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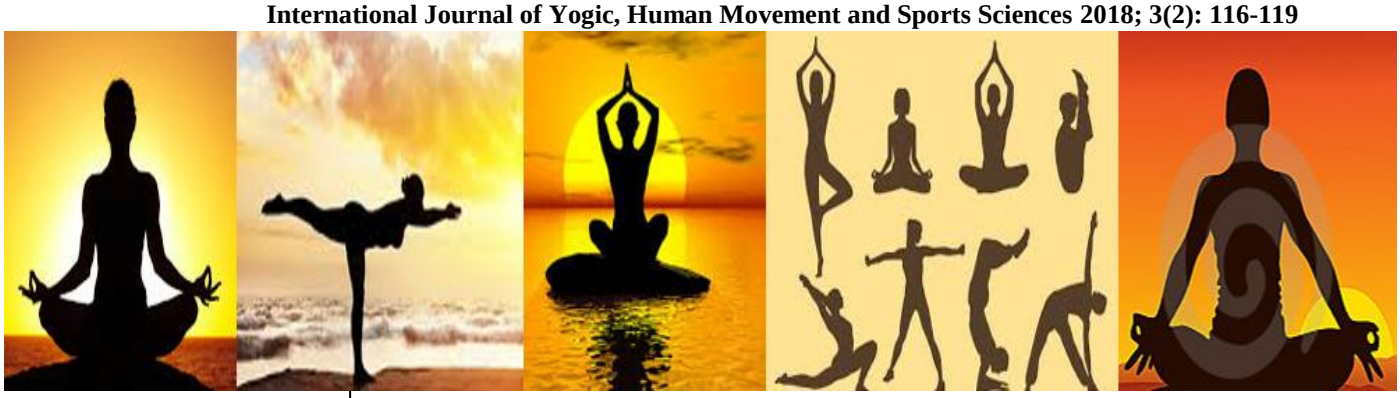

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Influence of selected yoga Sana and callisthenic practices on heart rate and blood pressure of college girls

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Abstract
Background: The cardiovascular morbidity is increasing in India in recent years. Medical treatment of hypertension is not always sufficient to achieve blood pressure control.
Objective: The present study was aimed to observe the influence of selected yogasana and callisthenic practices on heart rate and blood pressure of healthy female college student volunteers.
Methods: The cardiovascular status of the subjects was assessed clinically in terms of resting heart rate and blood pressure before the start of training and again after 8 weeks of training.
Results: The results were compared and analysed. From the study it was observed that significant reduction in the heart rate, systolic blood pressure and diastolic blood pressure occurs in the subjects ($P < 0.05$).
Conclusion: These findings suggest that the yogasana and callisthenic practices provides significant improvement of blood pressure and increase the efficiency of the heart and quality of life of the selected female college student volunteers.

Keywords: Yoga Sana, calisthenics, healthy volunteers, blood pressure, quality of life

Introduction
The word yoga is derived from its Sanskrit origin "YUJ" which means "to bind", "to join" or "to apply". In the words of Maharshi Patanjali, "yoga is the restraint of the process of the mind". Yoga has been extensively studied for the beneficial effects on human health (Bijilani, 1995; Gopal *et al*. 1973) [1, 2]. Yoga is practiced all over the world. It produces consistent physiological changes and have sound scientific basis (Iyengar, 1968) [3]. The cardiovascular changes due to the process of ageing are being pre-poned ever since the past few decades (Shah, 2003) [4].

Psychosocial stresses of our modern life precipitates various cardiovascular and other disorders by distorting basic neuroendocrine mechanism. The psychosocial stresses activate limbic system and hypothalamus which controls the autonomic nervous system. When this system is stimulated, increase in output of both adrenaline and nor-adrenaline occur, both from sympathetic nerve fibres as well as from adrenal medulla causing increase in heart rate, systolic and diastolic blood pressures. Chronic exposure to psychosocial stimuli will result in the development of increase in blood pressure, coronary thrombosis and heart failure (Joseph *et al*. 1981) [5]. The harmful effects of these stresses on bodily systems can be reduced effectively eliminated by enhancing the adaptive mechanisms of our body that can restore the equilibrium. By giving rest to the mind and body, yoga can shake off many disorders of psychosocial origin (Anand, 1991) [6].

Blood pressure is the pressure of circulating blood on the wall of the blood vessels. Blood pressure usually refers to the pressure in large arteries of the systemic circulation. It is usually expressed in term of the systolic pressure (maximum during one heart beat) over diastolic pressure (maximum in between two heart beats) and is measured in millimetre of mercury (mmHg) above the surrounding atmospheric pressure. Blood pressure is influenced by cardiac output, total peripheral resistance and arterial stiffness and varies depending on situation, emotional state and activity and relative health. In short term blood pressure is regulated by

baroreceptors and act via the brain to influence nervous and endocrine system (Lindholm *et al*. 2007) [7].

