

Effects of bumblebee yoga breathing on Attention and Blood Pressure

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ABSTRACT

This study investigates the physiological and cognitive effects of two variations of Bumblebee Yoga Breathing (BBYB) techniques i.e. slow and high sound humming on systolic blood pressure and attention. A sample of 20 healthy adult yoga practitioners participated in the study, undergoing BBYB sessions characterized by different sound pronunciations. Both BBYB variations led to significant reductions in systolic blood pressure, supporting previous findings (Upadhyay et al., 2023; Kuppusamy et al., 2016; Pramanik et al., 2010) that associate BBYB with improved cardiovascular function. The reduction is attributed to the vasodilatory effects of humming vibrations that promote relaxation. Additionally, improvements in attention, as indicated by increased total and net attempted scores, were observed following both slow and high sound BBYB sessions. These findings align with earlier studies (Pradhan et al., 2018) suggesting that BBYB enhances cognitive performance by reducing anxiety and increasing focus. The study underscores the potential of BBYB as a dual-purpose intervention for cardiovascular and cognitive health. However, findings are limited to experienced yoga practitioners and immediate effects.

Keywords: Bumble bee with low and high sound, Attention, Blood Pressure

INTRODUCTION

Bhramari Pranayama, or Bumblebee Yoga Breathing (BBYB), is a technique involving slow, prolonged exhalation paired with a rhythmic humming sound (Acharya et al., 2024). It has been noted for its potential benefits on overall physiological and psychological functioning (Kuppusamy et al., 2020; Trivedi et al., 2023).

BBYB includes several components that may contribute to its effectiveness, such as the vibrations generated by humming, varying sound intensity, and specific breathing patterns. These include the *Shanmukhi Mudra* (a hand gesture technique that inhibits the sensory gates,

promoting sensory withdrawal and internal focus) (Saraswati, 2012; Ushamohan et al., 2023), the vibrations generated by the humming sound, different breathing ratios (like prolonged exhalation), involving a low inhale-to-exhale ratio (Telles et al., 2023).

These vibrations, which can differ in pitch, are believed to stimulate cranial structures and influence brain activity (Goldman & Goldman, 2017). Traditional yogic texts like the Hatha Yoga Pradipika and Gheranda Samhita also highlight the significance of these elements.

Despite these insights, no study has yet investigated these components collectively especially the role of sound intensity. This study aims to explore how these slow and high sound pronunciation of BBYB, contribute to blood pressure and attention.

MATERIAL AND METHODS

Participants

Twenty healthy students (mean age $\pm$ SD: 22 ± 1.21 years; M:F = 1:1) from a state university in India were recruited through voluntary participation via classroom announcements.

Table 1 Baseline characteristics of the participants.

Characteristics	Sample size (n=20)
Age (years)	
Group mean age $\pm$ sd	22 $\pm$ 1.21
Age range	20-40
Age category n(%)	
20-30	20(100)
31-40	0.00
Gender n(%)	
Male: Female	01:01
Actual values	10:10
Education (in years)	
13 -15 (%)	93.0
16 -17 (%)	7.0
Experience of yoga (in months)	
6-12 (%)	8.0
13-60 (%)	75.5
61 and above (%)	17.5

Sampling

Sample size was calculated using G-power software (version 3.1) (Erdfelder, et al., 1996).

Inclusion and exclusion criteria

Inclusion criteria were: (i) normal health based on a semi-structured interview, (ii) at least three months of yoga breathing experience, and (iii) females with regular menses enrolled during the proliferative phase (5th–20th day of the menstrual cycle) to control for hormonal effects on autonomic function (Kuppusamy et al., 2020). Exclusion criteria included: (i) recent surgery, (ii) medication use, (iii) tinnitus or active ear infection, and (iv) regular tobacco/alcohol consumption.

Ethical considerations

The study had prior approval from the institution's ethics committee (approval no. PRF/YRD/023/005). The signed informed consent was obtained from all participants, also the procedure of assessments was explained before their participation. It was also mentioned in the consent form that (i) their identity would be kept confidential and (ii) they could withdraw from the study unconditionally at any time.

Study design

The study was a randomized crossover trial carried out between January to may, 2023. Each participant was assessed for two different sessions on two separate days. These were (i) Bumblebee with High Sound (BBHS), and (ii) Bumblebee with Slow Sound (BBSS). Hence for twenty participants there were $20 \times 2 = 40$ sessions. The assessments were conducted in a well-ventilated, dimly lit sound attenuated room, specially designed for research activity. There were two times for the assessments (i.e., forenoon and evening).

Each participant was assessed for (i) the physiological changes in blood pressure (BP), and (ii) attention using six letter cancellation test (SLCT).

Assessments

1. Blood Pressure

Blood pressure (BP) was recorded using the OMRON blood pressure monitor, (model: T9P [HEM-759P-c1] OMRON Healthcare Co., Ltd. Kyoto, Japan) before and after the intervention.

2. Six-Letter Cancellation Test (SLCT)

The Six-Letter Cancellation Test (SLCT) measures selective attention, focused attention, and visual scanning (Pradhan, 2013). Participants were instructed to cancel the same six target letters (arranged randomly in working area), listed in bold at the top, within 90 seconds. They could choose to cancel all at once or one by one, following horizontal, vertical, or random paths. To reduce test-retest and memory effects, 10 different worksheets were used, with varied target letters and letter arrangements. The SLCT has been validated for assessing attention and visual scanning in Indian populations, with reliability reported as $r = 0.781$, $P = 0.002$ (Pradhan & Nagendra, 2008)

Interventions

1. Bumblebee with high sound (BBV)

Participants rest their hands on their knees with palms facing upward (Maharan & Jayaprakash, 2023) while humming.

