Research Article

EFFICACY OF YOGIC PRACTICES WITH AND WITHOUT DHEERGHA SWASAM ON PULMONARY FUNCTION IN COLLEGE STUDENTS: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Objective: The objective of the study is found out the effects of yogic practices with and without Dheergha Swasam on pulmonary function among college students. Material and Methods: The study involved 45 participants were randomly assigned to three groups: the yogic practices with Dheergha Swasam group (YPDSG), the yogic practices without dheergha swasam group (YPG), and the control group (CG). Participants underwent pre-test assessments prior to starting a 12-week program of yogic practices, incorporating both the dheergha swasam intervention and standard yogic practices. Measurements included pulmonary functions such as FVC, PEFR, and RR, all assessed using a digital spirometer and Stopwatch. The same tests were administered again during the post-evaluation phase to monitor changes and evaluate the impact of the yoga interventions. Results: YPDSG had a significant improvement in pulmonary function compared to YPG and a minimal change in the control group. One-way ANOVA showed significant differences across groups [$F (2, 42) = 17.95$, $p < 0.001$, $\eta^2 = 0.46$]. PEFR increased significantly in YPDSG and YPG, but not in CG [$F (2, 42) = 20.40$, $p < 0.001$, $\eta^2 = 0.49$]. YPDSG and YPG showed significant decreases in respiratory rate, while CG showed no change ($F (2, 42) = 46.63$, $p < 0.001$, $\eta^2 = 0.68$]. The results suggest that Dheergha Swasam and yoga improve college students' lung function and respiratory efficiency. Conclusion: The results indicate that incorporating deep rhythmic breathing with yogic practices may be an effective non-pharmacological strategy for improving respiratory health and overall well-being.

Keywords: Yogic Practices, Dheergha Swasam, Forced Vital Capacity, Peak Expiratory Flow Rate, and Respiratory Rate.

1. Introduction

Yoga is an all-encompassing health practice that originated in ancient India and uses physical postures (asana), breathing techniques (pranayama), relaxation and meditation to enhance mental, emotional, physical well-being [1,2]. Researchers have shown that yoga is an excellent non-pharmacological intervention for enhancing autonomic balance, respiratory efficiency and quality of life during the past few decades. Regular yoga practice has been found to improve lung ventilation, respiratory muscle strength and breathing efficiency [3].Pranayama is one aspect of yoga that is essential to the respiratory system. Pranayama is the deliberate management and control of breathing patterns, which in turn affects physiological and mental processes. In healthy people regular pranayama practice has been shown to improve pulmonary metrics like FVC, PEFR and respiratory endurance [4,5]. Deep breathing exercises are thought to improve respiratory muscles, alveolar ventilation, airway clearance and oxygen diffusion [6,7].

Classical yoga scriptures define the fundamental concepts of pranayama as being closely related to Dheergha Swasam, a deep and rhythmic yogic breathing exercise. According to Patanjali's yoga sutras, pranayama is defined as “Tasmin sati svasa-prasvasayor gati-vicchedah pranayamah” (Sadhana Pada, Sutra 49), which means the deliberate control of breathing in and out [8]. In a same vein, Hatha Pradeepika says, “Chale vate chalam chittam, nischale nischalam bhavet” (Updesh 2, Verse 2), implying that the mind becomes steady when the breath does [9]. These traditional teachings serve as the philosophical and physiological basis for Dheergha Swasam, which improves respiratory efficiency, encourages mental tranquillity and cultivates mind –body harmony through slow, deep, rhythmic breathing that is coordinated with body movement and awareness.

