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Effect of yogic exercise on resting heart rate variability- a study in central India

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Abstract

Yoga is a science that facilitates homeostasis, also alters the autonomic nervous system as well as cardiovascular functioning. It is recommended as a non-pharmacological tool for managing stress by "National Centre for Complementary and Alternative Medicine India. Heart rate variability (HRV) a temporal variation in consecutive heart beats measured from a standard electrocardiogram. Being non-invasive technique has increased its use to measure the work load of individual. We assessed the effect of yogic exercise on resting HRV by using HRV software (AD-Instrument) in 20 healthy males of 18–20 years age both pre and post interventional. Practice of yogic exercise consist set of physical postures (asana), breathing techniques (pranayama) and meditation (dhyana). These were practised 35mins, 5times /wk for 6 months guided by certified yoga trainer. Analysis done by Student's paired 't' test of HRV revealed that all time domain parameters were increased while frequency domain parameters like low-frequency (LF) and LF/HF ratio were found to be decreased after practice of yogic exercise. Practicing yogic exercise has shown better improvement in autonomic balance by shifting towards parasympathetic predominance as suggested by resting HRV.

Keywords: Yogic exercise, Autonomic function, Heart rate variability, Meditation, Parasympathetic system.

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INTRODUCTION

Physical activity to be incorporated in one's lifestyle is emphasized worldwide. The modality of exercise that would be suitable and beneficial for masses has now become a topic of research. [(1)]. Stress is an integral and inevitable part of modern-day life and has an adverse impact on health in general and cardiovascular function in particular [(2)]. Stress during academic career leads to decrease in their psychological health causes mental distress and has negative impact on cognitive functioning and learning. The most common symptoms associated with stress are poor concentrations, headache, restlessness with associated fatigue, lack of sleep, sudden change in mood [(3)]. Today leading cause of morbidity and mortality in developed and developing countries are cardiovascular disorders. Sympathetic over activity leads to hypertension, arrhythmias, and metabolic dysfunction [(4,5)]. Despite widespread clinical acceptance and demonstration of therapeutic potential of yoga, there is uncertainty about its precise therapeutic efficacy.

Since ancient time's yoga is a science that facilitates homeostasis as well as intended to improve the quality of life, general health and fitness of an individual [(6)]. Since thousands of year's yoga is being practiced in India. Yoga unites individual self with the cosmic consciousness. In Sanskrit word yoga means yoke or union. Yoga is being considered a non-pharmacological tool for managing stress by "National Centre for Complementary and Alternative Medicine" [(7,8)]. Yoga is psychophysical in character as it has continuous focus on the mind ,body and breathing . For better maintenance of body functions even in normal healthy subject's yogic exercise are found to be beneficial. Yogic exercise includes physical postures (asana), breathing techniques (pranayama) and meditation (dhyana) [(9)]. Practice of physical postures (asana) helps in improvement of muscle strength, mind-body coordination and maintains balance. At cellular level there occurs improvement in the blood flow, tissue perfusion and oxygenation. Increase awareness and relaxation states can be brought by focussing on one's own breathing (pranayama) along with practising yoga body movements and vice versa [(10)]. Meditation (dhyana) helps in improving concentration, enhances work output and calms down the mind. By maintaining tranquillity of mind it thus promotes clear thinking, better judgment and effective decision making and finally alters the

autonomic balance to promote health [11].

For achievement of better physical and mental well-being yoga is emerging as an important modifying factor. It has been proposed that practise of yoga can alter the autonomic nervous system and affect the cardiovascular functioning. In healthy individual parasympathetic pathway is active during rest which is reflected by increased Heart rate variability (HRV) and is associated with good health. While low HRV indicates poor health and a higher sympathetic activity [11]. HRV is a temporal variation in consecutive heart beats measured from a standard electrocardiogram. Being non-invasive technique it has increased its use to measure the work load of individual [4]. Hence present study was intended to evaluate the effect of yogic exercise on resting heart rate variability a measure of the modulation of autonomic nervous system (ANS) at rest in normal healthy young males.

