Research Article

Nadi Shodhana As A Breathing-Based Intervention For Enhancing Psychological Well-Being and Quality of Life n College Female Students

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ABSTRACT

Background: Nadi Shodhana Pranayama, also known as alternate nostril breathing, is a traditional yogic breathing technique that may influence psychological well-being, respiratory function, and cardiovascular regulation. College students frequently experience academic and psychosocial stress, making breathing-based interventions a potentially accessible approach to promoting health and well-being.

Objective: To evaluate the effects of Nadi Shodhana Pranayama on perceived stress, quality of life, forced vital capacity (FVC), systolic blood pressure (SBP), and diastolic blood pressure (DBP) among female college students.

Methods: A quantitative, randomized controlled pre-test–post-test experimental study was conducted among 30 unmarried female college students aged 18–25 years. Participants were divided into two groups of 15 each. Group A performed Nadi Shodhana Pranayama twice daily for six weeks, while Group B continued their usual routine. Outcomes were assessed before and after the intervention using the Perceived Stress Scale (PSS), quality-of-life assessment, FVC measurement, and blood pressure measurements. Data were analyzed using paired and independent t-tests in SPSS version 25.0.

Results: Within Group A, statistically significant pre–post changes were reported in PSS ($p < 0.001$), quality of life ($p < 0.001$), FVC ($p < 0.001$), SBP ($p = 0.006$), and DBP ($p < 0.001$). Between-group comparisons indicated statistically significant differences in quality of life, FVC, SBP, and DBP, whereas the difference in PSS was not statistically significant ($p = 0.38$).

Conclusion: The findings suggest that six weeks of Nadi Shodhana Pranayama may be associated with improvements in quality of life and selected physiological parameters among female college students. However, the absence of a statistically significant between-group difference in perceived stress and inconsistencies in some reported statistical values warrant cautious interpretation. Further studies with larger samples and verified statistical analyses are required to establish its effectiveness.

Keywords: Nadi Shodhana Pranayama; alternate nostril breathing; female college students; perceived stress; quality of life; forced vital capacity; blood pressure.

INTRODUCTION

Nadi Shodhana Pranayama (NSP) is an ancient traditional breathing technique considered under Yoga specially Pranayama. A Sanskrit terminology “Nadi Shodhana” where nadi refers to subtle channels and shodhana means to Purify, here basically we use a controlled breathing technique with inhalation and exhalation alternately through the left and right nostrils. Also known as Alternate Nostril Breathing (ANB) or alternate nostril yoga breathing. Such terminology is not completely standardized; Nadi Shodhana breathing pattern may or may not depend on breath retention, breathing ratio, sequence, and the use of preparatory breathing. [1, 2] The physiological importance of Nadi Shodhana or alternate nostril breathing technique also depends on controlled respiratory modulation and on autonomic nervous system functioning. Slow, regulated breathing can modify the vitals and effect the respiratory rate, cardiovascular oscillations, heart-rate variability (HRV), and blood pressure. Previous researches suggested that nostril-specific yogic breathing could influence metabolic and autonomic variables, with voluntary manipulation of nasal airflow along with physiological responses. [3]

Some research specifically examining alternate nostril breathing showed reductions in respiratory and heart rate, along with additional reductions in systolic and diastolic blood pressure after regular routine practice. Such result findings led the researchers to suggest a shift toward parasympathetic predominance following ANB. [4] Raghuraj and Telles found effective changes in cardiovascular and autonomic parameters with alternate nostril yoga breathing, specially with reductions in systolic and diastolic blood pressure, influencing cardiovascular regulation. [5]

Similarly, Bhavanani et al. observed reductions in all cardiovascular parameters like heart heart-rate- and blood-pressure-related parameters following Nadi Shuddhi, an alternate-nostril breathing practice, whereas different responses were observed with right-nostril breathing techniques. [6] All the physiological responses are some or the other way dependant on the breathing protocols used. All around after 6 weeks it was observed that there were

significant changes in the vitals specially in CVS and ANS. [7] Depending upon the interventions, duration, breathing rate, breath retention, and outcome measures the data and results may vary. Researchers suggest that Nadi Shodhana/ANB may have beneficial effects on cardiovascular regulation, respiratory function, autonomic balance, and even the stress-related physiological responses; however, further well-designed randomized controlled trials are required to establish standardized protocols and clarify its clinical effectiveness.