The current study focused on "Dheergha Swasam" which is the practice of yoga poses combined with deep, rhythmic breathing and sound production (Nada). This technique improves the coordination between breathing and bodily movements by deliberately controlling intake and exhalation. In order to maximize oxygen intake, the practitioner slowly expands their chest and abdomen during inhalation, and they conduct a rhythmic, protracted exhalation to enable the full release of air from their lungs. Concentration, mental serenity, and breath awareness are all enhanced by Nada, the perception of subtle internal sound or vibration during breathing. Deep, calm, rhythmic inhalations and exhalations along with physical movement and sound vibration are all part of this age-old breathing practice [10]. It involves expanding the thorax, breathing from the diaphragm and balancing the breath with the body. The parasympathetic nervous system is stimulated, stress reactions are reduced and respiratory efficiency is increased by rhythmic breathing. Additionally, the vibration of the sound made during exhale may change autonomic systems, promoting calmness, relaxation and improved focus. An essential indicator of both physical fitness and respiratory health is lung function. However, college students' respiratory systems may be harmed by sedentary lifestyles, scholastics stress, a decrease in physical activity and environmental pollution. As a result, yoga breathing are becoming more well-known as preventative and health promoting treatments. Prior studies have demonstrated that in healthy adults and students yoga and pranayama enhance lung function and respiratory performance [11, 12]. Additionally, consistent yoga practice has been linked to lower respiratory rates and higher cardiorespiratory efficiency, indicating improved breathing control and autonomic modulation. Nevertheless, very few researches have looked at the extra advantages of Dheergha swasam in conjunction with yoga practices. Research on the synergistic effects of deep, rhythmic breathing and yoga poses may offer practical ways to enhance young adults' respiratory health and efficiency.

Literature review:

Yogic breathing techniques considerably enhanced pulmonary function metrics, such as FVC, FEVI, and PEFR, in healthy people, according to recent systematic review by Bandyopadhyay et al. (2026). According to the review, these yogic breathing techniques are useful non-pharmacological treatments for improving lung function and respiratory efficiency [13]. After three months of yoga practice, female college students' cardiopulmonary capacity, vital capacity and respiratory endurance significantly improved, according to Mitra et al. (2024) who investigated the effectiveness of a customized yoga module. The authors hypothesized that improved respiratory

muscle strength and oxygen utilization resulted from the combination of yoga poses and controlled breathing [14].

Apart from yoga, controlled breathing techniques have demonstrated positive impacts on lung function. According to quasi-experimental study by Karaca et al. (2013), slow controlled breathing exercise considerably enhanced autonomic balance and pulmonary function in young women in good health. The significance of diaphragmatic and rhythmic breathing in improving respiratory efficiency is supported by these results [15]. Zhang et al. (2025) found that lung function significantly improved when breathing exercises were combined with combined with plates training and respiratory muscle performance among female college students, indicating that breathing-focused exercise programs may have a beneficial effect on young adults' pulmonary health [16].

Aim:

Although research on the advantages of yoga and breathing techniques is mounting, few studies explicitly examine the extra benefits of Dheergha Swasam when combined with yogic practices in healthy college students. Therefore, the purpose of the current study was to assess how yoga practices, both with without Dheerga Swasam, affected college students' pulmonary function. Particularly after the 12-week intervention program, changes in Forced Vital Capacity, peak expiratory flow rate, Respiratory rate were noted.

