



## EFFECT OF DIFFERENT MODALITIES OF ANANDA YOGA ON CARDIAC AUTONOMIC MODULATION AND SUBJECTIVE WELLBEING SCORE EXPLORATORY STUDY

### General Medicine

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### ABSTRACT

**Background:** Ananda Yoga is a system of yoga practice based on the teachings of great yoga master Paramhansa Yogananda that includes different yoga modalities like- Energization Exercises, Yoga Postures, Pranayama and Meditation.

**Aim:** To study the effects of different modalities of Ananda Yoga on cardiac autonomic modulation and on subjective wellbeing.

**Method:** 25 yoga naive subjects with mean age 36.84±10.12yrs were enrolled. A questionnaire based subjective wellbeing and high sampled ECG was recorded for heart rate variability (HRV) analysis.

**Results:** Compared to resting baseline all HRV parameters (SDNN, LF (ms<sup>2</sup>), HF(ms<sup>2</sup>), Average Heart Rate ) showed statistically significant modulation in different yoga modalities (p value<0.05).

**Conclusion:** Different modalities of Ananda Yoga were found to affect cardiac autonomic modulation and subjective wellbeing of the participants. Large multi centre trials are needed to further explore these results.

### KEYWORDS

Yoga, Heart Rate Variability, Autonomic, Wellbeing

### INTRODUCTION

Scientific studies have shown the health benefits of yoga in relieving stress, anxiety, depression, hypertension, heart disorders and so on. (1)Most of these studies are outcome based that have focussed on effect of yoga on a particular clinical entity. To our understanding very few studies are available that have observed the cardiac autonomic modulation during different modalities of yoga. Most studies in the past have studied the overall effect of yoga session on the autonomic modulation which could not assess the specific modulation brought by individual yoga modalities.(2) It was precisely for these reasons that we decided to study the effect of different modalities of Ananda Yoga on cardiac autonomic modulation in yoga naive subjects.

Ananda Yoga is a popular branch of Hath yoga based on the teachings of great yoga master Paramhansa Yogananda developed by his direct disciple Swami Kriyananda. (3)There are essentially four modalities of this system- Energization exercises, Yoga postures, *Pranayama* and Meditation.(4)

In our study we have assessed the effect of all these modalities individually on cardiac autonomic modulation by obtaining a high sampled ECG recording for heart rate variability (HRV) analysis. We have also assessed the overall effect of yoga session on subjective wellbeing by using a questionnaire based tool.

Authors felt that assessment of cardiac autonomic modulation could help physician choose an appropriate yoga modality for a desired therapeutic goal.

### RESEARCH METHODS

#### Study Design

It was an exploratory study. The yoga naive subjects of the study were chosen from the health care professionals working in the Intensive Care Unit (ICU) of the SKNMC Pune. The study was approved by the local ethical committee. 40 minute yoga session led by an experienced yoga instructor was conducted before lunch hour for two participants each at work place. Inclusion criteria consisted of health professionals who were willing to participate in the study. Exclusion criteria included pain due musculoskeletal diseases that restricted mobility.

#### Study tools

The research tools of the study consisted of both subjective parameters of wellbeing and an objective biofeedback (HRV) monitor.

The demographic characteristics of all the participants were noted. Based on following questionnaire the participants were asked to give

themselves a score between 0 to 10 depending upon their physical and mental wellbeing status-

**a) Physical wellbeing score:** How would you rate your physical energy or stamina on a scale of 0 to 10, if let's say a person with full energy/stamina gives himself 10/10 and someone who is absolutely tired/fatigued would give himself 0/10?

**b) Mental wellbeing score:** How would you rate your mental wellbeing on a scale of 0 to 10, if let's say a person in absolute peaceful/alert/focussed state of mind gives himself 10/10 and someone who is very restless, not focussed at all and having emotional turmoil would give 0/10?

HRV monitor used in the study was Chronovisor Dx Data acquisition system which was pre-programmed to collect data of autonomic modulation in blocks in the following sequence-

#### Pre-session/Energization Exercises/Yoga postures/Pranayama-Meditation/Post-session

#### Intervention

Each yoga session was subdivided into five phases-

#### Phase 1: Resting phase: 5min

Here participants were sitting in chairs for 5 minutes during which their baseline HRV parameters were recorded.

#### Phase 2: Exercise phase: 7min

It started with a 5-7 cycles of full yogic breath where subjects had to exhale completely while bending forward flexing their torso on hip joints and touching their feet or ankles with their hands and then slowly lifting up inhaling completely while lifting the torso above and raising the arms above their heads. This was followed by a sequence of Energization exercises. These exercises were originally invented in 1920 by yoga master Paramhansa Yogananda. It involved coordinated breathing with alternate tensing and relaxing of individual muscles by using our will. It is a set of 39 such exercises but to keep it convenient for the study protocol we shared only ten of these.

#### Phase3: Yogasana phase: 20min

In order to keep the postures simple for yoga naive subjects only standing poses were kept in the study protocol. These were -*Vrikasana*, *Veerbhadrasana* and *Muktasana*.