Breathing interventions

The most beneficial simple, easily accessible among medical interventions is the Breathing interventions that promotes the overall physical and psychological well-being in females. Utlising common diaphragmatic breathing, slow-paced breathing, deep breathing, alternate nostril breathing, and pranayama with conscious regulation or awareness of respiration. All such techniques basically focus and influences the emotional regulation, and physiological responses to stress and Autonomic nervous regulation (Zaccaro et al., 2018). [8] Previous studies have reported that breathing interventions are effective in reducing the perceived stress, anxiety, and depressive symptoms among adults with further more protocols required in studies (Fincham et al., 2023). [9] Pursed slow breathing has also been associated with changes in heart rate and heart rate variability, effecting on cardiorespiratory regulation (Laborde et al., 2022). [10] More previous studies also reveal that breathing practices approaches for stress and anxiety reduction while highlighting the repeated practice (Hopper et al., 2019). [11] Such interventions may be beneficial for females experiencing all types of stress including academic, professional or workplace family, and reproductive-health-related stressors. Therefore, well-designed studies are needed to evaluate the effects of breathing interventions on psychological well-being, perceived stress, quality of life, and selected physiological parameters in females.

Psychological Wellbeing

Mental well-being is a crucial aspect of overall health, that involves emotional stability, a positive self-image, adaptive coping strategies, personal development, and the capability to handle daily challenges. It goes beyond merely not having mental illness; it also encompasses positive functioning, satisfaction with life, and meaningful connections with others leading to social behaviour. (Ryff, 1989; World Health Organization [WHO], 2004). Including the female health specially psychological well-being is dependent on physical, mental, social, cultural, and economic factors throughout the stages of life. Workplace demands, family responsibilities, education or academic loads, gender-based inequalities, interpersonal difficulties, and reproductive transitions may lead to changes in the psychological performances in some women (World Health Organization, 2000). Many Researches on mental health specially of females in India also focuses on the importance of gender-related social circumstances (Shidhaye & Patel, 2010). [12] Promoting psychological well-being necessitates strategies that consider both individual needs and the broader social determinants of health. Good social physical, healthy lifestyle practices with stress management skills improves emotional functioning. However, psychological well-being varies among individuals and should be assessed using appropriate, validated instruments. Assessment Tools such as the STAI, Psychological Well-Being Scales developed by Ryff (1989) and the WHO-Five Well-Being Index (WHO-5) can help researchers assess positive psychological functioning. Improving factors associated with psychological well-being in females is therefore essential for developing evidence-based interventions and promoting better quality of life. Previous Researches shows that stress and its management strategies are associated with physical health outcomes and health-related quality of life, particularly among women living with chronic health conditions. [13-16]

Alternate Hypothesis (H_1): Nadi Shodhana breathing intervention will produce a statistically significant improvement in psychological well-being and quality of life among female college students compared with baseline or a control condition.

Null Hypothesis (H_o): Nadi Shodhana breathing intervention will not produce a statistically significant improvement in psychological well-being and quality of life among female college students compared with baseline or a control condition.

METHODOLOGY

Research Design: It was a Quantitative, Experimental, Randomized Controlled pre-test–post-test.

Study Setting: The study was conducted at the Department of Physiotherapy and Allied Health Sciences, SAIMS, Indore, Madhya Pradesh, or an appropriate institutional research facility. A quiet, adequately ventilated and well-lit room was selected for administration of the Nadi Shodhana intervention. The room was free from excessive noise and other distractions to minimize environmental influences on respiratory and cardiovascular measurements. Physiological measurements were performed in the same designated assessment area, preferably at approximately the same time of day for all participants to minimize diurnal variation.

Study Population: The study population were consisting of apparently healthy young adults/college students meeting the predetermined eligibility criteria.
Sample Size: The sample size was 15 in each group, Group A (Nadi Shodhana) & Group B (Control)
Sampling Technique: Participants will initially be screened for eligibility using predetermined inclusion and exclusion criteria. Randomization will help reduce selection bias and improve comparability between the two groups.
Inclusion Criteria

1. Students aged between 18 to 25 years.
2. Apparently healthy according to the study screening procedure.
3. Are able to sit comfortably in the prescribed posture for the duration of the intervention.
4. Have not been regularly practicing Nadi Shodhana/alternate nostril breathing during the specified washout period before recruitment.
5. Are willing to attend the intervention sessions regularly.
6. Unmarried female

Exclusion Criteria

1. Diagnosed cardiovascular disease.
2. Uncontrolled hypertension or clinically significant hypotension.
3. Significant respiratory disease.
4. Neurological disorders affecting respiratory or autonomic function.
5. Severe musculoskeletal conditions preventing comfortable sitting.
6. Acute illness or infection at the time of assessment.
7. Current use of medication likely to substantially influence cardiovascular or autonomic parameters, where relevant to the study.
8. Regular practice of advanced pranayama or structured yoga breathing that could substantially influence the study outcomes.