METHOD AND MATERIALS

Study setting: Study was conducted in Exercise Physiology Lab in the Department of Physiology, J.N. M. C, Sawangi (M) Wardha after Institutional Scientific and Ethics Committee approval.

Study design: Prospective interventional study

Study duration: 6 months

Sample size: Participants of age group 18-20 years with normal BMI were randomly recruited from Datta Medical Institute and Medical College, Sawangi (M), Wardha. Total sample size was twenty; calculation was done based on testing a hypothesis in interventional studies [12] **.**Considering drop out sample size kept was 10% more than expected. All the participants were instructed not to do any other physical exercises during the present study.

Inclusion criteria:

1. 18-20 yrs male who were willing to do yogic exercise for six months.
2. Participants giving consent.
3. No previous experience of practice of yoga or meditation.

Exclusion criteria:

1. Subjects addicted to alcohol or smoking.
2. Suffering from or diagnosed with any chronic or metabolic disorders.
3. Subjects with chronic obstructive pulmonary disease, cardiovascular disorder, hypertension or diabetes.
4. Major surgery in recent past and treatment with drug having potential to
5. Modify autonomic functions participants were excluded from study.

Study Protocol

Participants were made aware of aim and plan of present research project and were detailed regarding present study protocol. Written informed consent was obtained from them.

Measurement of parameters

Participants were familiarized with the laboratory environment and were given instructions about the experimental procedures prior to the day of recording of parameters. On the day of recording they were advised to abstain from tea, coffee and any medication 24hr prior to recording of parameters. The actual recording protocol included morning recordings after a light breakfast. Subjects were initially rested for 5 mins. Data was extracted in the form of Lead II ECG using HRV software (AD-Instrument) while subjects were resting in supine position for duration of 10 min. The extracted ECG data were manually scanned for any artefacts and only artefact free 5 min data was used for analysis. If there were any artefacts, the recordings were repeated on the next day. The analysis from the HRV software provided information about time domain (SDNN, RMSSD, and PNN50) and frequency domain parameters (low-frequency [LF], high-frequency [HF], LF/HF ratio). The same protocol was followed for both pre- and post-interventional assessments.

Intervention

Subjects were trained under the guidance of certified yoga trainer. Yogic exercise comprised of 5 minute rest, 10 minute of *asana* (suryanamaskar, trikonasana, tadasan, vrikshasan, sukhasan) and *pranayama* (anulom- vilom, kapalbhati), again 5minutes of rest followed by 10 minutes of meditation and 5 minutes relaxation. Subjects used to perform same for 35minutes daily, 5 days a week for 6 months.

Manipulation Check

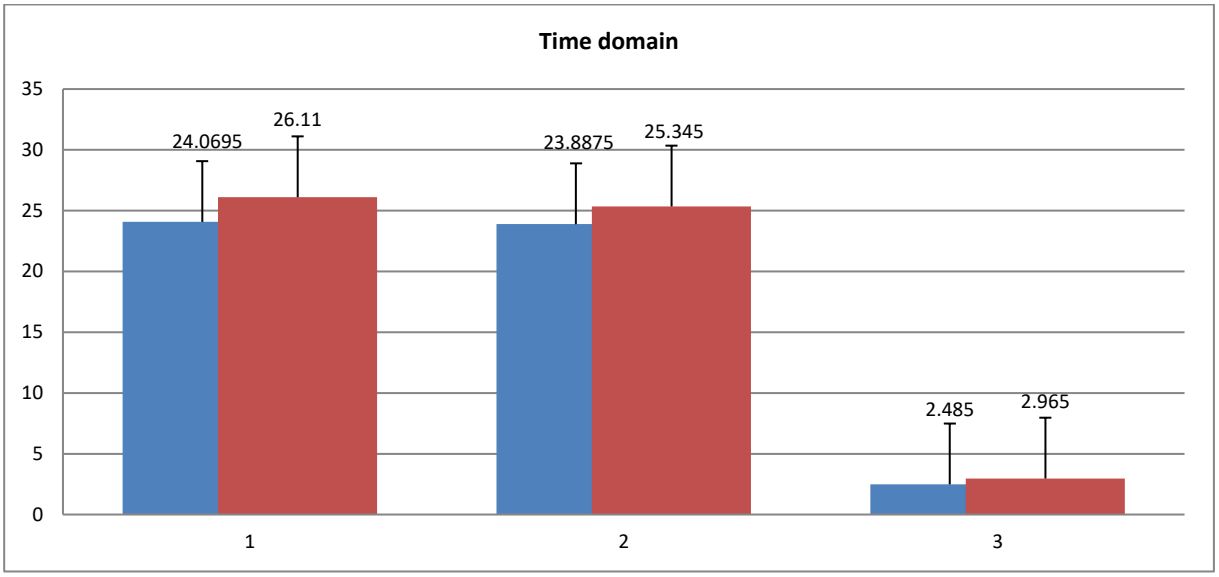
To check compliance with regard to the practice of the yogic exercise subjects were asked to maintain daily log book which was checked after every 15 days for initial 2 months then once a month till the end of study. As an additional compliance control, participants were asked if they had experienced any specific signs of relaxation during the practice of yogic exercise.

