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Original Research Article

Impact of Two Distinct Forms of Physical Activity on Heart Rate Variability (HRV) in Young Healthy Individuals

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Abstract

Aim: The aim of the present study was to compare the effect of two types of physical activity i.e. aerobic exercise and yoga on HRV in young healthy subjects.

Methods: The present study was conducted in the Department of Physiology and 120 healthy volunteers aged 30-40 years were selected for this study.

Results: In all the age groups, the mean age was not statistically significant ($p > 0.05$). There were male predominance in all the three group. The study showed increased LF in control group followed by athletes and Yoga group, also decreased HR, HF and LF/HF ratio in yoga group.

Conclusion: Our study results of yoga show reduction in LF component, significant decrease in HR & increase in HF component compared to aerobic exercise which coincides with the findings of other studies. This supports that yoga influences autonomic nervous system by increasing parasympathetic activity. Our study indicates that parasympathetic activity is substantially greater in yoga practitioners followed by athletes and control.

Keywords: HRV, Parasympathetic activity, Yoga, Aerobic exercise, ECG

Introduction

There is growing evidence that physiological and psychological stress disrupts autonomic balance and prolonged autonomic imbalance is associated with a wide range of somatic and mental diseases. [1] Such autonomic imbalance is reflected in measures of heart rate variability (HRV), which have been positively associated with aerobic fitness [2], resilience to stress [3] and psychological and physiological flexibility [4] and negatively associated with cardiovascular disease [1], stress, [1,5,6] neuronal atrophy [7], negative affective states [8] and maladaptive stress responses. [1]

Heart Rate (HR) in healthy humans is influenced by physical, emotional, and cognitive activities[7] and physiological oscillations that lead to variable beat-to-beat fluctuations in HR is known as HRV. HR and HRV are perhaps the most sensitive and easily accessible indicators of autonomic regulation and vagal activity. A high resting HR is a risk factor for cardiac disease [9,10] while HRV reflects the dynamic balance arising from the coactivation, coinhibition, or reciprocal activation or inhibition of the sympathetic and parasympathetic nervous systems [11] and provides a proxy for the health, adaptability, flexibility, and neural regulation of the cardiovascular system. [1,7,12]

Yoga is one of the best improvements in lifestyle & an ancient Vedic science that is believed to have originated in India in 5000 BC & is being used in the field of therapeutics. Breath is the complex bridge between body & mind, & Pranayama is one of the most important yogic practices. It involves the practice of particular posture (āsana), guided breathing (Pranayama) etc. [13-16] Two components compose the term Pranayama: 'prāna' & 'āyāma'. Prāna means essential energy or 'force of life'. Yāma is defined as 'extension' or 'expansion'. The term Pranayama therefore implies 'extension or expansion of the dimension of prana'. There are four significant aspects of breathing in the Pranayama

rituals, such as (1) Pūraka (inhalation), (2) Recaka (exhalation), (3) Anta' kumbhaka (internal holding of breath), & (4) Bahi' kumbhakaa (external breath retention). Kevala kumbhaka is considered an advanced stage of Pranayama that occurs during high stages of meditation (spontaneous breath retention). [17,18] In Yoga & its effects on brain waves, structural changes & activation, pulmonary function, chronic disease management such as type 2 diabetes, cerebro-vascular attack recovery, cardiovascular disease prevention & risk factors in general, & coronary heart disease prevention & hypertension management in particular, there are different review papers. [18-20]

The aim of the present study was to compare the effect of two types of physical activity i.e. aerobic exercise and yoga on HRV in young healthy subjects.

Materials and Methods

The present study was conducted in the Department of Physiology, Employee State Insurance Medical College and Hospital, Bihta Patna, Bihar, India and 120 healthy volunteers aged 30-40 years were selected for our cross sectional study. The mean height of subjects was 171±5 cm (range 164-178 cm) and weight 69±7 kg (range 57-79 kg). The study included 3 groups having 40 subjects in each group. Group 1(A): Subjects who practiced regular structured aerobic exercise for a period of minimum 6 months in sports schools of the city. Group 2(Y): Subjects practiced yoga regularly for a period of minimum 6 months in various yoga schools. Group 3(C): Healthy subjects (normal BMI) neither practiced yoga or any type of exercise regularly. Subjects with history of hypertension, diabetes mellitus, any chronic illness were excluded from the study. The subjects were ascertained to be healthy after a thorough clinical examination. They were briefed about the study & informed consent was obtained.

- Heart Rate and HRV were recorded in all subjects using standard procedures. Recordings were done for 5 minutes as both 24-hour and brief, resting HRV have been linked to cardiovascular outcomes and a brief, resting HRV measurement of five minutes is sufficient [21] for the measures used in our study in sound attenuated room by Niviqure ambulatory system which is a computerized ECG recording system, that allows to acquire, analyze and store ECG data over long hours (Niviqure Meditech Systems, Bangalore, India). [22] On each subject ECG was recorded using disposable Ag/ AgCl solid adhesive pre-gelled electrodes in standard lead II configuration. Heart rate variability was measured using Powerlab15T, HRV Machine (Ad instruments) using short time recording of around 5 minutes.