**Phase 4: Pranayama and Meditation: 3min**

In this session for first one minute (approx.) even count breathing was practiced where inhalation and exhalation was kept equal to a count of four for three cycles guided by the instructor. In last two minutes subjects were asked to practice observation of breath without controlling it by keeping the mind focussed within the nostrils.

**Phase 5: Post session resting: 5min**

Here participants were asked to stay in silence in sitting position.

**Statistical Analysis**

Descriptive analysis of all HRV indices was done. Comparison of HRV

parameters in different modalities with resting baseline was analyzed using Wilcoxon signed rank test and P value of < 0.05 was considered as significant.

**RESULTS**

**Demographic Characteristics**

n=25. 15 were men and 10 were women. The mean age of the participants in years was 36.84±10.12, the mean BMI in Kg/sq. m was 26.68±4.08.

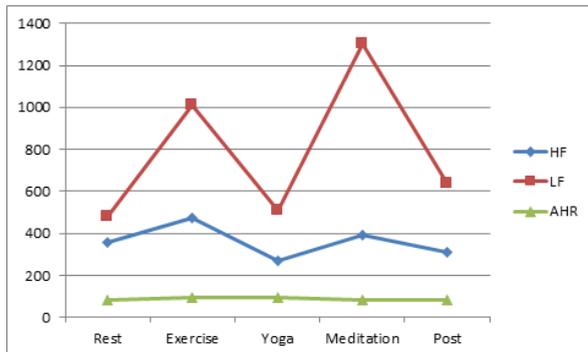
**HRV-Frequency and Time Domain Analysis**

**TABLE 1: Mean HRV Characteristics (Frequency and Time Domain Analysis) and P values of Wilcoxon signed rank test**

Study Block	SDNN	TP (ms <sup>2</sup> )	LF (ms <sup>2</sup> )	LF (nu)	HF (ms <sup>2</sup> )	HF (nu)	LF/HF	AHR
Resting	36.9±15.16	1679.77±1883.92	480.9± 482.21	63.87± 15.76	358.56± 583.69	36.12± 15.76	2.3±1.56	81.55±9.55
Energization Exercise	57.6±20.42	3587.09±2689.36	1008.57±765.34	71.91± 11.47	473.32± 508.11	28.08± 11.47	3.32±2.14	94.25±8.94
Yoga Postures	52.8±21.68	2961.22±2539.92	506.2± 386.03	73.28± 14.23	267.48± 406.57	26.71± 14.23	3.56±1.94	93.40±9.43
Meditation	45.8±17.55	2480.18±2004.17	1301.41±1339.4	74.8± 16.07	389.7± 419.17	25.2± 16.07	4.82±3.61	80.30±10.76
Post-session	60.3±44.89	2564.81±2112.64	638.02± 533.87	70.03± 15.96	307.82± 339.26	29.96± 15.96	3.34±2.48	82.03± 9.68
Wilcoxon score	P value	P value	P value	P value	P value	P value	P value	P value
Resting with Energization Exercise	<0.0001**	0.0001**	0.0001**	0.0164*	0.0434*	0.0164*	0.016*	<0.0001**
Resting with Yoga Postures	0.0005**	0.0003**	0.303	0.0121*	0.1118	0.0121*	0.0093*	<0.0001**
Resting with Pranayama-Meditation	0.0083*	0.0065*	0.0001**	0.0039**	0.2225	0.0039**	0.0008**	0.126
Resting with Post session	0.0002**	0.0008**	0.0105*	0.0203*	0.9761	0.0203*	0.0209*	0.4902

\* Statistically significant (p value<0.05)

\*\* High statistical significance (p value<0.005)



**FIGURE 1: Line diagram showing LF, HF and AHR relationship in different yoga modalities**

indicators of autonomic regulation and vagal activity. HRV is measured using the R-R interval (QRS peak) on an electrocardiogram with the beat-to-beat variation reflecting the chaotic properties of the heart. There are a variety of different algorithmic approaches for HRV analysis, but in this study we have chosen the guidelines of the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996) for the purpose of analysis.(6)

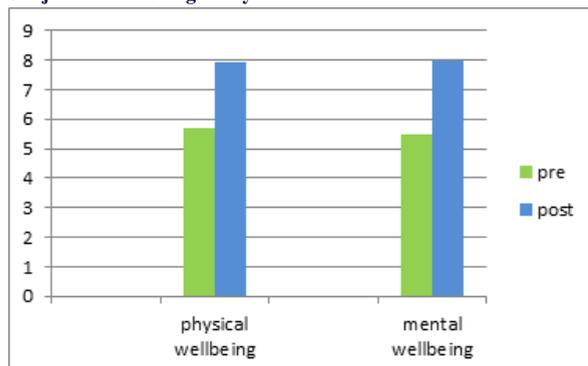
Mean SDNN during all modalities of Ananda Yoga used in the study showed statistically significant variance when compared with the resting state. This indicates that all Ananda Yoga modalities used in the study affect cardiac autonomic modulation individually. Following is an interpretation of HRV parameters observed during each yoga intervention when compared with the resting state.

