PART II

EFFECT OF *BHRĀMARI PRĀṆĀYĀMA* ON HEART RATE VARIABILITY

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ABSTRACT

EFFECT OF *BHRĀMARI PRĀṆĀYĀMA* ON HEART RATE VARIABILTY

Abstract:

Background: Different types of *yogic* breathing practices have shown different effects on autonomic nervous system, some increasing the parasympathetic and others the sympathetic tone; these studies provide sound basis to select the right practices while designing disease specific yoga modules. The present study was aimed at assessing the effect of *Bhrāmari prāṇāyāma* (BHP) on Heart Rate Variability (HRV) in healthy adults.

Subjects: The study was performed in 33 normotensive male volunteers with mean age of 24.51±2.89 years, who were undergoing training at a residential *yoga* University in south India.

Method: This was a randomized self as control within-subjects design. Heart rate variability was recorded continuously for 20minutes in all subjects while performing the experimental (*bhrāmari prāṇāyāma*) and control (breath awareness) sessions on different days; the day of recording for the two sessions was reversed using two group randomization table. Mean and SD of three epochs of HRV before (5mins), during (10mins), and after (5mins) the two sessions were used to compare within and between group effects on Repeated measures ANOVA.

Results: The baseline values were matched for all domains of frequency spectrum of HRV. There was significant reduction in HF power during *Bhrāmari* from 36.24 to 12.96 (64.24 % change and $p<0.001$) and control session from 40.61 to 22.24 (45.24 % change and $p<0.001$).There was an increase in LF power during both *Bhrāmari* from 63.75 to 87.04 (36.53 % change and $p<0.001$) and control sessions from 59.38 to 77.76 (30.95 % change and $p<0.001$). LF/HF ratio increased during *Bhrāmari* from 3.61 to 11.04(205.82 % change and $p<0.01$) and control sessions from 2.09 to 6.69 (220.10 % change and $p<0.001$).

Conclusion: It appears that there is a state of sympathetic predominance during practice during both *Bhrāmari prāṇāyāma* and breath awareness. However, there are shift towards dual, opposing effects of the sympathetic and parasympathetic nervous systems following *Bhrāmari Bhrāmari prāṇāyāma* but not after breath awareness.

Key words: *Yoga*, HRV, *Bhrāmari, prāṇāyāma*

CHAPTER 1

INTRODUCTION

The autonomic nervous system is highly adaptable and allows the organism to maintain its balance when experiencing psychophysiological challenges. Disturbances in functioning of autonomic nervous system can lead to somatic and psychological pathologies (Servant, Logier, Mouster, & Goudemand, 2009). The beneficial effects of Yoga in health and disease (Arias, Steinberg, Banga, & Trestman, 2006) seem to be traceable to its effect on HPA axis (Carlson, Speca, Patel, & Goodey, 2004). Several studies have shown the effects of different types of *yoga* on autonomic nervous system (Satyapriya, M., Nagendra, H. R., Nagarathna, R., & Padmalatha) by monitoring Heart Rate Variability HRV during or after the practices (Patra & Telles, 2009)

HRV, a non-invasive measure represents one of the most promising quantitative markers of autonomic activity (Task Force, 1996) useful for assessing mental health biologically (Shinba, et al., 2008); it is a good indicator of how the central nervous system regulates the autonomic nervous system and also how the peripheral neurons feed information back to the central level (Servant, Logier, Mouster, & Goudemand, 2009). These HRV indices, determined in either the time or frequency domain, closely reflect the parasympathetic and mixed sympathetic activity (Stein & Kleiger, 1999). Low frequency (LF; 0.04–0.15 Hz) reflects the mixed sympathetic nervous activities, while high frequency (HF; >0.15Hz) reflects the status of parasympathetic nervous system (Task Force, 1996) and LF/HF ratio correlates with sympathovagal balance (Malliani, Pagani, Lombardi, & Cerutti, 1991).

Yoga in its original form offers several practices that bring about balancing effect on physiological, spiritual and moral aspects of a human personality; these techniques promote several psychophysiological changes that prepare the system to move towards self-realization, the ultimate goal of human life (Nagendra, 2000). Different types of breath manipulations (*prāṇāyāmas*) were evolved to achieve different physiological effects (Jerath, Edry, Barnes, & Jerath, 2006). For example, we (Telles, Nagarathna, & Nagendra, 1996) had observed that right nostril breathing *prāṇāyāma* could cause sympathetic arousal and increase energy expenditure whereas left nostril breathing

prāṇāyāma caused the opposite effects (Telles, Nagarathna, & Nagendra, 1994). Many breathing practices seem to harmonize the autonomic nervous system and offer self corrective techniques in psychological and stress-related disorders (Brown & Gerbarg, 2005). In general, slow breathing practices showed improvement in both sympathetic and parasympathetic reactivity and high frequency breathing (eg. *kapālabhāti*) increased sympathetic activity with reduced vagal activity (Raghuraj, Ramakrishnan, Nagendra, & Telles, 1998).

Bhrāmari prāṇāyāma (BHP) changes the breathing rhythm by prolonging the exhalation time and resembles yogic chants used for meditation which was found to have a calming effect on neurophysiologic responses (Vialatte, Bakardjian, Prasad, & Cichocki, 2009). There are no studies that have looked at the effect of BHP on the autonomic status and hence the present study was designed.

CHAPTER 2
REVIEW OF LITERATURE

Yogic breathing is a unique method for balancing the autonomic nervous system and influencing psychologic and stress-related disorders(Brown & Gerbarg, 2005) and heart rate variability (HRV) is a more useful psychophysiological measure than heart rate alone (Raghuraj, Ramakrishnan, Nagendra, & Telles, 1998). Few studies have investigated relationship between different yoga based techniques and HRV.

"The autonomic nervous system sends messages through the sympathetic and parasympathetic nervous system. Heart rate is primarily controlled by vagal activity. Sensorial data coming from the heart are fed back to the central nervous system. The interaction of these messages towards the sinoauricular node is responsible for normal cardiac variability, which can be measured by monitoring HRV. HRV is an indicator of both how the central nervous system regulates the autonomic nervous system, and of how peripheral neurons feed information back to the central level. HRV measures are derived by estimating the variation among a set of temporally ordered interbeat intervals. The autonomic nervous system is highly adaptable and allows the organism to maintain its balance when experiencing strain or stress. Conversely, a lack of flexibility and a rigid system can lead to somatic and psychological pathologies. Several studies have shown a link between reduced HRV in postmyocardial infarction patients and increased risk for adverse cardiovascular events, including ventricular arrhythmias and sudden death. Recently, studies indicate that patients with depression and anxiety disorders exhibit abnormally low HRV compared with non-psychiatric controls would reflect deficit in flexibility of emotional physiological mechanisms. A few studies have also revealed that biofeedback using respiratory control, relaxation and meditation techniques can increase HRV. Although the literature is modest, this review suggests that the use of biofeedback with relaxation and meditation approaches may result in increased HRV and parasympathetic activity" (Servant, Logier, Mouster, & Goudemand, 2009).

Comparison of effects of recitation of the Ave Maria (in Latin) or of yoga mantra, during spontaneous and metronome controlled breathing, on breathing rate and on spontaneous oscillations in RR interval, and on blood pressure and cerebral circulation showed both

prayer and mantra caused striking, powerful, and synchronous increases in existing cardiovascular rhythms when recited six times a minute. Baroreflex sensitivity also increased significantly (Bernardi , et al., 2001).

