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Effect of Bhramari Pranayam on cardiovascular, autonomic and central nervous system – A systematic review

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Abstract:
Yoga is an ancient Indian technique followed from thousands of years. Yoga consists of different postures, asanas, pranayam and meditation. Beneficial effects of yoga are proved in normal and diseased subjects. Out of different types of pranayamas, we decided to review the effect of bhramari pranayam on health. We reviewed effect of bhramari pranayam on different body parameters like heart rate (HR), systolic blood pressure(SBP), diastolic blood pressure(DBP), mean blood pressure(MBP), heart rate variability, cognitive effects, stress level, memory, concentration, social responses, cold pressure test etc. Bhrarami pranayam involves slow deep inspiration followed by prolonged expiration in which humming bee type of sound is produced through nostrils. The studies were searched through online resource database like google scholar, embase , pubmed and manual search. We searched 41 articles out of which 37 articles were excluded because they did not match with our inclusion criteria. So finally we included 14 study articles for review. We found that many studies demonstrated decrease in heart rate and blood pressure during resting state as well as during cold pressure test in subjects practicing bhramari pranayam. Some studies also demonstrated reduction in stress, anxiety, depression, increased production of alpha waves in EEG, mind relaxation, state of peacefulness in subjects practicing bhramari pranayam. All these studies concluded that practicing bhramari pranayam regularly induces a state of parasympathetic dominance in body and reduction in sympathetic activity. This reduces the risk of different diseases like hypertension, angina, stroke etc. We reviewed that although all these studies demonstrated beneficial effect of bhramari pranayam on health but there is need to do research studies for longer time duration and to increase sample size. Also there is need to measure the changes in the level of stress markers in relation with bhramari pramayam.

Key words: Yoga, bhramari pranayam, heart rate, blood pressure, EEG, stress.

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1. Introduction

Yoga is an ancient Indian technique followed from thousands of years. Yoga includes asanas i.e. different postures, pranayamas i.e. breathing techniques, meditation i.e. mental exercises.

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Maharishi Patanjali, in his *Ashtanga yoga* has emphasized importance of pranayam for good physical health and for spiritual progress. According to swami Vivekananda pranayam consists of prana (vital energy/power) and yama (control).[1] Pranayam is also useful in deceased states like hypertension, stress, anxiety etc.[2, 3]

So pranayam means yogic activities done to control the vital energy regulating physiological activities in body. Pranayam consist basically of two types- kumbhak pranayam in which respiration is stopped for some time either after inhalation or exhalation. In other type of pranayam there is no breath holding. These pranayam are *Bhastrika, Kapalbhati, Anulom-vilom, Udgith, Bhramari* and still many others.[1, 4] Thus pranayam basically consists of regulating own's respiratory activities. Different types of pranayam have specific bodily responses. In general effects of pranayam are

1. GIT & Endocrine effects [5,6,7]
    - Decreased insulin resistance
    - Decreased serum cholesterol, LDL,VLDL
2. Respiratory effects [8,9]
    - Increased vital capacity
    - Reduced dead space
    - Better matching of V/P ratio
    - Improved oxygenation of blood
3. CVS Effects [8,9,10,11,12,13]
    - Reduced HR, BP, peripheral resistance
4. CNS and Cognitive effects [14,15,16,17,18]
    - Reduced stress
    - Improved memory and concentration
    - Relaxed state of mind
    - Better social responses
    - Increased in happy hormones
    - Reduced stress hormones
5. Autonomic effects [19,20,21,22,23,24,25,26]
    - Reduced sympathetic activity
    - Increased parasympathetic activity

In current systematic review study we are studying effects of bhramari pranayama on cognitive, CNS, autonomic and cardiovascular parameters.

Bhramari pranayam is a simple technique that can be practiced easily by anyone irrespective of age and gender. In this pranayam subject sits in any comfortable position and then inhales deeply through both nostrils. During slow and prolonged exhalation humming bee type of sound is produced through nostrils, keeping oral cavity and ears closed by fingers. In bhramari pranayam there is repetition of mantra *OM*. Practicing this pranayam daily results in subjective perception of mind refreshment and state of joyfulness.[4] Calming effect of bhramari pranayam is also effective in patients of anxiety, depression hypertension etc. [27, 28]

Need for this review article is high lightened by fact that very few isolated studies are available about effect of bhramari pranayam on health. So in this article we decided to demonstrate positive effect of bhramari pranayam on health.

