



**ORIGINAL RESEARCH PAPER**

**Physiology**

**SERUM CORTISOL, PLASMA ADRENALINE AND CARDIOVASCULAR PARAMETERS MODULATION IN REGULAR PRACTICE OF YOGA IN HYPER-REACTORS YOUNG HEALTHY MEDICAL STUDENTS TO COLD PRESSOR TEST.**

**KEY WORDS:** yoga, cold pressor test, cortisol, Adrenalin, cardiovascular parameters

**D C Khaleel**

Assistant Professor, Department of Physiology, S S M C H, Jabalpur, Dr Manila Jain, Professor & Head, Department of Physiology, Index medical College, Indore .M.P.

**Dr. Chanda Rajak\***

Professor & Head, Department of Physiology, Sukh S agar Medical College & Hospital, Jabalpur \*Corresponding Author

**ABSTRACT**

Stress, anxiety and depression are known to be significant factors in the onset and progression of a wide spectrum of illness ranging from cardiovascular diseases, asthma, cancer, HIV-infection & affect multiple systems of body. 'Almost any type of stress can greatly enhanced secretion of cortisol and adrenaline by stimulating the ACTH secretion and may be due to increased activity in the limbic system, especially in the region of the amygdala and hippocampus, The aim of this study was to investigate whether regular practice of yoga for sixty minutes twice a day for six months can improve the cardiovascular status and decrease serum cortisol and plasma adrenaline level in hyper-reactors to cold pressor test in young healthy medical students. **Summary-** The regular practice of yoga for six months acts as stress buster, to reduce the hyperreactivity to cold pressor test by inducing parasympathetic predominance and cortico- hypothalamo-medullary inhibition.

**INTRODUCTION**

The word stress first appeared in life science<sup>[1]</sup> by Hans Selye. The Latin word "stringere" which also defines "to be drawn tight" is the traditional word for indicating tension. Stress is a dynamic and complicated process in which an individual and his or her identity connect.

Stress is a major disease and excessive stress can negatively impact over an individual's physical, psychological, and behavioral well- being<sup>[2]</sup> Increased sympathetic activation and the release of stress hormones, including adrenaline, lead to increases in heart rate, blood pressure, breathing, body temperature, and muscle tension<sup>[3]</sup>. In case of mental stress this is believed to result from increased activity in the limbic system, especially in the region of the amygdala and hippocampus, both of which then transmit signals to the posterior medial hypothalamus. Cortisol has direct negative feedback effects on.<sup>[04]</sup> The increase in the stress hormones observed may be as a result of stimulation of the ACTH secretion by the stress stimuli which stimulated the synthesis of adrenaline and cortisol precursors.<sup>[05]</sup> In response to a stressor, neurons with cell bodies in the paraventricular nuclei of the hypothalamus secrete corticotrophin releasing hormone (CRH) into the hypophyseal portal system.<sup>[06,07]</sup>

Walter Cannon et al (1911)<sup>[08]</sup> was the first person to propose that emotional stress causes excess of adrenaline secretion from adrenal medulla leading to tachycardia, high blood pressure etc. Later it was found that all these manifestations occur not only from adrenaline secretion but also from over activity of the sympathetic nervous system which liberates nor- adrenaline at its nerve endings. Psychosocial stresses of our modern life precipitates various cardiovascular and other disorders by distorting basic neuroendocrine mechanism.

In the study of hypertension, cold pressor test, introduced by Hines and Brown, was employed to measure the cardiovascular reactivity. The persons hyper-reactive to cold pressor test are susceptible for early onset of hypertension, and other cardio vascular disorders in future.<sup>[09,10,11]</sup>

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 stimulate autonomic nervous system., increase in output of both adrenaline and nor-adrenaline, both from sympathetic nerve fibers as well as from adrenal medulla.<sup>[12]</sup>

We tested whether regular practice of Yoga for 6 months can reduce the serum cortisol , plasma adrenaline level and cardiovascular hyper reactivity, by inducing parasympathetic predominance and cortico-hypothalamo-medullary inhibition.<sup>[13]</sup> and de-stressing the hyper-reactors. because hyper-reactors are likely to develop hypertension and other stress related diseases in future life.

**AIMS & OBJECTIVE:**

The aim of present research was to study the effect of six month yoga practice and cold pressor test over serum cortisol, plasma adrenaline level and Systolic, diastolic blood pressure and pulse rate/ min on young healthy medical students.

**MATERIALS & METHOD:**

**Study Design:** Interventional Cross Sectional Study.

**Place of Research:** Department of Physiology, Index medical college Indore (M.P.)

**Study Period:** January to June 2020. Six months

**Study Subjects:** One hundred Fifty young healthy medical students, age group 18 to 27..

**Inclusion Criteria:**

All 150 subjects of age group 18 to 27 who were healthy, non-smoker, no history of hypertension and stress related diseases and not doing any type of physical exercise.

