Indian J Physiol Pharmacol 2013; 57(2) : 153–158

EFFECT OF YOGA ON SHORT TERM HEART RATE VARIABILITY MEASURE AS A STRESS INDEX IN SUBJUNIOR CYCLISTS : A PILOT STUDY

SATISH G. PATIL*, LATA M. MULLUR, JYOTI P. KHODNAPUR, GOPAL B. DHANAKSHIRUR AND MANJUNATHA R. AITHALA

Department of Physiology,
BLDE University's Sri B. M. Patil Medical College,
Bijapur, Karnataka, India

(Received on September 3, 2012)

Abstract : Subjunior athletes experience mental stress due to pressure from the coach, teachers and parents for better performance. Stress, if remains for longer period and not managed appropriately can leads to negative physical, mental and cognitive impact on children. The present study was aimed to evaluate the effect of integrated yoga module on heart rate variability (HRV) measure as a stress index in subjunior cyclists. Fast furrier transform technique of frequency domain method was used for the analysis of HRV. We have found a significant increase in high frequency (HF) component by 14.64% ($P<0.05$) and decrease in the low frequency component (LF) of HRV spectrum by 5.52% ($P<0.05$) and a decrease in LF/HF ratio by 19.63% ($P<0.01$) in yoga group. In the control group, there was decrease in the HF component and, no significant difference in the LF component of HRV spectrum and LF/HF ratio. The results show that yoga practice decreases sympathetic activity and causes a shift in the autonomic balance towards parasympathetic dominance indicating a reduction in stress. In conclusion, yoga practice helps to reduce stress by optimizing the autonomic functions. So, it is suggested to incorporate yoga module as a regular feature to keep subjunior athletes both mentally and physically fit.

Key words : yoga heart rate variability stress subjunior cyclists

INTRODUCTION

Sports uphold a well-balanced healthy lifestyle. It imparts both positive and negative influences on different developmental stages of children. Children practicing sports (subjunior athletes) experience dual pressure from coach demanding good performance and even from teachers and parents as well for better academic performance. This makes the children experience stress manifesting detrimental effects on their health (1).

*Corresponding author : Dr. Satish G Patil, Department of Physiology, BLDE University's Sri B.M.Patil Medical College, Bijapur, Karnataka, India; Email: sathupatil@yahoo.co.in; Cell No.: 9986789583

Inappropriate management of stress for longer period leads to negative physical, mental and cognitive impact on children (1, 2). It also leads to anxiety, depression, poor memory and lower academic achievement (3). Studies show that chronic life stress and diseases are very closely associated (4, 5). Stress influences the hypothalamus via the limbic system and cause changes in the heart rate variability (HRV) through the autonomic nervous system. Heart rate variability (HRV) is a non-invasive measure being used to evaluate the mental stress and to determine the status of autonomic nervous system (6).

Stress increases the sympathetic activity and decreases the activity of parasympathetic nervous system (7). In a short term HRV analysis in sub junior cyclists, an increase in sympathetic activity and decrease in parasympathetic dominance was observed indicating stress in these subjects (8). In addition to the cycling practice, notable increase in stress levels might be associated with the busy academic schedule and extra coaching classes. This might contribute to eminent mental stress than a physical one in an individual. These children necessitate a proper relaxation technique to overcome inordinate mental stress.

Yoga is an ancient system of life style having a psycho-somatic-spiritual discipline that helps to achieve a harmony between our mind, body and soul. Yoga helps to manage stress and to reduce anxiety leading to negative affects and enhances the positivity and mental Poise (9). Currently no documented studies depicting role of yoga on stress in sub junior athletes were available and hence the present study was conducted to evaluate the effect of integrated yoga module on HRV measure as a stress index in subjunior cyclists.

METHODS

The present study was conducted on 24 healthy subjunior cyclists of Government school of sports, Bijapur District, Karnataka. Both males (n=12) and females (n=12) were recruited for the study. The age of subjects ranged from 11-13 years. Subjects with LF/HF ratio >2; were included for the study. Subjects on any medication or suffering from any acute or chronic disease were excluded from the study. Informed consent was obtained for participation in the study. The study was approved by the institutional ethical committee.