2. Methodology:

Our study has been conducted according to standard guidelines for systematic review and meta-analysis.

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2a. Search for research article was done on google scholar, embase , pubmed etc for studies regarding effects of bhramari pranayam. Key words that were used for searching were bhramari pranayam, cognitive effects, mental health, cardiovascular parametrs, and autonomic functions.

2b. Selection of studies

Inclusion criteria: studies including bhramari pranayam only and it's generalized effects on health were included

Exclusion criteria: studies including bhramari pranayam and other yogic techniques were excluded

2c. Data collection and organization

Data collection was done by all the reviewers independently and then discussed by all. Then final set of studies was decided and manuscripts were studied by all team members. Data that was extracted included following things: need / objective of study, materials and methods used, inclusion and exclusion criterias, observation, results and recommendation resulting from study. Data was organized systematically by dividing study finding under cognitive and CNS effects, cardiovascular effects, autonomic effects

3. Results

A prizma flow diagram (Fig.1) depicting searching of article and selection criteria is shown in diagram. We searched 41 articles initially and then 37 articles were excluded in accordance with our exclusion criteria. So finally we included 14 articles for review study. Final included paper were related to effect of bhramari pranayam on various physiological parameters. The included papers are described in detail. (Table 1)

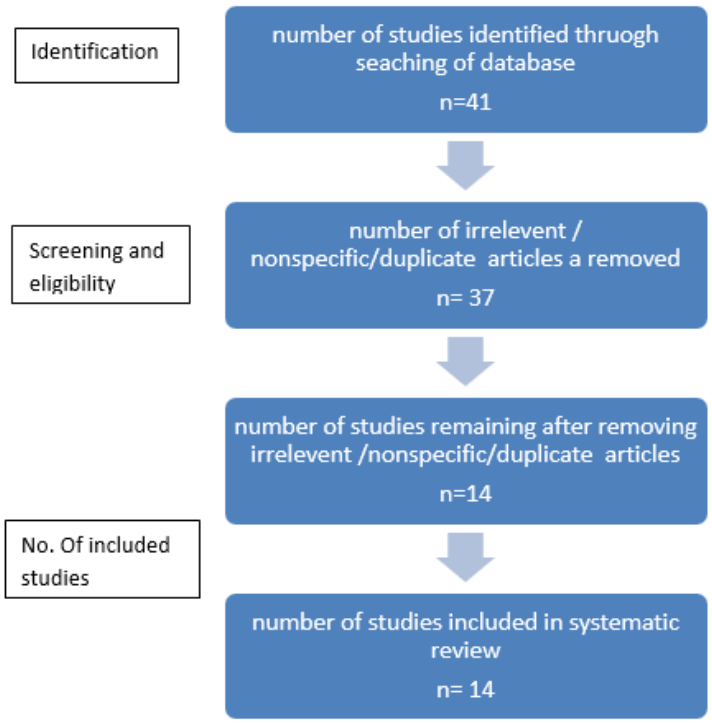

Fig. 1. Prisma flow diagram showing the process of data synthesis

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Table 1. Details of studies on bhramari pranayam

