

**EFFECT OF YOGA ON SERUM ADRENALINE, SERUM CORTISOL LEVELS AND
CARDIOVASCULAR PARAMETERS IN HYPER-REACTORS TO COLD PRESSOR
TEST IN YOUNG HEALTHY VOLUNTEERS.**Chanda Rajak^{*1}, Rahul Verma², Prabhakar Singh³, Amita Singh⁴ and Milind Shiralkar⁵

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ABSTRACT

Objectives: The aim of present study is to investigate the effect of regular Yoga practice for six months on the level of serum Adrenaline, serum cortisol and cardiovascular reactivity induced by cold pressor test. **Materials and Methods:** This study is conducted in the department of physiology, Medical College, Rewa MP. Study group comprises 60 healthy subjects of 18-25 years age group. The parameters like serum level of Adrenaline, serum cortisol, basal blood pressure, blood pressure before and after cold pressor test and pulse rate were recorded. Data were analyzed by using student 't' test. **Results:** Regular practice of yoga significantly reduces the level of Adrenaline, serum cortisol and cardiovascular hyper-reactivity to cold pressor test. Out of 40 hyper-reactors to cold pressor test; 35 were converted in to hypo-reactor group after six months of yoga therapy (87.5%). Regular Yoga practice also reduces basal blood pressure, rise blood pressure and pulse rate after six month. **Conclusion:** We concluded that regular practice of yoga for six months reduced the possibly by inducing parasympathetic predominance and cortico-hypothalamo-medullary inhibition., who was hyper-reactive to cold stress, This shows that yoga provides significant improvement in aging to reduce the morbidity and mortality from stress induced disorders.

KEYWORDS: Adrenaline, Serum cortisol. Yoga, Cold pressor test.**INTRODUCTION**

Now days, stress is dangerous and significant problems of World and it affect physical, mental, behavioral, and emotional health. Yoga has been reported to control stress, to be beneficial in treating stress related disorders, improving autonomic functions, lower blood pressure, increase strength & flexibility of muscles, improve the sense of wellbeing, slowed ageing process, control breathing, reducing signs of oxidative stress and improving spiritual growth.^[1] Stress is an extremely adaptive phenomenon in human, contributing to his/her survival, activities, and performance.^[2] Physical and psychological stresses can induce a wide range of immunological alteration in the cell mediated and humoral immunity.^[3] Stressors may influence the immune function via their impact on neuroendocrine, autonomic and central nervous system.^[4] Psychological stresses may influence the immunological functions both indirectly through hormonal changes, and directly through nervous regulation during brief but acute stressful periods.^[5] Stress is described as a state of anxiety, strain, nervousness, tension, constant worry or pressure. It is an accepted fact that psychosocial factors operate through mental processes, consciously or unconsciously, to produce hypertension and other cardiovascular disorders.^[6] Cardiovascular disease has

become a major cause of mortality in developing nations in the age group of 30- 69 years, the cardiovascular mortality due to hypertension is seen more in developing nations.^[7,8] Independent research has shown that significantly reduce levels of cortisol reduce the level of stress, relieve anxiety, depression, increase anti – oxidant production, enhance brain function, enhance health well – being and peace of mind.^[9] Yoga is an ancient philosophical and religious tradition thought to have originated in India in 5000 BC. It has been incorporated into modern medicine during the few decades because of increasing incidence of diseases of modern civilization such as obesity, hypertension, coronary artery diseases, and diabetes mellitus, which are rooted in faulty lifestyle and psychological stress. Yoga is the best lifestyle modification, which aims to attain the unity of mind, body and spirit through yoga.^[10] Meditation is relaxation technique to be used for treating stress and stress related illnesses.^[11] Walter Cannon (1911) et al 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.^[12]

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 causing increase in heart rate, systolic and diastolic blood pressures and an increased secretion of glucocorticoid and aldosterone from adrenal cortex causing salt and fluid retention which increases blood volume and blood pressure imposing severe strain on the heart.^[13] The stress hormone, cortisol, is public health enemy number one. Scientists have known for years that elevated cortisol levels: interfere with learning and memory, lower immune function and bone density, increase weight gain, blood pressure, cholesterol, Heart diseases and elevated cortisol levels act as a potential trigger for mental illness and decreased resilience—especially in adolescence.^[14]

In the study of hypertension, cold pressor test, introduced by Hines and Brown^[15] was employed to measure the cardiovascular reactivity. The persons hyper-reactive to cold pressor test are susceptible for early onset of hypertension.^[16,17,18,19] We tested whether regular practice of Yoga for 3 months can reduce the serum cortisol level and cardiovascular hyper-reactivity, for reducing the morbidity and mortality from cardiovascular disorders.

