Enhancing Autonomic Functions through OM Chanting and Bhramari Pranayama in Post-COVID Medical Students: A Cohort-Based Interventional Study

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ABSTRACT

Background:

Post-COVID-19 syndrome is often associated with autonomic dysregulation, reflected in decreased heart rate variability (HRV) and impaired parasympathetic tone. Non-pharmacological interventions such as OM chanting and Bhramari Pranayama have demonstrated potential in enhancing autonomic function by promoting vagal activation and reducing sympathetic overactivity. However, evidence in post-COVID young adult populations, particularly in high-stress academic settings, remains limited.

Objectives:

This study aimed to evaluate the effects of OM chanting and Bhramari Pranayama on heart rate variability in post-COVID medical students.

- To record HRV using time-domain parameters—SDNN, rMSSD, SDSD, and pNN50 before and after a 30-day supervised intervention.
- To compare pre and post-intervention HRV indices to assess improvements in autonomic balance.

Material and Methods:

A prospective interventional cohort study was conducted at Pt. Jawahar Lal Nehru Government

Medical College and Hospital, Chamba, Himachal Pradesh. A total of 109 post-COVID medical students (aged 18–25 years) were enrolled. Participants underwent a daily 30-day supervised breathing intervention comprising 10 minutes of OM chanting and 5 minutes of Bhramari Pranayama. HRV was assessed through five-minute ECG recordings before and after the intervention. Time-domain parameters (SDNN, rMSSD, SDSD, pNN50) were calculated manually. Statistical analysis was performed using paired t-tests.

Results:

All HRV parameters showed statistically significant improvement post-intervention. SDNN increased from 32.45 ± 6.17 ms to 37.96 ± 7.12 ms ($p < 0.0001$), rMSSD from 28.74 ± 5.49 ms to 34.14 ± 5.85 ms ($p < 0.0001$), SDSD from 25.61 ± 4.97 ms to 30.97 ± 5.45 ms ($p < 0.0001$), and pNN50 from 5.31 ± 1.72% to 5.81 ± 1.64% ($p = 0.029$). These findings indicate enhanced parasympathetic modulation and improved autonomic adaptability.

Conclusion:

The study highlights the efficacy of OM chanting and Bhramari Pranayama in enhancing HRV among post-COVID medical students. These techniques offer a simple, cost-effective and accessible approach to autonomic rehabilitation, particularly valuable in rural and high-altitude healthcare settings. Their integration into institutional wellness programs may yield sustained physiological and psychological benefits. Future research should incorporate randomized controlled trials with larger populations, biomarker profiling and neuroimaging to further elucidate underlying mechanisms.

Keywords:

OM chanting; Bhramari Pranayama; Heart Rate Variability; Post-COVID; Parasympathetic activity; Autonomic nervous system; Medical students; Vagal tone

Introduction

Post-acute COVID-19 recovery is frequently accompanied by persistent dysfunction in the autonomic nervous system, often reflected by reduced heart rate variability (HRV)—a key marker of cardiovascular resilience and neurocardiac adaptability [1]. HRV measures beat-to-beat variations in heart rate and is influenced by both sympathetic and parasympathetic branches of the autonomic nervous system [2].

Medical students recovering from COVID-19 represent a unique subset exposed to multiple stressors, including disrupted routines, academic pressure and emotional fatigue, all of which can exacerbate autonomic instability [3]. Non-pharmacological approaches that support physiological recovery in such settings are thus of increasing clinical interest.

Yogic breathing practices, including OM chanting and Bhramari Pranayama, have demonstrated neurophysiological effects conducive to vagal activation. OM chanting is believed to modulate limbic and brainstem circuits via vibratory and auditory resonance, resulting in autonomic stabilization [4,5]. Bhramari Pranayama as characterized by slow nasal breathing and a humming exhalation has been shown to enhance parasympathetic activity and baroreceptor sensitivity [6,7].

Although several studies highlight their efficacy in reducing anxiety and improving pulmonary and cardiovascular function [8-10], evidence specific to post-COVID populations, especially among young adults in rural or high-altitude environments, remains limited. This study aimed to address this gap by evaluating the effect of a 30-day protocol of OM chanting and Bhramari

Pranayama on HRV indices in post-COVID medical students.