Procedure: Experimental Group (Group A) was advised and taught to perform Nadi Shodhana Pranayama twice a day while Control group (Group B) was advised to follow normal standard routine for 6 weeks. Baseline measurements were obtained before commencement of the intervention. Following the intervention period, the same outcome measures was reassessed to determine within-group and between-group changes.

RESULTS

Data Analysis: Data was analysed by using SPSS Software 25.0.
Group A

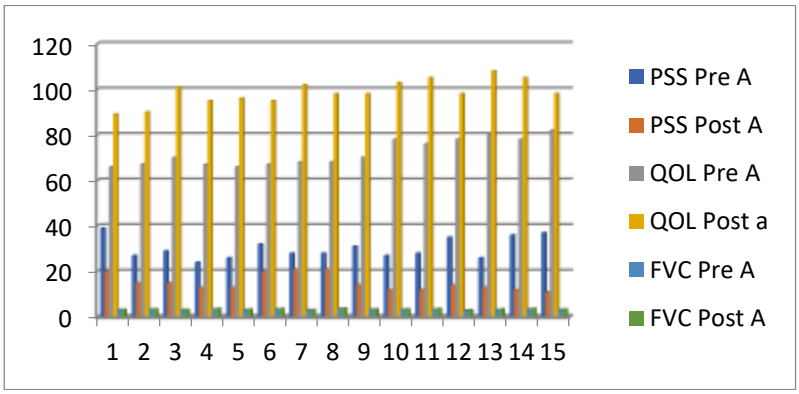
Table: 1 Mean and Standard deviation of age

Group	Mean	N	Std. Deviation
A	20.8000	15	2.17781
B	20.8000	15	2.17781

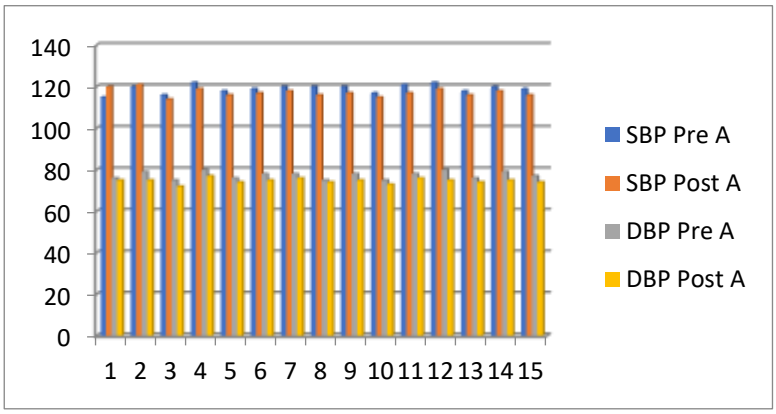
Paired t test
A paired t–test was conducted to compare the pre and post value of PSS, QOL, FVC, SBP, and DBP. There was a significant difference in the PSS pre (M=30.20, SD= 4.58), PSS post (M=32.00, SD=2.25), QOL Pre (M=72.06, SD=5.82), QOL Post (M=98.73, SD=5.39), FVC Pre (M=3.32, SD=0.160), FVC Post (M=3.47, SD=0.19), SBP Pre (M=119.13, SD=2.03), SBP Post (M=117.26, SD= 1.90), and DBP Pre (M=77.33, SD= 1.75), DBP Post (M=74.66, SD=1.23)..
The paired-samples t-test revealed a statistically significant improvement from pre-test to post-test in PSS scores, $t = 10.57$, $p < 0.001$, with a mean difference of 15.13 (95% CI: 12.06 to −18.2). QOL scores demonstrated a statistically significant improvement from pre-test to post-test, $t = −22.48$, $p < 0.001$, with a mean difference of −26.66 (95% CI: −29.21 to −24.12), FVC scores demonstrated a statistically significant improvement from pre-test to post-test, t = –-10.08, $p < 0.001$, with a mean difference of −14.93 (95% CI: −11.75 to −10.08), SBP demonstrated a statistically significant improvement from pre-test to post-test, $t = 3.23$, $p < 0.001$, with a mean difference of 1.866 (95% CI: 3.10 to 3.23),, DBP scores demonstrated a statistically significant improvement from pre-test to post-test, $t = −9.28$, $p < 0.001$, with a mean difference of 2.66 (95% CI: 3.28 to 9.28).