“Yogic” postures are now, one of the non-pharmacological therapies against stress and strain “Yoga” practice has been shown to be effective in improving mood and decreasing stress and depression.^[20] A state of mental tranquility is achieved by the practice of yoga as revealed by increase in alpha index of electroencephalogram^[21,22] and development of good physique, strong ethical values and good stress tolerance.^[22]

Yoga can protect the individual by bringing harmony between mind and body, modulating stress responses and one's attitude to stress as also improving mental faculties such as attention, sharpen memory, concentration, decrease anxiety levels, learning efficiency and positive attitude to life^[23,24,25,26,27] and bestows a proportionate, flexible, normally relaxed body with an ability to withstand stress efficiently.^[27] Yoga is the best lifestyle modification, which aims to attain the unity of mind, body and spirit through asanas, pranayama, and meditation.^[28] At spiritual level yoga creates an awareness to look for happiness from within oneself and to be at peace with oneself.

MATERIALS AND METHODS

Study group comprised 60 male healthy subjects of 18-25 years. They were subjected to cold pressor test according to Hines & Brown.^[17] Out of 60 volunteers, 40 turned out to be hyper-reactive to this provocative test. The hyper-reactivity of 35 volunteers converted to hypo-

reactivity after the yoga therapy of six months (87.5%). Other parameters like serum Adrenaline, serum Cortisol, level basal blood pressure, rise in blood pressure and pulse rate were also significantly reduced statistically by using student ‘t’ test.

The study protocol was explained to the subjects and written consent obtained. Approval by ethical committee of S.S. Medical College, Rewa, M. P., was obtained. All the volunteers were clinically examined to rule out any systemic diseases. All subjects were non-alcoholic and non-smokers. They were not taking any drugs, and they had similar dietary habits as well as physical and mental activities at work and home. These hyper-reactive volunteers performed yoga twice a day at Physiology department, S.S. Medical College, Rewa, M. P.

All the 40 volunteers were trained under the guidance of a certified “yoga” teacher for 15 days. They carried out “Yogasanas, Pranayama and Meditation” 80 minutes, twice a day for six months, under supervision, in a prescribed manner. The schedule consisted of-

Yogasanas-	-10 minutes
Pranayama-	-10 minutes
Meditation-	-60 minutes

The asanas practiced were: Ardha Chakrasana, Tadasana, Paschimottasana, Utthita Trikonasana, Vajrasana, Salamba Sarvangasana and Halasana.

The Pranayama performed was: Anulom –vilom

The volunteers practiced these exercises early in the morning and in evening, in a quiet, well ventilated room or in open airspace sitting in a comfortable posture.

BP was measured in supine posture by Sphygmomanometer.^[31] Two readings were taken five minutes apart and the mean of two was taken as the BP.

For cold pressor test, a thick walled thermocol box measuring 38 cm × 26 cm × 18 cm, closed from all sides, was used. A hole was made in the centre of the top of the box to allow entry to one hand of the subject. Another small hole was made at the corner of the top of the box for laboratory thermometer. Before starting the experiment the box was filled with a mixture of ice and water and the laboratory thermometer was placed such that its mercury bulb was immersed in the mixture of ice and water.^[16] Temperature inside the box was measured about 3^o-4^oC. The hand was immersed in cold water up to the wrist for one minute (cold stress). An elevation above the basal level of more than 20 mm of Hg in systolic or of more than 15 mm in diastolic was considered as hyper-reactive response.^[17]

Collection of blood sample for Serum cortisol & Serum Adrenaline levels

All of the subjects of study group were asked to report at 9 am. Taking all aseptic precautions, 5 ml venous blood sample was drawn from the antecubital vein of each

subject. Second blood sample was taken in study group after 6 month of yoga practice from the start of study. The serum separated after centrifugation was divided into aliquots and batch analyzed by Enzyme-Linked Immunosorbent Assay (ELISA), using a commercial ELISA kit (IBL-Hamburg GmbH).after every collection. Plasma adrenaline analysis was done by ELISA (Adrenaline EIA kit).

STATISTICS

The data were statistically analyzed by using statistical software Graph Pad in Stat vs. 3.10 and MS Excell (2003). Statistical analysis of serum Adrenaline, serum cortisol level, Systolic B.P., Diastolic.B.P. and pulse rate were done using student 't' test and $p < 0.01$ was considered as clinical significant.