Another study aims at investigating changes in HRV measured during meditation. Results from spectral measures of HRV from the RR indicate that meditation may have different effects on health depending on frequency of the resonant peak that each meditator can achieve. The possible effects may concern resetting baroreflex sensitivity, increasing the parasympathetic tone, and improving efficiency of gas exchange in the lung (Phongsuphap, Pongsupap, Chandanamattha, & Lursinsap, 2008).

Further study on HRV both in time and frequency domains during inward attention meditation on Zen-meditation practitioners and control subjects without any meditation experience. The major difference of effects between two groups were the decrease of LF/HF ratio and LF norm as well as the increase of HF norm, which suggested the benefit of a sympathovagal balance toward parasympathetic activity. Moreover, they observed regular oscillating rhythms of the heart rate when the LF/HF ratio was small under meditation. According to previous studies, regular oscillations of heart rate signal usually appeared in the low-frequency band of HRV under slow breathing. Hence they concluded such regular oscillations could also appear in the high frequency band of HRV but with smaller amplitude (Wu & Lo, 2008).

Further more study on HRV in two yoga practices which have been previously reported to have opposite effects, viz, sympathetic stimulation (*kapālabhāti*) and reduced sympathetic activity (*nāḍīsuddhi*,) on healthy male. The results showed a significant increase in low frequency (LF) power and LF/HF ratio while high frequency (HF) power was significantly lower following *kapālabhāti*. There were no significant changes following *nāḍīsuddhi*. The results suggest that *kapālabhāti* modifies the autonomic status by increasing sympathetic activity with reduced vagal activity (Raghuraj, Ramakrishnan, Nagendra, & Telles, 1998).

This study was designed to quantify and compare the instantaneous changes of heart ratevariability (HRV) during *Śāmbhavī mahāmudrā*, a practice of *Isha yoga*. It includes major stages viz. *Sukha prāṇāyāma*, 'AUM' chanting, rapid breathing, and relaxed

sitting. The short-term HRV were extracted from ECG, and analyzed using time, frequency-domain and Poincar´e plot methods. The results showed a combination of increased sympathetic tone and withdrawal of vagal tone during *Sukha prāṇāyāma*, an increased sympathetic tone during 'AUM' chanting, and withdrawal of vagal tone during rapid breathing (Selvaraj, et al., 2008).

There are no studies that have looked at the effect of BhPr on the automonic status. Hence, the present study was designed.

CHAPTER 3
AIM AND OBJECTIVES

Research Questions

Two specific related research questions guided the study:

1. Can *Bhrāmari prāṇāyāma* change Heart Rate Variability in healthy adults?
2. Is there any immediate effect of *Bhrāmari prāṇāyāma* on Heart Rate Variability in healthy adults?

Aim: To assess immediate and during effect of *Bhrāmari prāṇāyāma* and Breath awareness on the time and frequency domain of Heart Rate Variability in healthy adults.

Objectives

1. To assess the immediate effect of 10 min *Bhrāmari prāṇāyāma* and Breath awareness on the time and frequency domain of Heart Rate Variability in healthy adults.
2. To assess during effect of 10 min *Bhrāmari prāṇāyāma* and Breath awareness on the time and frequency domain of Heart Rate Variability in healthy adults.

Hypothesis

- The immediate effect of *Bhrāmari prāṇāyāma* may show changes in HRV.
- HRV may show changes while practicing *Bhrāmari prāṇāyāma*.

Null hypothesis

- The immediate effect of *Bhrāmari prāṇāyāma* does not show changes in HRV.
- HRV does not show changes while practicing *Bhrāmari prāṇāyāma*.

CHAPTER 4
METHODS

4.1 PARTICIPANTS

Subjects:

The study was performed on 33 normotensive male volunteers with mean age of 24.51±2.81 years. The experience of subjects practicing breathing techniques ranges from 6 months to 12 years.

Source of the subjects:

All participants were the students of a residential *yoga* University, Bengaluru in south India practicing *yoga* regularly as part of their curriculum.

4.2 INCLUSION CRITERIA

Those who were normal, healthy, and free from medication, smoking, alcohol consumption, and cardio-respiratory ailments by self report.

4.3 EXCLUSION CRITERIA

Females were excluded because autonomic variables vary during phases of menstrual cycle (Yildirir, Kabakci, Akgul, Tokgozoglu, & Oto, 2002)

4.4 DESIGN OF STUDY

This was a randomized self as control within-subjects design. Participants were divided randomly into two groups. One group performed the control session (BAW) on the first day and the experimental session (BHP) on the second day while the other half did the experimental session on the first day and the control session on the second day. To avoid diurnal variation, both sessions were performed at the same time (6 am to 8 am) of the two days. All subjects had a preparatory period of practicing the technique in a group for about one week to ensure uniformity and correctness of the practice of *Bhrāmari prāṇāyāma*. All subjects were taken to the laboratory one day before the actual recording sessions to acclimatize to the lab environment and observe recordings on other subjects. During the recordings, subjects were performing the selected breathing while sitting comfortably in a chair with spine erect without any body movements. The ECG was

recorded continuously throughout the session and analyzed in three epochs i.e. baseline (5 minutes), during (10 minutes) and post (5 minutes).

The approval of the Institutional Ethics Committee of the university was obtained. Informed consent was collected from all participants after they understood the study design.

Figure 1:

GROUP A

Day 1	PRE (5 min) HRV	*Bhrāmari* (10 min)	Post (5 min) HRV
Day 2	PRE (5 min) HRV	Breath awareness (10 min)	Post (5 min) HRV

GROUP B

Day 1	PRE (5 min) HRV	Breath awareness (10 min)	Post (5 min) HRV
Day 2	PRE (5 min) HRV	*Bhrāmari* (10 min)	Post (5 min) HRV

4.5 ASSESSMENT

Socio-demographic questionnaire:

A socio-demographic check list was developed for this study to document the following: name, address, level of education, gender and age.

Heart Rate Variability (HRV)

Recording of Electrocardiogram (ECG) was done in the sound attenuated chamber at the Neurophysiology lab of University using BIOPAC™ MP 100 system and associated AcqKnowledge® software. During recordings, subjects were asked to sit comfortably in the chair without any body movements. Proper instructions were given at pre, during, and post segments of both BHP and BAW. Data were acquired at the sampling rate of 1,024

Hz and were analyzed offline. The recordings of ECG of all subjects were done by the same person of our team in order to avoid any inter-observer error.

4.6 INTERVENTION

Experimental session (*Bhrāmari prāṇāyāma*)

This practice was carried out for 10 minutes with closed eyes. The term *Bhrāmari* is a sanskrit word that means 'female bee'. In this *prāṇāyāma* one produces a low pitched humming audible sound resembling the sound of a female bee during exhalation as long as possible (Nagendra, 2000).

Control session (Breath awareness)

In this BAW session the participant was asked to sit comfortably in a chair with erect spine and observe their normal breathing without manipulating its rate for 10 minutes with closed eyes.

During the pre and post (5mins each) sessions the participants sat quietly with normal breathing with closed eyes.

4.7 DATA EXTRACTION

Preprocessing of the recorded data were done using AcqKnowledge® software and a freely available HRV Analysis software version 2.0, developed by the Biomedical Signal Analysis Group at the University of Kuopio, Finland (Niskanen, Tarvainen, Ranta-Aho, & Karjalainen, 2004).

4.7 DATA ANALYSIS

Statistical analysis was done using Statistical Package for Social Sciences, SPSS version 10.0. Repeated measure ANOVA was done for 'within subject's factor' (pre, during and post), 'between subjects factor' (BHP and BAW) and both session-time interaction effect. Post-hoc tests were done with Bonferroni's correction for changes at different time points and between sessions.

