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# Three-step Rhythmic Breathing Practice and Self-Reported COVID-19 Positivity in a Community Sample from India: An Exploratory Cross-Sectional Study

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## ABSTRACT

**Background:** Breathing-based mind-body practices were widely discussed during the COVID-19 pandemic as adjunctive strategies for respiratory well-being, stress regulation and resilience; however, evidence for reducing SARS-CoV-2 infection risk remains limited. This study examined the association between regular three-step rhythmic breathing (3SRB) practice and self-reported COVID-19 positivity in a community sample from India.

**Methods:** A community-based online cross-sectional survey was conducted during July-August 2020. The analysis included 1083 valid records: 598 3SRB practitioners and 485 non-practitioners. The primary outcome was self-reported COVID-19 positivity. Descriptive statistics, chi-square and Fisher exact tests, effect-size estimates, exploratory logistic regression, modified Poisson regression with robust standard errors and duplicate-record sensitivity analysis were performed.

**Results:** Overall, 23 participants (2.1%) reported COVID-19 positivity. Positivity was lower among 3SRB practitioners than non-practitioners (1.3% vs 3.1%). The absolute risk difference was -1.75 percentage points (95% CI -3.55 to 0.04), risk ratio 0.43 (95% CI 0.18 to 1.01), and odds ratio 0.42 (95% CI 0.18 to 1.01). Pearson chi-square was significant (p=0.046), whereas Fisher exact (p=0.056) and Yates-corrected chi-square (p=0.075) were not. In adjusted logistic regression, the association remained protective but non-significant after adjustment for demographic, occupational, morbidity and exposure variables (aOR 0.48, 95% CI 0.19 to 1.19; p=0.113). Further adjustment for exercise and herbal use showed similar results (aOR 0.50, 95% CI 0.19 to 1.30; p=0.155). Sensitivity analysis weakened the association.

**Conclusion:** Lower self-reported COVID-19 positivity was observed among 3SRB practitioners, but the association was statistically weak and non-significant after adjustment and sensitivity analysis. The findings are exploratory and hypothesis-generating.

***Keywords:*** COVID-19, three-step rhythmic breathing, 3SRB, refining exercise, India

## INTRODUCTION

The COVID-19 pandemic generated a simultaneous respiratory, psychological and social burden. SARS-CoV-2 infection primarily affected the respiratory system, but its wider consequences included stress, sleep disturbance, fear, isolation and disruption of routine health behaviours. During the early phase of the pandemic, several non-pharmacological and self-care practices were promoted as complementary approaches to support respiratory comfort and emotional regulation. Among these, yoga-based breathing, pranayama, meditation and structured breath regulation practices received considerable public and scientific attention.

Breathing practices are biologically plausible as health-promotion interventions because slow and regulated breathing may influence autonomic balance, vagal tone, cardiorespiratory coupling, perceived stress, sleep and respiratory efficiency. Reviews of yogic breath regulation have reported favourable effects on psychophysiological, respiratory and metabolic outcomes in different populations, although study designs and intervention protocols vary substantially [1]. Meta-analytic evidence on breathwork also suggests modest improvements in stress, anxiety and depressive symptoms, while emphasizing heterogeneity, small samples and risk of bias in the available literature [2]. Earlier studies of rhythmic breathing, yogic breathing and Sudarshan Kriya have also reported favourable immunological, pulmonary and neurophysiological effects, supported biological plausibility while not proving infection prevention [3-5].

