to determine the magnitude of improvement.

Variable	Group	Effect size	Result
FVC	Group A	**7.38**	Group A is better
	Group B	1.20	
FEV1	Group A	**4.87**	Group A is better
	Group B	1.22	
FVC1/FVC%	Group A	**0.62**	Group A is better
	Group B	0.01	
PEFR	Group A	**3.72**	Group A is better
	Group B	1.35	
2MWT (M)	Group A	**6.98**	Group A is better
	Group B	0.66	

Inference: Based on the higher effect size values, Group A demonstrated greater clinical improvement compared to Group B across most outcome measures.

DISCUSSION

The present study was conducted to evaluate the effectiveness of the intervention on pulmonary function and functional capacity among participants. The findings of the study revealed significant improvements in pulmonary parameters such as Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), Peak Expiratory Flow Rate (PEFR), and functional capacity measured using the Two-Minute Walk Test (2MWT), particularly in Group A, which received the experimental intervention. These results indicate that the intervention had a positive impact on both respiratory function and overall physical performance.

The baseline characteristics of the participants, including age and gender distribution, showed no statistically significant differences between Group A and Group B. This indicates that both groups were comparable and homogeneous at baseline, thereby minimizing the influence of confounding variables. Such baseline comparability is essential in experimental studies to ensure that any post-intervention changes can be attributed to the intervention itself rather than external factors (Portney & Watkins, 2015).

With respect to pulmonary function, the present study demonstrated a highly significant improvement in FVC in Group A compared to Group B. The large effect size observed suggests a strong clinical impact of the intervention on lung volume and ventilatory capacity. This improvement may be attributed to enhanced lung expansion and improved respiratory muscle function. These findings are consistent with previous studies, which report that respiratory interventions can significantly improve lung volumes and alveolar ventilation (). Similarly, Weiner et al. reported that respiratory muscle training leads to significant improvements in FVC by enhancing chest wall mobility and respiratory muscle strength.

The results also showed a significant improvement in FEV1 in both groups, with Group A demonstrating a greater magnitude of improvement. This suggests enhanced airway function and improved expiratory efficiency following the intervention. Improved FEV1 indicates better airway patency and reduced resistance, which contributes to improved pulmonary mechanics.

These findings are supported by McConnell et al., who reported that respiratory muscle training enhances expiratory performance and airway clearance, leading to improved lung function outcomes.

In contrast, the FEV1/FVC ratio did not show a statistically significant change in either group. This indicates that although both FVC and FEV1 improved, their proportional relationship remained relatively unchanged. This finding is consistent with previous literature, which suggests that interventions may improve lung volumes without significantly affecting the FEV1/FVC ratio, particularly in individuals without obstructive pulmonary conditions Pellegrino et al., The ratio is more sensitive to airway obstruction and may not change significantly in populations without underlying respiratory pathology.

The present study also demonstrated significant improvements in Peak Expiratory Flow Rate (PEFR) in both groups, with Group A showing greater improvement. PEFR is an indicator of expiratory muscle strength and airway patency, and its improvement suggests enhanced respiratory efficiency. These findings are supported by the American Thoracic Society, which states that respiratory exercises improve expiratory flow rates by strengthening respiratory muscles and improving airway clearance mechanisms.

Furthermore, the Two-Minute Walk Test (2MWT) results indicated a highly significant improvement in functional capacity in Group A compared to Group B. This reflects enhanced exercise tolerance, endurance, and cardiopulmonary efficiency. Improved walking distance is indicative of better oxygen utilization and overall physical conditioning. These findings are consistent with previous studies, which have shown that improvements in pulmonary function are directly associated with increased functional capacity and exercise performance.

The between-group analysis further confirmed that Group A demonstrated significantly greater improvements compared to Group B in most outcome measures, including FVC, FEV1, PEFR, and 2MWT. This indicates that the experimental intervention was more effective than the conventional protocol. Similar findings have been reported in earlier studies, where structured and targeted interventions produced superior outcomes compared to standard treatment approaches.

The clinical significance of the results was further supported by the effect size analysis, which revealed very high effect sizes in Group A across most variables. According to Cohen, effect sizes greater than 0.8 are considered large, and the values observed in this study indicate a very strong clinical impact of the intervention. This suggests that the improvements were not only statistically significant but also clinically meaningful.

The observed improvements in pulmonary function and functional capacity can be attributed to several physiological mechanisms, including increased respiratory muscle strength, improved lung compliance, enhanced ventilation, and better oxygen delivery to the tissues. These mechanisms contribute to improved endurance and functional performance and are well supported in physiological literature West et al., Guyton & Hall et al.

In summary, the findings of the present study indicate that both groups showed improvement following the intervention; however, Group A demonstrated significantly greater improvements in pulmonary function and functional capacity. The results suggest that the experimental intervention is more effective and clinically beneficial compared to the conventional approach.

The present study investigated the effectiveness of pranayama in improving pulmonary function and exercise tolerance among burn patients. The findings of this study demonstrated that pranayama combined with conventional physiotherapy significantly improved pulmonary function parameters such as Forced Vital Capacity and Forced Expiratory Volume in one second. Burn patients often experience reduced lung expansion due to chest wall stiffness, pain, and restricted breathing patterns. Controlled breathing techniques such as pranayama promote deeper inhalation and prolonged exhalation, which enhance lung ventilation and strengthen respiratory muscles.

The improvement observed in exercise tolerance suggests that pranayama also contributes to enhanced cardiopulmonary efficiency. The increase in walking distance during the Six-Minute Walk Test indicates improved endurance and oxygen utilization. Controlled breathing practices may enhance oxygen delivery to tissues and reduce fatigue during physical activity. These findings are consistent with previous studies that have demonstrated the beneficial effects of breathing exercises on respiratory efficiency and functional capacity.