Table 2: Paired t test for PSS, QOL, FVC, SBP and DBP (Pre & Post)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PSS Pre–Post A	15.133	5.540	1.430	12.065	18.201	10.579	14	.000
Pair 2	QOL Pre–Post A	-26.666	4.592	1.185	-29.210	-24.123	-22.487	14	.000
Pair 3	FVC Pre–Post A	-.149	.057	.014	-.181	-.117	-10.080	14	.000
Pair 4	SBP Pre–Post A	1.866	2.231	.576	.630	3.102	3.239	14	.006
Pair 5	DBP Pre–Post A	2.666	1.112	.287	2.050	3.282	9.282	14	.000



Graph 1: Graphical representation of PSS, QOL, and FVC Pre –Post (group A)



Graph 2: Graphical representation of SBP and DBP Pre –Post (group A)

Group B

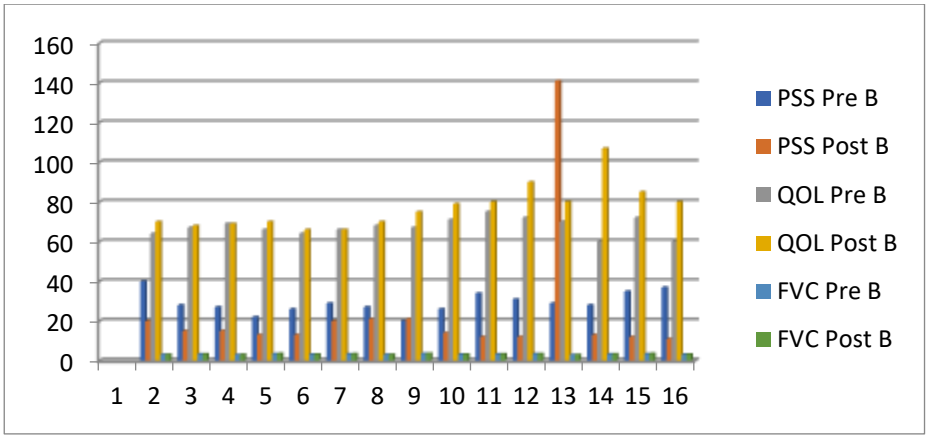
Paired t test

A paired t–test was conducted to compare the pre and post value of PSS, QOL, FVC, SBP, and DBP. There was a significant difference in the PSS pre (M=29.26, SD= 5.39), PSS post (M=23.53, SD=32.69), QOL Pre (M=67.40, SD=4.30), QOL Post (M=77.00, SD=11.02), FVC Pre (M=3.33, SD=0.188), FVC Post (M=3.36, SD=0.19), SBP Pre (M=119.20, SD=2.24), SBP Post (M=118.80, SD= 1.85), and DBP Pre (M=77.26, SD= 1.94), DBP Post (M=77.00, SD=1.69)..

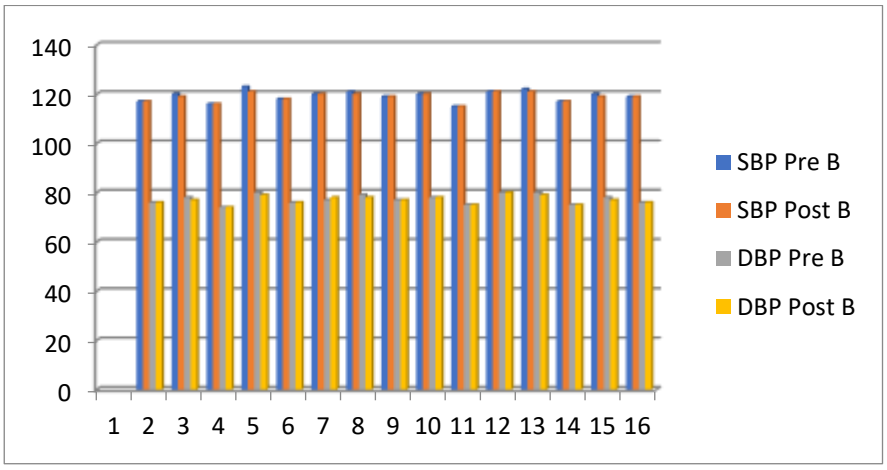
The paired-samples t-test revealed a statistically significant improvement from pre-test to post-test in PSS scores, $t = 0.66$, $p < 0.001$, with a mean difference of 5.73 (95% CI: -12.72 to 24.18). QOL scores demonstrated a statistically significant improvement from pre-test to post-test, $t = -3.08$, $p < 0.001$, with a mean difference of −9.60 (95% CI: −16.27 to −2.92), FVC scores demonstrated a statistically significant improvement from pre-test to post-test, $t = -7.35$, $p < 0.001$, with a mean difference of −0.028 (95% CI: −0.036 to −0.019), SBP demonstrated a statistically significant improvement from pre-test to post-test, $t = 2.44$, $p < 0.001$, with a mean difference of 0.40 (95% CI: 0.04 to 0.75),, DBP scores demonstrated a statistically significant improvement from pre-test to post-test, $t = 1.74$, $p < 0.001$, with a mean difference of 0.26 (95% CI: -0.062 to 0.59).