During the COVID-19 pandemic, studies on yoga, breathing and meditation focused mainly on psychological well-being, respiratory rehabilitation and physiological recovery rather than infection prevention. Mahendru et al. conducted a randomized controlled trial among asymptomatic or mildly symptomatic SARS-CoV-2-positive participants under institutional isolation and found improvements in depression, stress and sleep outcomes after meditation and breathing exercises [6]. Jagadeesan et al. reported that Bhramari Pranayama improved stress, anxiety, depression, sleep quality and quality of life among COVID-19 patients in home isolation [7]. A confirmatory randomized trial of integrated tele-yoga among asymptomatic COVID-19-positive patients reported improvements in physiological, psychological and mindfulness variables [8]. Rain et al. assessed yogic breathing protocols among COVID-positive, COVID-recovered and healthcare worker groups, reporting favourable changes in selected biochemical and functional outcomes, including D-dimer and exercise capacity [9]. An online randomized study during lockdown also suggested that specific breathing practices may reduce perceived exertion during breath-holding, although this outcome is not equivalent to infection prevention [10]. The evidence for prevention of SARS-CoV-2 infection is much more limited. A quasi-randomized clinical trial among exposed healthcare professionals suggested a possible protective effect of a pranayama protocol [11]. However, the transferability of findings from exposed healthcare workers to community settings is uncertain. Systematic reviews on yoga, meditation and breathing in relation to inflammatory biomarkers suggest mechanistic plausibility but do not establish that breathing practice prevents COVID-19 infection [12].

Three-step rhythmic breathing (3SRB), also referred to in some practice traditions as refining exercise, is a structured breathing practice that emphasizes rhythmicity, regularity and mind-body coordination. Although 3SRB is culturally rooted and practiced in community settings, empirical evidence on its association with COVID-19 outcomes remains sparse. The present study therefore examined whether self-reported COVID-19 positivity differed between community participants who practiced 3SRB and those who did not practice structured breathing techniques. Given the study design, the analysis was framed as exploratory, with emphasis on effect size, confidence intervals, confounding and statistical uncertainty rather than causal inference.

## MATERIALS & METHODS

**Study design and setting:** A community-based cross-sectional observational study was conducted using an online self-administered questionnaire. Data were collected between July and August 2020, during the early phase of the COVID-19 pandemic in India. The study followed an exploratory analytical framework and was reported with attention to cross-sectional study principles recommended by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [17].

**Participants and recruitment:** Participants were adults who responded to the online survey. Total 1083 participants participated in the study. Participants were classified into two groups: those who reported practicing 3SRB and those who did not report practicing 3SRB or any structured breathing technique.

**Exposure variable:** The primary exposure was self-reported practice of 3SRB, coded as yes or no. Among 3SRB practitioners, additional variables captured duration of practice, frequency of weekly practice, average minutes per day and whether the participant used 3SRB for any chronic disease. Missing or not-applicable practice-detail responses were retained as such and not imputed.

**Outcome variable:** The primary outcome was self-reported COVID-19 positivity. The survey did not independently verify COVID-19 status through laboratory reports; therefore, the outcome is best interpreted as self-reported COVID-19 positivity rather than laboratory-confirmed infection. Symptoms of fever and cough in the previous three months were analysed as a related descriptive indicator, not as a diagnostic outcome.

**Covariates:** Covariates included age, sex, occupation, state, current morbidity, household COVID-19 exposure, COVID-19 cases in the ward or residential area, fever/cough symptoms, other yoga/meditation/exercise practices, and herbal product use. Household and area-level exposure indicators were included because transmission studies and systematic reviews have shown that household and close-contact exposure were important determinants of SARS-CoV-2 infection risk [13-16].

### Statistical Analysis

Descriptive statistics were presented as frequencies, percentages, means and standard deviations. Group differences were assessed using Pearson chi-square tests for categorical variables and Welch independent-sample t-tests for continuous age. For the primary rare binary outcome, both Pearson chi-square and Fisher exact tests were reported. Absolute risk difference, risk ratio, odds ratio and 95% confidence intervals were calculated. Logistic regression was used to estimate unadjusted and adjusted odds ratios. Given the small number of COVID-positive events, models were kept parsimonious and interpreted as exploratory because overfitting is a concern when the number of outcome events is limited [19]. A modified Poisson regression with robust standard errors was also fitted to estimate prevalence ratio, following the approach recommended for direct estimation of relative risk or prevalence ratio in binary outcome data [18]. A sensitivity analysis was conducted after removing potential exact duplicate records when the serial number was excluded. Potential duplicates were retained in the primary analysis because they carried unique serial numbers and could represent different respondents with identical response patterns. However, their influence was examined because duplicate rows can materially affect rare-event estimates.

