Effect of Long Term Yoga Practice and Anaerobic Exercise (Gym Practice) on Resting Heart Rate Variability (HRV) Parameters in Young Adults

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Background: Heart rate variability (HRV) is an important quantitative tool to appraise the autonomic activity and also to assess and monitor the cardiovascular diseases. The last two decades have witnessed the recognition of significant liaison between autonomic nervous system and cardiovascular mortality. Recent studies have shown that low heart rate variability is a clear signal of increased risk for severe ventricular arrhythmia and sudden cardiac death. Physical exercise in general is reported to reduce the occurrence of cardiovascular diseases and possible complications arising out of them. Physical activity shall modify the dysregulation of autonomic activity seen in life style associated diseases. Meanwhile, Yoga techniques aim to develop and retain healthy balance between all aspects of body and mind. Yoga has also been associated with improved cardio-respiratory performance.

Aims and Objectives: This study is to assess the effect of long term practice of yoga versus Anaerobic exercise on Heart Rate Variability (HRV) Parameters in Young Adults.

Methodology: This was a cross-sectional study, conducted in the Department of Physiology of Medical College in Tiruvannamalai, Tamilnadu, India. Only males with written and informed consent were enrolled into the study. 60 Volunteers of age group between 20 – 30 are included in the study. They were divided into two groups. Group A: 30 volunteers were enrolled to Yoga Group,

who practiced yoga regularly for a period of minimum 1 year and Group B: 30 volunteers into the Anaerobic Exercise group, who practiced regular anaerobic exercise or went for gym for a period of minimum 1 year. HRV was recorded in resting supine position with minimum of 5 minutes by Ambulatory Digital ECG Recorder for short term HRV analysis. The data obtained was analyzed using software and statistical analysis were done. In our study the resting HRV indicating the resting cardiac autonomic function was evaluated mainly using both time and frequency domain analysis. This study concludes a parasympathetic dominance in regular yoga practitioners than the Anaerobic exercise individuals (Gym Goers), this gives an increased resting HRV which is an good indicator of cardiac autonomic activity during rest and the possibility of reducing cardiac risks in regular yoga practitioners than the Anaerobic exercise individuals (Gym goers).

Keywords: Heart rate variability, Physical exercise, yoga, Anaerobic exercise, Cardiac autonomic function, Gym goers.

1. Introduction

Cardiovascular functions are primarily controlled by neural factors (autonomic regulation), through the activity of sympathetic and parasympathetic pathways of the autonomic nervous system, which plays a major role in maintaining and regulating cardiac functions. Heart rate has a close relationship to sympathetic and parasympathetic nervous systems. Numerous studies indicate a strong association between compromised ANS (e.g., decreased vagal activity or increased sympathetic activity) and sudden and non-sudden cardiac death and the imbalances in the ANS pilot to cardiovascular disorders such as hypertension, ischemia, infarction, etc [1]. Heart rate variability (HRV) is an important index for health and fitness and indicator of autonomic regulation. Heart rate variability (HRV), a non-invasive measure describing beat-to-beat variations of the time intervals between successive heart beats. These variations are the result of heart-brain interactions and dynamic non-linear autonomic nervous system (ANS) processes [2]. Consequently HRV reflects the dynamic balance arising from the coactivation, coinhibition, or reciprocal activation or inhibition of the sympathetic and parasympathetic nervous systems. Heart rate variability has been used as a proxy to assess and monitor cardiovascular diseases or signs such as arrhythmia, hypertension, myocardial infarction, coronary artery diseases, etc [3]. The intrinsic firing rate of heart is 100 impulses per minute. The change in the Heart rate (HR) is response to activation of that organ by the sympathetic nervous system, one of the two branches of the autonomic nervous system (ANS). The autonomic nervous system then exerts continuous signal over the heart to keep resting heart rate in the normal range of 60 to 80 beats per minute and also responsible for regulating human physiological processes during both normal and pathological conditions [4]. The sympathetic system stimulates organ functioning, resulting in increased heart rate, stroke volume, systemic vasoconstriction, etc. Meanwhile the parasympathetic nervous system, is charged with the inhibitory tasks of decreasing heart rate, stroke volume, systemic vasodilatation, etc. The two subsystems interact to form a dynamic balance; and this dynamic state as it is constantly changing in