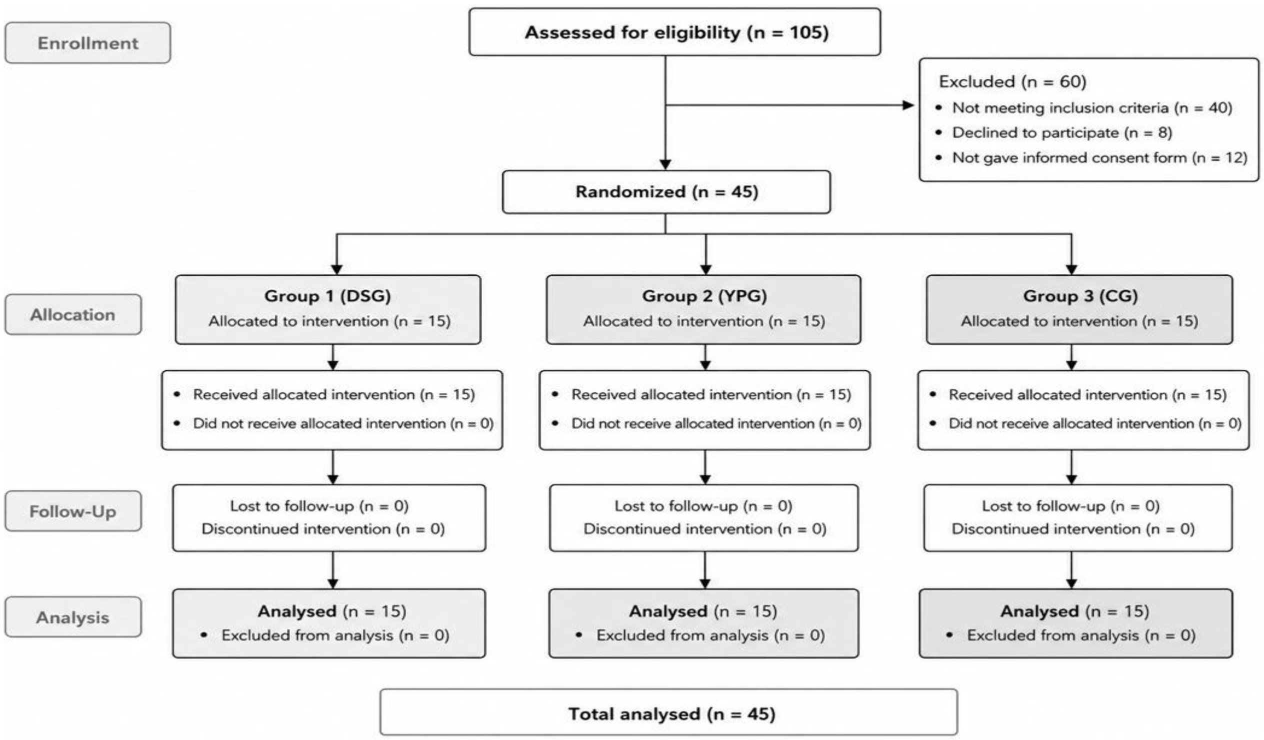
Material and Methods:

Study Design and Participants:

The purpose of this randomized controlled trial was to investigate the effects of yoga practices on specific pulmonary function measure in college students, both with and without Dheergha Swasam. After receiving approval from the Institutional Ethics Committee, the study was carried out a 12 week period (MAHER/IEC/PHD/120/April25).

Each subject voluntarily agreed to take part in the study and provided signed informed consent prior to data collection. From Sri Venkateswaraa College of Technology in Tamil Nadu, India, 45 female college students, ages 18 to 21, were chosen. To account for the well-established sex-based differences in baseline pulmonary function, the sample was limited to female participants. The average total lung capacity of healthy adult males is 6 Litres, while that of healthy adult females is 4.2 Litres. This difference can be attributed to differences in thoracic cage size, respiratory muscle mass and alveolar surface area. This source of physiological variability was reduced by limiting enrolment to a single sex, which also made it possible to compare intervention-related pre-post alterations to a more uniform baseline. Purposive sampling was used to find participants in accordance with the predetermined inclusion criteria. Following baseline screening, participants were divided into three equal groups of fifteen each; the control Group, the yogic practices with Dheergha Swasam Group, and the yogic practices without Dheergha Swasam Group.

Figure.1 Consort Flow Diagram for participants allocation:



Inclusion and Exclusion Criteria:

Healthy female college students between the ages of 18 to 21 who had not had any formal yoga instruction in the six months prior to the study and who consented to participate during the intervention period were included in the study. Participants with chronic respiratory conditions, such as asthma or chronic obstructive pulmonary disease (COPD), as well as those with cardiovascular, neurological or musculoskeletal diseases, were excluded. Participants with inconsistent attendance during the intervention period were also eliminated in order to preserve the consistency and dependability of the intervention outcomes.