## RESULT

The analysis included 1083 participants, of whom 598 (55.2%) reported practicing 3SRB and 485 (44.8%) were non-practitioners. The mean age was 45.5 years (SD 14.6) among 3SRB practitioners and 47.5 years (SD 13.2) among non-practitioners. The sex distribution was similar across groups. However, the two groups differed by age category, occupation and state distribution. Other yoga, meditation or exercise practices were substantially more common among 3SRB practitioners than non-practitioners, indicating potential lifestyle-related confounding. Household exposure and local area exposure to COVID-19 were similar across groups (Table 1).

**Table 1. Baseline characteristics of participants according to 3SRB practice status**

| Characteristic | 3SRB practitioners (n=598) | Non-practitioners (n=485) | p-value |
|---|---|---|---|
| Age, mean (SD) | 45.5 (14.6) | 47.5 (13.2) | 0.015 |
| Age group | | | |
| 18-33 years | 126 (21.1) | 69 (14.2) | 0.036 |
| 34-49 years | 236 (39.5) | 205 (42.3) | |
| 50-65 years | 184 (30.8) | 163 (33.6) | |
| 66 years and above | 52 (8.7) | 48 (9.9) | |
| Sex | | | |
| Male | 307 (51.3) | 252 (52.0) | 0.839 |
| Female | 291 (48.7) | 233 (48.0) | |
| Occupation | | | |
| Service | 156 (26.1) | 148 (30.5) | 0.007 |
| Business | 121 (20.2) | 102 (21.0) | |
| Frontline worker | 34 (5.7) | 12 (2.5) | |
| Homemaker/retired | 208 (34.8) | 140 (28.9) | |
| Other | 79 (13.2) | 83 (17.1) | |
| Known morbidity | | | |
| Yes | 106 (17.7) | 91 (18.8) | 0.660 |
| No/unspecified | 492 (82.3) | 394 (81.2) | |
| Household COVID-19 exposure | | | |
| Yes | 25 (4.2) | 19 (3.9) | 0.827 |
| No | 573 (95.8) | 466 (96.1) | |
| COVID-19 cases in ward/residential area | | | |
| Yes | 498 (83.3) | 393 (81.0) | 0.336 |
| No | 100 (16.7) | 92 (19.0) | |
| Any other yoga/meditation/exercise | | | |
| Yes | 349 (58.4) | 137 (28.2) | <0.001 |
| No/not applicable | 249 (41.6) | 348 (71.8) | |
| Herbal product use | | | |
| Yes | 198 (33.1) | 159 (32.8) | 0.909 |
| No | 400 (66.9) | 326 (67.2) | |

*Values are n (%) unless stated otherwise. p-values are from Pearson chi-square tests for categorical variables and Welch t-test for continuous age. Percentages were recalculated from the participant-level dataset.*

Among 3SRB practitioners, most participants reported frequent practice. Of those with practice-detail responses, daily practice was common and most practiced for 16 minutes or longer per day. A small proportion reported using 3SRB in relation to chronic disease management. Some 3SRB practitioners had missing or not-applicable responses for detailed practice variables; these were retained rather than redistributed across exposure categories (Table 2).