RESULTS

Our results showed that "Yoga" causes significant reduction in serum Adrenaline, serum cortisol level & the cardiovascular hyper-reactivity. A total of 60 male volunteers were included in the study. Out of which 40 were hyper-reactor to cold pressor test. These hyper-reactors practiced yoga regularly for six months and after this period 35 volunteers become hypo-reactors. The statistical analysis was carried out using student t' test. It was observed that the serum Adrenaline, serum cortisol level, basal blood pressure and pulse rate before & after yoga were statistically more significantly reduced. (Table-1) The effect of cold pressor test on all above parameters before and after yoga were statistically more significantly reduced. (Table-2)

Basal Parameters: The mean basal systolic blood pressure was 123.8 ± 3.02 mm Hg, mean diastolic B.P. 81.94 ± 3.30 mm Hg, mean basal Pulse rate 77.89 ± 5.45 / min, the serum Adrenaline level 9.76 ± 0.66 /L and basal Serum cortisol level 10.09 ± 0.61 microgram / dl. Due to cold pressor test before yoga, the mean, rise in systolic blood pressure, was 145.3 ± 2.79 mm Hg

($p < 0.000$). While the rise in diastolic blood pressure was 95.03 ± 17.04 mm Hg, ($p < 0.001$). Rise in Pulse rate 86.06 ± 5.27 / min ($p < 0.000$) rise in. serum Adrenaline 375.2 ± 45.33 picogram/L & rise in Serum cortisol level 12.71 ± 0.526 microgram / dl ($p < 0.000$).

The effect of 06 months of yoga only in study group

The mean systolic blood pressure decreased from 123.8 ± 3.02 mmHg to 119.6 ± 2.15 mm Hg ($p < 0.000$), mean diastolic Blood pressure was decreased from 81.94 ± 3.30 to 77.71 ± 4.17 mm Hg. ($p < 0.000$), mean Pulse rate was decreased from 77.89 ± 5.45 / min to 75.31 ± 2.57 / min ($p < 0.000$), the serum Adrenaline level 9.76 ± 0.66 /L to 8.71 ± 0.88 picogram/L and mean Serum cortisol level was decreased from 10.09 ± 0.61 microgram / dl to 8.71 ± 0.88 microgram / dl ($p < 0.000$), after 6 months of yoga were statistically highly significant. (Table-1).

The effect of cold pressor test before yoga & after yoga

The mean rise in systolic blood pressure, was 145.3 ± 2.79 mm Hg before yoga and the mean fall in systolic blood pressure, was 135.8 ± 3.78 mm Hg due to effect of CPT after yoga ($p < 0.000$), the mean rise in Diastolic blood pressure, was 95.03 ± 17.04 mm Hg before yoga & the mean fall in diastolic blood pressure, was 81.94 ± 14.92 mm Hg due to effect of CPT after yoga ($p < 0.001$), the mean rise in pulse rate, was 65.06 ± 5.27 mm Hg before yoga and the mean fall in diastolic blood pressure, was 78.51 ± 4.83 mm Hg due to effect of CPT after yoga ($p < 0.000$), the mean rise in serum Adrenaline was 375.2 ± 45.33 picogram/L before yoga and the mean fall in, serum Adrenaline was 135.8 ± 3.78 picogram/L due to effect of CPT after yoga ($p < 0.000$), the mean rise in Serum cortisol level 12.71 ± 0.526 microgram / dl before yoga and the mean fall in, Serum cortisol level was 9.15 ± 0.76 microgram / dl due to effect of CPT after yoga ($p < 0.000$), indicate that the reactivity of CPT after yoga was also reduced statistically highly significant. (Table-2).