**Energization Exercises**

During Energization Exercises a statistically significant increment in LF (ms<sup>2</sup>), HF (ms<sup>2</sup>), Total power (ms<sup>2</sup>) and Average Heart Rate (AHR) was observed. This could be interpreted as autonomic modulation with both sympathetic and parasympathetic components but with overall sympathetic dominance. These results are different from what observed by Howorka et al (7) where they found that aerobic exercise had no effect on HRV parameters, whereas another comparative study done by Khattab et al (8) found that heart rate decreased in yoga group when compared with the walking group.

Authors feel that this difference could be because of the fact that the Energization Exercises used in this study intervention are specific yogic exercises invented by Paramhansa Yogananda, which are different from aerobic exercises. Some of these exercises involve double/deep inhalation and exhalation which may explain increment in HF (ms<sup>2</sup>). Moreover as they involve tensing and relaxing of individual set of muscles by consciously engaging our will, it is quite possible that these exercises are capable of bringing an additional parasympathetic component apart from sympathetic component by consciously engaging the prefrontal cortex of our brains. It would be interesting to explore this particular yoga modality in future studies.

**Subjective Wellbeing Analysis**



**FIGURE 2: Showing pre and post session subjective wellbeing improvement.**

**DISCUSSION**

Heart Rate (HR) in healthy humans is influenced by physical, emotional, and cognitive activities and physiological oscillations that lead to variable beat-to-beat fluctuations in HR is known as HRV.(5) HR and HRV are perhaps the most sensitive and easily accessible

**Yoga Postures**

During yoga posture rise in LF (ms<sup>2</sup>) and AHR and fall in HF (ms<sup>2</sup>) was observed when compared with the resting state. Now this may suggest that rise in AHR was due to both components of sympathetic drive and vagal withdrawal.

Here our results match with Pitale et al (9) who found the same results with standing poses on regular yoga practitioners. Similarly Melville et al (10) in their study on sedentary health office employees with chair yoga intervention and Sarang and Telles (11) with their study on regular yoga practitioners reported similar results.

It is noteworthy to see that the participants of our study were all yoga naive, we did expect autonomic modulation with a sympathetic dominance.

### Pranayama and Meditation

Both LF ( $\text{ms}^2$ ) and HF ( $\text{ms}^2$ ) were found to be elevated during Pranayama-meditation when compared with the resting state. Rise in LF was statistically significant. On the contrary mean AHR was found to be decreased, although it did not reach statistical significance. This finding appears paradoxical because with the significant rise in LF which is a marker of sympathetic modulation a rise in mean AHR was expected. We may interpret this finding as suggestive of higher parasympathetic modulation during Pranayama-meditation which was balancing or overwhelming the effect of sympathetic drive.

Here our results were similar to observed by Peng et al (12) with kundalini meditation, Bernardi et al (13) with mantra chanting, Raghuraj and Telles (14) with alternate nostril breathing. On the other hand Telles et al (2013) (15) in their study on regular yoga practitioners found fall in LF and AHR and rise in HF values during *dhyana* (meditation). This discrepancy could be due to possible conditioning of autonomic response in regular yoga practitioners.

We also speculate that greater sympathetic drive observed during Pranayama and meditation could be due to modulated increase in levels of neurotransmitters like nor adrenaline, dopamine and serotonin. The recent study done by Michael Melnychuk at Trinity College of Neuroscience, Trinity, gives more evidence in this regard. Authors found that breath-practices involving focused observation modulates the activity of locus coeruleus which in turn regulates the release of nor adrenaline. (16)

### Post-session

Post-session analysis showed statistically significant rise in LF (nu) and fall in HF (nu) when compared with the resting baseline. On the other hand mean AHR almost reached the baseline. Similar study done by An et al in 2010 (16) showed fall in LF (nu) and AHR and rise in HF (nu) in healthy female non yoga practitioners. Authors feel that with rising LF and drop in HF, a rise in AHR was expected. This indicates that there could be some other pathways through which yoga modalities could bring heart rate modulation. Study done by Innes and Selfe, 2014 using neurophysiologic and neuroimaging tools is especially noteworthy in this regard where they found that yoga selectively activates specific brain structures and neurochemical systems related to attention and positive effect which in turn can promote favourable changes in autonomic balance. (18)

### Subjective wellbeing

The study shows that a single 40 min multi modality session of Ananda Yoga could uplift the subjective wellbeing scores by 39 and 45 percent in physical and mental wellbeing respectively. Recent studies indicate that perception of chronic mental stress is an independent risk factor of chronic morbidity. (19) This study highlights the value of developing yoga based preventive and therapeutic tools to alleviate stress.

### CONCLUSION

Different modalities of Ananda Yoga were found to bring statistically significant effect on cardiac autonomic modulation. Some of these effects hint at possible use of these modalities for therapeutic advantage. A single 40 min multi modality session of Ananda Yoga significantly uplifted the physical (39%) and mental wellbeing (45%) of the participants. It can be used as a cost effective intervention to alleviate stress related morbidity. Large multi centre trials are needed to further explore these results.

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