2. Bumblebee with slow sound (BBSS)

In this component, the participants were asked to hum the same rhythmic sound, but at a slow sound intensity or silently.

Reason for choosing two sound pressure levels

Many studies on BBYB have focused on aspects like breathing frequencies, mudras, humming, and resonance, but none have examined the impact of different sound pressure levels during humming. Managing sound pressure is crucial to determine if sound intensity affects the outcomes.

Data extraction

Blood Pressure (BP)

The separate values of systolic blood pressure and diastolic blood pressure of five different sessions was used to calculate mean arterial pressure and presented in mmHg. The mean arterial pressure was calculated using the standard formula $[MAP = DBP + 1/3(SBP - DBP)]$ (Glasser et al., 2015).

Six Letter Cancellation Test (SLCT)

A standard procedure was followed for the scoring of the six letter cancellation test (Sarang & Telles, 2007). These scores were obtained before pre and after post states of all sessions.

Data analysis

The mean values for each participant in each session were recorded and analyzed using SPSS (SPSS version 24.0, IBM SPSS, New York, USA).

RESULTS

Post-hoc analyses for multiple comparisons (Bonferroni adjusted)

Table 2 Changes in blood pressure and attention after the two sessions i.e. slow and high sound BBYB. Values are group mean $\pm$ SD.

Variables	Subscales	States	BBHS	BBSS
Blood pressure	Systolic	Pre	113.20 $\pm$ 10.2	112.65 $\pm$ 11.21
		Post	106.10$\pm$9.19***	106.54$\pm$11.31**
	Diastolic	Pre	75.81 $\pm$ 5.89	75.68 $\pm$ 9.5
		Post	75.74 $\pm$ 5.96	73.33$\pm$6.95*
SLCT	Total attempts	Pre	38.90 $\pm$ 11.10	37.23 $\pm$ 8.21
		Post	41.60$\pm$10.10*	41.90$\pm$9.39***
	Wrong attempts	Pre	2 $\pm$ 2.22	1 $\pm$ 0
		Post	1 $\pm$ 0	2 $\pm$ 0
	Net attempts	Pre	39.76 $\pm$ 11.14	37.0 $\pm$ 8.10
		Post	41$\pm$9.88*	41.70$\pm$9.54***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; *post-hoc* analyses following RM-ANOVA with Bonferroni adjustment, comparing post with pre values.

SD: Standard deviation, SLCT: Six letter cancellation test.

DISCUSSION

Significance of the changes in blood Pressure

The systolic blood pressure is reduced in both slow and high sound pronunciation BBYB sessions. The change in blood pressure in both sessions can be explained by the previous studies on BBYB which resulted in the same findings of reduced blood pressure (Upadhyay et al., 2023; Kuppusamy et al., 2016). The same results after practicing BBYB on blood pressure have been established in an earlier study by Pramanik and colleagues in 2010, in this study fifty healthy adults of both sexes were assessed before and after 5 minutes of BBYB practiced at 3 cycles/minute. The study reported a significant reduction in systolic and diastolic blood pressure (Pramanik et al., 2010).

In the BBSS session, when practiced with slow sound pronunciation, the humming is quieter and reverberates gentle vibrations throughout the brain (Ushamohan et al., 2023; Taneja, 2018). Even at slow sound pronunciation, these humming vibrations may still have a cardiovascular effect, promoting vasodilation (relaxation of blood vessels) and relaxation throughout the body, which could have led to a decrease in systolic blood pressure.

Apart from these changes, the study had secondary aim to determine the effects of two components of BBYB session on attention. The results are discussed below.

Significance of changes in attention

Increased total and net attempted scores following the BBSS and BBHS session in the present study, support the finding of an earlier study carried out on visually impaired students who showed increased scores in the braille version of six letter cancellation test following 10 minutes of the BBYB session (Pradhan et al., 2018). The improvements in total and net attempted scores of the present study, indicate that the vibrations generated by low and high sound humming during these sessions positively generated a calming effect by reducing anxiety which helped participants engage more effectively with attention-related tasks.

Conclusions

The study examined two modified breathing techniques of bumblebee yoga breathing session to assess their effects on blood pressure and attention. The results of the present study suggest that both low and high sound humming can enhance both blood pressure and attention. Furthermore, the study supports previous research that links BBYB to shift into positive

cognitive outcome i.e. improved attention. The consistent reduction in systolic blood pressure across these two BBYB sessions also aligns with earlier studies, further establishing the practice's potential as an effective tool for cardiovascular health.

Strengths of the study

The study includes a diverse sample of 20 healthy adults with a balanced gender, which improves the generalizability of its findings across different demographics.

Limitations and future suggestions

This study exclusively incorporates yoga practitioners, who had a minimum of three months experience of practicing yoga including breathing practices. Scoring of all questionnaire and data extraction was done by the same researcher, therefore not blinded. The study primarily assessed the immediate effects of two components of BBYB, in addition to this future research should address these limitations by incorporating longitudinal investigations with different populations to evaluate the long-term effects and robustness of observed results.

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