**Table 2. Practice profile among 3SRB practitioners (n=598)**

| Practice variable | n | % |
|---|---|---|
| Duration of 3SRB practice | | |
| <1 year | 243 | 40.6 |
| 1-5 years | 150 | 25.1 |
| 6-10 years | 57 | 9.5 |
| >10 years | 121 | 20.2 |
| Missing/not applicable | 27 | 4.5 |

| | | |
|---|---|---|
| Frequency of practice | | |
| 1-2 days/week | 12 | 2.0 |
| 3-4 days/week | 34 | 5.7 |
| 5-6 days/week | 94 | 15.7 |
| Every day | 431 | 72.1 |
| Missing/not applicable | 27 | 4.5 |
| Minutes per day | | |
| 5 minutes | 38 | 6.4 |
| 6-15 minutes | 135 | 22.6 |
| 16-30 minutes | 250 | 41.8 |
| >30 minutes | 148 | 24.7 |
| Missing/not applicable | 27 | 4.5 |
| Use of 3SRB for chronic disease | | |
| Yes | 72 | 12.0 |
| No | 526 | 88.0 |

Overall, 23 participants (2.1%) reported COVID-19 positivity. Positivity was lower among 3SRB practitioners than among non-practitioners: 8/598 (1.3%) versus 15/485 (3.1%). The absolute risk difference was -1.75 percentage points. The unadjusted risk ratio was 0.43 and the unadjusted odds ratio was 0.42, both with confidence intervals crossing the null value. Although the Pearson chi-square test yielded p=0.046, the Fisher exact test yielded p=0.056 and the Yates-corrected chi-square test yielded p=0.075. Thus, the primary association was directionally favourable but statistically fragile (Table 3). Fever and cough symptoms, household exposure and local ward/residential-area exposure did not differ significantly between groups.

**Table 3. COVID-19 positivity and unadjusted association with 3SRB practice**

| **Measure** | **3SRB practitioners** | **Non-practitioners/ reference** | **Estimate or p-value** |
|---|---|---|---|
| Self-reported COVID-19 positive | 8/598 (1.3) | 15/485 (3.1) | Fisher p=0.056 |
| Self-reported COVID-19 negative | 590/598 (98.7) | 470/485 (96.9) | |
| Absolute risk difference | -1.75 percentage points | Reference | 95% CI -3.55 to 0.04 |
| Risk ratio | 0.43 | Reference | 95% CI 0.18 to 1.01 |
| Odds ratio | 0.42 | Reference | 95% CI 0.18 to 1.01 |
| Fever/cough in previous 3 months | 39/598 (6.5) | 37/485 (7.6) | p=0.478 |
| Household member COVID-19 positive | 25/598 (4.2) | 19/485 (3.9) | p=0.827 |
| Ward/residential-area COVID-19 exposure | 498/598 (83.3) | 393/485 (81.0) | p=0.336 |

## Characteristics of COVID-positive participants

Among the 23 participants who reported COVID-19 positivity, 19 were men (82.6%), 16 were aged 34-49 years (69.6%), and 7 were aged 50-65 years (30.4%). No COVID-positive participant in the participant-level dataset was aged 18-33 years or 66 years and above. Eleven COVID-positive participants (47.8%) reported fever and cough in the previous three months. Four (17.4%) reported a COVID-positive household member, while 21 (91.3%) reported COVID-19 cases in their ward or residential area. These descriptive patterns suggest the importance of exposure context and occupational or mobility-related risks, but the small number of positive cases precludes robust subgroup analysis.

In exploratory regression models, the point estimates remained in the protective direction but did not reach statistical significance. Table 4 presents exploratory regression and sensitivity analysis. Adjustment for age and sex produced an odds ratio similar to the unadjusted estimate. After further adjustment for high-exposure occupation, known morbidity, household COVID-19 exposure and local ward/residential-area exposure, the adjusted odds ratio attenuated to 0.48 and was not statistically significant. A fuller exploratory model additionally adjusting for other yoga/meditation/exercise and herbal product use yielded an adjusted odds ratio of 0.50. Modified Poisson regression with robust standard errors produced an adjusted prevalence ratio of 0.53. Sensitivity analysis after removal of potential exact duplicate records reduced the dataset to 937 participants and further weakened the association (Table 4).