Sr. no.	Author name	Objectives of study	Methodology	No. of participants	tools used	Findings	Importance
1.	Latha R. et.al.,[23] [2022]	To study effect of bhramari pranayam on heart rate variability and BP	Experimental study (3 weeks)	110	heart rate variability, ECG, PHYSIOPAC-PP4	Decreased heart rate Variability, SBP,DBP in study group	Bhramari pranayam led to autonomic balance that produces the improvement of parasympathetic activity
2.	Jagadeesan et.al.,[16] [2022]	To study effect of bhramari pranayama on stress, anxiety, depression and sleep quality among COVID 19 patients in home isolation	Experimental study (15 days)	40	(Depression Anxiety and Stress Scale-21 [DASS-21], sleep quality (Pittsburgh SleepQuality Index- PSQI) and overall quality of life (WHOQOL-BREF)	Significant ($P < 0.05$) decrease in DASS-21 score of depression, anxiety and stress. significant improvement in quality of sleep and quality of life	Bhramari pranayam led to Relaxation of mind due to decreased released of stress hormone NE, dopamine
3.	Ismail et.al.,[24] [2022]	to study the efficacy of bee humming respiratory training on cardiovascular ,autonomic functions elderly tinnitus patients	Experimental study (4 weeks)	23	SBP, DBP , PR,	bee humming respiratory training improves autonomic function in study group	bee humming respiratory training led to parasympathetic dominance, reduced sympathetic activity
4.	Patil et.al.,[29] [2021]	To study effect of bhramari pranayama in generalized anxiety disorder(GAD)	Experimental study (5 minute practice)			Bhramari pranayam can be effective in reducing the symptoms associated with GAD. More research	Bhramari pranayam causes increase of parasympathetic activity and reduces the release of hormones associated with

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						should be conducted in the form of clinical trials	stress, and enhances GABA
5.	Sathe et.al.,[22] [2020]	To study effect of bhramari pranayam on heart rate and blood pressure heart rate ,oxygen saturation in hypertensive subject	Experimental study (5 minutes practice)	42	BP apparatus, SBP, DBP, HR, SPO2	In study group there was statistically significant difference only in the Systolic BP values.	Bhramari pranayam led to parasympathetic dominance to decrease SBP
6.	Kuppusamy et.al.[30] [2020]	To study effect of bhramari pranayam on heart rate variability	Experimental study (6 months)	260	ECG, heart rate, RR interval	HRV showed significant improvement	Parasympathetic predominance led to decreased cardiovascular morbidity
7.	Nivethitha et.al.,[26] [2017]	effect of bhramari pranayam on heart rate variability chnages	Experimental study (5 minute practice)	16	SBP, DBP, MAP	significant reduction in SBP, DBP, MAP	Parasympathetic predominance was observed in subjects practicing bhramari pranayam
8.	Srivastava et.al .,[17] [2017]	To study effect of bhramari pranayam on mental health	Experimental study (5 minute practice)	60	Mental Health Scale (Kamlesh Sharma 1996)	increased mental health score after Bhramari Pranayam intervention	Bhramari Pranayama reduces stress hormone level and led to joyful mental state through biofeedback mechanism
9.	Kuppusamy et.al.,[19] [2016]	To assess the effect of Bhramari pranayam on the cardiovascular parameters in adolescents	Experimental study (3 months practice)	30	BP apparatus, BP, heart rate, pulse pressure	HR, pulse pressure, BP, MAP reduced significantly (p-0.001) in study group	Bhramari pranayam reduced sympathetic and increased parasympathetic activity and thus improves resting CVS

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							parameters.
10.	Bajpai et.al.,[25] [2015]	Effect of bhramari on cardiovascular hyper-reactivity to cold pressor test	Experimental study (3 months)	94	cold pressor test, SBP DBP	reduction in hyper-reactivity to SBP , DBP in cold pressor test	Bhramari pranayam led to decreased in stress induced changes in cardiovascular parameters thus reduces cardiovascular hyper-reactivity to stress
11.	Rastogi et.al.,[14] [2015]	To study effect of bhramari pranayam on self-confidence female students	Experimental study (30 days)	30	Agnihotri self-confidence inventory (A.S.C.I)	Significant increase in self-confidence was observed	Bhramari pranayam led to Relaxation of mind, reduces stress ,improve parasympathetic dominance, reduced sympathetic activity
12.	Sahu et.al.,[15] [2015]	To study effect of bhramari pranayam on α EEG waves and Hb	Experimental study (30 days)	50	Sahli's Hemometer, α-EEG Bio feedback apparatus	Bhramari pranayam induces increased α-EEG level in study group	Bhramari pranayam balances autonomic nervous system, calm s the mind thereby increases alpha waves in EEG
13.	Rampalliwar et.al.,[20] [2012]	To study effect of Bhramari Pranayam as a preventive measure of pre eclampsia.	Experimental study (2 months)	28	BP apparatus, BP, hand deep in cold water (4 degree Celsius)	Basal BP , RISE IN BP(after hand immersion in cold water), pulse rate reduced significantly after 2 months of practice of bhramari	Bhramari pranayam is useful to prevent pre-eclampsia

