Research article

A study on immediate and training effect of Bhramari pranayama on heart rate variability in healthy adolescents

Latha R., Sarveghna Lakshmi S.

1Department of Physiology, 2Sri Venkateshwara Medical College Hospital and Research Centre, Ariyur, Puducherry 605102, India

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Corresponding author: Latha R. Email: latha@svmchrc.ac.in

ABSTRACT

Introduction and Aim: Bhramari pranayama (Humming bee breath) is the most common slow pranayama practice involving inhalation through both nostrils followed by exhalation which produces sound of humming bee. Practicing pranayama reduces the effects of stress on different systems by increasing the vagal tone. With the ongoing COVID-19 pandemic, there are heightened feelings of stress, anxiety and depression and pranayama can be an effective way to improve our mental and emotional well-being. This study has been chosen to assess the effect of Bhramari pranayama on autonomic functions and to compare the immediate and training effects of Bhramari pranayama in the study group.

Materials and Methods: An observational study was conducted in a medical college among 110 students aged between 18-22 years for a period of 2 months. The participants were instructed to do 9 rounds of Bhramari pranayama every day for 3 weeks. The immediate and training effect of pranayama practice on HRV (Heart Rate Variability) was assessed. The parameters of HRV (time and frequency domains) were assessed by PHYSIOPAC-PP4 (MEDICAID SYSTEMS, Chandigarh).

Results: After training of Bhramari pranayama for 3 weeks, there was a decrease in Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and PNN50 and a decrease in frequency domain parameters, LFnu and LF/HF ratio were observed significantly.

Conclusion: The study shows the possibility that Bhramari pranayama has a beneficial effect on HRV in medical students, as the autonomic balance produces the improvement of parasympathetic tone.

Keywords: Autonomic balance; heart rate variability; pranayama; stress; vagal tone.

INTRODUCTION

Yoga is an ancient Indian science (1) and the way of life that includes the practice of specific posture (Asana) and controlled breathing (Pranayama; 2). It is a 3000-year-old spiritual discipline, which has been designed to bring harmony to the physical, mental, emotional, and spiritual health of an individual (3). Pranayama is one of the most common yogic practices which can produce various physiological responses in healthy individuals (4). Pranayama involves manipulation of breathing pattern (1,5,6) where the breath is a dynamic bridge between the body and mind (1). It can be practiced in both slow and fast manner (1,7). Pranayama is the method of prolongation and control of breath, which helps to bring conscious awareness in breathing, to reshape breathing habits and patterns. Practicing pranayama reduces the effects of stress and strain on various systems by increasing the vagal tone (7). With the ongoing COVID-19 pandemic, there are heightened feelings of stress, anxiety and depression and pranayama can be an effective way to improve our mental and emotional well-being.

Bhramari pranayama (Humming bee breath) is the most common slow pranayama practice involving inhalation through both nostrils followed by exhalation which produce sound of humming bee (2,5,7). It can be easily practiced by all irrespective of their age or gender (5,7). It changes the normal breathing pattern, with short inspiration and prolonged expiration producing significant impact in physiological system. Practice of Bhramari pranayama continuously induces subjective feelings of mind refreshment and blissfulness (7).

The heart rate variability (HRV), a non-invasive tool (2) measures the time interval between consecutive heart beats in milliseconds. Classical spectral analysis of HRV signals differentiates sympathetic from parasympathetic activity (4). Pranayama improves cardiovascular functions markedly (1,5,7).

As there are very few studies on the effects of Bhramari pranayama (2,7) and none compares the immediate and training effect of Bhramari pranayama on cardiovascular functions in healthy adolescents, this study has been chosen to assess the effect of Bhramari pranayama on autonomic functions and to

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compare the immediate and training effects of this pranayama in the study group.

MATERIALS AND METHODS

The observational study was conducted in a medical college among 110 students aged between 18-22 years for a period of 2 months from 30/08/2021 to 30/10/2021.

Data collection

The subjects were selected by convenient sampling technique and the selection is based on the following criteria:

Inclusion criteria

Subjects aged between 18-22 years of both genders were included.

Exclusion criteria

Subjects practicing yoga in the past one year; Subjects with inability to practice pranayama due to physical abnormalities; Subjects with history of chronic respiratory illness and on medication; Subjects with history of any acute illness 3 months prior to the study; Subjects with history of any surgery in recent past and athletes; smokers and alcoholics were excluded from the study.

