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Comparative Study on the Effect of *Pranayama* on *Pranavaha Srotas* in COVID-19 Recovered Individuals and Apparently Healthy Individuals

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ABSTRACT

Background: The COVID-19 pandemic has highlighted the need for effective interventions to restore respiratory health, particularly in recovered individuals. *Pranayama*, a yogic breathing technique rooted in *Ayurveda*, is posited to enhance the function of *Pranavaha Srotas* (respiratory channels). This study evaluates its efficacy in COVID-19 recovered individuals compared to healthy controls.
Methods: A prospective study was conducted with 200 participants (100 COVID-19 recovered, 100 healthy) aged 21–40 years in Jodhpur, India. Participants performed *Anulom-Vilom Pranayama* for 3 months, with pulmonary function assessed via spirometry (FEV1, FVC). Demographic, socioeconomic, and *Ayurvedic* parameters were analyzed, with statistical significance tested using Mann-Whitney U and Chi-square tests.
Results: The COVID-19 group (mean age 33.06 years, 98% male) showed significant post-treatment improvements in FEV1 (20.32%) and FVC (23.40%) ($P<0.0001$), though not reaching healthy group levels (FEV1: 4.24 L, FVC: 4.87 L). Demographic disparities (age, gender, occupation) and dietary differences were notable, while *Ayurvedic* factors (*Prakriti*, *Sara*) showed no significant variation. The alternative hypothesis was accepted, rejecting the null.
Conclusion: *Pranayama* significantly enhances respiratory function in COVID-19 recovered individuals, influenced by demographic and lifestyle factors, suggesting its potential as a cost-effective rehabilitation tool.

Keywords: *Pranayama*, *Pranavaha Srotas*, COVID-19, pulmonary function, *Ayurveda*, *Anulom-Vilom*

INTRODUCTION

The COVID-19 pandemic, triggered by the SARS-CoV-2 virus, has impacted millions worldwide, leaving many recovered individuals with notable respiratory issues [1]. In *Ayurveda*, the ancient Indian life science, health is sustained by balancing *Doshas*, *Dhatus*, and *Srotas*—channels that transport essential elements [2]. The *Pranavaha Srotas*, or respiratory channel, is vital for the flow of *Prana* (life energy), and its malfunction is associated with respiratory problems [3].

According to the World Health Organization, cardiovascular and respiratory diseases contribute significantly to global mortality, with India experiencing a high prevalence of respiratory conditions (30%) [4]. *Pranayama*, a yogic breathing technique, is acknowledged for its ability to improve lung capacity and immunity, presenting a possible solution for post-COVID respiratory issues [5]. This study examines its impact on *Pranavaha Srotas* in individuals who have recovered from COVID-19 compared to seemingly healthy controls, exploring two research questions: (1) Does Pranayama influence *Pranavaha Srotas*? (2) Are there differences between COVID-19 recovered individuals and healthy ones? The null hypothesis (H_0) suggests no effect, while the alternative hypothesis (H_1) proposes a positive impact [6].

METHODS

Study Design and Population

This prospective research was carried out at Dr. S.R. Rajasthan Ayurved University (DSRRAU) in Jodhpur, from March to June 2023. The study involved two distinct groups, each with 100 participants aged 21 to 40 years. Group 1 consisted of individuals who had recovered from COVID-19 within the past two years, whereas Group 2 included those who were seemingly healthy. Participants were drawn from DSRRAU, the surrounding areas of Jodhpur, and local hospitals to gather COVID-19-related data.

Inclusion and Exclusion Criteria

Inclusion criteria included individuals of either sex, aged 21–40 years, with COVID-19 recovery ≤2 years for Group 1. Exclusion criteria comprised ages <21 or >40 years and conditions like epistaxis, nasal polyps, or tumors.

Intervention

For a duration of three months, participants engaged in the practice of *Anulom-Vilom Pranayama*, which involves breathing through alternate nostrils. Initially, they performed 20 to 30 cycles each day, with the number gradually increasing over time, all under the careful supervision of a guide.