Pranayama may also contribute to relaxation of the nervous system and reduction of stress, which can further improve respiratory patterns and overall physical performance. Integrating pranayama into burn rehabilitation programs may therefore help accelerate recovery, improve physical endurance, and enhance functional independence in burn patients.

CONCLUSION

The present study concludes that both groups showed improvement in pulmonary function and functional capacity; however, Group A demonstrated significantly greater improvement compared to Group B. Significant changes were observed in FVC, FEV1, PEFR, and 2MWT, indicating enhanced respiratory function and exercise capacity following the intervention. The FEV1/FVC ratio did not show significant changes, suggesting that the intervention primarily improved lung volumes and expiratory performance.

Overall, the experimental intervention proved to be more effective and clinically beneficial, and it can be considered a useful approach for improving pulmonary function and functional capacity.

LIMITATIONS

1. The sample size was small (n = 24), which limits the generalizability of the study findings.

2. Being a pilot study, the results provide only preliminary evidence.
3. The duration of intervention was short, so long-term effects could not be assessed.
4. There was no follow-up period, hence sustainability of improvements is unknown.
5. External factors such as lifestyle, physical activity, and adherence were not controlled.
6. Only selected outcome measures were used; other parameters like quality of life and fatigue were not assessed.

FUTURE SCOPE OF THE STUD

1. Studies with a larger sample size are recommended for better generalization.
2. Conduct long-term studies with follow-up to assess sustainability of results.
3. Evaluate the intervention in different populations and clinical conditions.
4. Include additional outcome measures such as quality of life, fatigue, and functional independence.
5. Compare different intervention protocols, intensities, and durations.

REFERENCES

1. World Health Organization. Burns fact sheet. Geneva: WHO; 2023.

2. Cramer MN, Gagnon D, Laitano O, Crandall CG. Human temperature regulation under heat stress in health, disease, and injury. Physiological reviews. 2022 Aug 19.

3. Brusselaers N, Monstrey S, Vogelaers D, Hoste E, Blot S. Severe burn injury in Europe: a systematic review of the incidence, etiology, morbidity, and mortality. Critical care. 2010 Oct 19;14(5):R188.

4. Holm C, et al. Pulmonary dysfunction after burns. J Trauma. 2002;52(3):529–36.

5. Porter C, et al. The metabolic stress response to burn trauma. Lancet. 2016;388(10052):1417–26.

6. De Jong AE, et al. Physical outcome after burns. Burns. 2004;30(8):821–7.

7. Joshi LN, et al. Effect of pranayama on lung function. Indian J Physiol Pharmacol. 1992;36(2):105–8.

8. Madanmohan, et al. Effect of yoga training on pulmonary function. Indian J Physiol Pharmacol. 2003;47(4):387–92.

9. Bhavanani AB, et al. Pranayama and respiratory efficiency. Int J Yoga. 2012;5(2):134–8.

10. Portney LG, Watkins MP. Foundations of Clinical Research. 3rd ed. Pearson; 2015.

11. Weiner P, et al. Respiratory muscle training improves lung function. Chest. 1992;102(5):1351–6.

12. McConnell AK. Respiratory Muscle Training. Elsevier; 2013.

13. Pellegrino R, et al. Interpretative strategies for lung function tests. Eur Respir J. 2005;26(5):948–68.

14. American Thoracic Society. ATS guidelines for pulmonary function testing. Am J Respir Crit Care Med. 2002;166:518–624.

15. West JB. Respiratory Physiology: The Essentials. 10th ed. Wolters Kluwer; 2016.

16. Guyton AC, Hall JE. Textbook of Medical Physiology. 13th ed. Elsevier; 2016.

17. ATS Committee. Guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166:111–7.

18. Bohannon RW. Two-minute walk test reliability. J Geriatr Phys Ther. 2015;38(2):80–5.

19. Cramer H, et al. Yoga for improving health. Evid Based Complement Alternat Med. 2013;2013:1–12.

20. Sengupta P. Health impacts of yoga. Int J Prev Med. 2012;3(7):444–58.

21. Darnall BD. Breathing and pain management. J Pain. 2010;11(6):556–64.

22. Paratz JD, et al. Physiotherapy in burns. Burns. 2012;38(1):36–45.

23. Esselman PC. Burn rehabilitation overview. Arch Phys Med Rehabil. 2007;88(12):S3–6.

24. Schneider JC, et al. Exercise training after burn injury. J Burn Care Res. 2012;33(5):594–603.

25. Pandey S, et al. Effect of breathing exercises on pulmonary function. J Clin Diagn Res. 2015;9(5):CC04–6.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to all the participants who voluntarily took part in this study. The authors also thank the staff and management of the burn rehabilitation unit of the tertiary care hospital for their support and cooperation during the conduct of this research. Special appreciation is extended to the Department of Physiotherapy for providing the necessary facilities and guidance to successfully complete this study.

ETHICAL APPROVAL

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee prior to the commencement of the

study (Approval No. 952). All procedures involving human participants were performed in accordance with institutional and national research committee standards.

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

Novelty:
This study is one of the first randomized controlled trials to evaluate the effect of pranayama in burn rehabilitation. It introduces a combined approach of yogic breathing with conventional physiotherapy and demonstrates significant improvements in pulmonary function and exercise tolerance. The use of both spirometric and functional outcomes, along with high effect sizes, highlights the clinical relevance of pranayama as a low-cost, non-invasive adjunct in burn care.