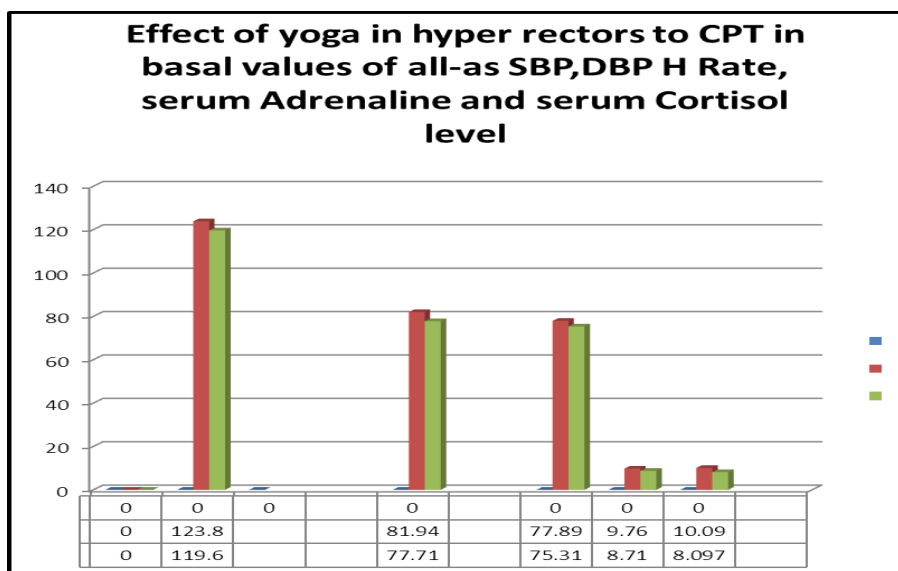
OBSERVATIONS

Table: 1 Effect of Yoga on basal Systolic B.P., basal Diastolic B.P., Pulse Rate s/min, serum Adrenaline ng/L and serum Cortisol microgm/dl after six months of yoga in hyper-reactors to cold pressor test.

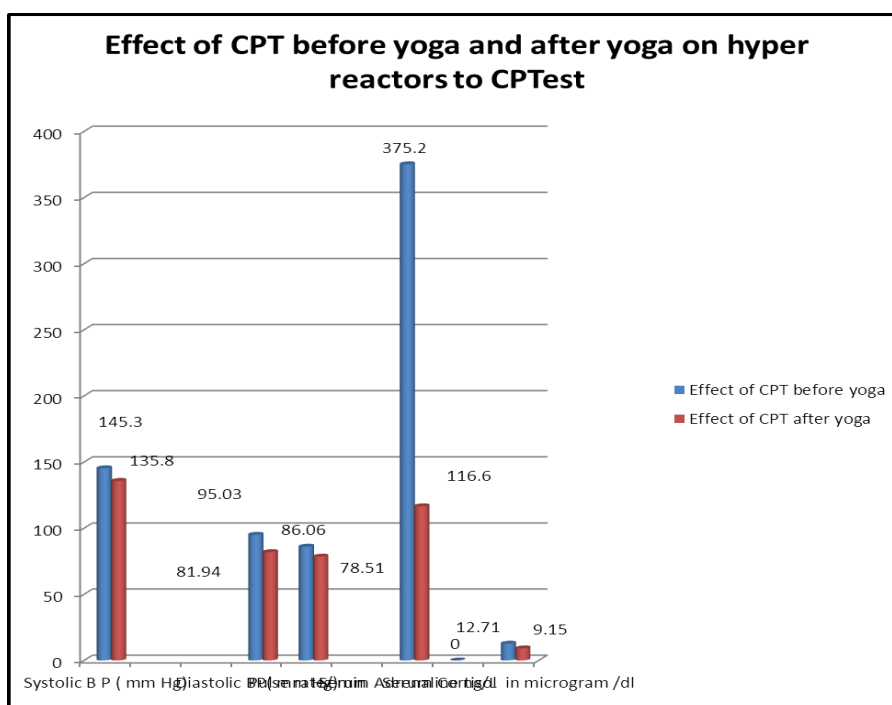
S. No.	Parameters	Before yoga.		After six months of yoga.		P Value
		Mean Value	S. D.	Mean Value	S. D.	
1	Basal Systolic B.P. (mm Hg)	123.8	± 3.02	119.6	± 2.15	$p < 0.000$
2	Diastolic B.P.(mm Hg)	81.94	3.30	77.71	± 4.17	$p < 0.000$
3	Pulse Rate/min	77.89	± 5.45	75.31	± 2.57	$p < 0.000$
4	Serum Adrenaline ng/L	9.76	± 0.66	8.71	± 0.88	$p < 0.000$
5	Serum Cortisol microgram /dl	10.09	± 0.61	8.097	± 0.75	$p < 0.000$

Table No: 2 Effects of cold pressor test before and after 6 month of Yoga practices on basal Systolic B. P. Diastolic B. P., basal Pulse rate/ min, serum Adrenaline and Serum Cortisol level in hyper-reactors to cold pressor test.