**Exclusion Criteria.**

Subjects who were taking physical activity like gym, athletics etc .smokers, alcoholic, with respiratory disorders, jaundice, diabetes, hypertension and stress related diseases.

**Methodology:**

The present study was conducted on 150 young healthy medical students of Index medical college, underwent thorough clinical examination with proper history. also related to hypertension and stress related diseases.

Afterwards record the basal .B.P., pulse pressure and estimated serum cortisol by ELISA and Plasma Adrenaline by Semi-automated method. They were subjected to cold pressor test according to Hines & Brown.<sup>[09,10,11]</sup> Rise of systolic BP more than 20 mm Hg and dias.B.P 15 or more mm Hg was considered as hyper-reactive response.<sup>[12]</sup> Out of 150

volunteers, 105 (70%) turned out to be hyper-reactors. These hyper-reactors carried out Yoga under supervision and guidance of a certified “yoga” teacher, for 60 minutes, twice a day for six months and lastly cold pressor test was done and compared the all parameters, including Sys. B.P., Dias. BP, Pulse rate/min, level of serum cortisol and plasma adrenaline before and after yoga, and after cold pressor test, were found to be statistically significantly reduced by using student “t” test.

**RESULTS**

Our results showed that, Yoga practices significantly reduced the cardiovascular hyper-reactivity . In 150 male volunteers, the 105 became hyper-reactor to cold pressor test and practiced yoga regularly for six months and again cold pressor test was done, all became hypo-reactors by carried out statistical analysis using student paired t test and observed that the serum cortisol, plasma adrenaline level, basal B.P., rise in BP and pulse rate due to cold stress, were statistically highly significantly decreased. (Table-1, 2 and 3).

**Table No. 1:** Showing basal values and effects of yoga on Sys. B. P., Dias. B. P., Pulse rate/ min, Serum Cortisol level & plasma adrenaline level with their Mean & Standard Deviation and p value in study group.

Parameters	Effect of cold pressor test		P value
	Effect of cold pressor test before yoga	Effect of six month of yoga	
Systolic Blood Pressure( mm Hg)	1422 ± 5.87	120.0 ± 1.98	(p<0.000)
Diastolic Blood Pressure( mm Hg)	98.77 ± 3.39	78.25 ± 4.15	(p<0.000)
Pulse rate/ min	85.77 ± 5.32	75.28 ± 4.89	(p<0.000)
Serum Cortisol in microgram /dl	12.62 ± 0.579	8.18 ± 0.726	(p<0.000)
Plasma Adrenaline in Pg/ml	1 372.40 ± 48.28	8.60 ± 0.961	(p<0.000)

**Table No. 2:** Showing effect of cold pressor test before and effects of yoga, on Sys. B.P., Dias. B. P, Pulse rate/ min and Serum Cortisol & plasma adrenaline level with their Mean, Standard Deviation and p value in study group

Parameters	Basal value	Effect of six month of yoga	P value
Systolic Blood Pressure( mm Hg)	124.1 ± 2.82	120.0 ± 1.98	(p<0.000)
Diastolic Blood Pressure( mm Hg)	82.68 ± 3.13	78.25 ± 4.15	(p<0.000)
Pulse rate/ min	77.79 ± 5.14	75.28 ± 4.89	(p<0.000)
Serum Cortisol in microgram /dl	10.05 ± 0.612	8.18 ± 0.726	(p<0.000)
Plasma Adrenaline in Pg/ml	9.68 ± 0.688	8.60 ± 0.961	(p<0.000)

**Table No 3:** Showing effects of cold pressor test, before & after Yoga practices of six months on Sys. B. P. Dias. B. P., Pulse rate/ min and Serum Cortisol level with their Mean , Standard Deviation and P value in study group.

Parameters	Effect of cold pressor test		P Value
	before Yoga Practices (C.P.T. 1st)	After Yoga Practices of six month (C.P.T.2nd)	
Systolic Blood Pressure (mmHg)	1422 ± 5.87	133.93 ± 3.93	(p<0.000)

Diastolic Blood Pressure (mmHg)	98.77 ± 3.39	92.06 ± 3.65	(p<0.000)
Pulse rate/ min	85.77 ± 5.32	78.59 ± 4.68	(p<0.000)
Serum Cortisol in microgram /dl	12.62 ± 0.579	9.22 ± 0.728	(p<0.000)
Plasma Adrenaline in Pg/ml	372.40 ± 48.28	108.9 ± 21.88	(p<0.000)