CHAPTER 5

RESULTS

There was no significant difference between pre values of the two sessions on all variables (except HR of time domain) indicating good baseline matching.

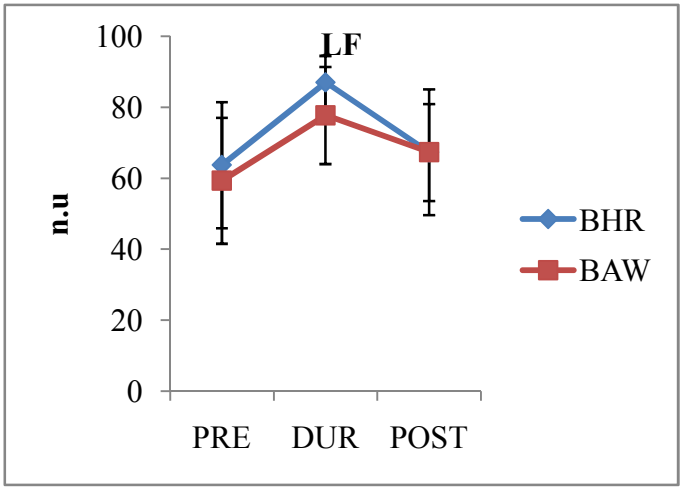
Frequency spectra

LF spectrum: In repeated measures ANOVA, there was significant ($p<0.001$) within group difference between Pre vs during phases in both sessions. There was an increase in LF by 36.53% during BHP and 31% during BAW. The mean values reduced after the practice of *Bhrāmari* but continued to be marginally (not significantly) higher as compared to pre values. After BAW the post values were significantly higher ($p<0.01$) than pre values. There was no significant interaction between groups.

Bhrāmari					
Variable	Pre	During	%	Post	%
LF	63.75±17.76	87.04±7.50@@@	36.53% ***	67.32±13.67	5.60%
Breath Awareness					
Variable	Pre	During	%	Post	%
LF	59.38±17.75	77.76±13.68	30.95% ***	67.41±17.72**	13.52% **

@@@ $p < 0.001$, Repeated Measures ANOVA with Bonferroni Adjustments Between Group Comparisons (Pre vs Pre, Dur vs Dur, Post Vs Post)

** $p < 0.01$, *** $p < 0.001$, Repeated Measures ANOVA with Bonferroni Adjustments within Group.

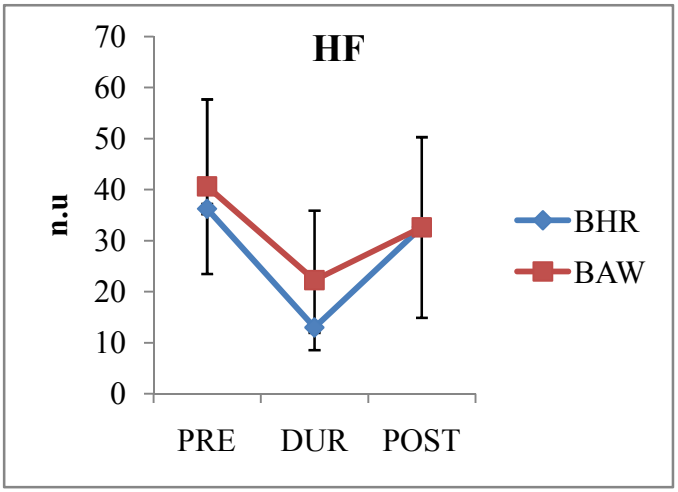


HF spectrum: There was significant ($p<0.001$) within group difference between Pre vs during phases in both sessions. There was a decrease in HF by 64.24 % during BHP and 45.24% during BAW. The mean values decreased after the practice of *Bhrāmari* with no significant difference between pre and post values (10%). After BAW the post values of HF decreased and remained significantly ($p<0.01$) lower than pre values (19.8%).There was no significant interaction between groups.

Bhrāmari					
Variable	Pre	During	%	Post	%
HF	36.24±17.75	12.96±7.50@@@	64.24% ***	32.68±13.67	-9.82%
Breath Awareness					
Variable	Pre	During	%	Post	%
HF	40.61±17.12	22.24±13.68	45.24% **	32.59±17.72	19.75% **

@@@ $p < 0.001$, @@@ $p < 0.001$, Repeated Measures ANOVA with Bonferroni Adjustments Between Group Comparisons (Pre vs Pre, Dur vs Dur, Post Vs Post)

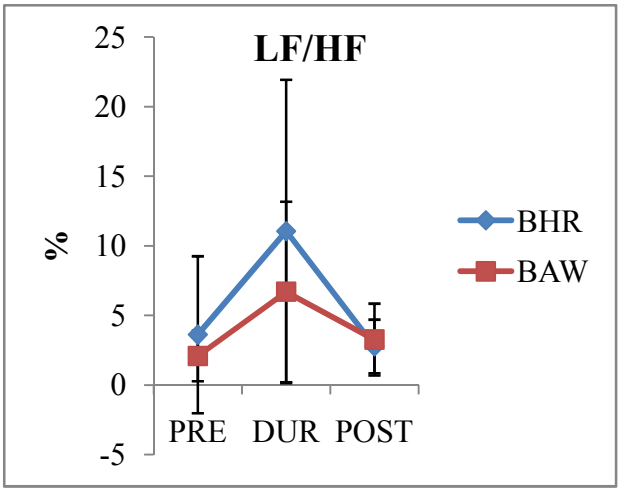
*** $p < 0.001$, ** $p < 0.01$, Repeated Measures ANOVA with Bonferroni Adjustments within Group



LF/HF ratio: There was significant (p=0.002) within group difference between Pre vs during phases in both sessions. There was a significant (p=0.002) increase in LF/HF ratio by 205.82 % during BHP and 220.10 % during BAW. After BHP the post values of LF/HF ratio decreased to values lower than pre values (23.3%) although not significant. After BAW the post values of LF/HF ratio increased significantly (p<0.05) higher than pre values (56.4%).There was no significant interaction between groups.

Bhrāmari					
Variable	Pre	During	%	Post	%
LF/HF	3.61±5.64	11.04±10.89	205.82% **	2.77±1.93	23.27%
Breath Awareness					
Variable	Pre	During	%	Post	%
LF/HF	2.09±1.81	6.69±6.48	220.10% ***	3.27±2.58	56.4% *

* p < 0.05, ** p < 0.01, *** p < 0.001, Repeated Measures ANOVA with Bonferroni Adjustments within Group

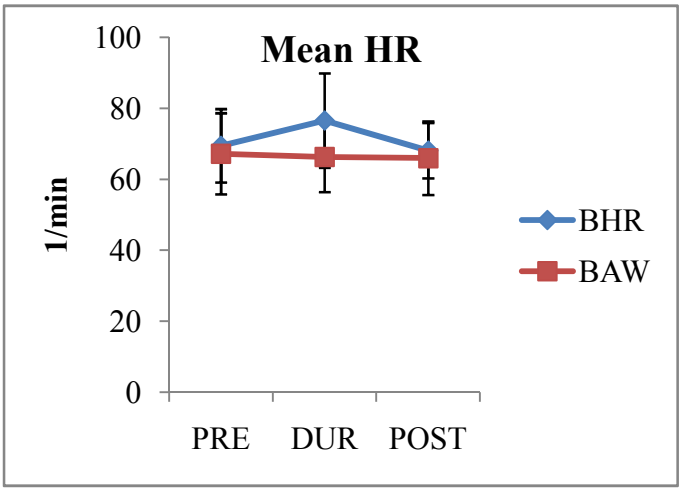


Time domain spectra

HR: The baseline HR was significantly lower in BAW than BHP. There was a non-significant increase during BHP and decrease during BAW which decreased after the practice to values below the pre values after both sessions. There was a significant ($p<.001$) group time interaction during the sessions between the two sessions.