Parameters	Effect of cold pressor test before yoga Mean value & Standard deviation	Effect of cold pressor test after Six month Yoga Practices Mean value & Standard deviation	P Value
Systolic Blood Pressure (mm Hg)	145.3 ± 2.79	135.8 ± 3.786	(p<0.000).
Diastolic Blood Pressure (mm Hg)	95.03±17.04	81.94±14.92	(p<0.001).
Pulse rate/ min	86.06 ± 5.21	78.51 ± 4.83	(p<0.000)
Serum Adrenaline ng/L	375.2 ± 45.33	116.6±24.55	
Serum Cortisol in microgram /dl	12.71 ± 0.526	9.15 ± 0.76	(p<0.000).



Graph No. 1



Graph No. 2

DISCUSSION

On analyzing the effect of yoga on hyper reactor subjects of first-year MBBS student age group 18-25 years, in our study, the basal level of serum Adrenaline, serum cortisol level & cardiovascular autonomic function tests were studied in study group before yoga and after six months of “yoga” (Asana, Pranayama & Meditation) & also were studied the effect of CPT before yoga and after six months of “yoga”.

The study group volunteers showed the effect of cold pressor test on mean serum Adrenaline level, mean serum cortisol level, mean systolic blood pressure, mean diastolic blood pressure & mean pulse rate were increased ($p < 0.000$) due to increase sympathetic activity of nervous system & were statistically highly significant before yoga & the reactivity to cold pressor test were also decreased ($p < 0.000$) due to decrease sympathetic activity & increase parasympathetic activity of nervous system & were statistically highly significant after yoga.

In the present study we observed that due to regular practices of yoga, mean serum Adrenaline, mean serum cortisol, mean systolic blood pressure, mean diastolic blood pressure & mean pulse rate were decreased ($p < 0.000$) & due to autonomic equilibrium between sympathetic and parasympathetic nervous system & due to increase in vagal tone^[30,31,32,33] were statistically highly significant.

On Transcendental Meditation, the cortisol levels was a significant drop in the meditation group^[34,35,36,37,38] mainly due to decrease release of stress hormone “cortisol” from adrenal cortex & the Adrenaline levels was also significant drop in the meditation group^[39,40,41] due to decrease sympathetic discharge from Adrenal medulla & on Transcendental Meditation, the Adrenaline & cortisol levels both was a significant drop in the meditation group^[42, 43] decrease release of Adrenaline & cortisol from adrenal gland.

The significant decrease in resting pulse rate, systolic and diastolic blood pressure after the yoga practice in the present study is in accordance with the findings of other studies on physiological effects of yoga practice in healthy individuals.^[44,45,46,47] Similar reduction in resting PR and blood pressure after yoga practice were also reported in hypertensive patients^[48,49], in asthmatic patients^[50] and in diabetic patients^[51]. Can be attributed to modulation of autonomic activity with parasympathetic predominance and relatively reduced sympathetic tone.

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.^[52] Mechanical and hemodynamic adjustments causing both tonic and phasic changes in cardiovascular functioning^[53] and increases the

baroreflex sensitivity and decreases the sympathetic tone, thereby restoring blood pressure in patients of essential hypertension.^[54]

The practice of “asanas” relaxes the muscles and joints which influences the hemodynamic mechanism, thereby improving blood circulation to vital organs. This may also activate the neuro-endocrine axis which is important in facing physical and mental stress. Restoring equilibrium, thereby avoiding intervention of inhibitory parasympathetic system.^[55] Combined practice of physical posture, breathing exercises, and meditation, needs of society, thus yoga to stop the stress response.^[56]

Yoga with physical, emotional, mental, personality developmental and holistic understanding offers to cope with stressful states. To meet the modern lifestyle full of challenges, stress and tensions an all round personality development has become mandatory for the student. The aspect of relaxation and detachment is lacking in our education process and it is this new dimension that needs to be added to the curriculum. Thus yoga can be beneficial in achieving a tranquil state of mind during routine activities and yet providing then concentration and arousal essential in demanding or stressful situations like examinations.^[57]

CONCLUSION

Non pharmacological methods like yogic asanas, pranayama, and meditation should be encouraged to control the modifiable risk factors by increasing parasympathetic activity and decreasing sympathetic activity and provides significant improvements in cardiovascular parameters and respiratory functions. It can thus be concluded that these results would justify the incorporation of yoga as part of our life style in prevention of hyper-reactivity to stress related disorders and age-related cardiovascular complications.

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

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