Hypertension is one of the most common diseases in the world, affecting approximately 26% of the adult population (Kearney *et al*. 2005) [8]. Persistent hypertension increases the risk of developing coronary heart disease, stroke and other cardiovascular diseases, such as heart failure. Hypertension is a common diagnosis in primary health care and the societal costs of examination and treatment of hypertension and its consequences are considerable (Wolff *et al*. 2013) [9]. One third of individuals in Europe receive antihypertensive drugs treatment to control blood pressure (140/90) (Kjeldsen *et al*. 2008). Thus, additional strategies to normalize BP have been evaluated, e.g. lifestyle changes such as increased physical activity, weight loss, dietary improvement, stress management and reduced tobacco and alcohol intake (Wolff *et al*. 2013) [9]. If yoga has a BP lowering effect it may be useful as a supplementary therapy in addition to medical treatment. Since some studies have shown that yoga positively impacts quality of life and subjective well-being, patients who regularly practice yoga may also experience better quality of life (Sharma *et al*. 2008) [11]. The word callisthenics comes from the ancient Greek words 'Kallos' which means perfect or good (to emphasize the aesthetic pleasure that derives from the perfection of the human body), and 'Sthenos' means strength (great mental strength, courage, strength and determination). It is the art of using one's body weight as resistance in order to develop physique. It has already been established that yogasana and callisthenic exercises are necessary for improving the overall health. Yoga has many physiological and psychological benefits. Many studies have proved that yoga practice improves flexibility, strength and a positive effect on immunity (Cowen and Adams, 2005) [12]. In another study it has also found that yoga improve balance and aerobic capacity (Schure *et al*. 2008) [13]. On the other hand callisthenics exercises consisting of a variety of gross motor movement increase body strength, body fitness and flexibility. When callisthenics performed vigorously and with variety, provide the benefits of muscular and aerobic capacity including psychomotor skills such as balance, agility and coordination (Patel, 1973) [14]. The present study was aimed to observe the influence of selected yogasana and callisthenic practices on heart rate and blood pressure of healthy female college student volunteers.

2. Materials and Methods

2.1 Subject selection, explanation of study protocol and consent taken

Fifty (50) female college student volunteers of Physical Education Department of Ramananda College ages between 18-20 years were randomly selected for this study. All the subjects were healthy and were informed about the nature and purpose of the study. All the volunteers were clinically examined to rule out any systemic diseases. The study protocol was explained to the subjects and written consent was obtained.

2.2 Methods for collection of data

Before recording the parameters, the subject was asked to relax physically and mentally for 30 minutes. Heart rate was measured by placing the thumb over the subject's arterial pulsation, and feeling, timing and counting the pulses usually in a 30 second period and then by multiplying the obtained number by 2. The blood pressure was recorded with the sphygmomanometer in supine position in the right upper limb by auscultatory method. Three readings were taken at an interval of 15 minutes each and average of the three values calculated.

2.3 Training Schedule

The subjects were trained under the guidance of certified Physical Education teacher. All the subjects underwent a training session thrice per week (Tuesday, Thursday and Saturday) for 8 weeks from 8 AM to 9 AM in college ground. Each training session lasted for 60 minutes and started with light stretching of joints (loosening exercise). The training session consisted of manly two things (i) Yogasana practices such as Sarwangsan, Uttanpadasana, Halasana, Pawanmuktasana, yogmudrasana and Makrasana, each for five minutes (total 30 minutes) and (ii) Callisthenics practices with own body weight for 25 minutes. Each asana practiced three times and after a break of 5 minutes students were performed callisthenics.

2.4 Statistical analysis

The data were expressed as mean ± SEM. Comparisons between the means of each parameter before and after training were made by one-way ANOVA test (using a statistical package, Origin 6.1, Northampton, MA 01060 USA) with student's t-tests, $p < 0.05$ as a limit of significance.

3. Results

Fifty subjects who practiced in training for 8 weeks were analysed for the results. The results obtained are expressed as Mean ± SEM. Cardiovascular changes of the subjects are depicted in Table-1.

Table 1: Cardiovascular changes before and after 8 weeks of training

Variable	Before training	After training	P value
Heart Rate (bts/min)	79.6±5.05	72.7±4.63	P<0.05*
Systolic blood pressure (mmHg)	134.8±12.17	122.9±10.31	P<0.05*
Diastolic blood pressure (mmHg)	88.9±7.02	81.2±6.87	P<0.05*

* indicates Significant

Heart rate (bts/min) of subjects before and after training is presented in Fig. 1. Heart rate was significantly decreasesed (P<0.05) by 8.67% after training in subjects.

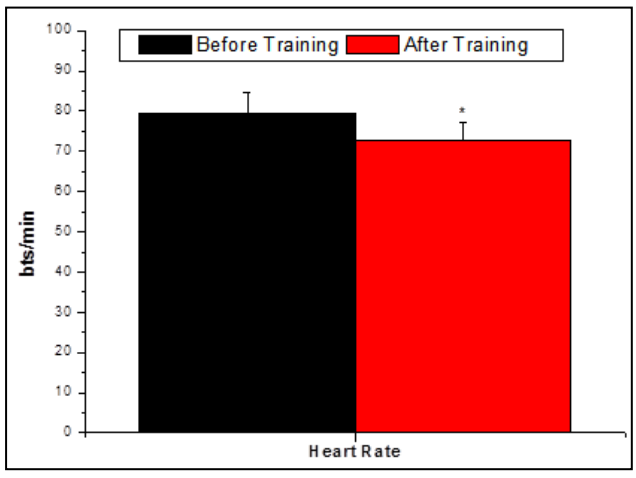

Fig 1: Heart rate (bts/min) of healthy female college student volunteers before and after 8 weeks of training session.