**DISCUSSION**

On analyzing the effect of yoga on hyper reactors 105 medical students, age group 18-27 years, in our study. The basal sys. B. P, dias. B.P., pulse rate and serum cortisol and plasma adrenaline values were studied before yoga and after six month of yoga and also studied the effect of cold pressor test before and after yoga., Statistically highly significant (p<0.000) decreased all parameters & all subjects became hypo-reactors due to decrease sympathetic activity & increase parasympathetic activity of A.N.S. due to increase in vagal tone<sup>[14,14,16,17]</sup>,

were statistically highly significant. DBP depends upon peripheral resistance and lung inflation has been known to decrease systemic vascular resistance and decrease in DBP.<sup>[19]</sup> H.P.A. axis is structured by P.V. nucleus of the hypothalamus, the anterior lobe of the pituitary gland, and adrenal gland. The major regulator of HPA axis is C.R.F.<sup>[19]</sup> Moreover HPA axis, responses to stress secreted CRF produce ACTH by the stimulation of pituitary gland and adrenal gland and to release cortisol and adrenaline hormone.<sup>[20,17.]</sup> On Transcendental Meditation, the cortisol and adrenaline level was a significant drop.<sup>[21]</sup>

Yoga is known to result in enhancement of parasympathetic (vagal) tone. Increased parasympathetic activity may cause reduced firing of nucleus of medulla to locus ceruleus, could decrease norepinephrine output, resulting in reduced respiratory and heart rates. Reduced input of norepinephrine to paraventricular nucleus of hypothalamus may explain the decreased C.T.R. hormone and cortisol.<sup>[22,23]</sup>

**CONCLUSION**

It was concluded that regular practice of yoga control release of stress hormones, beneficial in stress related disorders, improving autonomic functions, lower blood pressure, increase strength & flexibility of muscles, improve the sense of wellbeing, slowed ageing process, and improving physically, mentally, spiritually and financially spiritual growth. Thus society becomes more disciplined.

**REFERENCES**

- Selys, H. Stress and Coping: the Indian Experience, Sage Publication: 1936, 2nd Edition, p15
- Kulkarni GK. Indian Journal of Occupational and Environmental Medicine: 2006 [cited 2008 Feb 28];10:3-4 K.
- Quelle:-http://kukaimikkyo.wordpress.com.The science of pranayama, 2007; 10:20.
- Loft Pet al. Examination stress results in altered cardiovascular responses to acute challenge and lower cortisol. Psychoneuroendocrinology., 2007; 32: 367-75.
- Tsigos C, Chrousos G.P.H.P.axis, neuroendocrine factors, and stress. Journal of Psychosomatic Research, 2002; 53: 865-871.
- Selvamurthy W. Physiological responses to cold (10°) in man after six months of yoga exercise. Int J Biomet, 1983a; 32: 188-193.
- Sabyasachi S. Medical Physiology. Thieme Publishing Group., 2007; 536-546
- https://www.hormone.org/hormones-and-health/hormones/adrenaline
- Hines E.A. and Brown G.E. The Cold Pressor Test for measuring the reactivity of the blood pressure in: Normal and Hypertensive subject, American Heart Journal, 11(1):1936.
- Selvamurthy W et al. Physiological responses to cold (10°) in man and yoga exercise. Int J Biomet, 1987; 32: 188-193.
- Selvamurthy et al Physiological responses to cold (10°) and yoga exercise in man. Int J Biomet, 1983a; 32: 188-193.
- Indla Devasena et al Effect of yoga on heart rate and blood pressure and its clinical significance. Int J Biol Med Res. 2011; 2(3):750-753.
- Nagarathna R, Nagendra HR. Yoga for promotion of positive health. 4th ed. Bangalore: Swami Vivekananda Yoga Prakashana, 2006.
- Perloff D et al. Human blood pressure determination by sphygmomanometry. Circulation, 1993; 88: 2460.
- Gopal KC et al. Effect of yoga on blood pressure, pulse rate & respiratory functions. Indian J Physiol Pharmacol, 1973; 17(3):273-6.
- Vyas et al. Effect of meditation on respiratory, cardiovascular system and lipid profile. Indian Journal of Physiol and Pharmacol, 2002; 46(4):487-91.

17. Rajak C et al. Effect of yoga on plasma adrenaline, serum cortisol levels, plasma melatonin and cardiovascular parameters in hyper-reactors to C.P.T.in young healthy volunteer. International Journal of Current Research, July,2016;8(7):35159-65.
18. Vyas,et al. Effect of meditation on respiratory system, cardiovascular system and lipid profile. Indian Journal of Physiol and Pharmacol,2002;46(4):487-91.
19. Sean M. Smith, The role of hypothalamic- pituitary- adrenal axis in neuro endocrine responses to stress. Dialogues ClinNeurosci,2006;8(4):383-395.
20. C. R. K. MacLean et al., Effects of the transcendental meditation: changes in hormone levels responses to stress after 4 months of practice, Psychoneuroendocrinology,1997;22(4):277-295.
21. krishnan, kumarsaisailesh, Effect of forced freshwater and cold water swimming stress physiological and biochemical parameters in wistar albino rats Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2015;6(3):750-75.
22. Schüle C, et al. Time course of HPA axis activity during treatment with reboxetine and mirtazapine in depressed patients. Psychopharmacology (Berl),2006;186:601-11.
23. Bravo JA, et al. Desipramine prevents stress-induced changes in depressive-like behavior and hippocampal markers of neuroprotection. Behav Pharmacol,2009;20:273-85.