RESULTS

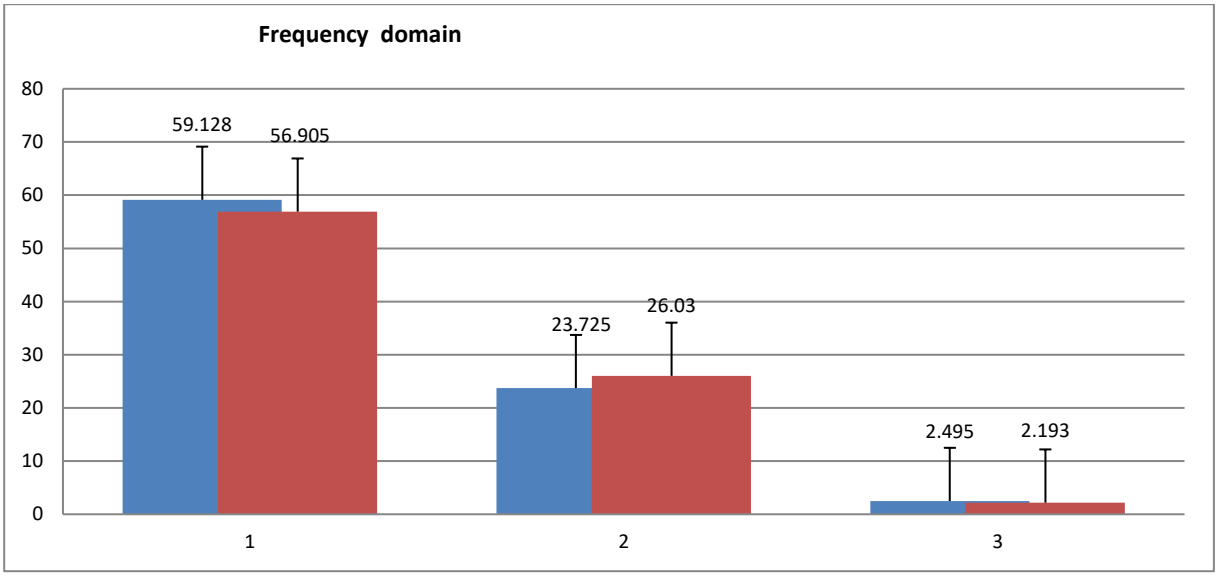
All data obtained pre as well as post interventionally was presented as mean & standard error of mean. Student's paired't' test was used for statistical analysis. Results of HRV after intervention revealed that in time domain parameters SDNN increased from 24.06 $\pm$ 2.01 to 26.11$\pm$ 1.90, RMSSD increased from 23.88 $\pm$ 2.15 to 25.34 $\pm$ 2.11 and PNN50 increased from 2.48 $\pm$ 0.21 to 2.96 $\pm$ 0.24. While in the frequency domain parameters, the low-frequency (LF) power spectrum reduced from 59.12 $\pm$ 3.65 to 56.90 $\pm$3.57 , high –frequency power spectrum increased from 23.7 $\pm$ 1.55 to 26.0 $\pm$2.15 and LF/HF ratio was reduced from 2.49 $\pm$ 0.18 to 2.19 $\pm$ 0.19 after 6 months practice of yogic exercises. $P < 0.05$ was considered statistically significant.