Brief procedure

The study was carried out in the Physiology department of our Institution. The Institutional Research and Ethics committee’s approval (No: 91/SVMCH/IEC- Cert/Jun 21) was obtained prior to the commencement of the study. The subjects were recruited from our institution among the undergraduate medical students and informed written consent was obtained from all the subjects prior to the study.

A qualified yoga instructor trained the students about the procedure of Bhramari pranayama, and the participants were instructed to sit in a comfortable posture with erect spine and eyes closed. They were instructed to take slow and deep inhalation through both nostrils for 6 seconds, followed by deep and slow exhalation for 10 seconds with their index finger on both external auditory canals. While exhalation, they were instructed to chant a humming nasal sound like a bee. Nine such rounds were done.

The participants were called in groups of 5 to the physiology lab and were instructed to do 9 rounds of Bhramari pranayama after which the immediate effect of the pranayama on HRV and cognitive functions was done. The readings were noted within an interval of 5 minutes. Bhramari pranayama training was given by the yoga instructor every day in the evening for 15 minutes for 3 weeks after which training effect of Bhramari pranayama was assessed.

A total of 110 subjects with age group (18-22 years) were recruited. The anthropometric measurements (height and weight) were recorded, and BMI was calculated as: BMI = Weight (kg)/Height (m)².

Heart rate variability

The subjective sensations and ECG were recorded. The basal cardiovascular parameters such as heart rate (HR), blood pressure, time domain [RR interval, standard deviation of all normal RR intervals (SDNN), root mean square of differences between adjacent normal RR intervals (RMSSD) and the percentage of adjacent RR intervals with a difference of duration greater than 50 msec (PNN50)] and frequency domain (Total power (TP), low frequency normalized unit (LFnu), high frequency normalized unit (HFnu) and low frequency-high frequency (LF/HF ratio) parameters of HRV were assessed by the frequency analysis of sequential R wave to R wave intervals of ECG obtained from 5-min recordings using PHYSIOPAC SYSTEM, MEDICAID SYSTEMS, Chandigarh. The HRV analysis was done according to International Guidelines and the RR time interval series was extracted from ECG records using Kubios HRV analysis software.
Statistical analysis

Data were entered in Microsoft - Excel and analysis was done using SPSS version 23. Categorical variable was expressed in frequency and percentage, continuous variables was expressed in mean and SD and Students paired ‘t’ test was used to test the significant difference. p value less than 0.05 was statistically significant.

RESULTS

Total of 110 MBBS students participated in the study. The demographic characteristics of the study group like age, gender distribution and Body mass index are recorded. The age distribution of participants (n=110) expressed in frequency (%). About 44% of study participants were belonged to 21 years of age and minimum belonged to 19 years of age with 15%. The gender distribution of participants (n=110). Data expressed in frequency (%). Maximum number study participants were female with 64.5%. The Body Mass Index of the participants (n=110). Data expressed in frequency (%). About 65% of the study participants were in normal weight category according to WHO classification.

Table 1: Demographic characteristics of study participants expressed in Mean ± SD

<table>
<thead>
<tr>
<th>Demographic variable</th>
<th>Study participants (n=110)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>20.29 ± 0.70</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.48 ± 8.76</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>62.82 ± 12.09</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.43 ± 3.47</td>
</tr>
</tbody>
</table>

Comparison of immediate and training values of Bhramari pranayama on frequency domain parameters namely LFnu and LF/HF ratio. p < 0.05 was statistically significant.

Table 2: The frequency domain indices of HRV on immediate and after the practice of Bhramari pranayama expressed as mean ± SD

<table>
<thead>
<tr>
<th>Parameters measured</th>
<th>Immediate effect of Bhramari pranayama</th>
<th>After Bhramari pranayama practice</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP (ms²)</td>
<td>2062.9 ±348.13</td>
<td>1139.7 ±89.89</td>
<td>0.085</td>
</tr>
<tr>
<td>LF nu</td>
<td>87.4 ±2.24</td>
<td>86.8±2.01</td>
<td>0.047*</td>
</tr>
<tr>
<td>HF nu</td>
<td>12.5 ±2.24</td>
<td>12.9±2.29</td>
<td>0.134</td>
</tr>
<tr>
<td>LF/HF ratio</td>
<td>7.2±1.87</td>
<td>6.8±1.29</td>
<td>0.04*</td>
</tr>
</tbody>
</table>

Table 2 depicts the frequency domain indices of HRV on immediate and after 3- week the practice of Bhramari pranayama expressed in mean ± SD. After training of Bhramari pranayama, there was a significant decrease in frequency domain parameters namely LFnu and LF/HF ratio. p < 0.05 was statistically significant.