response to changing environmental demands [5]. Any discrepancy, the ANS is a product of sympathetic over activity and parasympathetic under activity. On the other hand, a healthy individual is characterized by activity of both systems, with parasympathetic dominance. HRV describes the variations between consecutive heartbeats. The continuous modulation of the heart beat by the autonomic nervous system produces a constantly changing rhythm, from which the Heart rate variability (HRV) or the variation between consecutive beats, can be computed [6]. These changes from beat to beat are not only normal, but healthy, and also occur during various physiological responses to environmental stimuli, including breathing, exercise, mental stress, metabolism, sleep, and even attempt to compensate for the disorders associated with disease. The regulation mechanisms of HRV originate from the sympathetic and parasympathetic nervous systems, Hence HRV can be used as a quantitative marker of the autonomic nervous system [3]. HRV analysis has long time been considered only as a ‘‘research toy’’, but nowadays it has gained growing interest in the clinical field as well.

Lifestyle diseases are increasing at an higher rate, especially in developing countries. Meanwhile advancements 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, this in turn leads to prolonged autonomic imbalance which is associated with a wide range of somatic and mental diseases. Lifestyle modifications plays an imperative role in the treatment, prevention, and rehabilitation of cardiovascular disorders [1]. Yoga is a mind body medicine and one of the best lifestyle modifications. Yoga is commonly perceived and become very popular for its minimal expenditure and simplicity. The ultimate aim of yoga techniques to develop and maintain a healthy balance between all aspects of body and mind [7]. It includes practice of specific posture (āsana), regulated breathing (Prāṇāyāma) etc., Breath is the energetic bridge between body and mind and Prāṇāyāma is one of the most important facet of yogic practices [8]. Mounting body of evidence supports the belief that yoga also benefits physical & mental health. Many studies report that regular yoga practice improves a wide range of clinical conditions associated with autonomic dysfunction, such as hypertension diabetes, anxiety, depression, and pain [9]. It is also been associated with enhanced cardio-respiratory performance, enlightening the aerobic nature of yoga [10].

As a known fact, Physical activity is proved to be highly beneficial when concerned with life style disorders. A recent meta-analysis published showed that, with increasing levels of physical activities there is a decrease in the risk of all CV outcomes and diabetes mellitus incidence [11]. Exercise is a subset of this physical activity and considered as an acceptable method for improving & maintaining both physical and mental health. Physical exercise is one of the most effective methods to promote cardiovascular health and helps to prevent cardiovascular (CV) diseases. Exercises are two types, Aerobic and anaerobic exercises, that the difference between these exercises is based on the intensity, interval and types of muscle fibers incorporated. Aerobic exercise has been revealed to have a positive impact on General health, especially on Cardio vascular health. Quite a lot of studies have been published that bear out the advantages of aerobic exercise in reversing and preventing Cardiovascular diseases. Alike aerobic exercise, the anaerobic exercise may wield a potentially beneficial influence on the CV system. Performing anaerobic exercise training

can increase the intensity of the heartbeat and improve the Cardiac function. It can also preserve the vitality of blood vessels, lymphatic vessels, and progress the function of delivering nutrients to the human body. But there are speculations about disadvantages of such Anaerobic exercise program. There are two main problems with anaerobic training. First one is that incorrect exercise and unhealthy exercise concepts methods can cause damage to body and deteriorates the health. Another problem is that the training concept of the traditional training mode is relatively backward, and the guiding effect of anaerobic exercise training practice which is very prevalent among gym goers is not evident. Meanwhile there are very limited studies on Anaerobic exercises. Hence, this study is proposed to compare the effect of two types of physical activity i.e. yoga and anaerobic exercise on HRV in young adults.