Aim and Objectives

Aim

To assess and evaluate the impact of OM chanting and Bhramari Pranayama on heart rate variability (HRV) in post-COVID medical students over a 30-day supervised intervention period.

Objectives

1. To measure baseline and post-intervention HRV time-domain parameters—SDNN, rMSSD, SDSD, and pNN50.
2. To compare changes in HRV indices following the breathing intervention.
3. To evaluate the feasibility of using traditional breathing techniques as autonomic rehabilitation tools in post-COVID recovery.

Materials and Methods

Study Area

The study was conducted in the Department of Physiology and the Darbar Hall at Pandit Jawahar Lal Nehru Government Medical College and Hospital (Pt. JLNGMCH), Chamba, Himachal Pradesh. These facilities were adequately equipped to support the teaching, training, and research activities involved in the study.

Study Design

An interventional prospective cohort study design was employed to evaluate the impact of OM chanting and Bhramari Pranayama on heart rate variability (HRV). Baseline and post-intervention measurements were recorded and compared to assess the effectiveness of the intervention.

Study Population

The study population comprised post-COVID medical students enrolled at Pt. JLNGMCH, Chamba. Students from first-year MBBS till internship who met the inclusion criteria were considered for participation.

Sample Size

Using Cochran's formula with a 95% confidence level and 5% margin of error, the initial sample was 384. After applying finite population correction for the eligible population (N = 130), the minimum required sample was 98. A total of 109 students participated. A previous study by Kuppusamy et al. supports the adequacy of this sample size for HRV studies using similar interventions [11].

Inclusion Criteria

1) The medical students between age group of 18 to 25 years who had suffered Covid-19 infection and in whom clinical diagnosis was confirmed through positive RT-PCR or positive RAT testing.
2) All the post covid medical students either symptomatic or asymptomatic from both the genders.
3) Students who were willing to participate in the study and adhere to the intervention protocol.
4) No underlying medical conditions contraindicating pranayama practices.

Exclusion Criteria

1) Students giving history of pre -existing lung disease before the Covid infection.

2) Students giving history of smoking and substance abuse.
3) Students who were already performing any type of yoga and meditation before the start of study.
4) Students suffering from any other respiratory disease at the time of study.

Period of Study

The study was conducted over a duration of 12 months, commencing upon approval from the Institutional Ethics Committee.

Intervention Protocol

Participants engaged in daily 45-minute sessions for 30 consecutive days including:

- **OM Chanting** (10 minutes): Deep inhalation followed by exhalation with "AA-UU-MMM" vibration repeated with a 10-second pause, followed by 20 minutes of rest.
- **Bhramari Pranayama** (5 minutes): Nasal inhalation and exhalation with humming sound performed in a meditative posture, followed by 10 minutes of rest.

All participants received initial demonstrations and practice sessions before formal data collection to ensure consistency, safety and proper technique.

Procedure

The study was conducted following ethical approval and informed written consent was obtained from all participants prior to the initiation of any procedures. The entire process was carried out in a well-ventilated, quiet and temperature-controlled room to minimize external distractions and ensure consistency during data collection. Participants were advised in advance to wear loose, comfortable clothing and to avoid consuming caffeine, heavy meals, or engaging in strenuous physical activity at least two hours before the session to prevent any interference with respiratory measurements.

Heart Rate Variability (HRV) was assessed to evaluate autonomic nervous system function and cardiac adaptability in participants before and after the intervention. HRV reflects the physiological variation in the time intervals between successive heartbeats, specifically quantified as R-R (or NN) intervals on an electrocardiogram (ECG) [102]. In this study, time-domain parameters of HRV were analyzed to provide insights into both sympathetic and parasympathetic activity. Electrocardiographic recordings were obtained using a standard 12-lead ECG machine (MDT company Cardiomax Model ECG Machine). For each participant, ECG was recorded continuously for five minutes, both pre and post-intervention, under identical conditions in the hospital's ECG room. All recordings were performed with the participant in a resting supine position in a quiet, temperature-controlled room with minimal external stimuli to avoid influencing autonomic tone [12,13].