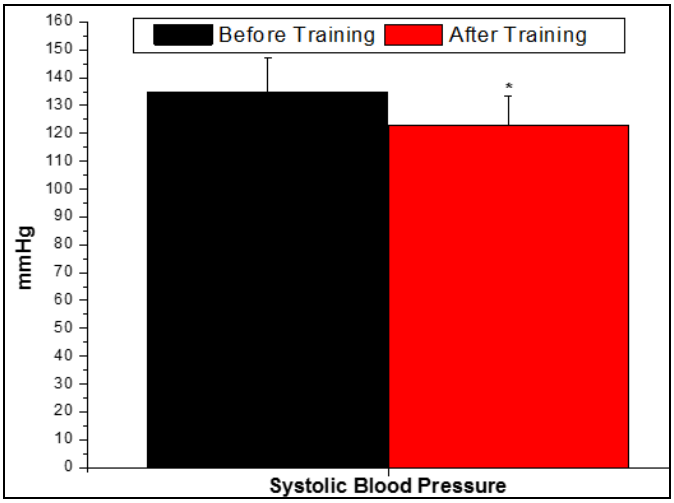

Fig 2: Systolic blood pressure (mmHg) of healthy female college student volunteers before and after 8 weeks of training session

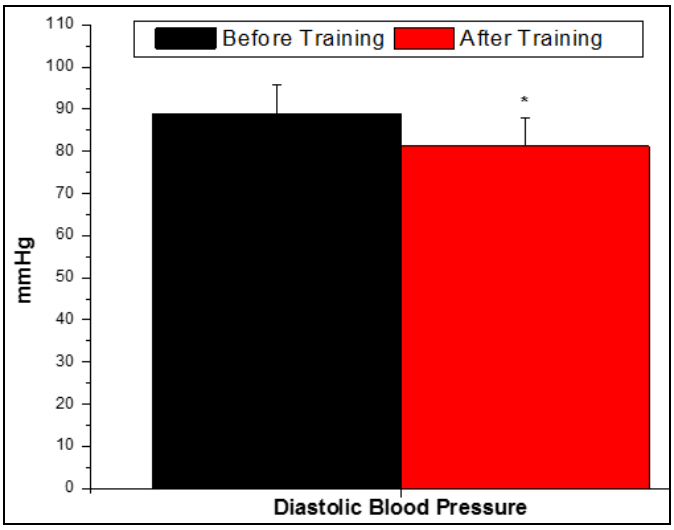

Fig 3: Diastolic blood pressure (mmHg) of healthy female college student volunteers before and after 8 weeks of training session.

Systolic blood pressure (mmHg) of subjects before and after training is presented in Fig. 2. Systolic blood pressure was significantly decreasesed ($P<0.05$) by 8.83% after training in subjects**.**

Diastolic blood pressure (mmHg) of subjects before and after training is presented in Fig. 3. Systolic blood pressure was significantly decreasesed ($P<0.05$) by 8.66% after training in subjects.

4. Discussion

The mean values of heart rate, systolic blood pressure and diastolic blood pressure are significantly reduced after 8 weeks of training.

Reduction in heart rate and blood pressure indicate a shift in the balancing components of autonomic nervous system towards the parasympathetic activity (Joseph *et al*. 1981; Anand, 1991) [6]. This modulation of autonomic nervous system activity might have been brought about through the conditioning effect of yoga on autonomic functions and mediated through the limbic system and higher areas of central nervous system (Selvamurthy *et al*. 1983) [15].

Regular practice of yoga increases the baroreflex sensitivity and decreases the sympathetic tone, thereby restoring blood pressure to normal level (Vijayalakshmi *et al*., 2004) [16]. Meditation by modifying the state of anxiety reduces stress induced sympathetic over activity thereby decreasing arterial tone and peripheral resistance, and resulting in decreased diastolic blood pressure and heart rate. This ensures better peripheral circulation and blood flow to the tissues (Bhargava *et al*. 1988; Gopal *et al*. 1973) [2].

5. Conclusion

Non-pharmacological methods like yoga, meditation, diet, weight reduction and life style modification should be encouraged to control the modifiable risk factors. The cardiovascular parameters alter with age, but these alterations are slower in persons ageing with regular yoga practice.

It can thus be concluded that these results and their explanations would justify the incorporation of yoga as part of our life style in prevention of age-related cardiovascular complications.

"In a tension-filled society, yoga, pranayama and meditation alone will bring solace from all problems and hence they are the essence of life".

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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