Data Collection

Information on demographics such as age, gender, and occupation, along with socioeconomic status and *Ayurvedic* characteristics like *Prakriti* and *Sara*, was gathered through questionnaires. Respiratory performance was evaluated using a spirometer to measure Forced Expiratory Volume in 1 second (FEV1) and Forced Vital Capacity (FVC) both before and after the intervention. Symptoms following COVID-19, including shortness of breath and cough, were assessed using the Modified MRC Dyspnea Scale and cough severity scales [7].

STATISTICAL ANALYSIS

The analysis of continuous variables, including FEV1 and FVC, was conducted using Mann-Whitney U tests. For categorical variables such as gender and diet, Chi-square tests were employed. Statistical significance was determined with a P-value threshold of less than 0.05. The study received ethical approval from the Institutional Ethics Committee (IEC) at DSRRAU.

RESULTS

Demographic and Socioeconomic Characteristics

The COVID-19 group had a mean age of 33.06 years (SD 4.2), significantly older than the healthy group's 22.11 years (SD 3.1) (P<0.0001). Gender distribution showed 98% males in the COVID-19 group versus 45% in the healthy group (P<0.0001) (Table 1). Occupationally, the COVID-19 group included students (28%), job holders (50%), shopkeepers (13%), and farmers (9%), while the healthy group was entirely students (100%) (P<0.0001). Socioeconomic status differed, with 76% middle-class and 24% upper-class in the COVID-19 group, versus 97% middle-class in the healthy group (P<0.0001).

Table 1: Demographic Characteristics

Variable	COVID-19 Group (n=100)	Healthy Group (n=100)	P-value
Age (years, mean±SD)	33.06 ± 4.2	22.11 ± 3.1	<0.0001
Gender (Male, %)	98 (98%)	45 (45%)	<0.0001
Occupation (Students)	28 (28%)	100 (100%)	<0.0001
SES (Middle-class)	76 (76%)	97 (97%)	<0.0001

Dietary and Lifestyle Factors

Dietary habits showed 56% of the COVID-19 group followed a mixed diet versus 21% in the healthy group, with 79% of the latter being vegetarian (P<0.0001) (Figure 1). Marital status differed significantly, with 68% of the COVID-19 group married versus 0% in the healthy group (P<0.0001).