Bhrāmari					
Variable	Pre	During	%	Post	%
HR	69.47±10.35 @	76.58±13.27@@@	10.23%	68.11±7.79	1.96%
Breath Awareness					
Variable	Pre	During	%	Post	%
HR	67.21±11.43	66.30±9.87	1.35%	65.98±10.34	1.83%

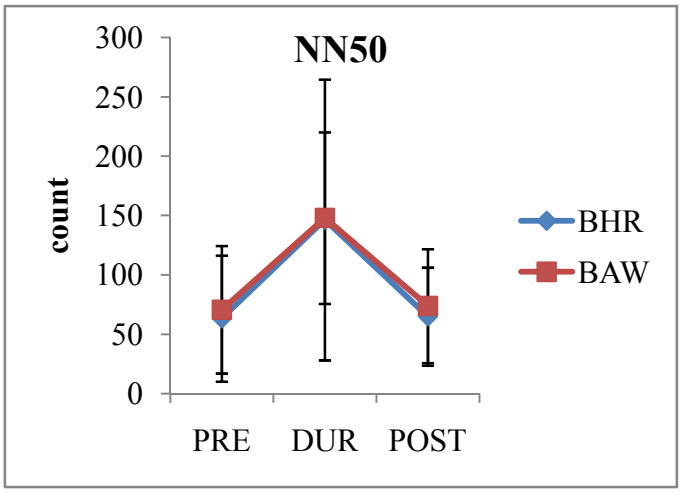
@ $p < 0.05$, @@@ $p < 0.001$,Repeated Measures ANOVA with Bonferroni Adjustments Between Group Comparisons (Pre vs Pre, Dur vs Dur, Post Vs Post)



NN50: There was an increase by 131.5% (p = NS) during BhPr and 109.25 % (p <0.001) during BAW .The values increase after the practice with no significant difference between pre and post values.

Bhrāmari					
Variable	Pre	During	%	Post	%
NN50	63.21±53.19	146.33±118.35	131.50%	64.85±41.35	2.59%
Breath Awareness					
Variable	Pre	During	%	Post	%
NN50	70.67±53.67	147.88±72.29	109.25% ***	73.79±48.03	4.41%

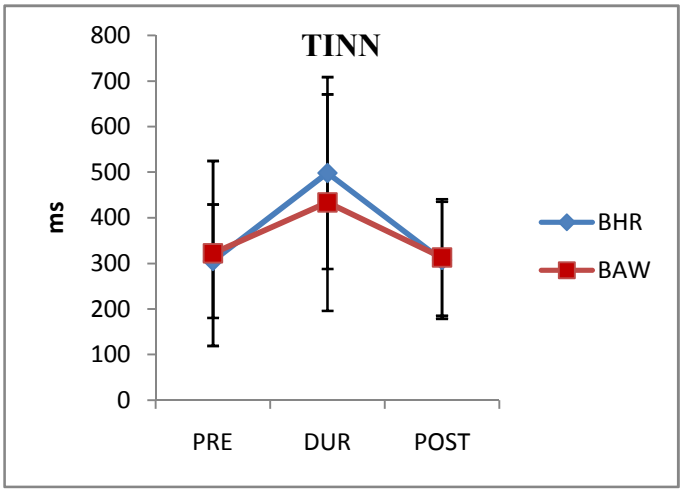
*** p < 0.001, * p < 0.05, Repeated Measures ANOVA with Bonferroni Adjustments within Group



TINN*:* There was significant within group difference between Pre vs during phases in both sessions. There was an increase by 63.28% ($p< 0.001$) during BHP and 34.62 % during BAW .The values increase after the practice with no significant difference between pre and post values.

Bhrāmari					
Variable	Pre	During	%	Post	%
TINN	305.15±124.25	498.24±210.18	63.28%***	307.12±128.12	0.65%
Breath Awareness					
Variable	Pre	During	%	Post	%
TINN	321.97±202.68	433.45±237.18	34.62%*	313.18±127.60	-2.73%

*** $p < 0.001$, Repeated Measures ANOVA with Bonferroni Adjustments within Group



The changes in other measures of time domain did not show any significant differences during or after the practice of both sessions.

CHAPTER 6
DISCUSSION

In the present study, we evaluated the changes in Heart rate variability at baseline, during and after the practice of *Bhrāmari prāṇāyāma* and compared with a control period of Breath Awareness. In frequency spectrum of HRV, there was significant increase in LF power and LF/HF ratio with reduction in HF power during both *Bhrāmari* and breathe awareness sessions with no significant difference between groups during the practice. This indicates that both these practices produce a shift towards a state of sympathetic predominance during the practice with marginally higher degree of changes during *Bhrāmari*. The post values returned after the practice and were significantly different after BWA and not after *Bhrāmari* pointing to a steady return to baseline immediately after stopping the practice of *Bhrāmari prāṇāyāma* and not after BAW. There was no significant interaction between *Bhrāmari* and BAW either during or after the sessions and hence it is not possible to draw any conclusion on how *Bhrāmari* practice is different from BAW in its effect on autonomic status.

Comparisons

The increase in LF power and LF/HF ratio and reduction in HF power during *Bhrāmari prāṇāyāma* suggests sympathetic activation. This result is similar to observations in earlier studies on meditators. Telles et al., observed increased cutaneous peripheral vascular resistance during mental chanting of 'OM' (Telles, Nagarathna, & Nagendra, 1995) and Selvaraj, et al., (2008) observed increased sympathetic activation during 'AUM' chanting phase of *Śāmbhavī mahāmudrā* practice. It is known that the final phase of chanting of 'AUM' is similar to *Bhrāmari prāṇāyāma*.

The control session of BAW that was used in this study seems to be similar to the breath awareness phase of *vipāsana* meditation where the practitioner starts the session with breathe awareness and then goes on to deeper meditation without any attention on breath. In trained *vipāsana* mindfulness meditators there was increase in parasympathetic (Telles,

Mohapatra, & Naveen, 2005) activity after the practice, whereas we observed increased sympathetic tone during and after BAW .This may indicate that focused observation on breath helps in increasing sympathetic arousal and meditation that follows a short breath awareness session in experienced *vipāsana* meditator is relaxing and helps to improve parasympathetic tone.

Mechanism

It is known that any focused mental activity increases sympathetic tone and relaxing type of mental activity improves parasympathetic tone. The traditional texts recommend *Bhrāmari prāṇāyāma* as a preparatory practice to achieve mental focusing (*dhāraṇa*) before moving on to the defocused type of meditation (*dhyāna*) .The final goal (*kaivalya*) of all yoga practices is to achieve a state of total silencing of all thoughts in the mind and arrive at a blissfully quiet state in which the awareness of 'I' (the subtlest single thought) can merge in the universal consciousness. The wakeful mind which is defined as a conglomeration of thoughts(Nagendra,2000), passes through several stages before reaching this state of merger (*samādhi*) that helps in the final merger in universal consciousness(*kaivalya*). *Dhāraṇa* or focusing is the initial step that helps the distractible mind to move towards 'one pointed attention' on a single thought in the mental space (*deśa banda cittasya dhāraṇa* – fixing or binding the mind on a focused space is *dhāraṇa*). The mind passes on to the next phase of *dhyāna* in which the alert full rested state is achieved by defocusing (by slowing down and expanding the mental space) the thoughts effortlessly (*tatra pratyaya ekatānatā dhyānaṁ* – effortless flow of a single thought).