Fig. 2 shows cardiovascular parameters and time domain indices of HRV on immediate and after the practice of Bhramari pranayama expressed in mean ± SD. After training of Bhramari pranayama for 3 weeks, there was a significant decrease in Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and PNN50. p<0.05 was statistically significant.

Fig. 2: Comparison of immediate and training effects of Bhramari Pranayama on time domain indices of Heart Rate Variability. HR: Heart Rate, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, RR intervals: The intervals between adjacent QRS complexes, SDNN: Standard deviation of the RR intervals, RMSSD: The number of interval differences of successive NN intervals greater than 50 ms, PNN50: Proportion derived by dividing NN50 by the total number of NN intervals. Statistical analysis was done by Students paired ‘t’ test. *p value <0.05, **p value < 0.01.
DISCUSSION

Yoga is a science that facilitates homeostasis which is the ancient way of life intended to improve the quality of life of an individual (8). Pranayama practice involves voluntary breath regulation, which allows a practitioner to alter physiological functions and mental state within physiological limits (9). The present study was undertaken to assess the immediate and training effect of Bhramari pranayama on HRV.

HRV is an index of beat-to-beat changes in the heart rate (9) and is the most sensitive and accessible indicator of sympathetic and parasympathetic activity and autonomic regulation (2). A study on the effect of pranayama on perceived stress and cardiovascular parameters in young health-care students reported that there was a significant decrease in PSS scores in both fast and slow pranayama groups and a significant decrease in HR, DBP, RPP in slow pranayama groups (1).

Results of our study showed that after 3 weeks of Bhramari pranayama training produced a significant decrease of SBP and DBP. This is due to the extended voluntary expiration, there is a rise in intra thoracic pressure causing more blood flow to the heart from lung and increasing the stroke volume. This in turn increases BP and the baroreceptors are stimulated in carotid sinus. The increased baroreceptor discharge inhibits the vasoconstrictor nerves and excites the vagus leading to fall in SBP and DBP (5). There is also a significant change in PNN50% in the study, which suggests parasympathetic predominance evidenced by increased duration of cardiac cycle (10). There was no significant change in time domain parameters like RR intervals, SDNN, RMSSD on immediate and training effect.

In frequency domain analysis of HRV, Bhramari pranayama training produced a significant reduction in LF and LF/HF ratio. LF, the quantitative marker of sympathetic activity is decreased after practice of the pranayama indicating low sympathetic activity (11). This may be attributed to inhibition of posterior or sympathetic area of the hypothalamus which balances the body’s responses to stressful stimuli (8). LF/HF ratio, a marker of sympathovagal balance, is reduced after training of pranayama suggesting the shift of autonomic balance toward parasympathetic predominance (12). We believe that the reduction is predominantly attributed to withdrawal of sympathetic and to a limited extent by increasing parasympathetic activity. The HF value and total power were unchanged. However, an insignificant increase in HF value is seen after training period suggests mild increase in the parasympathetic activity (10), as HF value is main indicator of parasympathetic activity (2). Our finding is supported by previous study on heart rate variability changes during and after the practice of Bhramari pranayama, there was a significant increase in heart rate and LF spectrum of HRV and a significant decrease in HF spectrum of HRV during the practice of Bhramari pranayama, and it reverts to normal during the recovery period of practice. It also showed a significant decrease in SBP, DBP, MAP and a slight fall in heart rate after 5 mins of pranayama practice (2).

The breath and the mind are closely interconnected according to the Ancient Yoga Tradition, and their influence is bidirectional (13). Therefore, with continuous pranayama practice, the ability to concentrate will enhance the changes in mental processing (Eg., focused attention and stress reduction) are rapidly expressed in the body via the autonomic and neuroendocrine systems. This reorganizes neural representation within the CNS and improves the bidirectional communication between the cerebral cortex and the limbic, autonomic, neuroendocrine, and behavioral activation (6). Hence, it is evident that the beneficial psychological effects of pranayama are likely to be a result of both neurohumoral mechanisms, mainly involving the sympathetic-parasympathetic nervous system (3).

CONCLUSION

The present study throws light on extreme beneficial effect of pranayama to mankind in maintaining sound physical and mental health. The findings of our study conclude that, if Bhramari pranayama is practiced regularly, the cardiovascular functions improve significantly which is due to sympathetic withdrawal and increased parasympathetic activity. This study was conducted on healthy adolescents and hence future studies should broaden the current research and should include patients with cardiovascular problems and psychiatric disorders, whose cognitive functions are adversely compromised.

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CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES


