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Impact of Practicing Surya Namaskar on Lung Function and Heart Rate Recovery in Healthy Young Adults

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Abstract: Background: Surya Namaskar, the most widely practiced Indian yoga sequence, links twelve forward- and backward-bending postures to a structured breathing pattern and has been proposed to benefit both respiratory and cardiovascular function, though evidence in healthy young adults remains limited. Objective: To examine the effect of 45 days of Surya Namaskar practice on lung function and heart rate recovery (HRR) compared with a no-intervention control group. Methods: Healthy students aged 18-25 years (n = 50 per group) were allocated to a Surya Namaskar group (45 minutes, six days a week, for 45 days) or a waitlist control. Spirometry (FVC, FEV1, FEV1/FVC, PEFR, MVV), rate-pressure product (RPP), and HRR were measured before and after. Within-group change was tested with paired t-tests; between-group differences in change scores were tested with Welch's t-test ($\alpha = .05$). Results: Surya Namaskar significantly increased FVC (3.50 to 3.56 L, $p = .013$), FEV1 (2.85 to 2.92 L, $p = .006$) and HRR (20.44 to 23.00 bpm, $p < .001$); PEFR, MVV and FEV1/FVC were unchanged. Control showed a smaller but significant HRR rise (20.34 to 21.00 bpm, $p < .001$) and no other change. Between groups, the HRR gain was significantly greater with Surya Namaskar (+2.56 vs. +0.66 bpm, $p < .001$); no other outcome differed between groups. Conclusion: Surya Namaskar practice produced a clinically meaningful improvement in heart rate recovery and modest within-group gains in FVC and FEV1, but did not demonstrate superiority over the control group for spirometric outcomes in this sample.

Keywords: Surya Namaskar; yoga; lung function; spirometry; heart rate recovery; healthy young adults

INTRODUCTION

Yoga-based movement sequences are increasingly studied as low-cost interventions for respiratory and cardiovascular health. Surya Namaskar (sun salutation) is the most widely practiced and most widely studied Indian sequence (Bandyopadhyay et al., 2025; Mody, 2011; Singh et al., 2025). It links twelve postures in a fixed order, repeatedly moving the trunk through flexion and extension, with each posture coordinated to a phase of breathing. Because the body moves against its own weight through repeated transitions, the sequence provides a whole-body stimulus; surface electromyography shows muscle activity is generally greater during the transitions than in the held postures themselves (Mullerpatan et al., 2020).

Two pathways are commonly proposed to link such practice to measurable outcomes. First, the coordinated expansion and compression of the thorax across backward- and forward-bending postures may recruit respiratory muscles more fully than quiet breathing, plausibly improving indices such as FVC and FEV1 over repeated sessions (Jahan et al., 2020; Parikh et al., 2014; Tah et al., 2025). Second, the slow, breath-paced rhythm may shift autonomic balance toward greater vagal tone, reflected in faster heart rate recovery (HRR) after exertion and reduced resting cardiac workload, indexed by the rate-pressure product (RPP) (Krishna et al., 2014; Sreenath et al., 2026; Thrower et al., 2023).

Evidence for these pathways is mixed. Respiratory gains after yoga in healthy adults are generally modest and sometimes attributable to testing effort rather than true adaptation (Kakkar et al., 2025). Cardiovascular findings for Surya Namaskar come mostly from single-session studies (Mody, 2011; Thrower et al., 2023) or clinical populations (Krishna et al., 2014), leaving its effect over a sustained multi-week practice in healthy young adults under-examined. Practice intensity and cadence also matter: different yoga sequences elicit different metabolic and heart-rate demands (Cheruka et al., 2023;

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Majhi et al., 2026; Park & Yang, 2023), so findings cannot be assumed to generalize across sequences. Using data from the Surya Namaskar and non-intervention control arms of a larger controlled trial, the present study examined, over a 45-day practice period, whether Surya Namaskar improves lung function (FVC, FEV1, FEV1/FVC, PEFR, MVV) and cardiovascular recovery (RPP, HRR) within practitioners, and whether any such change exceeds that seen with no intervention, in healthy young adults aged 18-25 years.