Bhrāmari prāṇāyāma, mantra chanting (loud or mental) and many other practices are recommended for achieving *dhāraṇa* in which we could expect sympathetic arousal in a recent study with a novel design, Naveen(2005) studied the differences in the effect of *dhāraṇa* and *dhyāna* on EEG and autonomic variables and showed this phenomenon of sympathetic arousal followed by parasympathetic dominance. Thus the observation of the present study is in accordance with the expected physiological changes. The aim of

Bhrāmari as recommended by the texts is to move to introspective *dhāraṇa* state of mind through prolonged slow chanting of the low pitched sound.

May be due to breathing rhythm resembling mantra repetition enhanced respiratory sinus arrhythmia (Bernardi, et al., 2001) if respiratory sinus arrhythmia increases then HF should increase.

In conclusion, *Bhrāmari prāṇāyāma* produces increase in LF power and the LF/HF ratio with a decrease in HF power in HRV indicating sympathetic activation during the practice which returns steadily to base level immediately after stopping the practice. *Bhrāmari* produces marginally better changes than the control session of breath awareness. Future research is needed to determine the mechanism of reduced shift as well as possible cardiovascular events related to these autonomic modulations considering enough recovery period.

CHAPTER 7

APPRAISAL

7.1 SUMMARY AND CONCLUSION:

Yoga based interventions are emerging as a technique to improve various medical and psychological ailments. *Bhrāmari prāṇāyāma* produces increase in LF power and the LF/HF ratio with a decrease in HF power in HRV indicating sympathetic activation during the practice which returns steadily to base level immediately after stopping the practice. *Bhrāmari* produces marginally better changes than the control session of breath awareness.

7.2 LIMITATIONS:

The subjects were experienced practitioners of several yoga techniques as students of a yoga university. When they were asked to practice breath awareness in control session they would have been doing a similar type of focusing on the breath as they would during the *Bhrāmari* session. Hence the results may not have shown significant differences between groups. The difference may stand out if the study is designed by a short period of training in novices who have not had earlier experience.

We did not quantify respiration and physical exertion simultaneously which are considered likely to enhance HRV accuracy to predict autonomic control. Thus, the generalizability of these results needs to be tested further.

7.3 STRENGTH:

This was the first Randomized self as controlled trial to our knowledge that has studied effect of *Bhrāmari* in HRV.

7.4 FUTURE STUDIES:

Future research is needed to determine the mechanism of the cardiovascular events related to these autonomic modulations by studying the effect in novices and by including more variables such as autonomic function tests.

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APPENDIX (A) - RAW DATA

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			LF			LF		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	65.90	86.50	65.20	44.60	90.90	70.90
2	Sharath	26	77.00	98.30	76.10	68.20	70.40	89.80
3	Sateesh	18	55.80	88.50	54.60	35.30	54.70	46.30
4	Santhosh	28	73.70	69.50	52.40	69.70	63.40	86.00
5	Sanjay	20	73.80	83.40	62.90	79.40	71.50	84.20
6	Rishi	28	95.50	94.30	89.70	51.10	91.20	64.80
7	RP Singh	25	59.80	80.80	47.10	61.40	93.40	52.80
8	Prakash	24	71.60	86.40	55.30	28.90	71.10	38.10
9	Poornenth	25	69.10	89.50	67.10	64.70	81.80	82.90
10	Kaushal	25	96.30	95.60	80.90	80.40	81.10	83.20
11	Himanshu	25	67.00	78.70	56.80	72.00	77.80	63.00
12	Hareesh	20	59.10	81.10	41.20	65.60	57.10	77.50
13	Haneesh	25	92.40	91.20	80.10	45.90	90.30	50.90
14	Dr vijay	26	46.30	80.20	54.30	23.70	94.40	31.80
15	Revanth	25	41.80	89.00	77.00	53.40	68.90	40.80
16	Sushanth	26	35.20	86.00	41.70	50.90	63.20	81.50
17	Subhash	25	43.10	85.30	73.80	66.90	67.40	62.40
18	Subeer	27	60.00	73.70	62.10	37.20	57.30	41.70
19	Srisailam	30	24.00	88.10	51.10	29.50	93.00	79.90
20	Rohith	26	47.30	97.30	72.00	48.70	67.50	63.70
21	Dr.Hemant	26	44.20	72.10	79.60	69.30	82.00	85.00
22	Rajendra	18	73.20	90.40	82.40	66.50	79.60	90.70
23	Prasanth	28	59.00	77.40	67.80	48.80	84.00	41.00
24	Omprakas	22	85.10	89.30	85.40	87.30	65.70	75.40
25	Navaneeth	25	69.40	94.50	58.70	89.50	91.20	87.30
26	Mandeep	21	33.10	87.30	58.90	43.70	92.30	62.70
27	Mahesh	23	70.10	95.20	70.20	58.50	94.40	76.10
28	Hemanth	22	62.40	93.10	56.60	61.90	64.20	55.30
29	Dharmvir	26	78.20	90.80	86.30	82.20	84.60	77.60
30	Bharath	25	67.40	78.00	67.30	67.70	96.50	82.10
31	Ashwin	26	85.60	93.40	85.40	78.50	95.20	89.40
32	Anurag	28	55.80	95.30	78.10	61.20	51.00	47.60
33	Anand	21	65.70	92.10	83.30	66.90	79.10	62.20

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			HF			HF		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	34.10	13.50	34.80	55.40	9.10	29.10
2	Sharath	26	23.00	1.70	23.90	31.80	29.60	10.20
3	Sateesh	18	44.20	11.50	45.40	64.70	45.30	53.70
4	Santhosh	28	26.30	30.50	47.60	30.30	36.60	14.00
5	Sanjay	20	26.20	16.60	37.10	20.60	28.50	15.80
6	Rishi	28	4.50	5.70	10.30	48.90	8.80	35.20
7	RP Singh	25	40.20	19.20	52.90	38.60	6.60	47.20
8	Prakash	24	28.40	13.60	44.70	71.10	28.90	61.90
9	Poornenth	25	30.90	10.50	32.90	35.30	18.20	17.10
10	Kaushal	25	3.70	4.40	19.10	19.60	18.90	16.80
11	Himanshu	25	33.00	21.30	43.20	28.00	22.20	37.00
12	Hareesh	20	40.90	18.90	58.80	34.40	42.90	22.50
13	Haneesh	25	7.60	8.80	19.90	54.10	9.70	49.10
14	Dr vijay	26	53.70	19.80	45.70	76.30	5.60	68.20
15	Revanth	25	58.20	11.00	23.00	46.40	31.10	59.20
16	Sushanth	26	64.80	14.00	58.30	49.10	36.80	18.50
17	Subhash	25	56.90	14.70	26.20	33.10	32.60	37.60
18	Subeer	27	40.00	26.30	37.90	62.80	42.70	58.30
19	Srisailam	30	76.00	11.90	48.90	70.50	7.00	20.10
20	Rohith	26	52.70	2.70	28.00	51.30	32.50	36.30
21	Dr.Hemant	26	55.80	27.90	20.40	30.70	18.00	15.00
22	Rajendra	18	26.80	9.60	17.60	33.50	20.40	9.30
23	Prasanth	28	41.00	22.60	32.20	51.20	16.00	59.00
24	Omprakas	22	14.90	10.70	14.60	12.70	34.30	24.60
25	Navaneeth	25	30.60	5.50	41.30	10.50	8.80	12.70
26	Mandeep	21	66.90	12.70	41.10	56.30	7.70	37.30
27	Mahesh	23	29.90	4.80	29.80	41.50	5.60	23.90
28	Hemanth	22	37.60	6.90	43.40	38.10	35.80	44.70
29	Dharmvir	26	21.80	9.20	13.70	17.80	15.40	22.40
30	Bharath	25	32.60	22.00	32.70	32.30	3.50	17.90
31	Ashwin	26	14.40	6.60	14.60	21.50	4.80	10.60
32	Anurag	28	44.20	4.70	21.90	38.80	49.00	52.40
33	Anand	21	34.30	7.90	16.70	33.10	20.90	37.80