All HRV parameters were manually calculated by visually analyzing printed ECG strips. No computer software or automated tools were employed. R-R intervals were measured with a ruler, and subsequent calculations were performed using a scientific calculator to ensure manual precision. Only R-R intervals corresponding to normal sinus rhythm were included; ectopic beats, artifacts and non-sinus intervals were excluded from the analysis [14]. Following parameters were analyzed.

1) The first parameter assessed was the **Standard Deviation of NN intervals (SDNN),** which provides a global measure of heart rate variability by calculating the standard deviation of all normal R-R intervals over the five-minute period. SDNN reflects overall autonomic

activity, with normal values in short-term recordings typically ranging from 30 to 50 milliseconds and an acceptable physiological range between 20–60 milliseconds [15,16].

2) The second parameter evaluated was the **Root Mean Square of Successive Differences (rMSSD)**, which represents the square root of the mean squared differences between adjacent R-R intervals. It is considered a reliable marker of parasympathetic (vagal) activity. For healthy adults at rest, rMSSD values usually fall between 25 and 40 milliseconds with acceptable ranges from 20 to 50 milliseconds [15,17].
3) The third parameter calculated was the **Standard Deviation of Successive Differences (SDSD)**, which assesses the variability of differences between successive R-R intervals and correlates strongly with rMSSD. Normal SDSD values generally lie between 15 and 45 milliseconds [16].
4) The fourth time-domain parameter, **Percentage of successive normal sinus RR intervals greater than 50 milliseconds (pNN50)**, denotes the percentage of successive R-R interval pairs that differ by more than 50 milliseconds and serves as an additional index of vagal modulation. This was manually calculated by counting all R-R pairs differing by over 50 ms and expressing them as a percentage of total pairs measured. In healthy young adults, pNN50 values typically range between 3% and 12%, with values above 3% considered indicative of normal autonomic tone [15,18].

All physiological measurements, including heart rate variability (HRV) indices, were conducted both prior to and following the intervention, adhering strictly to the same standardized protocols in each instance to maintain procedural consistency. This approach ensured that any observed differences in outcomes could be reliably attributed to the effects of the intervention, rather than variations in measurement technique. The primary aim of this repeated-measures design was to assess the short-term impact of the OM chanting and Bhramari Pranayama practices on autonomic nervous system function. By analyzing changes in HRV parameters such as SDNN, rMSSD, SDSD, and pNN50% before and after the intervention period, the study sought to determine whether these breathing techniques could elicit measurable shifts in autonomic regulation, particularly in terms of enhanced parasympathetic activity and reduced sympathetic dominance.

Data Analysis Method:

All collected data were compiled using Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including means and standard deviations, were used to summarize the heart rate variability (HRV) parameters—SDNN, rMSSD, SDSD, and pNN50. To assess the significance of changes before and after the intervention, paired sample t-tests were performed. A p-value less than 0.05 was considered statistically significant, while $p < 0.01$ was regarded as highly significant. This repeated-measures approach minimized inter-individual variability and enhanced statistical power by allowing each participant to act as their own control. The statistical methodology adhered to best practices in biomedical research for within-subject comparisons and outcome evaluation in physiological studies [19].

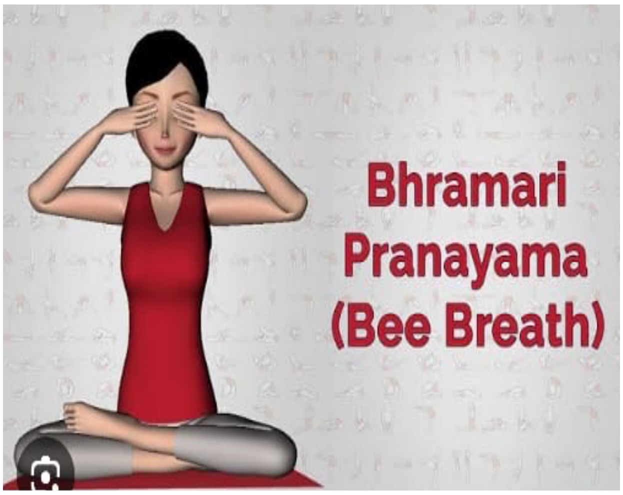

Figure 1 and Figure 2: Position for Om Chanting and Bhramari Pranayama.

Figure 3 and Figure 4: Medical students performing Om Chanting and Bhramari Pranayama.