2. Materials and methods:

This was a Cross sectional study, carried out in the Department of Physiology in Govt. Medical College, Ramanathapuram, Tamilnadu for a period of about 2 months. Institutional Humans Ethical Committee approval was obtained before the initiation of the study. 72 Male volunteers of age group between 20 to 30 are recruited for study and 60 subjects are enrolled for the study based on inclusion and exclusion criteria. The subjects are divided into two groups. Only male volunteers after explaining the study procedures and obtaining written informed consent were included in the study.

Group I: (yoga group) 30 male regular yoga practitioners practicing routinely for 30-60 min daily for minimum 4 days per week for more than 1 year of age group between 20-30 years are recruited for study. All the volunteers are not practicing any kind of anaerobic exercises or going to gym were recruited in this group based on their willingness to participate in the study from reputed yoga centers.

Group II: (anaerobic exercise group) corresponding age and location matched 30 non-yoga exposed male individuals who practiced regular structured anaerobic exercise or going to gym routinely for 30-60 min / day for minimum 4 days per week for more than 1 year of age group between 20-30 years are recruited for study. Recruitment is based on their willingness to participate in the study.

Inclusion criteria:

Volunteers of age 20-30 male subjects doing regular yoga for more than 1 year for 30-60 min / day for minimum 4 days / week. Volunteers of age 20-30 male subjects doing regular structured Anaerobic exercise or going to gym routinely for 30-60 min daily for minimum 4 days / week for more than 1 year.

Exclusion criteria:

Females excluded for study because of procedural constraints. Individuals with history of cardiovascular problems, renal disorders, pulmonary function problem, neuromuscular disorders, neurological problem, smoking or alcohol are excluded.

In the current study, we aimed at investigating heart rate and heart rate variability in the volunteers of age 20-30 male subjects doing regular yoga for more than 1 year and

volunteers doing regular anaerobic exercise or going to gym for more than 1 year.

Materials:

Niviqure Ambulatory Digital ECG Recorder, Sphygmomanometer, Stethoscope, Weighing Machine, Inch tape.

Methodology:

Heart rate variability recorded by NIVIQURE Ambulatory Digital ECG Recorder (INCO – version 53). The study procedures were explained to all the volunteers participating in the study. Study participants were asked to fill the proforma which contains various questions related to the study, and informed consent was obtained from all the study volunteers before the initiation of the study. Height in meters and weight in kilograms were measured and their BMI were calculated. Resting heart rate and blood pressure was measured with the stethoscope and sphygmomanometer at rest in supine position.

Procedure: For all the study participants the skin area is shaved and cleaned by normal saline for placing the Electrocardiogram (ECG) electrodes for HRV recording. After the ECG electrodes are placed, the study participant is asked to rest quietly without moving with eyes closed, in an awake state, with lights subdued in supine position for a minimum of 10 minutes. The rest period also increased up to 30 minutes. The recordings are performed in quiet room with normal room temperature. A continuous ECG recording of 5 minutes is done for short term HRV analysis. It was recorded for 320 sec of sampling rate of 1024/sec. This test is done to examine the variability of heart rate at rest. Resting heart rate variability was recorded in both the groups with normal respiratory rate ranging of 12-16/min. The leads were connected to the ECG recorder which in turn was connected by a signal processing unit to the personal computer.

The following precautions were taken while performing the resting HRV:

- The study participants were made comfort.
- Free from stress without any significant anxiety and any recent distress.
- Compressive garments are requested to remove.
- Recordings are done after 30 minutes in supine position
- Recordings were done when they are relaxed in resting condition.
- HRV recording is carried out between 10.30 -11 am, (i.e) 2-2.30 hours after breakfast.
- Caffeine, nicotine & alcohol, are advised to stop 24 hours before the day of the study.
- Any other medications that could alter the blood pressure and heart rate are asked to

be stopped ideally 24 hours prior to the study.