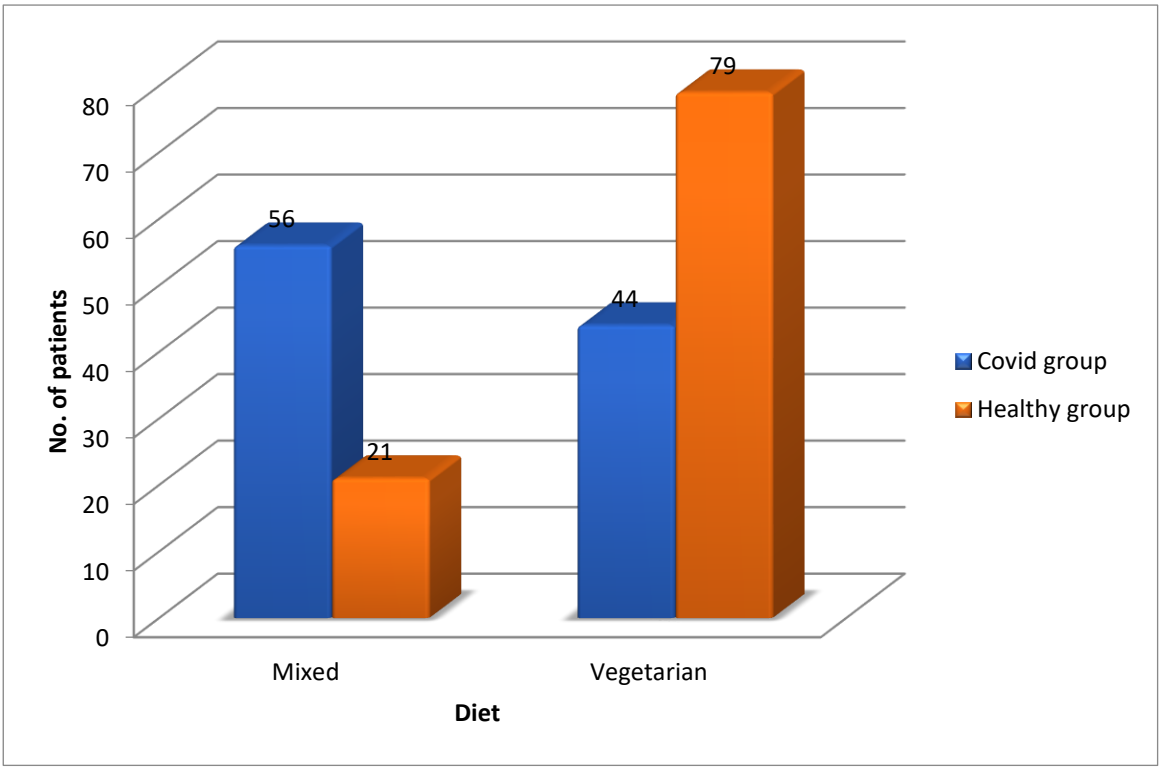


Figure 1: Dietary Distribution (Bar graph showing percentages of vegetarian vs. mixed diet in both groups; COVID-19: 44% vegetarian, 56% mixed; Healthy: 79% vegetarian, 21% mixed)

Ayurvedic Parameters

No significant differences were observed in *Prakriti* (body constitution, P=0.995), *Sara* (tissue quality, P=0.987), *Samhanana* (body build, P=0.959), or other *Ayurvedic* factors (*Satmya*, *Satva*, *Ahara Shakti*, *Vyayam Shakti*) (P>0.05) (Table 2).

Table 2: Ayurvedic Parameters

Parameter	COVID-19 Group (%)	Healthy Group (%)	P-value
Prakriti (Vata-Pitta)	40	42	0.995
Sara (Tvaksara)	35	36	0.987
Samhanana (Madhyam)	60	62	0.959

Pulmonary Function Outcomes

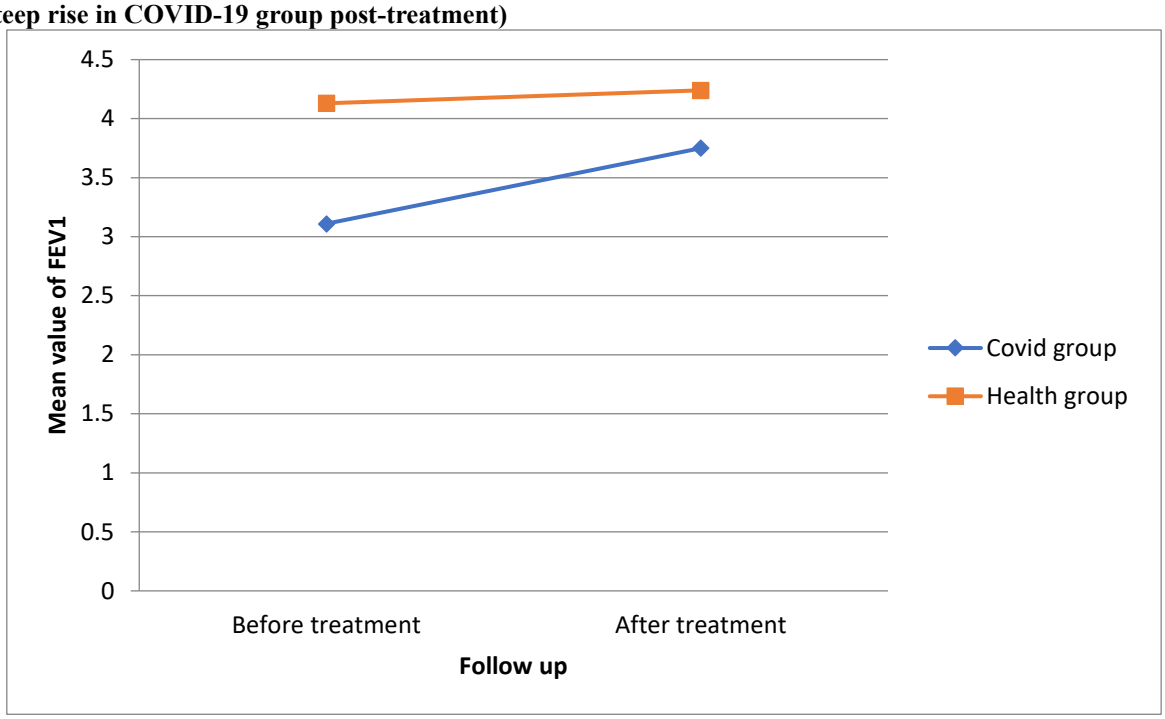
Pre-treatment, the COVID-19 group exhibited lower FEV1 (3.11 L, SD 0.4) and FVC (3.62 L, SD 0.5) compared to the healthy group (FEV1: 4.13 L, SD 0.3; FVC: 4.65 L, SD 0.4) (P<0.0001). Post-treatment, the COVID-19 group improved significantly: FEV1 to 3.75 L (20.32% increase) and FVC to 4.47 L (23.40% increase) (P<0.0001). The healthy group