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						pranayam	
14.	Pramanik et.al.,[21] [2009]	To study effect of bhramari pranayam on heart rate and blood pressure	Experimental study (5 minutes practice)	50	BP apparatus, SBP, DBP, MBP, HR	Fall in SBP, DBP, MBP, HR in study group	Bhramari pranayam led to parasympathetic dominance on CVS

3.1 Effect of bhramari pranayam on CNS and cognitive functions

Improved self confidence was noted in 30 students practicing bhramari pranayam daily for 5 minutes. [11] increase in alpha waves of EEG was noted in 50 boys practicing bhramari pranayam daily for 30 days.[12] Significant reduction in depression , anxiety and stress was noted in 60 covid-19 patients practicing bhramari pranayam daily 20 minuts for 15 days [16]. Improved mental health score was noted in 60 college students practicing this pranayam daily for 15 minutes for 20 days as an interventional variable in study.[17]

3.2 Effect of bhramari pranayam on autonomic and cardiovascular parameters

HR, PP, BP reduced significantly in 30 participants practicing bhramari pranayam daily for 45 minutes.[19] Basal BP and increased in BP pulse rate reduced significantly after 2 months of practice of bhramari pranayam in 28 participants practicing bhramari pranayam daily for 45 minutes.[20] significant Fall in SBP, DBP, MBP, HR was noted in 50 participants practicing bhramari pranayam daily for 5 minutes.[21] significant decrease in SBP was noted in 42 participants practicing bhramari pranayam daily for 5 minutes.[22] Decrease HR variability , SBP,DBP was noted in 110 participants practicing bhramari pranayam daily for 30 days.[23] Improved autonomic function were noted in 23 participants practicing bhramari pranayam daily for 4 weeks.[24] Significant improvement in HR variability was found in 260 participants practicing bhramari pranayam daily for 6 months.[30] Decrease in hypersensitivity to SBP and DBP in cold pressure test was noted in 94 participants practicing bhramari pranayam daily for 3 months.[25] Significant reduction in SBP, DBP and MAP was in 16 participants practicing bhramari pranayam daily for 5 minutes.[26]

DISCUSSION:

Generalized effect of bhramari pranayam is stimulation of parasympathetic and inhibition of sympathetic system. Increase parasympathetic dominance led to decrease heart rate , decrease blood pressure(SBP,DBP).[19,20,21,23,25,26] Decrease in SBP was observed in some studies.[22] Decrease in HR variability was observed in some studies.[23,30] Decrease in SBP, DBP was noted during cold pressure test in different studies. [20,25]

Bhramari pranayam leads to release of hormones associated with state of joyfulness and peace like endorphins and encephalin. It leads to decrease in release of stress hormone like dopamine. this lead to relaxed state of mind as evidenced by increase proportion of alpha waves in EEG.[15] Improved mental health, cognition, relaxed state of mind, improvement in quality of sleep and life was notes in some of the studies.[14,15,16,17] Thus practicing bhramari pranayam for long period will lead to parasympathetic predominance in body.[27,28] Thus it will reduced the risk of occurrence of diseases resulting from excess sympathetic stimulation like hypertension, angina, stroke etc.[2] Practicing bhramari pranayam for long period will lead to improved mental health , improved quality of sleep , improved quality of life and longevity.[31,32]

Improvement in current studies available for bhramari pranayam has certain limitations. Measurement of serum cortisol, alpha amylase (stress markers) would prove more useful. Thus

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the systematic review which we have done, we found comparatively less number of studies studying relation of bhramari pranayam with physical and mental health. So there is a need to study in detail impact of bhramari pranayam on health.

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