Figure 5: Cardiomax Model MDT ECG Machine.

Figure 6,7,8 and 9: Medical students undergoing ECG for 5 minutes.

Observations & Results

Following the 30-day supervised intervention, all four time-domain heart rate variability (HRV) parameters showed statistically significant improvement, indicating enhanced autonomic modulation and increased parasympathetic activity among post-COVID medical students.

Table 1: Comparison of HRV Time-Domain Parameters Pre and Post-Intervention

Parameters	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	t-value	p-value
SDNN (ms)	32.45 ± 6.17	37.96 ± 7.12	6.106	<0.0001 **
rMSSD (ms)	28.74 ± 5.49	34.14 ± 5.85	7.027	<0.0001 **
SDSD (ms)	25.61 ± 4.97	30.97 ± 5.45	7.587	<0.0001 **
pNN50 (%)	5.31 ± 1.72	5.81 ± 1.64	2.197	0.029 *

Significance-

ϕ- Not significant *-p < 0.05 (Significant) **- p < 0.01 (Highly Significant)

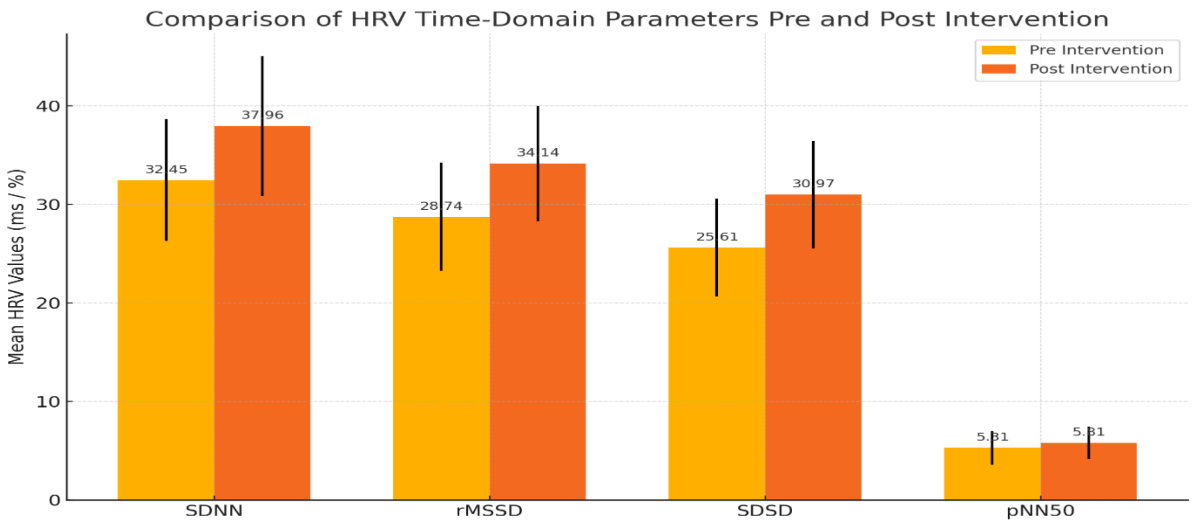

Chart 1: **Comparison of HRV Time-Domain Parameters Pre and Post-Intervention**

Table 1 and **Chart 1** summarizes the comparison of pre- and post-intervention values for SDNN, rMSSD, SDSD, and pNN50. The mean values and standard deviations were analyzed using paired t-tests to determine statistical significance.

1) Standard Deviation of NN Intervals (SDNN)

The mean SDNN increased from 32.45 ± 6.17 ms before the intervention to 37.96 ± 7.12 ms after the intervention. This difference was highly statistically significant ($t = 6.106$, $p < 0.0001$), indicating an overall improvement in autonomic balance and global HRV.

2) Root Mean Square of Successive Differences (rMSSD)

The mean rMSSD rose from 28.74 ± 5.49 ms to 34.14 ± 5.85 ms post-intervention. The change was statistically significant ($t = 7.027$, $p < 0.0001$), suggesting enhanced parasympathetic tone and vagal modulation as a result of the breathing intervention.

3) **Standard Deviation of Successive Differences (SDSD)**

The SDSD parameter showed an increase from 25.61 ± 4.97 ms at baseline to 30.97 ± 5.45 ms post-intervention. This improvement was also statistically significant ($t = 7.587$, $p < 0.0001$), further supporting the positive impact of the intervention on short-term vagal activity.