Randomization:

Using a straightforward random sample procedure, participants who satisfied the eligibility requirements were divided into three groups at random. In order to minimize selection bias and guarantee an equitable distribution among the groups, this randomization was carried out using a computer-generated random allocation approach

Intervention Protocol:

Training sessions were held five days a week over the 12-week intervention period under the guidance of a certified yoga instructor. Each session was scheduled to take place in a well-ventilated yoga hall between 6am to 7am. For the yoga practices with the Dheergha Swasam Group and from 7am to 8am for without Dheergha Swasam group. Each session lasted for around 60minutes. Throughout the study period, the control group did not engage in any activities.

Table.1 – Training Protocol for 12 weeks:

Name of the yogic practices	Counts of breath	Round	Duration (Including relaxation between each asana)
Om Chanting	3	1	3 minutes
Tadasana kriya	18	1	1 minute
Artha chakra Pada hastasana kriya	18	1	1 minute
Kati chakrasana kriya	18	1	1 minute
Mukha dhouthi	18	1	1 minute
Dwi pada peetam	18	2	3 minutes
Utthana padasana	18	2	3 minutes
Utthitha padasana	18	2	3 minutes
Pawana muktasana single leg (Left & Right)	18	2	3 minutes
Pawana muktasana double leg	18	2	3 minutes
Bhujangasana	18	2	3 minutes
Artha salabhasana	18	2	3 minutes
Dhanurasana	18	2	3 minutes
Viparitakarani & matsyasana	18	2	4 minutes
Sasanga ushtrasana kriya	18	2	3 minutes
Kapalabhati kriya	120	3	5 minutes
Nadi shuddhi pranayama	-	7	7 minutes
Shanthi asana	-	2	10 minutes
Total			**60 minutes**

Outcome Variables:

The highest amount of air that may be forced out of the lungs after a deep, maximal inhalation is known as forced capacity. This measurement is expressed in litres, is an essential indicator of lung capacity and the effectiveness of respiratory muscles. Peak respiratory flow rate is the fastest air may leave the lungs during a vigorous exhale following a complete inhale. This measurement, which is given in litres per minute (L/min), represents both airway patency and the strength of the expiratory muscles. The number of breaths taken per minute while at rest is known as respiratory rate (RR) it is a measure of autonomic control and respiratory efficiency [17]

Instrumentation and Testing Procedure: The pulmonary function was evaluated using a standardized digital spirometer that was calibrated before to each testing session. While the participant was at rest, the respiration rate was recorded using a stop watch by tracking thoracic movements for a minute. To reduce observer bias, RR was evaluated by an examiner who was blind to participant's group assignment and was not involved in group allocation. Before the exam, participants were told not to engage in any strenuous physical activity. Every measurement was done in a standardized setting while seated. Three trials were conducted for each spirometer variable, and the highest value was selected for analysis. Prior to the intervention period, pre-test measurements were collected, and once the 12-week intervention program was over, post-test measurements were acquired.

Statistical Analysis:

The data was analysed using JASP software. Feasibility and recruiting limitations determined the sample size (n =45; 15 per group), which is in line with similar yogic-breathing intervention trials in the literature (e.g., references 11, 12 and 14, which used 12-20 individuals per group). This sample was sufficient to detect a large effect (Cohen's $f \geq 0.40$) according to a sensitivity analysis (one-way ANOVA, 3 groups, $\alpha = 0.05$, power = 0.80); the large effect sizes actually observed for all three outcomes (partial $\eta^2 = 0.49$-0.68) corroborate that the study was sufficiently powered. Once the required assumptions were confirmed, a one-way ANOVA was performed on the pre-to-post change score (Δ =