METHODS

Study Design and Participants

This was a controlled, two-arm, parallel-group study drawn from the Surya Namaskar and control arms of a larger trial approved by an institutional ethics committee; all participants gave written informed consent. Healthy students aged 18-25 years from the same institution were allocated to a Surya Namaskar group (n = 50) or a no-intervention control group (n = 50). Inclusion criteria were age 18-25, current enrolment in a degree program, no yoga or meditation practice in the previous six months, and general good health; exclusion criteria were diagnosed psychiatric, respiratory, cardiac, neurological, or musculoskeletal conditions, and medication affecting cognition, mood, or physiology.

Intervention

The Surya Namaskar group practiced the traditional twelve-posture sequence, each posture linked to inhalation, exhalation, or breath retention, in 45-minute supervised sessions, six days a week, for 45 days, under a qualified instructor. The control group continued their usual routine with no additional practice over the same period; no adverse events were reported.

Outcome Measures

Demographic and lifestyle data were recorded at baseline. Lung function and cardiovascular measures were assessed at baseline and after 45 days under standardized conditions. FVC, FEV1 and PEFR were taken as the best of three spirometric efforts; MVV was measured over 12-15 seconds and extrapolated to L/min. Cardiovascular function was assessed as RPP (heart rate × systolic blood pressure after 5 minutes of seated rest) and HRR, the fall in heart rate from peak exertion to a fixed recovery interval.

Statistical Analysis

Baseline comparability was examined with independent-samples t-tests (continuous variables) and chi-square tests (categorical variables). Within-group change was analyzed with paired-samples t-tests, with Cohen's d reported as effect size. Between-group differences were analyzed using Welch's t-test on change scores (post minus pre). Significance was set at $\alpha = .05$. Analyses were conducted in Jamovi (version 28.14)

RESULTS

Baseline Characteristics

The groups were comparable at baseline in age (21.88 ± 2.23 vs. 21.68 ± 2.08 years, $p = .644$), BMI ($p = .450$), systolic blood pressure ($p = .202$), resting pulse ($p = .938$), gender ($p = 1.000$), education ($p = .841$) and diet ($p = .244$). The Surya Namaskar group was taller and heavier than control (172.1 vs. 167.1 cm, $p = .004$; 68.5 vs. 63.3 kg, $p = .019$) and had higher diastolic blood pressure (76.6 vs. 73.1 mmHg, $p = .009$). The groups also differed in lifestyle: Surya Namaskar participants reported longer sleep and less screen time (both $p < .001$), and more regularly engaged in sports/exercise (62% vs. 32%, $p = .005$). These baseline differences, consistent with non-random allocation, are addressed as a limitation below.

Within-Group Change: Surya Namaskar

Within the Surya Namaskar group, FVC rose from 3.50 ± 0.55 to 3.56 ± 0.57 L ($p = .013$, $d = 0.37$) and FEV1 from 2.85 ± 0.47 to 2.92 ± 0.50 L ($p = .006$, $d = 0.41$). FEV1/FVC ($p = .172$), PEFR ($p = .425$) and MVV ($p = .541$) did not change significantly. RPP fell from 8.95 ± 1.37 to 8.75 ± 1.60 ($p = .034$, $d = -0.31$), and HRR rose from 20.44 ± 1.50 to 23.00 ± 1.90 bpm ($p < .001$, $d = 1.68$), the largest effect observed for any outcome.

Within-Group Change: Control

Within control, no spirometric measure changed significantly (FVC $p = .170$; FEV1 $p = .346$; FEV1/FVC $p = .503$; PEFR $p = .059$; MVV $p = .119$), nor did RPP ($p = .504$). HRR, however, rose significantly even in control, from 20.34 ± 1.26 to 21.00 ± 1.88 bpm ($p < .001$, $d = 0.59$) — a smaller rise than Surya Namaskar, plausibly reflecting familiarity with repeat recovery testing.

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Variable	Group	Pre-test M ± SD	Post-test M ± SD	p	Cohen's d
FVC (L)	Surya Namaskar	3.50 ± 0.55	3.56 ± 0.57	.013*	0.37
	Control	3.67 ± 0.60	3.70 ± 0.63	.170	0.20
FEV1 (L)	Surya Namaskar	2.85 ± 0.47	2.92 ± 0.50	.006**	0.41
	Control	3.02 ± 0.50	3.04 ± 0.53	.346	0.13
FEV1/FVC (%)	Surya Namaskar	81.39 ± 3.89	81.79 ± 4.53	.172	0.20
	Control	82.36 ± 3.62	82.18 ± 4.47	.503	-0.10
PEFR (L/s)	Surya Namaskar	7.13 ± 1.40	7.18 ± 1.51	.425	0.11
	Control	6.86 ± 1.41	6.99 ± 1.50	.059	0.27
MVV (L/min)	Surya Namaskar	110.80 ± 19.22	111.64 ± 21.50	.541	0.09
	Control	121.44 ± 20.12	123.06 ± 19.81	.119	0.22
RPP (×10)	Surya Namaskar	8.95 ± 1.37	8.75 ± 1.60	.034*	-0.31
	Control	8.77 ± 1.21	8.69 ± 1.55	.504	-0.10
HRR (bpm)	Surya Namaskar	20.44 ± 1.50	23.00 ± 1.90	<.001***	1.68
	Control	20.34 ± 1.26	21.00 ± 1.88	<.001***	0.59