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			LFHF			LFHF		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	1.94	6.40	1.87	0.81	9.95	2.43
2	Sharath	26	3.35	56.88	3.19	2.14	2.37	8.82
3	Sateesh	18	1.26	7.71	1.20	0.55	1.21	0.86
4	Santhosh	28	2.81	2.28	1.10	2.30	1.74	6.16
5	Sanjay	20	2.82	5.01	1.70	3.86	2.51	5.31
6	Rishi	28	21.11	16.54	8.67	1.05	10.40	1.84
7	RP Singh	25	1.49	4.20	0.89	1.59	14.20	1.12
8	Prakash	24	2.52	6.34	1.24	0.41	2.46	0.62
9	Poornenth	25	2.24	8.53	2.04	1.83	4.51	4.86
10	Kaushal	25	26.09	21.65	4.24	4.11	4.30	4.95
11	Himanshu	25	2.03	3.70	1.32	2.57	3.51	1.70
12	Hareesh	20	1.44	4.30	0.70	1.91	1.33	3.45
13	Haneesh	25	12.19	10.36	4.02	0.85	9.29	1.04
14	Dr vijay	26	0.86	4.05	1.19	0.31	16.74	0.47
15	Revanth	25	0.72	8.08	3.35	1.15	2.22	0.69
16	Sushanth	26	0.54	6.16	0.72	1.04	1.72	4.40
17	Subhash	25	0.76	5.78	2.82	2.02	2.07	1.66
18	Subeer	27	1.50	2.80	1.64	0.59	1.34	0.72
19	Srisailam	30	0.32	7.44	1.05	0.42	13.25	3.99
20	Rohith	26	0.90	35.75	2.58	0.95	2.08	1.76
21	Dr.Hemant	26	0.79	2.58	3.90	2.26	4.57	5.67
22	Rajendra	18	2.73	9.42	4.69	1.99	3.91	9.74
23	Prasanth	28	1.44	3.42	2.10	0.95	5.23	0.70
24	Omprakas	22	5.70	8.33	5.85	6.86	1.91	3.07
25	Navaneeth	25	2.27	17.23	1.42	8.53	10.34	6.85
26	Mandeep	21	0.50	6.86	1.43	0.78	11.94	1.68
27	Mahesh	23	2.35	19.77	2.35	1.41	16.71	3.19
28	Hemanth	22	1.66	13.53	1.30	1.63	1.79	1.24
29	Dharmvir	26	3.58	9.82	6.31	4.63	5.50	3.47
30	Bharath	25	2.07	3.55	2.06	2.09	27.33	4.60
31	Ashwin	26	5.94	14.09	5.86	3.66	19.68	8.41
32	Anurag	28	1.26	20.19	3.57	1.58	1.04	0.91
33	Anand	21	1.92	11.59	4.99	2.02	3.79	1.65

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			Mean RR			Mean RR		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	0.89	0.81	0.83	0.89	0.84	0.88
2	Sharath	26	0.81	0.81	0.83	0.76	0.80	0.78
3	Sateesh	18	0.81	0.76	0.88	0.87	0.90	0.91
4	Santhosh	28	0.73	0.77	0.84	0.77	0.78	0.80
5	Sanjay	20	0.65	0.67	0.73	0.60	0.63	0.63
6	Rishi	28	0.90	0.84	0.82	1.04	1.05	1.01
7	RP Singh	25	0.89	0.84	0.88	0.97	1.01	0.91
8	Prakash	24	0.77	0.71	0.80	0.88	0.89	0.90
9	Poornenth	25	0.97	0.89	0.91	0.99	0.98	0.94
10	Kaushal	25	0.72	0.74	0.81	0.79	0.83	0.88
11	Himanshu	25	0.78	0.81	0.83	0.79	0.80	0.77
12	Hareesh	20	1.20	1.10	1.12	1.21	1.20	1.14
13	Haneesh	25	1.07	0.89	1.05	1.13	1.09	1.15
14	Dr vijay	26	1.07	0.94	1.04	1.15	1.13	1.16
15	Revanth	25	0.80	0.73	0.78	0.77	0.80	0.80
16	Sushanth	26	1.00	0.87	1.00	1.02	1.01	0.95
17	Subhash	25	0.60	0.86	0.88	0.94	1.06	1.08
18	Subeer	27	1.00	1.03	1.08	0.96	1.06	1.10
19	Srisailam	30	0.97	0.91	0.99	1.05	0.97	1.04
20	Rohith	26	0.76	0.71	0.77	0.83	0.89	0.90
21	Dr.Hemant	26	1.03	0.59	0.95	1.08	1.04	1.02
22	Rajendra	18	0.68	0.68	0.78	0.64	0.69	0.65
23	Prasanth	28	0.92	0.79	0.89	1.01	0.99	1.01
24	Omprakas	22	0.79	0.78	0.81	0.79	0.85	0.87
25	Navaneeth	25	0.95	0.87	1.01	0.98	0.94	0.99
26	Mandeep	21	1.03	0.95	1.06	0.90	0.92	0.89
27	Mahesh	23	0.88	0.76	0.92	0.85	0.84	0.82
28	Hemanth	22	1.11	0.98	1.11	1.18	1.17	1.21
29	Dharmvir	26	0.73	0.75	0.81	0.95	0.91	0.95
30	Bharath	25	0.85	0.89	0.95	0.86	0.86	0.89
31	Ashwin	26	0.92	0.84	0.86	0.92	0.93	0.93
32	Anurag	28	0.86	0.78	0.83	0.83	0.92	0.93
33	Anand	21	0.85	0.70	0.83	1.01	1.03	1.02