Parameter	Group	Test	Mean	SD	SS	MS	F	Partial η²
Forced Vital Capacity	YPDSG	Pre	2.87	0.19	2.52	1.26	17.95*	0.46
		Post	3.42	0.22				
	YPG	Pre	2.82	0.19				
		Post	3.21	0.22				
	CG	Pre	2.82	0.33				
		Post	2.84	0.33				
Peak Expiratory Flow Rate	YPDSG	Pre	358.00	23.66	22524.44	11262.22	20.40*	0.49
		Post	410.66	16.24				
	YPG	Pre	350.00	24.49				
		Post	386.66	24.68				
	CG	Pre	352.00	29.56				
		Post	356.00	27.98				
Respiratory Rate	YPDSG	Pre	19.13	1.50	212.57	106.28	46.63*	0.68
		Post	14.86	1.12				
	YPG	Pre	19.80	1.69				
		Post	15.60	1.76				
	CG	Pre	19.93	1.71				
		Post	19.80	1.568				

Post – Pre) for each outcome variable to compare the degree of improvement across the three groups. The Bonferroni post hoc test was used for post hoc analysis to pinpoint the precise group differences when significant F – ratios were found. A significance level of 0.05 was established.

Results: After confirming that all requirements for one-way ANOVA normality, homogeneity of variance, and independence of observations were satisfied, the analysis was carried to ascertain the effect of the interventions on the selected lung variables among the three groups. There were statistically significant differences between the groups in forced vital capacity, peak expiratory flow rate and respiratory rate.

Table 2. One Way Analysis of variance across the groups:

*Significant level p<0.001; SS-sum square; MS-mean square

Table 3. Post Hoc Test across the groups:

Parameter	Comparison	Mean Difference	Lower	Upper	p_{bonf}
FVC	YPDSP –YPG	-0.20	-0.44	0.03	0.117
	YPDSP – CG	0.57	0.33	0.81	< 0.001
	YPG – CG	0.36	0.12	0.60	0.001
PEFR	YPDSP – YPG	-24.00	-45.39	-2.60	0.023
	YPDSP – CG	54.66	33.27	76.06	< .001
	YPG – CG	30.66	9.27	52.06	0.003
RR	YPDSP – YPG	0.73	-0.64	2.10	0.572
	YPDSP – CG	-4.93	-6.30	-3.55	< .001
	YPG – CG	-4.20	-5.57	-2.82	< .001

Note: YPDSP- yogic practices with dheergha swasam group, YPG-yogic practices without dheergha swasam group; CG-control group

Changes in Forced Vital Capacity:

According to Table 2, the yogic practices Group rose from 2.82 to 3.21 in Forced Vital Capacity, whereas the Dheergha Swasam group improved from 2.87 to 3.42. From 2.82 to 2.84, the control group had slight change. A one-way ANOVA revealed a significant difference between the groups (Table 3), with an F ratio of $F(2, 42) = 17.95$, $p < 0.001$. The effect size (n2 = 0.46) indicates that the intervention had a moderate to high practical effect on lung capacity. These results imply that the therapies were successful in enhancing pulmonary function, especially yogic activities in conjunction with Dheergha Swasam.

The YPDSG and YPG groups did not differ significantly, according to Table 3's post hoc Bonferroni comparison (Mean = -0.20, p = 0.117). However, there were notable variations between YPDSG and CG (Mean Difference = 0.573, p< 0.001) and between YPG and CG (Mean Difference = 0.367, p = 0.001). According to these findings, both yoga practice groups outperformed the control group. Although there was a greater difference between YPDSG and YPG, it was not statistically significant.

Changes in Peak Expiratory Flow Rate:

Table 2 indicates that in terms of Forced Peak Expiratory Flow Rate, the YPDSG group exhibited a significant improvement, increasing from 358.00 to 410.66. In contrast, the YPG group saw an improvement from 350.00 to 386.66. The CG exhibited only a slight increase from 352.00 to 356.00. The ANOVA results demonstrated statistically significant differences among the groups with an F-ratio of $F(2,42) = 20.40$, $p < 0.001$. The effect size ($\eta^2 = 0.49$) suggested a substantial intervention effect, indicating that nearly half of the variance in PEFR was attributable to the treatment conditions. The greatest improvement was observed in the YPDSG, followed by the YPG.