**Table 4. Exploratory adjusted and sensitivity analyses for association between 3SRB practice and self-reported COVID-19 positivity**

| Model | Estimate for 3SRB | 95% CI | p-value |
|---|---|---|---|
| Logistic regression: unadjusted | OR 0.42 | 0.18 to 1.01 | 0.053 |
| Logistic regression: age and sex adjusted | aOR 0.43 | 0.18 to 1.02 | 0.055 |
| Logistic regression: exposure and morbidity adjusted | aOR 0.48 | 0.19 to 1.19 | 0.113 |
| Logistic regression: fully adjusted exploratory | aOR 0.50 | 0.19 to 1.30 | 0.155 |
| Modified Poisson with robust SE | aPR 0.53 | 0.21 to 1.33 | 0.177 |
| Sensitivity (possible duplicates removed) | OR 0.55 | 0.22 to 1.39 | 0.245 |

OR=odds ratio; aOR=adjusted odds ratio; aPR=adjusted prevalence ratio; SE=standard error.

## DISCUSSION

The study revealed a COVID-19 prevalence rate of 2.1% across the sampled population, translating to 23 self-reported positive cases. Positivity was 1.3% among participants practicing 3SRB or refining exercise and 3.1% among those not practicing refining exercise. This prevalence was slightly higher than the prevalence reported among healthcare workers in India (1.8%) [11] and comparable to the population-based estimate reported from Espírito Santo, Brazil (2.1%) [12]. The crude association between 3SRB practice and COVID-19 positivity was statistically significant using Pearson's chi-square test (p=0.046). However, the scientific interpretation must remain cautious. Although the crude comparison suggested lower observed positivity among practitioners, the confidence intervals for the risk ratio and odds ratio crossed the null value. The finding was also sensitive to the statistical test applied: Pearson's chi-square test was significant at the 0.05 level, whereas Fisher's exact test and Yates-corrected chi-square test were not. After adjustment for potential confounders and sensitivity analysis for possible duplicate records, the association was no longer statistically significant.

These results suggest that the observed difference may reflect a combination of a possible protective association, residual confounding, differences in health consciousness, differences in exposure opportunities, selection bias and random variation due to the small number of COVID-positive events. Exposure-related factors are particularly important because household and close-contact transmission were major drivers of SARS-CoV-2 spread during the pandemic [16-19]. In the present study, 3SRB practitioners were also more likely to report other yoga, meditation or exercise practices. Therefore, the measured association may not represent an independent effect of 3SRB alone. It may instead reflect a broader health-promoting lifestyle, differential risk perception, social behaviour during lockdown, or adherence to preventive behaviours such as masking, distancing and reduced mobility.

The findings are broadly consistent with pandemic-era studies showing favourable effects of breathing, pranayama, meditation and yoga on stress, sleep, respiratory comfort and selected physiological outcomes among COVID-19 patients and exposed groups [6-11]. However, most published trials addressed recovery, psychological well-being or physiological regulation rather than infection prevention. The present study therefore adds community-based exploratory evidence, but it does not provide causal evidence that 3SRB prevents SARS-CoV-2 infection.

Several mechanisms may explain why breathing practices are relevant to health promotion even when infection-prevention evidence is weak. Regulated breathing can influence autonomic regulation, reduce sympathetic arousal, improve respiratory awareness, support emotion regulation and reduce perceived stress [1-5]. Stress is relevant because prolonged stress can influence sleep, immune function and health behaviour. Breathing practices may also improve subjective respiratory comfort and help individuals manage anxiety related to breathlessness. Evidence on inflammatory biomarkers provides a plausible but indirect biological pathway; however, such mechanisms cannot be assumed to reduce viral acquisition without prospective evidence and objective biological measurement [12].

The adjusted analyses are important for interpreting the robustness of the observed association. The crude odds ratio for COVID-19 positivity among 3SRB practitioners compared with non-practitioners was 0.42. After adjustment for age, sex, high-exposure occupation, known morbidity, household COVID-19 exposure and local exposure, the adjusted odds ratio was 0.48. When other exercise practices and herbal product use were additionally included in the model, the adjusted odds ratio was 0.50. Thus, the direction of association remained consistently below the null value, suggesting a possible lower odd of self-reported COVID-19 positivity among 3SRB practitioners. However, the estimates were imprecise, with wide confidence intervals, which is expected given the small number of outcome events. Only 23 participants reported COVID-19 positivity, limiting statistical power and model stability. Therefore, the findings should be interpreted as suggestive of a possible protective association, but insufficient to establish a statistically significant or independent association after adjustment for potential confounders.