4) **Percentage of NN Intervals Differing by More Than 50 ms (pNN50)**

The mean pNN50 increased modestly from 5.31 ± 1.72% to 5.81 ± 1.64% following the intervention. This change, though relatively smaller in magnitude, reached statistical significance ($t = 2.197$, $p = 0.029$), reflecting improved vagal modulation.

Interpretation

The observed improvements in all four HRV parameters indicate a statistically significant shift toward parasympathetic dominance following the 30-day practice of OM chanting and Bhramari Pranayama. The marked increases in SDNN, rMSSD, and SDSD values support enhanced cardiac vagal control and autonomic adaptability. Although the increase in pNN50 was modest, its significance further corroborates the effectiveness of the intervention in restoring autonomic balance.

Summary and Conclusion

This cohort-based interventional study assessed the impact of OM chanting and Bhramari Pranayama on heart rate variability (HRV) in post-COVID medical students. Over a 30-day period, participants engaged in a supervised daily breathing protocol designed to activate the parasympathetic nervous system and restore autonomic equilibrium.

Time-domain HRV parameters—namely SDNN, rMSSD, SDSD, and pNN50—were recorded before and after the intervention. Statistically significant improvements were observed in all four indices. SDNN, rMSSD, and SDSD demonstrated marked increases ($p < 0.0001$), suggesting enhanced autonomic adaptability and global variability. A smaller yet significant rise in pNN50 ($p < 0.05$) further supported the positive influence of the breathing practices on vagal tone.

The findings indicate that regular practice of OM chanting and Bhramari Pranayama is associated with measurable physiological improvements in autonomic function among young adults recovering from COVID-19. These techniques offer a low-cost, accessible, and non-pharmacological approach to cardiorespiratory and autonomic rehabilitation. Their simplicity and scalability make them particularly suitable for high-stress environments, rural healthcare settings, and academic institutions especially in high-altitude or resource-constrained regions.

The results also reinforce the potential for integrating pranayama-based modules into institutional wellness initiatives aimed at promoting student health, reducing stress and supporting recovery from post-viral syndromes. However, to strengthen the generalizability of these outcomes, further studies involving randomized controlled designs, larger populations, and longer follow-up periods are recommended. Additionally, future research incorporating biomarker profiling, neuroimaging and long-term autonomic monitoring could offer deeper insight into the neuro-cardiological mechanisms underlying the observed effects.

Limitations

While the present study provides valuable insights into the autonomic benefits of OM chanting and Bhramari Pranayama in post-COVID medical students, certain limitations must be acknowledged:

1. **Lack of a Control Group:**
   The absence of a parallel control group limits the ability to definitively attribute the observed HRV improvements solely to the intervention. While the pre-post design offers within-subject comparison, inclusion of a non-intervention group would strengthen causal inferences.
2. **Manual Measurement of HRV:**
   All HRV parameters were calculated manually using printed ECG strips and a scientific calculator. Although this approach ensured high attention to detail, it may introduce minor observer bias or measurement variability compared to automated software-based HRV analysis.
3. **Short-Term Follow-Up:**
   The study evaluated the immediate effect of a 30-day intervention. Long-term retention of autonomic improvements and the sustainability of benefits over time were not assessed.
4. **Homogeneous Population:**
   The study exclusively involved young, healthy, post-COVID medical students from a single institution. This restricts the generalizability of the findings to broader age groups, non-medical populations, or individuals with comorbidities.
5. **No Biomarker or Neurophysiological Correlates:**
   The study did not include biological markers such as cortisol, inflammatory cytokines, or neuroimaging data to corroborate the autonomic and stress-reduction outcomes. Such correlates would provide a more comprehensive understanding of the underlying physiological mechanisms.
6. **Self-Reported Adherence and Lifestyle Factors:**
   Although participants were supervised during daily sessions, external lifestyle factors (e.g., sleep, caffeine, emotional stress) were not strictly controlled or quantified, which could have influenced HRV readings.

Despite these limitations, the study provides a valuable foundation for future research and demonstrates the feasibility and efficacy of yogic breathing practices as supportive interventions in post-COVID recovery.

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