In Table.3, Bonferroni post hoc analysis revealed significant differences among all three groups. A significant difference was observed between YPG and YPDSG (Mean Difference = −24.00, p = 0.023), between YPG and CG (Mean Difference = 30.667, p = 0.003), and between YPDSG and CG (Mean Difference = 54.667, p < .001). These findings indicate that both intervention groups showed significant improvement compared to the control group, while the YPDSG demonstrated greater improvement than the YPG.

Changes in Respiratory Rate:

Table 2 shows that, In Similarly, Respiratory Rate showed significant reductions following the intervention period. The YPDSG decreased from 19.13 breaths per minute at pre-test to 14.86 at post-test, while the YPG reduced from 19.80 to 15.60. In contrast, the CG demonstrated almost no change, decreasing slightly from 19.93 to 19.80. The One-Way ANOVA indicated highly significant differences among the groups with an F-ratio of $F(2,42) = 46.63$, $p < 0.001$. The large effect size (n2 = 0.68) reflected a strong influence of the intervention on respiratory regulation & efficiency.

The post hoc Bonferroni comparison showed (Table 3) that there was no significant difference (Mean Difference = 0.733, p = 0.572). However, both the YPDSG and YPG differed significantly from the CG. The YPG showed a significant improvement compared to CG (Mean Difference =-4.200, p<0.001) and the YPDSG also showed a significant improvement compared to CG (Mean Difference =-4.933, p <0.001). This indicates both the intervention groups were more effective, while the difference between YPDSG and YPG was not significant.

Overall, the results show that the interventions produced significant improvements in pulmonary function variables. Among the three groups, the yogic practices with Dheergha Swasam Group consistently demonstrated the greatest enhancement in FVC & PEFR and the greatest reduction in Respiratory Rate. Therefore, the results suggest that yogic practices combined with Dheergha Swasam were more effective than yogic practices alone and the control condition in improving respiratory efficiency and pulmonary health among the participants.

Discussion:

This study investigated the efficacy of yogic practices with and without Dheeergha Swasam on selected pulmonary variables among the college students. The findings demonstrated significant improvements in Forced Vital Capacity, Peak Expiratory Flow Rate, and Respiratory Rate following the intervention. Among the experimental groups, the Dheergha Swasam Group (YPDSG) exhibited greater improvement than the Yogic Practices Group (YPG), while the Control Group (CG) showed minimal changes. These results suggest that the incorporation of deep breathing techniques along with yogic practices (asana) may provide additional benefits for respiratory efficiency and pulmonary functioning.

The significant increase observed in FVC indicates enhanced lung expansion capacity and improved respiratory muscle performance. Yogic practices emphasize controlled breathing, thoracic expansion, diaphragmatic activation and postural alignment all of which contribute to better ventilation and increased pulmonary compliance [18]. The greater improvement in the YPDSG may be attributed to the regular practice of Dheergha Swasam, which encourages slow and deep inhalation and exhalation with nada, thereby improving alveolar ventilation and strengthening respiratory musculature. Deep breathing practices are also known to reduce airway resistance and facilitate optimal oxygen exchange, which may explain the superior improvement observed in this group [19].

Similarly, the improvement in PEFR reflects enhanced expiratory power and airway function. Peak expiratory flow is strongly associated with bronchial patency and respiratory muscle co-ordination. The marked increase in PEFR among the YPDSG participants suggests that the combined intervention improved airway clearance and expiratory efficiency. Yogic breathing practices may stimulate better neuromuscular coordination of the respiratory system and enhance bronchial relaxation through autonomic regulation [7]. In addition slow breathing influenced the balance between sympathetic and vagal activity, which was significantly disrupted in patients with COPD [20].