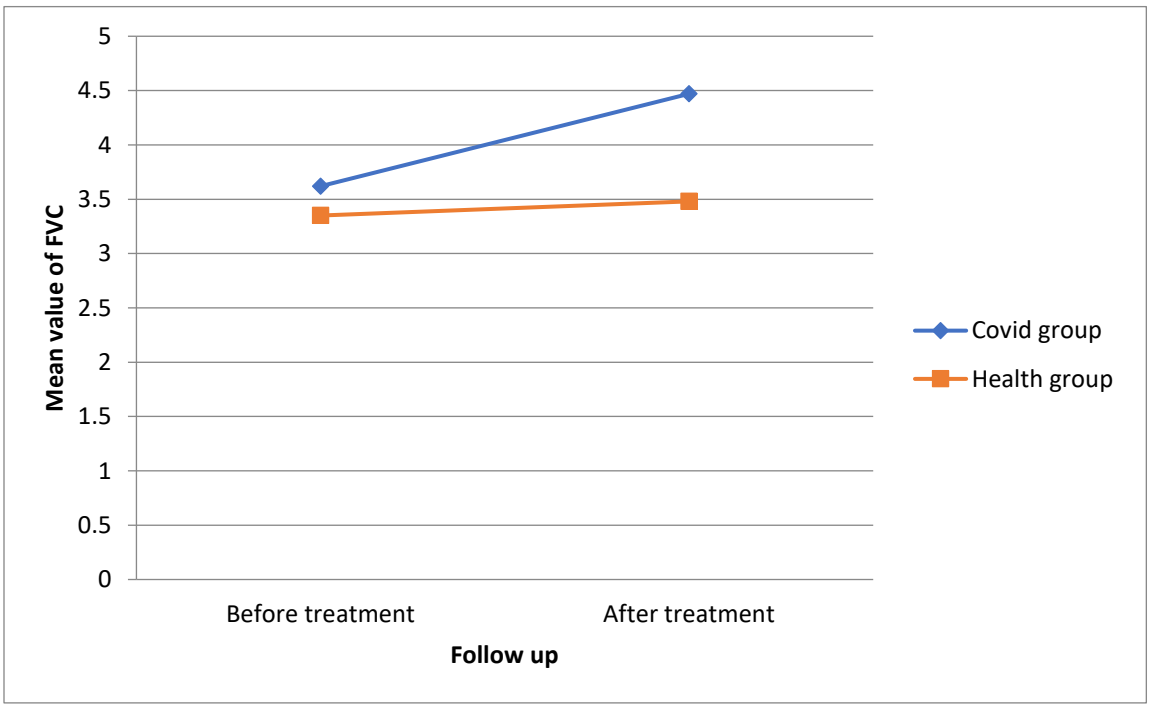
showed minor improvements (FEV1: 4.24 L, FVC: 4.87 L) (P>0.05) (Table 3, Figure 2).