Table 3: Paired t test for PSS, QOL, FVC, SBP, DBP (Pre and Post)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PSS Pre–Post B	5.733	33.328	8.605	-12.723	24.189	.666	14	.516
Pair 2	QOL Pre–Post B	-9.600	12.052	3.111	-16.274	-2.925	-3.085	14	.008
Pair 3	FVC Pre–Post B	-.028	.014	.003	-.036	-.019	-7.359	14	.000
Pair 4	SBP Pre–Post B	.400	.632	.163	.049	.750	2.449	14	.028
Pair 5	DBP Pre–Post B	.266	.593	.153	-.062	.595	1.740	14	.104



Graph 3: Graphical representation of PSS, QOL and FVC Pre–Post (Group B)



Graph 4: Graphical representation of SBP and DBP Pre –Post (group B)

INDEPENDENT t-TEST between both groups

Table 4: Mean and Standard deviation of PSS, QOL, FVC, SBP, DBP (Group A-B)

Mean and Standard deviation										
	PSS A	PSS B	QOL A	QOL B	FVC A	FVC B	SBP A	SBP B	DBP A	DBP B
Mean	15.133	14.466	26.666	8.933	.149	.028	2.9333	.400	2.733	.466
N	15	15	15	15	15	15	15	15	15	15
SD	5.540	6.685	4.592	11.828	.057	.014	1.533	.632	1.099	.639

Table 5: Independent t test for PSS between both groups

PARAMETER	PSS	QoL	FVC	SBP	DBP
Pooled Variance	37.70	80.51	0.00	1.38	0.81
Standard Error	2.24	3.28	0.02	0.43	0.33
t-value	0.297	5.412	7.932	5.914	6.899
df	28	28	28	28	28
Mean Difference	0.666	17.73	0.121	2.533	2.266
95% Confidence Interval	-3.925-5.259	11.022-24.444	0.090-0.152	1.655-3.410	1.593-2.939
p-value	0.38	0.00	0.00	0.00	0.00

PSS: The student's t-test assuming equal variances showed a mean difference of 37.70 between Group A and Group B. The calculated t-value was 0.297 with 28 degrees of freedom. The p-value was 0.38, which is MORE than 0.05, indicating a statistically non-significant difference between the two treatments. The 95% confidence interval for the mean difference was -3.925 to 5.259, which does not include zero.

Therefore, Group A and Group B Showed non-significantly equal values.

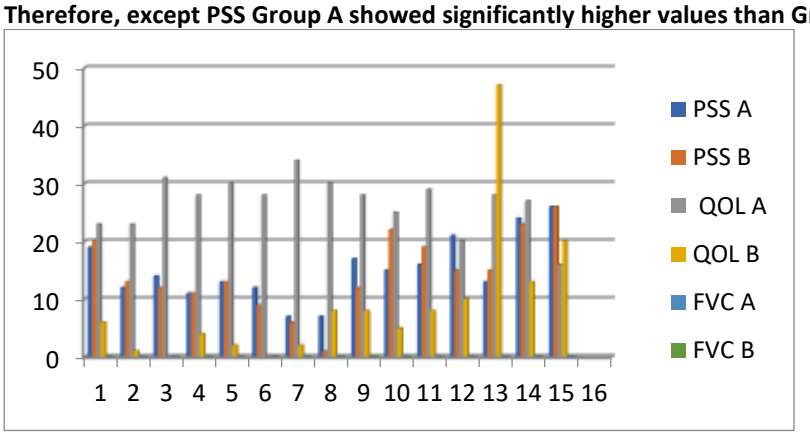
QOL: The Student's t-test assuming equal variances showed a mean difference of 80.51 between Group A and Group B. The calculated t-value was 5.412 with 28 degrees of freedom**.** The p-value was 0.001, which is less than 0.05, indicating a statistically significant difference between the two groups. The 95% confidence interval for the mean difference was 11.022 to 24.444**,** which does not include zero.