Table 1. Pre-test and post-test values for Surya Namaskar and Control groups (paired-samples t-test, n = 50 per group). *p < .05; **p < .01; ***p < .001. A negative d indicates a decrease from pre-test to post-test.

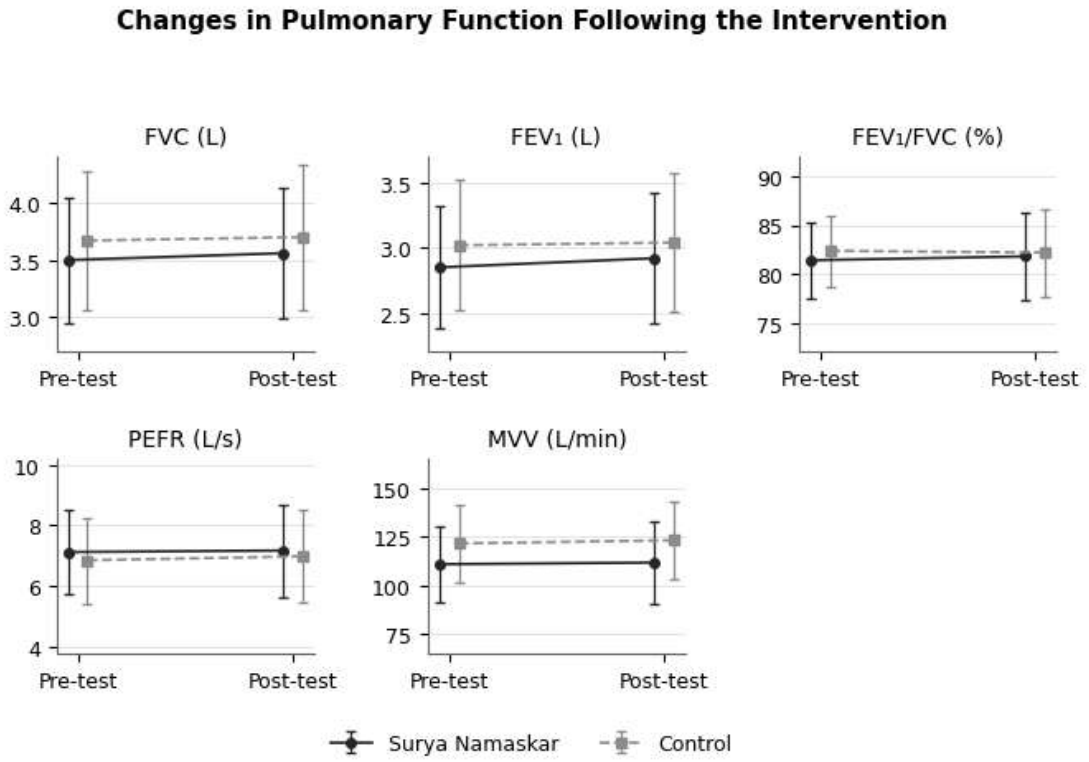
Between-Group Comparison

On between-group comparison of change scores (Table 2), only HRR differed significantly: Surya Namaskar improved 2.56 ± 1.53 bpm versus 0.66 ± 1.12 bpm in control (Welch's t = 7.10, p < .001). No other outcome differed significantly (FVC, p = .508; FEV1, p = .250; FEV1/FVC, p = .143; PEFR, p = .362; MVV, p = .650; RPP, p = .409). In percentage terms (Figure 1), Surya Namaskar improved FVC by 1.8% and FEV1 by 2.3% versus control's 1.1% and 0.8%, but these gaps did not reach significance at this sample size; PEFR and MVV improved marginally more in control than in Surya Namaskar, though neither change was statistically significant.