Table 3: Pulmonary Function Test Results

Parameter	Group	Pre-treatment (L, mean±SD)	Post-treatment (L, mean±SD)	% Change	P-value
FEV1	COVID-19	3.11 ± 0.4	3.75 ± 0.3	20.32%	<0.0001
	Healthy	4.13 ± 0.3	4.24 ± 0.3	2.66%	0.12
FVC	COVID-19	3.62 ± 0.5	4.47 ± 0.4	23.40%	<0.0001
	Healthy	4.65 ± 0.4	4.87 ± 0.3	4.73%	0.08

Figure 2: Pre- and post-treatment FEV1 and FVC (Line graph comparing FEV1 and FVC across groups; steep rise in COVID-19 group post-treatment)





Symptom Improvement

In the COVID-19 group, dyspnea severity decreased by 53.96%, cough type improved by 67.23%, and cough duration reduced by 59.48% (P<0.0001) (Table 4).

Table 4: Symptom Improvement in COVID-19 Group

Symptom	Pre-treatment Score	Post-treatment Score	% Improvement	P-value
Dyspnea (MRC)	2.8 ± 0.7	1.3 ± 0.5	53.96%	<0.0001
Cough Type	1.9 ± 0.6	0.6 ± 0.4	67.23%	<0.0001
Cough Duration	1.7 ± 0.5	0.7 ± 0.3	59.48%	<0.0001

Hypothesis Testing

The significant improvements in the COVID-19 group rejected the null hypothesis (H_0), accepting the alternative (H_1) that *Pranayama* affects *Pranavaha Srotas* differently in COVID-19 recovered versus healthy individuals.

DISCUSSION

Key Findings

This study demonstrates that *Anulom-Vilom Pranayama* significantly enhances pulmonary function in COVID-19 recovered individuals, aligning with prior research on its benefits for respiratory health [5,8]. The 20.32% increase in FEV1 and 23.40% in FVC (P<0.0001) reflect improved airflow and lung capacity, critical for post-COVID recovery [9]. However, these values did not reach the healthy group's baseline, indicating residual respiratory impairment, consistent with reports of "long COVID" [10].

Demographic Influences

The older age (33.06 vs. 22.11 years) and male predominance (98% vs. 45%) in the COVID-19 group align with global trends of worse outcomes in older males [11]. Occupational diversity in the COVID-19 group suggests higher exposure risks, unlike the student-only healthy group, possibly protected by pandemic restrictions [12]. Socioeconomic disparities (24% upper-class in COVID-19 vs. 3% in healthy) may reflect initial infection patterns tied to travel or social interactions, later shifting to poorer populations [13].

Dietary and Lifestyle Impact

The higher prevalence of mixed diets in the COVID-19 group (56% vs. 21%) versus vegetarianism in the healthy group (79%) raises questions about dietary influences on immunity. Vegetarian diets, rich in antioxidants, may bolster respiratory health [14], warranting further investigation. Marital status differences (68% married in COVID-19 vs. 0% in healthy) could correlate with age or exposure via family networks [15].

Ayurvedic Parameters

The lack of significant differences in *Prakriti*, *Sara*, and other *Ayurvedic* factors (P>0.05) suggests these may not critically influence COVID-19 outcomes, contrasting with *Ayurvedic* theory linking constitution to disease susceptibility [2]. This finding may reflect the overriding impact of viral pathology over constitutional factors.

Clinical Implications

The substantial symptom relief (e.g., 53.96% dyspnea reduction) and pulmonary improvements underscore *Pranayama's* role as a cost-effective, accessible intervention [16]. Its integration into post-COVID rehabilitation could reduce reliance on mechanical ventilation, aligning with global calls for holistic approaches [17].

Limitations and Future Directions

The study's 3-month duration limits insights into long-term outcomes, such as chronic respiratory sequelae [10]. The predominantly male COVID-19 cohort may skew results, necessitating gender-balanced studies. Future research should explore dietary impacts, long-term Pranayama effects, and its efficacy across diverse populations.

CONCLUSION

Pranayama significantly enhances *Pranavaha Srotas* function in COVID-19 recovered individuals, modulated by demographic and lifestyle factors. Its adoption as a complementary therapy could optimize recovery, supporting a holistic approach to post-pandemic health management.

Declaration by Authors

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