The reduction in Respiratory Rate observed in the experimental groups further supports the beneficial role of yogic intervention in respiratory regulation. A lower resting respiratory rate is commonly associated with improved cardiorespiratory efficiency and reduced physiological stress. Participants practicing dheergha swasam demonstrated the greatest reduction in respiratory rate, possibly due to enhanced parasympathetic activation and improved breath awareness. Slow and rhythmic breathing patterns help optimize respiratory mechanics, reduce unnecessary energy expenditure during breathing, and promote a calmer physiological state [21]. These adaptations may collectively contribute to improved pulmonary efficiency and respiratory control.

Diaphragmatic Breathing enhances lung expansion and thoracic capacity through improved movement of the diaphragm and increased lung volume. Improves the efficiency of diaphragmatic breathing and alveolar ventilation, resulting in better respiratory mechanics. Promotes enhanced oxygenation and respiratory endurance by increasing tidal volume and reducing the respiratory rate [22]. Breathing techniques enhance chest opening through synchronized breathing and foster efficient thoraco-abdominal coordination. They also support autonomic balance and vagal tone by increasing heart rate variability and baroreflex sensitivity [23]. Improves emotional balance and relaxation by modulating cardiovascular and emotional functions while enhancing concentration and mindful awareness through slow-paced and controlled breathing practices [24]. Pranayama improves perceived energy flow and reduces emotional tension in the chest region through relaxation and autonomic modulation. Nada vibration and chanting practices may calm the nervous system and improve inner awareness through vagal stimulation and neuromodulation [25]. After 16-weeks of neuromuscular breathing exercise with yogic practices significantly enhanced the cardiopulmonary parameters like blood pressure, FEV1, FVC, and PEFR among women asthma patients [26].

The findings of the present study are consistent with earlier investigations reporting positive effects of yoga and pranayama on pulmonary function. Previous studies have shown that regular yogic practices improve respiratory endurance, lung ventilation, airway function, and autonomic balance [18, 19]. The present results extend these observations by demonstrating that the addition of Dheergha Swasam may further augment the benefits of conventional yogic practices on respiratory health.

The statistically significant F-ratios and large effect sizes obtained in the present study indicate that the interventions produced not only statistical significance but also meaningful practical effects. The substantial effect sizes observed for respiratory variables highlight the clinical relevance of integrating breathing based yogic interventions into health promotion and respiratory rehabilitation programs.

Limitations:

Despite the positive results, this study includes a number of drawbacks. The results may not apply to male or mixed-sex populations because the study only recruited healthy female college students between the ages of 18 to 21 in order to minimize physiological variability linked to sex-based variations in pulmonary function. Furthermore, the evaluation of only a few pulmonary function markers and the rather than brief 12 week intervention period may restrict how broadly the results can be interpreted. To increase the external validity and mechanistic comprehension of the results, future research should incorporate both sexes, larger sample sizes, longer intervention periods and more physiological and biochemical variables. Overall, the present study demonstrates that yogic practices, particularly when combined with Dheergha Swasam, significantly enhance pulmonary function and respiratory efficiency. These findings support the therapeutic value of integrated yogic breathing practices as a non-pharmacological approach for improving respiratory health and overall well-being [27].

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Conflict of interest:

Regarding the information in this publication, the authors have no conflicts of interest.

Informed Consent & Ethical Approval:

The Institutional Ethics Committee (MAHER/IEC/PHD/120/April25) approved all procedures, which were carried out in compliance with the Declaration of Helsinki. The participants provided written informed consent for their involvement and the release of anonym zed clinical data.

AI Guidelines:

The authors affirm that this manuscript does not employ generative AI.

Data Accessibility:

Upon reasonable request, the corresponding author will provide the datasets used and analysed in this study. The paper itself contains all the information required to evaluate the findings reached.

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