**Implications for the non-pandemic era**

In the non-pandemic era, the most appropriate public-health framing of 3SRB is as a low-cost, culturally acceptable health-promotion and self-regulation practice rather than as an infection-prevention intervention. The potential relevance is strongest in respiratory well-being, stress management, sleep promotion, chronic disease self-care and community resilience. The 3SRB may be examined as a respiratory health-promotion practice for improving breathing awareness, perceived respiratory comfort and confidence in self-regulation. Its role in stress management may be useful for students, caregivers, healthcare workers, older adults, persons with chronic disease and people experiencing high psychological strain. Because stress, sleep, hypertension, diabetes and lifestyle behaviour are interconnected, 3SRB may be tested as an adjunct to non-communicable disease self-care programmes, while clearly stating that it is not a substitute for medical treatment. Community platforms such as health and wellness centres, educational institutions, workplaces and digital health programmes could evaluate 3SRB using implementation-science designs that measure reach, adherence, safety, equity and sustainability.

Future non-pandemic studies should move beyond self-reported infection status and use objective outcomes. Suitable outcomes include spirometry, oxygen saturation, respiratory rate, heart-rate variability, perceived stress, sleep quality, inflammatory biomarkers, quality of life, uptake of healthcare services and adherence to healthy lifestyles [5-10, 12, 14]. For infection-related outcomes, prospective designs should record objectively confirmed respiratory infections, vaccination status, previous infection, exposure intensity and preventive behaviours. Evidence from

COVID-19 transmission studies [16-22] shows that exposure timing, household contact, asymptomatic infection and antibody dynamics are important for interpreting infection risk, and these factors should be incorporated into future study designs.

**Strengths and limitations of the study**

The study has several strengths. First, it addresses an underexplored and culturally relevant breathing practice during the COVID-19 pandemic. Second, it included a relatively large community sample of 1083 participants. Third, it compared 3SRB practitioners with non-practitioners using a clearly defined outcome. Fourth, the study examined self-reported COVID-19 positivity during the early phase of the pandemic. Fifth, the analysis included effect-size measures, while exploratory logistic regression and modified Poisson regression strengthened the statistical interpretation. However, the study also has limitations. The cross-sectional design prevents causal inference and does not establish temporality between 3SRB practice and COVID-19 positivity. There is also a possibility of selection bias, as online recruitment was facilitated through 3SRB networks. Potential confounding may have influenced the findings because 3SRB practitioners and non-practitioners differed in terms of age, occupation, state and other health practices. In addition, the event count was very small, with only 23 participants reporting COVID-19 positivity, which limited model stability and produced wide confidence intervals. Despite these limitations, the study provides important preliminary insights into the possible association between 3SRB practice and COVID-19 positivity and offers a useful foundation for future prospective and experimental research on 3SRB, respiratory health and resilience.

## CONCLUSION

The prevalence of self-reported COVID-19 positivity was lower among 3SRB practitioners than among non-practitioners in this community-based online sample. However, the association was statistically fragile and became non-significant in adjusted and sensitivity analyses. The findings should therefore be interpreted as exploratory, not as evidence that 3SRB prevents COVID-19. The study supports further scientific evaluation of 3SRB as a culturally acceptable health-promotion practice with possible relevance for stress regulation, respiratory well-being and resilience. Future studies should use prospective cohort or randomized designs, objective diagnostic confirmation, adequate event numbers, careful measurement of exposure risk and biological, respiratory and psychological outcome markers.

### *Declaration by Authors*

**Ethical Approval:** Ethical approval was not sought. However, the study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from participants through the online survey process.

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