Table 1: Parameters pre and post intervention

Variables	Pre intervention (mean$\pm$ SD)	Post intervention (mean$\pm$ SD)	Significance (p<0.05)
SDNN	24.06$\pm$ 2.01	26.11$\pm$ 1.90	Significant
RMSSD	23.88$\pm$2.15	25.34$\pm$2.11	Significant
PNN50%	2.48+0.21	2.96+0.24	Significant
LF%	59.12$\pm$3.67	56.90$\pm$3.57	Significant
HF%	23.7$\pm$1.55	26.0$\pm$2.15	Significant
LF/HF ratio	2.49+ 0.18	2.19+0.19	Significant



Graph 1: Comparison of pre and post-intervention time domain parameters



Graph 2: Comparison of pre and post-intervention frequency domain parameters

DISCUSSION

Practice of yogic exercises for six months duration in our study has shown improvement in the cardiac autonomic function in terms of changes in HRV parameters both frequency and time domain in the study participants as shown in table -1. HRV is the temporal variation in consecutive heart beats measured from a standard electrocardiogram. It expresses the balance between the regulation of sympathetic and parasympathetic nervous system [(13)]. Stress decreases the HF component of HRV spectrum and increases the LF component and LF/HF ratio indicating an increase in the activity of sympathetic nervous system. This increase in sympathetic activity is the key factor for development of cardiovascular disease [(14, 15)].

Present study attempted to evaluate the beneficial effect of practise of yogic exercise on cardiac autonomic function.The results of our study as shown in graph -1, revealed time domain parameters such as SDNN, RMSSD, and PNN50 were significantly increased while in frequency domain parameters the low-frequency (LF) power spectrum and LF/HF ratio was decreased and high –frequency(HF) power spectrum was increased as shown in graph-2.Significant decrease in LF and increase in HF value suggests parasympathetic dominance and changes in both time and frequency domain parameters indicate sympathetic withdrawal coupled with parasympathetic predominance. These changes can be attributed to yogic exercise benefiting hypothalamic–pituitary–adrenal (HPA) axis, sympathetic nervous system (SNS) and thus improving mental and physical health. Similar findings of increase in SDNN, RMSSD, PNN50 and HF, while decrease in LF and LF/HF ratio was also observed by Vinay *et al* 2016 in his study after short term practise of yoga which was conducted on 32 healthy male subjects.They suggested changes in HRV parameters were due to shift of autonomic balance from the sympathetic nervous system to the parasympathetic nervous system[(6)].

Selvamurthy W *et al* 1998, Tulppo *et al* 2003 have found increase in the HRV parameters measured by variance of NN interval after aerobic training. They concluded increased in high frequency power is indicated as increase in parasympathetic activity which have been demonstrated after yogic exercises by other researchers also [(16, 17)].

Similar findings of decreased in LF/HF ratio which changes the sympathovagal balance in favor of parasympathetic component has also been reported after exercise by Hautala AJ *et al* 2003, Billman GE 2006 [(18,19)].

Yogic exercise promotes positive health and has a noticeable benefit on general health status of the individual. With beneficial results of yogic exercise observed in our study it is reasonable to believe that regular and long-term practice of yogic exercise will help reduce the incidence of non-communicable diseases resulting in better quality of life.

CONCLUSION

Results of our study indicates that regular practise of yogic exercise helps to optimize autonomic functions and minimize cardiovascular dysfunctions. Apart from the preventive value of yogic exercise there is also an emerging realization of its benefit as a complementary therapy in therapeutic and rehabilitative medicine.

Limitation of our study was that only male participants and smaller sample size was included in the study.

Future directions- Next research is lined up with evaluation of effect of yogic exercise in low cardio respiratory reserves participants, especially in patients in whom heavy exercises are contraindicated.

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Conflict of interest: None declared

Contribution of Authors: Both authors worked for plan and work for the said article.

Both authors worked for conduction and processing and implementation of the task. The work is submitted by Komal Meshram and she is corresponding author.

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