Study design

The subjects were screened and those with LF/HF ratio >2; were selected for the study after thorough examination. The subjects were randomly divided into study group (n=12) and control group (n=12) by using random number table. The study group was assigned to yoga training by a yoga instructor for one hour daily in the evening from 5.30 PM to 6.30PM for four weeks. The yoga training includes asanas, pranayama and meditation (10) (Table I). The control group was assigned to routine practice for the same duration, under the supervision of their coach. Two subjects, one from the yoga group and another from the control group discontinued the study because they got selected for the national level competition. All the recordings were made twice, before and after four weeks of intervention.

Table I: Integrated Yoga module for stress.

Sl.No.	*Yoga practice*	*Duration (60 min)*
A	Starting prayer	1 min
B	Breathing practices	
	1. Hands stretch breathing	02 min
	2. Hands in and out breathing	02 min
	3. Ankle stretch breathing	02 min
	4. Tiger breathing	02 min
C	Quick relaxation technique	03 min
D	Asana	
	1. Ardhakati cakrasana (both sides)	2 min
	2. Garudasana	1 min
	3. Bhujangasana	1 min
	4. Sashankasana	1 min
E	Deep relaxation technique	7 min
F	Pranayama	
	1. Nadishudhi	5 min
	2. Sitali	2 min
	3. Bhramari	3 min
G	Meditation	
	1. Nadanusandhana	15 min
	2. Om Meditation	10 min
H	Closing prayer	01 min

Data acquisition

All the parameters were recorded after supine rest for 10 minutes in the morning between 8 am to 10 am at room temperature. Blood pressure was measured by using the sphygmomanometer. A 5 minute ECG was recorded in the standard limb lead II configuration using a four channel digital polygraph (Medicaid systems Pvt Ltd, Chandigarh, India). The recorded data were visually inspected off-line and only noise free data were included for analysis. No ectopic beats were found on offline scrutiny. The subjects were asked to breathe normally during the ECG recording.

Data analysis

HRV assessment was done using the HRV analysis software version 2.0, developed by the Biomedical Signal Analysis group, University of Kuopio, Finland (11). Frequency domain method was used for analysis of HRV. A non parametric Fast Furrier Transform (FFT) technique was used to obtain the Power spectral density of the RR Series. Total power in the frequency range (0-0.40Hz) was divided into very low frequency (VLF: 0-0.04), low frequency (LF: 0.04-0.15Hz) and high frequency (HF: 0.15-0.40Hz). LF measure reflects both sympathetic and parasympathetic activity. HF measure reflects parasympathetic activity. The LF and HF components were expressed in normalized units (n.u). LF/HF ratio was calculated to assess overall balance between the sympathetic and the parasympathetic systems. HRV analysis was done as per the guidelines of a Task force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (12). Heart rate (HR) was calculated from the RR interval obtained from the ECG recording.

Statistical analysis

The obtained data was expressed in mean and standard deviation. A student's paired 't' test was applied to determine the statistical significance. Statistical significance was established at $P<0.05$. Data was analyzed using the SPSS software.

RESULTS

The demographic characteristics of the subjects in yoga and control group were shown in Table II. There was no significant difference between the study and control group, indicates equal distribution.

TABLE II : Demographic Characteristics of subjects in Yoga and control group (n=22).

Variable	*Yoga group (n=11)*	*Control group (n=11)*	*P-value*
Sex (Male/Female)	6/5	5/6	—
Age (Years)	11.63±0.67	11.52±0.62	0.29
BMI (kg/m2)	17.37±3.2	18.56±2.6	0.37
Heart Rate (bpm)	81.78±8.43	85.74±9.9	0.111
Systolic BP (mmHg)	107.12±4.83	104.9±4.95	0.331
Diastolic BP (mmHg)	70.96±4.84	70.15±3.38	0.281
Pulse Pressure (mmHg)	39.84±2.79	39±1.08	0.29
MAP (mmHg)	80.71±4.92	81.9±3.9	0.582
LF/HF ratio	2.7±0.5	2.62±0.49	0.591

Values are expressed in Mean±SD. *P<0.05, **P<0.01, ***P<0.001.

BMI – Body mass index; MAP – Mean arterial pressure; LF – Low frequency component of HRV; HF – High frequency component of HRV.