Acquiring ECG:

ECG is recorded at quiet supine rest. ECG is acquired from lead II which contains maximum peak for R wave (fiducial point). While acquiring ECG, care is taken to record noise free,

mobile phones switched off, stationary, dysarrythmic events without missing data.

After acquiring ECG:

After recording is over, i.e after acquiring ECG, the module is then connected to the Personal computer (PC). The analog to digital conversion of the resting ECG signal was done using Analog digital (AD) converter with sampling frequency of 1024/sec. Power spectral analysis of the converted ECG signal was done using Fast Fourier transformation. The data was obtained from the selected RR intervals. Artifacts removal was done manually for screening the violent and arrhythmic data. Obtained data was analyzed through HRV analyzing software Finland IV of version 1.1 to obtain of converted ECG signal. Finally the Report sheet (Appendix E enclosed) of analyzed HRV data is obtained.

Statistical analysis: All the data obtained are taken for statistical analysis and using Independent 't' test the results are obtained. P value of below 0.005 is taken as significant.

Parameters Studied: Mean HR, Mean RR, , NN50, pNN50, LF power, HF power, LF(n.u), HF(n.u), LF/HF ratio.

3. Results:

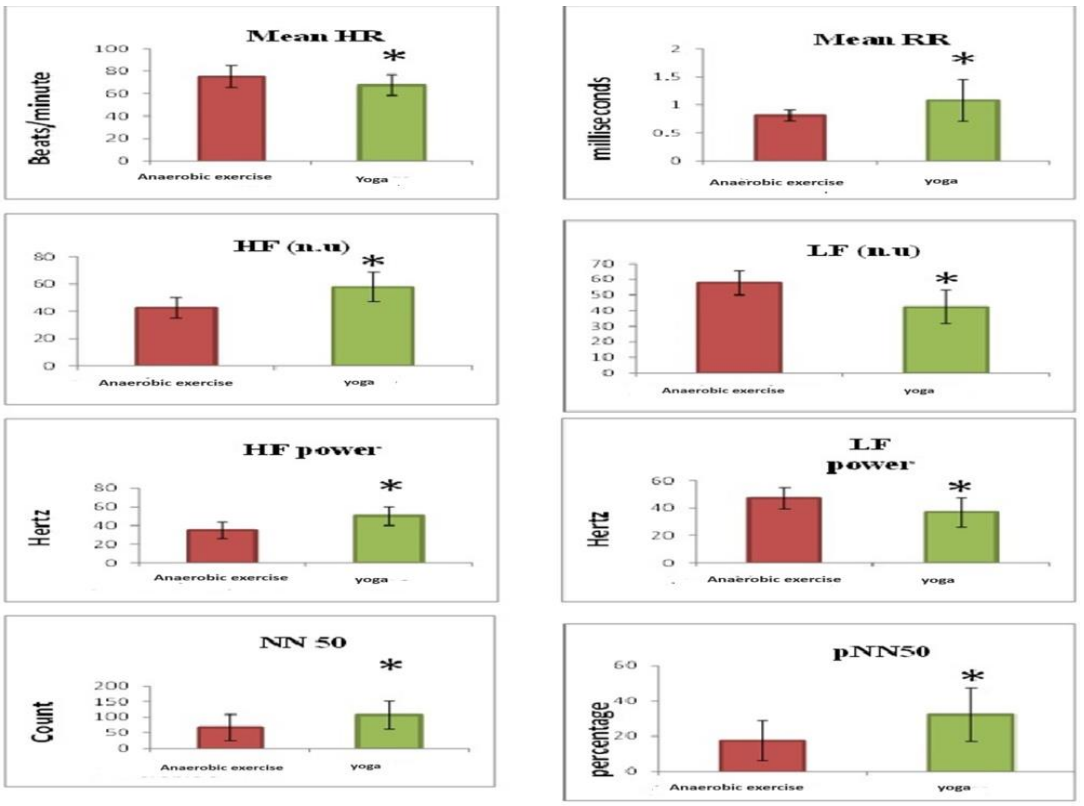
The data obtained are analyzed and expressed as Mean ± SD (Table 1). P Value less than 0.005 is considered as significant.