The variables were measured were, LF (Low frequency power of HRV spectrum), HF (High frequency power of HRV spectrum), LF/HF Ratio of low and high frequency powers, HR (beats/min). HF reflects efferent vagal activity. LF is considered by some researchers to reflect both sympathetic and parasympathetic modulation while others consider it a measure of vagal withdrawal. The LF/HF ratio was calculated to assess the sympathovagal balance. [23]

Results

Table 1: Distribution of the patients as per age & sex

	Group A	Group B	Group C	P Value
Mean age	35 ± 3.45	36 ± 3.27	37 ± 3.23	>0.05
Gender				
Male	38	30	32	>0.05
Female	12	20	18	>0.05

In all the age groups, the mean age was not statistically significant (p> 0.05). There was male predominance in all the three groups.

Table 2: Frequency domain parameters of HRV of all three groups (Mean ± SD)

Parameters	Group1(A)	Group2(Y)	Group3(C)	pvalue
HR(beats/min)	68.07±8.86	67.03±7.03	73.54± 10.32	0.007
LFms^2	514.36±783.07	368.02±286.44	634.32± 626.14	0.002
HFms^2	988.12±1002.52	1438.78±1194.46	806.94±1008.82	0.003
LH/HF	1.86±1.54	1.34±0.96	2.22±1.96	0.001

The study showed increased LF in control group followed by athletes and Yoga group, also decreased HR, HF and LF/HF ratio in yoga group.

Discussion

Lifestyle diseases are increasing, especially in developing countries at high rate. Advancement in the technology has led to physical inactivity, which has been majorly blamed for the rise in life style associated disorders which is indicated by disruption of autonomic balance and prolonged autonomic imbalance is associated with a wide range of somatic and mental diseases. The cardiovascular system is mostly controlled by autonomic regulation through the activity of sympathetic and parasympathetic pathways of the autonomic nervous system. Analysis of HRV permits insight in autonomic control mechanism. [24] Heart rate variability (HRV) has been used as a proxy for health and fitness and indicator of autonomic regulation. The three components found in HRV power spectrum: (a) a peak at respiratory frequency that corresponds to respiratory sinus arrhythmia (HF, > 0.15 Hz) ; (b) a peak centered at about 0.1 Hz that is related to arterial pressure control (LF 0.04-0.15 Hz); (c) a component at very low frequency (VLF, <0.04 Hz) considered to be expression of the peripheral vasomotor regulation. [25]

Neural factors such as temperature, hormones, etc. are regulated by cardiovascular functions, in which neural factors mainly affect the autonomic nervous system (ANS), which plays a major role in sustaining & managing cardiac functions, e.g. systolic blood pressure (SBP), diastolic blood pressure (DBP), & heart rate (HR). [26-28] In all the age groups, the mean age was not statistically significant ($p > 0.05$). There was male predominance in all the three groups. The study showed increased LF in control group followed by athletes and Yoga group, also decreased HR, HF and LF/HF ratio in yoga group.A significant decrease in LF was observed in Yoga & exercise group compared to control and significant decrease in yoga group compared with exercise. This may be attributed to inhibition of posterior or sympathetic area of the hypothalamus which optimizes the body's sympathetic responses to stressful stimuli. This helps restore autonomic regulatory reflex mechanisms associated with stress. [29] A significant increase in HF was observed in Yoga & exercise group compared to control and significant increase in yoga group compared with exercise group, similar to the finding in study by Peter done in different age group individual. A significant decreased LF/HF ratio (low frequency/ high frequency) in yoga & exercise group compared with control, and yoga group showed further decrease in ration compared with exercise group, indicating a switch towards vagal dominance. In other studies the LF/HF ratio decreased but this change was not significant. [30] An increased LF/HF ratio is often seen in older age [31] but has also been related to depression and stress. [32]

Several studies report links between yoga & autonomic activity markers such as HR, sensitivity to baro-reflex, resistance to galvanic skin, evoked capacity, focus, cognitive skill, emotional control, & mental resilience. Further studies report that routine practice of yoga improves a wide variety of autonomic dysfunction-related health conditions, such as diabetes with hypertension, anxiety, depression, & pain. [33-35] The overall beneficial effect of yoga which is shown to be superior to exercise can be explained by, (a) Respiratory modulation involved in yoga- respiratory frequency & depth which influences autonomic control mechanism. (b) Yoga involving pranayama as one of important component helps in reducing chemo reflex sensitivity. (c) Slow controlled breathing in yoga functionally resets the autonomic nervous system through stretch induced inhibitory signals and hyperpolarization currents propagated through both neural and non- neural tissue which synchronizes neural elements in the heart, lungs, limbic system and cortex. Both inhibitory impulses and hyperpolarization current are known to synchronize neural elements leading to the modulation of the nervous system and decreased metabolic activity indicative of the parasympathetic state. [36]

Conclusion

Our study results of yoga shows reduction in LF component, significant decrease in HR & increase in HF component compared to aerobic exercise which coincides with the findings of other studies. This supports that yoga influences autonomic nervous system by increasing parasympathetic activity. Our study indicates that parasympathetic activity is substantially greater in yoga practitioners followed by athletes and control. Yoga proves to be as effective as or better than exercise at improving cardiac health and maintenance of autonomic balance. Hence yoga can be implemented in preventing life style associated disorders.

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