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			Mean HR			Mean HR		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	67.55	75.27	72.07	67.61	72.69	68.54
2	Sharath	26	74.82	74.69	72.58	79.36	76.03	77.43
3	Sateesh	18	74.87	79.43	69.12	69.78	67.69	66.68
4	Santhosh	28	82.45	78.97	71.46	77.57	77.11	74.99
5	Sanjay	20	92.90	91.44	83.18	100.53	96.06	95.56
6	Rishi	28	67.06	72.24	73.23	57.92	57.78	59.68
7	RP Singh	25	68.32	73.77	69.65	62.54	61.57	69.26
8	Prakash	24	78.58	85.62	75.20	68.29	68.69	66.89
9	Poornenth	25	62.11	69.28	65.84	60.59	61.88	64.33
10	Kaushal	25	84.05	81.30	74.67	76.40	72.96	68.59
11	Himanshu	25	78.21	75.85	73.18	76.58	75.57	78.03
12	Hareesh	20	50.76	56.69	53.77	50.04	51.12	53.54
13	Haneesh	25	56.38	67.57	57.38	53.27	55.52	52.19
14	Dr vijay	26	56.22	64.80	57.73	52.12	53.66	52.00
15	Revanth	25	75.51	82.93	77.44	78.55	75.65	75.29
16	Sushanth	26	61.34	69.87	60.03	58.84	59.54	63.36
17	Subhash	25	62.80	70.43	68.59	64.19	57.03	55.53
18	Subeer	27	60.34	58.87	56.09	62.45	56.63	54.84
19	Srisailam	30	62.62	67.87	61.19	57.51	62.92	58.89
20	Rohith	26	79.62	85.87	77.94	71.52	68.05	66.85
21	Dr.Hemant	26	58.39	132.82	64.08	56.10	58.22	59.27
22	Rajendra	18	89.21	89.58	77.52	94.85	87.66	92.74
23	Prasanth	28	65.71	76.99	68.26	59.92	61.29	59.80
24	Omprakas	22	76.77	78.32	74.13	76.19	70.67	68.95
25	Navaneeth	25	63.52	69.27	59.76	61.77	64.68	61.26
26	Mandeep	21	58.42	65.58	57.40	67.16	66.22	68.12
27	Mahesh	23	68.64	79.41	65.81	71.50	72.70	73.92
28	Hemanth	22	54.54	61.60	54.47	52.03	51.78	50.08
29	Dharmvir	26	81.97	81.13	74.85	63.45	66.59	63.40
30	Bharath	25	71.13	69.15	63.82	70.18	70.72	67.90
31	Ashwin	26	65.32	73.00	69.74	65.46	65.24	65.25
32	Anurag	28	70.90	78.18	74.23	73.98	65.58	65.16
33	Anand	21	71.35	89.41	73.09	59.98	58.70	59.29

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			RMSSD			RMSSD		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	39.20	46.90	19.50	33.40	39.00	26.00
2	Sharath	26	27.00	37.80	29.30	24.80	27.50	26.50
3	Sateesh	18	88.40	61.20	113.70	125.70	92.00	75.90
4	Santhosh	28	41.60	67.00	53.80	14.00	24.30	21.00
5	Sanjay	20	29.90	65.00	34.90	11.20	26.30	20.30
6	Rishi	28	30.50	30.10	18.90	46.40	60.40	43.60
7	RP Singh	25	93.70	123.50	100.30	114.30	160.80	127.20
8	Prakash	24	34.20	44.10	46.20	65.60	80.20	50.10
9	Poornenth	25	38.70	85.30	36.10	45.70	47.00	43.00
10	Kaushal	25	11.80	26.60	16.50	19.00	18.70	26.90
11	Himanshu	25	45.30	69.10	45.10	29.30	40.50	38.90
12	Hareesh	20	149.30	169.10	83.10	98.30	135.20	99.40
13	Haneesh	25	47.20	28.10	31.00	35.80	60.50	38.80
14	Dr vijay	26	46.70	88.80	36.40	68.10	60.50	78.50
15	Revanth	25	28.60	38.50	41.70	25.40	33.70	31.00
16	Sushanth	26	196.40	40.70	59.30	46.00	47.90	39.50
17	Subhash	25	40.30	40.90	31.80	36.00	52.30	61.80
18	Subeer	27	38.80	75.90	67.20	34.50	60.20	50.90
19	Srisailam	30	68.40	84.70	77.60	86.80	74.80	106.30
20	Rohith	26	21.90	30.50	29.70	37.30	37.20	40.00
21	Dr.Hemant	26	79.60	221.00	76.50	49.00	44.10	41.60
22	Rajendra	18	23.00	36.20	28.70	36.90	35.70	33.50
23	Prasanth	28	57.70	52.10	57.40	111.90	91.90	76.50
24	Omprakas	22	31.50	67.90	24.70	17.70	30.10	36.40
25	Navaneeth	25	34.30	27.70	42.30	48.60	35.70	44.40
26	Mandeep	21	92.20	153.70	114.30	65.50	77.40	54.10
27	Mahesh	23	44.30	24.90	58.40	48.50	60.90	36.50
28	Hemanth	22	62.30	47.90	62.00	145.30	81.10	101.50
29	Dharmvir	26	21.60	39.90	28.70	53.40	54.90	47.10
30	Bharath	25	27.30	92.20	43.60	28.30	53.10	31.00
31	Ashwin	26	19.80	46.90	20.10	26.20	49.70	34.20
32	Anurag	28	87.40	43.70	90.20	65.90	60.00	79.60
33	Anand	21	47.60	78.20	53.30	53.40	72.30	66.90

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			NN50			NN50		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	50.00	100.00	3.00	32.00	83.00	14.00
2	Sharath	26	17.00	93.00	24.00	12.00	40.00	24.00
3	Sateesh	18	30.00	82.00	73.00	57.00	120.00	61.00
4	Santhosh	28	54.00	151.00	100.00	0.00	31.00	12.00
5	Sanjay	20	12.00	146.00	30.00	1.00	21.00	6.00
6	Rishi	28	36.00	67.00	4.00	87.00	213.00	83.00
7	RP Singh	25	156.00	160.00	130.00	151.00	293.00	169.00
8	Prakash	24	48.00	92.00	92.00	149.00	234.00	76.00
9	Poornenth	25	62.00	187.00	53.00	98.00	168.00	69.00
10	Kaushal	25	1.00	45.00	0.00	4.00	13.00	23.00
11	Himanshu	25	87.00	170.00	88.00	29.00	115.00	20.00
12	Hareesh	20	119.00	290.00	62.00	105.00	183.00	115.00
13	Haneesh	25	61.00	52.00	27.00	43.00	166.00	49.00
14	Dr vijay	26	57.00	145.00	44.00	135.00	173.00	156.00
15	Revanth	25	22.00	97.00	78.00	10.00	93.00	29.00
16	Sushanth	26	209.00	80.00	112.00	88.00	176.00	58.00
17	Subhash	25	59.00	136.00	39.00	48.00	164.00	104.00
18	Subeer	27	37.00	119.00	99.00	11.00	152.00	89.00
19	Srisailam	30	151.00	249.00	130.00	178.00	237.00	157.00
20	Rohith	26	8.00	59.00	30.00	72.00	115.00	68.00
21	Dr.Hemant	26	36.00	703.00	45.00	55.00	127.00	58.00
22	Rajendra	18	18.00	67.00	27.00	19.00	61.00	22.00
23	Prasanth	28	111.00	107.00	114.00	164.00	288.00	162.00
24	Omprakas	22	24.00	184.00	21.00	2.00	67.00	57.00
25	Navaneeth	25	50.00	49.00	79.00	106.00	87.00	82.00
26	Mandeep	21	184.00	272.00	152.00	138.00	231.00	109.00
27	Mahesh	23	79.00	48.00	95.00	88.00	201.00	48.00
28	Hemanth	22	81.00	131.00	86.00	124.00	186.00	111.00
29	Dharmvir	26	13.00	119.00	35.00	103.00	153.00	80.00
30	Bharath	25	17.00	188.00	67.00	22.00	179.00	32.00
31	Ashwin	26	4.00	104.00	10.00	22.00	137.00	46.00
32	Anurag	28	113.00	135.00	111.00	87.00	182.00	164.00
33	Anand	21	80.00	202.00	80.00	92.00	191.00	82.00