All the study parameters and their significance with their Mean ± SD are shown in Fig 1.

Table 1: Comparison of Mean ± SD and their respective p Values between the groups are tabulated

Parameters	Yoga group Mean ± SD	Anaerobic group Mean ± SD	P value
Mean HR	67.3425 ± 9.6569	74.566 ± 9.8872	0.002
Mean RR	1.0679 ± 0.3611	0.9192 ± 0.0892	0.004
NN50	105.33 ± 43.617	76.1 ± 40.534	0.002
pNN50	32.2 ± 15.126	17.503 ± 11.249	0.002
LF power	38.0496 ± 10.396	48.520 ± 7.2769	0.002
HF power	50.8102 ± 10.121	34.1126 ± 8.4516	0.001
LF / HF ratio	0.8101 ± 0.41	1.3519 ± 0.4339	0.003
LF (n.u)	43.179 ± 10.6327	56.1930 ± 7.6491	0.005
HF (n.u)	56.7104 ± 10.6761	42.6925 ± 7.4932	0.002

Figure 1; All the study parameters and their significance with their Mean ± SD.



4. Discussion:

There is remarkably strong association between heart rate and survival, an organization that transcends species [12]. On a patient level, decreased levels of parasympathetic tone or increased levels of sympathetic tone have been linked to obesity, insulin resistance, diabetes, hypertension, hypercholesterolemia, depression, anxiety, heart failure, and peripheral vascular disease [13]. Short as well as Long range of fluctuations in the HR are related to the autonomic nervous system, which control group activity of heart and vasomotor. These phenomenon seem to be associated with a structural change of the beat to beat interval dynamics. Recent studies have shown that low HRV is a clear indication of an increased risk for sudden cardiac death and severe ventricular arrhythmia.

Yoga has vital influence on Autonomic nervous system. In particular, yoga techniques offer the possibility of reducing inappropriate activation of the sympathetic nervous system. In this study there was a significant decrease in mean heart rate and significant increase in mean RR interval in regular yoga practitioners compared with the participants of anaerobic exercise group. This may be due to the calming effects of regular yoga practice. For instance, deep breathing activates the parasympathetic nervous system, possibly because regular movement of the diaphragm stimulates the vagus nerve, which leads to the decrease

in the heart rate and increased RR interval as reported [14]. In our study, it was observed a significant increase in HF normalization unit and HF power in regular yoga practitioners than the Exercise group. Adding to this there was a significant decrease in the LF normalization unit and LF power was observed in regular yoga practitioners compared to Anaerobic exercise group. Similar effect was seen in a study in regular Hatha yoga practitioners, as significant decrease in heart rate and increased heart rate variability [15]. Also a significant increase in high frequency was observed which is an indication of increased parasympathetic activity and was similar to our observations in the present study. Also there was a significant increase in the NN50 and pNN50 in regular yoga practitioners with attendant increase in HF power and HF (n.u) indicates an increase in the parasympathetic activity after regular yoga training in our study. The LF/HF ratio is considered by some researchers as a mirror of sympatho / vagal balance or to reflect sympathetic modulations. In the present study there was a significant decrease in the LF/HF ratio in regular yoga practitioners which clearly indicates that sympatho / vagal balance upon regular balance. Certain yoga techniques and exercises result in a chronic increase in muscular strength, endurance, flexibility, and cardio-respiratory endurance [16]. Even short term yoga practices have also produced an acute increase in HRV [17].