FVC: The Student's t-test assuming equal variances showed a mean difference of 0.00 between Group A and Group B. The calculated t-value was 7.932 with 28 degrees of freedom. The p-value was 0.001, which is less than 0.05, indicating a statistically significant difference between the two treatments. The 95% confidence interval for the mean difference was 0.090 to 0.152, which does not include zero.

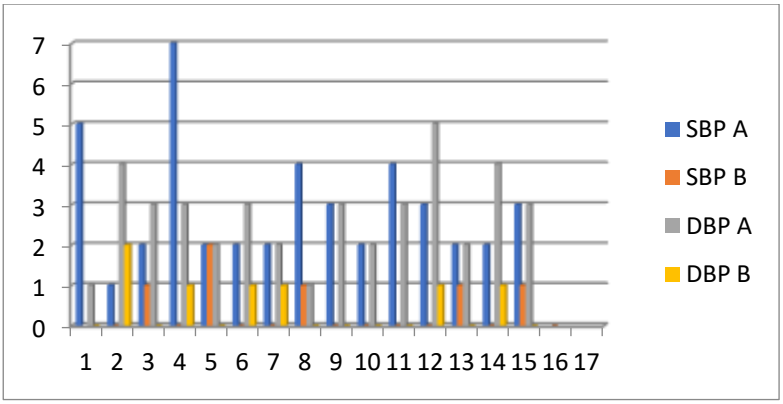
SBP: The Student's t-test assuming equal variances showed a mean difference of 1.38 between Treatment 1 and Treatment 2. The calculated t-value was 5.914 with 28 degrees of freedom. The p-value was 0.001, which is less than 0.05, indicating a statistically significant difference between the two treatments. The 95% confidence interval for the mean difference was 1.655 to 3.410, which does not include zero.

DBP: The Student's t-test assuming equal variances showed a mean difference of 0.81 between Group A and Group B. The calculated t-value was 6.899 with 28 degrees of freedom. The p-value was 0.001, which is less than 0.05, indicating a statistically significant difference between the two treatments. The 95% confidence interval for the mean difference was 1.593 to 2.939, which does not include zero.

Therefore, except PSS Group A showed significantly higher values than Group B.



Graph 5: independent t test for PSS, QOL, FVC between both groups



Graph 6: independent t test for SBP, DBP between both groups

DISCUSSION

The present study investigated the effects of Nadi Shodhana Pranayama on psychological well-being, quality of life (QoL), and physiological parameters among female college students. The findings indicated significant between-group differences in QoL, forced vital capacity (FVC), systolic blood pressure (SBP), and diastolic blood pressure (DBP), whereas the perceived stress scale (PSS) showed no statistically significant difference as reported. These findings can be compared with Sunita et al., who observed improvements in anxiety, depression, anger, and well-being among female undergraduate medical students following a 12-week pranayama intervention, supporting the potential psychological benefits of breathing practices. [17] Similarly, Nautiyal et al. investigated Nadi Shodhana and other yogic techniques among medical students, highlighting the relevance of pranayama-based interventions for student health. [18] Differences in intervention duration, sample characteristics, and outcome measures may explain variations between studies. Overall, Nadi Shodhana appears promising as an adjunctive wellness intervention; however, larger controlled studies are needed to establish its effectiveness conclusively.

Additionally, a study by Dullo et al. reported significant improvements in pulmonary function following alternate nostril breathing, supporting the present study's findings regarding FVC. [19] Similarly, Srivastava et al. observed changes in cardiorespiratory and autonomic parameters after alternate nostril breathing practice, suggesting its potential physiological benefits. These findings provide physiological evidence supporting Nadi Shodhana as a complementary wellness intervention. However, variations in study populations, intervention duration, and assessment methods should be considered when interpreting the results. [20]

CONCLUSION

The results of the study have proven that Nadi Shodhana Pranayama has shown the significant changes in improving Psychological Well Being and Quality of Life in college going female students.

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Informed Consent - A prior written consent was taken from all the participants.
Data availability statement – 'The datasets generated during and/or analyzed during the current study are available from the corresponding author'.

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