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			PNN50			PNN50		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	15.10	13.50	0.80	9.60	11.60	4.10
2	Sharath	26	4.60	12.70	6.70	3.10	5.30	6.30
3	Sateesh	18	8.20	10.50	21.60	16.80	18.00	18.60
4	Santhosh	28	13.30	19.40	28.30	0.00	4.10	3.20
5	Sanjay	20	2.60	16.30	7.30	0.20	2.20	1.30
6	Rishi	28	10.90	9.40	1.10	30.50	37.40	28.20
7	RP Singh	25	47.10	36.70	38.50	49.50	49.70	51.70
8	Prakash	24	12.40	10.90	24.80	44.20	34.70	23.00
9	Poornenth	25	20.20	27.80	16.40	32.80	27.50	22.00
10	Kaushal	25	0.20	5.60	0.00	1.10	1.80	6.80
11	Himanshu	25	22.80	22.90	24.40	7.70	15.40	5.20
12	Hareesh	20	48.40	53.60	23.50	43.00	36.70	44.40
13	Haneesh	25	22.00	7.80	9.60	16.30	30.40	19.10
14	Dr vijay	26	20.60	22.80	15.50	52.50	32.70	60.90
15	Revanth	25	5.90	11.90	20.50	2.60	12.40	7.80
16	Sushanth	26	70.10	11.60	37.80	30.30	29.90	18.50
17	Subhash	25	19.00	19.60	11.50	15.20	29.10	38.10
18	Subeer	27	12.40	20.60	36.00	3.60	27.10	33.00
19	Srisailam	30	49.20	37.80	43.50	63.10	38.50	54.90
20	Rohith	26	2.00	7.00	7.80	20.50	17.10	20.60
21	Dr.Hemant	26	12.50	69.30	14.40	19.90	22.00	19.90
22	Rajendra	18	4.10	7.60	7.10	4.10	7.00	4.80
23	Prasanth	28	34.40	14.10	34.10	55.80	47.90	55.10
24	Omprakas	22	6.30	24.10	5.70	0.50	9.60	16.70
25	Navaneeth	25	16.00	7.20	26.90	35.00	13.80	27.20
26	Mandeep	21	64.10	43.30	54.30	41.80	35.60	32.50
27	Mahesh	23	23.50	6.10	29.50	25.00	28.20	13.20
28	Hemanth	22	30.20	21.60	32.10	49.40	36.50	45.30
29	Dharmvir	26	3.20	14.90	9.50	33.10	23.30	25.70
30	Bharath	25	4.80	27.90	21.40	6.30	25.80	9.60
31	Ashwin	26	1.20	14.60	2.90	6.80	21.40	14.30
32	Anurag	28	32.60	17.60	31.00	24.20	28.00	51.40
33	Anand	21	22.90	23.80	22.30	31.20	33.10	28.30

INTERVENTION			BHRĀMARI PRĀṆĀYĀMA			BREATH AWARENESS		
VARIABLE			TINN			TINN		
Sl.No	Name	Age	Pre	During	Post	Pre	During	Post
1	Shishupal	24	260	355	165	220	365	200
2	Sharath	26	255	400	200	195	260	280
3	Sateesh	18	465	510	575	545	555	525
4	Santhosh	28	375	380	265	100	190	155
5	Sanjay	20	235	445	335	115	235	200
6	Rishi	28	290	335	175	220	335	245
7	RP Singh	25	475	685	520	615	1364	820
8	Prakash	24	225	410	215	365	510	300
9	Poornenth	25	235	597	240	225	335	380
10	Kaushal	25	190	345	120	215	225	230
11	Himanshu	25	350	625	305	210	330	355
12	Hareesh	20	515	1035	420	480	1120	505
13	Haneesh	25	315	245	235	165	490	210
14	Dr vijay	26	280	405	210	270	430	300
15	Revanth	25	195	360	305	190	265	190
16	Sushanth	26	480	380	265	225	305	260
17	Subhash	25	245	330	220	240	315	270
18	Subeer	27	250	550	325	250	415	245
19	Srisailam	30	325	585	425	360	555	445
20	Rohith	26	135	300	170	235	245	240
21	Dr.Hemant	26	660	965	475	270	295	290
22	Rajendra	18	185	375	235	240	295	265
23	Prasanth	28	290	385	350	870	520	375
24	Omprakas	22	200	595	175	150	225	215
25	Navaneeth	25	220	295	260	305	485	280
26	Mandeep	21	360	780	550	445	605	310
27	Mahesh	23	330	365	395	305	455	265
28	Hemanth	22	340	410	305	1000	450	390
29	Dharmvir	26	170	340	260	370	425	315
30	Bharath	25	225	1065	245	180	430	200
31	Ashwin	26	135	595	190	205	415	280
32	Anurag	28	545	400	605	570	435	420
33	Anand	21	315	595	400	275	425	375

APPENDIX (B) – TABLES AND GRAPHS

HRV Variables	Bhramari					Breath Awareness				
	Pre	During	% diff pre - during	Post	% diff Pre-post	Pre	During	% diff pre-during	Post	% diff Pre-post
LF	63.75 ±17.76	87.04 ±7.50 @@@	36.53 ***	67.32 ±13.67	5.60	59.38 ±17.75	77.76 ±13.68	30.95 ***	67.41 ±17.72	13.52 **
HF	36.24 ±17.75	12.96 ±7.50 @@@	64.24 ***	32.68 ±13.67	9.82	40.61 ±17.12	22.24 ±13.68	45.24 **	32.59 ±17.72	19.75 **
LF/HF	3.61 ±5.64	11.04 ±10.89	205.82 **	2.77 ±1.93	23.27	2.09 ±1.81	6.69 ±6.48	220.10 ***	3.27 ±2.58	56.4 *
HR	69.47 ±10.35 @	76.58 ±13.27 @@@	10.23	68.11 ±7.79	1.96	67.21 ±11.43	66.30 ±9.87	1.35	65.98 ±10.34	1.83
RMSSD	52.92 ±38.50	66.25 ±66.24	25.19	50.68 ±27.02	4.23	52.98 ±33.57	58.36 ±30.30	10.15	52.39 ±26.92	1.11
NN50	63.21 ±53.19	146.33 ±118.35	131.50	64.85 ±41.35	2.59	70.67 ±53.67	147.88 ±72.29	109.25 ***	73.79 ±48.03	4.41
Pnn50	20.08 ±18.19	20.32 ±14.28	1.20	20.21 ±13.70	0.65	23.51 ±18.84	24.05 ±12.84	2.30	24.6 ±17.30	4.64
TINN	305.15 ±124.25	498.24 ±210.18	63.28 ***	307.12 ±128.12	0.65	321.97 ±202.68	433.45 ±237.18	34.62 *	313.18 ±127.60	2.73

LF (low frequency), HF (high frequency).Time domain measures: ,RMSSD(root mean square of successive NN interval differences), NN50 (number of successive NN intervals differing more than 50 ms), TINN(Triangular index and triangular interpolation of NN intervals)

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$, Repeated Measures ANOVA with Bonferroni Adjustments within Group.

$^{@}p < 0.05$, $^{@@}p < 0.01$, $^{@@@}p < 0.001$,Repeated Measures ANOVA with Bonferroni Adjustments Between Group Comparisons (Pre vs Pre, Dur vs Dur, Post Vs Post)

Bhrāmari					
Variable	Pre	During	%	Post	%
RMSSD	52.92±38.50	66.25±66.24	25.19%	50.68±27.02	-4.23%
Breath Awareness					
Variable	Pre	During	%	Post	%
RMSSD	52.98±33.57	58.36±30.30	10.15%	52.39±26.92	-1.11%

Bhrāmari					
Variable	Pre	During	%	Post	%
Pnn50	20.08±18.19	20.32±14.28	1.20%	20.21±13.70	0.65%
Breath Awareness					
Variable	Pre	During	%	Post	%
Pnn50	23.51±18.84	24.05±12.84	2.30%	24.6±17.30	4.64%