Although several studies have reported an increasing HRV trends in overtrained athletes especially those involved in endurance sports. An increased HRV is an indicator of healthy autonomic tone. One such study published by Manshouri et al., which concluded that anaerobic training led to a significant reduction in Human Growth Hormone (HGH) [18]. This long-standing HGH deficiencies may lead to the development of premature atherosclerosis, which attribute towards CV morbidity and mortality. Another study states that, HGH deficiency has been shown to result in higher BMI and TG, lower concentrations of HDL-C, as well as the development of hypertension (HTN) [19]. The most common response is a progressive decrease in HRV due to overload exercise or training. In such situation, the resting HR is elevated and HRV decreases. These typical alarm responses to a stressor, results in activation of sympathetic arm of the autonomic nervous system. Sufficient rest or recovery time is needed for the fully recover to baseline of HRV before the next training or exercise stimulus. Otherwise this will result in a downward trend when this cycle is perpetuated. An intense day of exercise or training is reported in suppressed HRV for up to 72 hours post-exercise [20]. A study conducted by Pichot et al. endow with a good example of a decreasing HRV trend in response to overload training [21]. Meanwhile, an increasing HRV trend throughout training is not always a good thing and thus should not always be interpreted as such. A study done by, Le Meur et al. showed decreased maximal incremental exercise performance and increased weekly HRV mean values in elite endurance athletes following a 3-week overload period, compared to a control group who observed no changes. Following a taper, as performance super recompense was pragmatic along with a return of HRV toward baseline from an increased HRV [22].

Yoga which is shown to be superior to exercise based on its overall benefits which are explained as follows, Respiratory frequency & depth which influence autonomic control mechanism. As respiratory modulation involved in yoga. Pranayama as one of the key component of yoga helps in reducing chemoreflex sensitivity. 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 [23]. Yoga involving stretch of all muscles can attribute to an increase in HRV. Mechanism, after stretching there will be release of vasodilative agents (EDRF = Endothelium-derived relaxing factor) which reduces muscle tone, but could also result from a general systemic psychic-physical relaxation [24].

Summary: The study was aimed to evaluate the resting heart rate variability in subjects practicing the yoga and Anaerobic exercise regularly in the age group of 20 – 30 years for a minimum duration of 1 year. In our study the resting heart rate variability indicating the resting cardiac autonomic function in regular yoga practitioners was evaluated mainly using frequency domain analysis and also time domain analysis. Our study concludes a parasympathetic dominance in regular yoga practitioners than the regular anaerobic exercise individuals as evidenced by

- ❖ The decreased heart rate with an associated increase of RR interval.
- ❖ The decrease in LF power and increase in HF power
- ❖ The LF/HF ratio was towards parasympathetic dominance
- ❖ The decrease in LF power and an increase in HF power both in normalization unit
- ❖ A decrease in low frequency spectrum and an increase in high frequency spectrum in the heart rate variability at rest showing a parasympathetic dominance in yoga group compared to Exercise group

5. Conclusion:

Our study concludes that there is an increased parasympathetic activity and decreased sympathetic activity in regular yoga practitioners as compared to Anaerobic exercise individuals, this gives an increased Resting Heart rate variability in them which is a good indicator of cardiac-autonomic activity during rest and the possibility of reducing cardiac risks in regular yoga practitioners than anaerobic exercise individuals

Limitations of the study:

Larger sample size is needed to generalize the study findings. Presence of age group constraints in this study. Women are excluded in this study. Only the minimum duration of practice of yoga and exercise were taken into consideration in this study, whereas the maximum duration of both the practice should be taken into concern. As the duration of both the practices will influence the study parameters to a greater extent.

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Author's contribution:

Dr Prem and Dr Vishnu facilitated the design of the study and carried out the study, compliance ensured statistics high-quality, manuscript writing and editing, and also conceded data compilation and interpretation. Dr Selva helped in statistical analysis and Publication guidance

All authors read and approved the very last manuscript.

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