Variable	Surya Namaskar change, M ± SD	Control change, M ± SD	p
FVC (L)	0.064 ± 0.176	0.039 ± 0.200	.508
FEV1 (L)	0.067 ± 0.163	0.026 ± 0.190	.250
FEV1/FVC (%)	0.39 ± 2.00	-0.18 ± 1.85	.143
PEFR (L/s)	0.047 ± 0.416	0.129 ± 0.472	.362
MVV (L/min)	0.84 ± 9.67	1.62 ± 7.21	.650
RPP (×10)	-0.20 ± 0.65	-0.08 ± 0.82	.409
HRR (bpm)	2.56 ± 1.53	0.66 ± 1.12	<.001***

Table 2. Comparison of change scores (post-test minus pre-test) between Surya Namaskar and Control groups, Welch's independent-samples t-test. ***p < .001.

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Note. Data are presented as mean ± standard deviation (SD). FVC = forced vital capacity; FEV_1 = forced expiratory volume in one second; FEV_1/FVC = ratio of forced expiratory volume in one second to forced vital capacity; PEFR = peak expiratory flow rate; MVV = maximum voluntary ventilation. Error bars represent ±1 SD.

DISCUSSION

The principal finding is that 45 days of Surya Namaskar produced a robust improvement in heart rate recovery, approximately fourfold that of the control group. A faster post-exertion fall in heart rate is widely interpreted as reflecting faster vagal reactivation, and long-term yoga practitioners have been shown, cross-sectionally, to recover faster than aerobically or resistance-trained adults (Sreenath et al., 2026). The present prospective data extend that picture, showing a comparable advantage emerging within a short, 45-day structured practice period in previously untrained young adults, relevant to short academic-term or workplace wellness programs.

The within-group gains in FVC and FEV1 are consistent with prior reports that yoga and pranayama modestly raise these measures in healthy young adults (Jahan et al., 2020; Parikh et al., 2014; Tah et al., 2025), aligning with the proposed mechanism that repeated flexion-extension postures linked to breath recruit trunk musculature more than at rest (Mullerpatan et al., 2020). The gains were nonetheless small (about 0.06-0.07 L) and not significantly different from control; spirometric performance is sensitive to effort and familiarity, which can inflate apparent gains on repeat testing (Kakkar et al., 2025). PEFR and MVV, which depend more on expiratory strength and short-burst effort than on chest-wall mobility, showed no change in either group, suggesting that 45 days of a flexion-extension-dominant sequence may influence volume-based measures more than flow- or ventilation-based measures over this timeframe.

RPP fell significantly within the Surya Namaskar group but not significantly versus control. RPP reductions after yoga have mainly been reported in clinical populations (Krishna et al., 2014), and the cardiovascular response to a single session depends heavily on timing of measurement (Thrower et al., 2023); any resting RPP benefit of Surya Namaskar here, if present, was too small to detect against control at this sample size. More broadly, different sequences impose different metabolic and heart-rate demands depending on tempo and structure (Cheruka et al., 2023; Majhi et al., 2026; Park & Yang, 2023); since neither rounds nor pace were standardized beyond the fixed 45-minute session, the physiological dose delivered may have varied across participants, plausibly contributing to the selective pattern of significant findings.

Limitations

The study was not blinded. The groups differed at baseline on sleep, screen time, physical activity and sports participation, plus height, weight and diastolic blood pressure, consistent with non-random allocation; although within-participant

change scores partly control for stable baseline differences, residual confounding cannot be excluded, and ANCOVA adjusting post-test scores for baseline covariates would strengthen future analyses. All participants were from a single rural institution, limiting generalisability. Cadence, rounds, and perceived exertion were not recorded; spirometry and HRR are effort- and protocol-sensitive; and there was no follow-up beyond 45 days to confirm whether gains, particularly in HRR, are sustained.

CONCLUSION

In healthy young adults, 45 days of Surya Namaskar produced a clear, statistically robust improvement in heart rate recovery, substantially larger than with no intervention, together with small but significant within-group gains in FVC and FEV1. Surya Namaskar did not, however, show a significant advantage over control for any spirometric or RPP outcome. These findings support Surya Namaskar as a feasible, low-cost practice for improving post-exertion cardiac autonomic recovery in young adults, while lung-function benefits merit confirmation in larger, baseline-matched trials with standardized practice dose and longer follow-up.

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