There was a significant decrease in the LF component and an increase in the HF component of HRV spectrum following a four weeks of yoga practice. The LF/HF ratio was also significantly decreased in this group (Table III).

In the control group, a significant decrease in the HF component was found, suggesting a decrease in the parasympathetic activity. Though not significant, but an increase in the mean LF and LF/HF ratio was found in this group (Table IV).

DISCUSSION

HRV is a known prime non-invasive measure for cardiovascular autonomic regulation. HRV also provides an opportunity to study and assess the association between

TABLE III : Heart rate variability before and after yoga intervention (n=11).

Variables	*Before yoga Mean±SD*	*After yoga Mean±SD*	*95% confidence interval*		*t value*	*P value*
			Lower	*Upper*		
LF (n.u)	72.7±3.47	68.69±4.51	0.417	7.619	2.486	0.032*
HF (n.u)	27.29±3.47	31.3±4.52	–7.619	–0.417	–2.486	0.032*
LF/HF ratio	2.7±0.5	2.17±0.45	0.207	0.846	3.677	0.004**

Values are expressed in Mean±SD. *P<0.05, **P<0.01, ***P<0.001. LF – Low frequency component of HRV; HF – High frequency component of HRV.

TABLE IV : Heart rate variability at baseline and after four weeks in control group (n=11).

Variables	*Baseline yoga Mean±SD*	*After 4 weeks Mean±SD*	*95% confidence interval*		*t value*	*P value*
			Lower	*Upper*		
LF (n.u)	71.8±3.64	73.78±3.03	–4.987	1.096	–1.425	0.185
HF (n.u)	28.21±3.67	25.24±2.74	0.083	5.861	2.293	0.045*
LF/HF ratio	2.62±0.49	2.94±0.38	–0.733	0.087	–1.751	0.111

Values are expressed in Mean±SD. *P<0.05, **P<0.01, ***P<0.001.
LF – Low frequency component of HRV; HF- High frequency component of HRV.

psychological processes and physiological reactions. 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 (7). This increase in sympathetic activity is the key factor for development of cardiovascular disease (14).

In the present study, we have found a significant increase in HF component by 14.64% ($P<0.05$), decrease in the LF component of HRV spectrum by 5.52% ($P<0.05$) and decrease in LF/HF ratio by 19.63% ($P<0.01$) in Yoga group. These changes suggest a decrease in sympathetic activity and increase in parasympathetic dominance. This shift in the autonomic balance towards the parasympathetic dominance indicates a reduction in stress. It has been reported in various studies that yoga practice will help to bring about a balance and optimization of autonomic functions (15-16). In the control group, a significant decrease in HF component ($P<0.05$) and, an increase in mean LF component of HRV spectrum and LF/HF ratio was observed suggesting an increase in sympathetic activity. We have also observed a significant reduction in HR by 18.13% ($P<0.01$) in yoga group where as no significant change was observed in the control group. A shift in an autonomic balance towards the parasympathetic dominance may explain the reduction in HR in the subjects of yoga group.

The hypothalamic controlled two important pathways of the stress response system are: the hypothalamic-pituitary-adrenocortical axis (HPA) and the sympathetic-adrenal-medullary (SAM) system. Cortisol is released in response to the HPA activation where as SAM system activation releases catecholamines. These two hormones help to cope with any form of stress. But continuous or prolonged stress interferes in the regulation of physiological systems by the HPA and SAM systems resulting in an increased risk for physical and mental disorders (5). Kamie T et al., found a significant decrease in the serum cortisol level during yoga practice in yoga instructors (17). Schimdt et al., found a decrease in urinary excretion of adrenaline, nor adrenaline, dopamine and aldosterone during a comprehensive residential three months of yoga training (18). By this one can conclude that yoga practice helps in optimization of autonomic functions and stress response system thereby enhancing the coping mechanism for stress.

It may be concluded from the finding of the study that the yoga intervention reduces the stress by optimizing the autonomic functions. So, it is suggested to incorporate this yoga module as a regular feature for subjunior athletes to keep them both mentally and physically fit.

ACKNOWLEDGMENTS

We are thankful to BLDE University, Karnataka, India for the financial support to the study. We express sincere thanks to the coach and head of the Government sports school, Bijapur, Karnataka, India. We also thank to all the cyclists who volunteered to be subjects in this study.

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