

## Original Research Article

# Effect of yoga on salivary cortisol in medical student

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### ABSTRACT

**Background:** Yoga is a spiritual discipline for the development of a state of mental and physical health, well-being, it has also been used clinically as a therapeutic intervention. This study observes the effects of yoga poses on salivary cortisol. Salivary cortisol is potential biomarker of psychological stress. Nonetheless, psychobiological mechanisms stimulate the hypothalamus-pituitary-adrenal axis (HPAA) can only indirectly be assessed by salivary cortisol measures. The unlike instances that control HPAA sensitivity (e.g.- hippocampus, hypothalamus, pituitary, adrenals) and their respective modulators, receptors, or binding proteins possibly will all have an effect on salivary cortisol measures. Possible fundamental mechanisms proposed leading to enhanced vagal activity and decrease cortisol. The drop in cortisol, sequentially, may give positive outcome.

**Methods:** Healthy medical student volunteers (N=40), males and females, ranged in age from 18 to 25 years (mean age: 23.3years), participated in the present study. They are divided in two groups one is Yoga Group and second is Control Group. Each group consist 20 subjects. Morning saliva samples were collected of both groups. Levels of cortisol in the saliva samples were determined and compared with levels in comparison samples of saliva obtained after three-month of yoga practice.

**Results:** In all subjects who received yoga (n=20), the change in salivary cortisol level was significant ( $10.27 \pm 2.54$  ng/ml;  $4.023 \pm 1.82$  ng/ml;  $P=0.00$ ); it was not so in those who were not practicing yoga ( $11.43 \pm 3.77$  ng/ml;  $10.27 \pm 2.54$  ng/ml;  $P=0.06$ ). Salivary cortisol level significantly decreased and reacted positively to yoga practicing subjects.

**Conclusions:** The effort of comparing the effects of yoga on salivary cortisol seems to indicate that it is a promising modality for stress management. Everyone should practice yoga for stress management to improve their day today life because yoga as one of the approaches of stress reduction.

**Keywords:** Saliva, Salivary cortisol, Stress, Yoga

### INTRODUCTION

Over the decade, hundreds of studies have specifically focused on the effects of stressors on cortisol activation. The process by which this regulation is achieved is complex and our understanding of it has evolved markedly over the last century. Physical stressors, psychological stressors are capable of activating the HPA axis; a number of studies have reported that laboratory tasks can increase cortisol levels.<sup>1</sup> Salivary cortisol offers a non-invasive and stress-free alternative to serum. In the

last few years, saliva analysis has been a useful method of choice for hormone analyses. Numerous articles have described the use of saliva for analytical purposes in clinical investigations (i.e. in the field of endocrinology, neuroendocrinology) and in physiological research.<sup>2</sup>

A growing body of research evidence supports the belief that certain yoga techniques may improve physical and mental health through down-regulation of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS). The HPA axis and

SNS are triggered as a response to a physical or psychological demand (stressor), leading to a cascade of physiologic, behavioural, and psychological effects, primarily as a result of the release of cortisol and catecholamine's (epinephrine and norepinephrine).

This response leads to the mobilization of energy needed to combat the stressor through the classic "fight or flight" syndrome. Over time, the constant state of hypervigilance resulting from repeated firing of the HPA axis and SNS can lead to deregulation of the system and ultimately diseases such as obesity, diabetes, autoimmune disorders, depression, substance abuse, and cardiovascular disease.<sup>3,4</sup>

In the ancient system of education of various yogic practices like Suryanamaskar, Pranayama, meditation as well as good value systems were introduced with the formal education to enable the development of good physique, strong ethical values and good stress tolerance.<sup>5</sup> A state of mental tranquillity is achieved by the practice of yoga as revealed by increase in alpha index of electroencephalogram after short-term yoga.<sup>5,6</sup> 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.<sup>7</sup>

"Yogic" postures are now, one of the non-pharmacological therapies against stress and strain. "Yoga" practice has shown to be effective in improving mood and decreasing stress and depression<sup>8</sup>. The aim of this study was to address the effect of yoga on salivary cortisol level.

### ***Salivary cortisol***

Cortisol has a strong circadian rhythm, with cortisol levels peaking during the first hour after awakening, and decreasing for the rest of the day, with cortisol reaching its nadir around midnight.<sup>9,10</sup> Thus, careful consideration of time of testing is crucial, as single assessments of cortisol levels are dependent on the time of day. To avoid these potential confounds, collecting saliva samples at multiple test times throughout the day to reflect differing points of the circadian pattern of cortisol secretion for 3-4 days is recommended.<sup>11</sup> Alternatively, repeated measurement of free cortisol levels within the 60 min after awakening in the morning considered a stable and reliable biological marker of adrenocortical activity.<sup>9</sup> Therefore, instructions for saliva collection should provide specific information regarding timing of first morning collection for data consistency.

### ***Yoga***

Yoga is the best lifestyle modification, which aims to attain the unity of mind, body and spirit through asanas,

pranayama, and meditation.<sup>6</sup> At critical times necessary energy gets evoked to deal with the stressful state. At intellectual level, yoga can sharpen memory, concentration, decrease anxiety levels.<sup>6,12</sup> 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, memory, learning efficiency and positive attitude to life.<sup>5,8</sup>

Total growth of personality at physical, mental, intellectual and social level can result with the regular practice of yoga.<sup>6</sup> At physical level regular practice of asanas, pranayama bestows a proportionate, flexible, normally relaxed body with an ability to withstand stress efficiently.<sup>12</sup> Yoga is the best lifestyle modification, which aims to attain the unity of mind, body and spirit through asanas, pranayama, and meditation.<sup>13</sup> At critical times, necessary energy evoked to deal with the stressful state.<sup>3</sup> At intellectual level, yoga can sharpen memory, concentration, decrease anxiety levels.<sup>6,12</sup> At spiritual level, yoga creates an awareness to look for happiness from within oneself and to be at peace with oneself.

## **METHODS**

A total of 40 healthy medical student volunteers, males and females, ranged in age from 18 to 25 years (mean age: 23.3years), participated in the present study. The study protocol was explained to the subjects and written consent obtained. Approval by ethical committee of B.R.D. Medical College, Gorakhpur, Uttar Pradesh, India, was obtained. All the volunteers were clinically examined to rule out any systemic diseases. All subjects were non-alcoholic and non-smokers.

Questionnaires administered prior to the experiment indicated that no volunteers had a physical or mental illness, were taking corticosteroids. They had similar dietary habits as well as physical and mental activities at work and home. They were not practicing any known stress relieving or relaxation technique previously. They randomly divided into 2 groups. Each group consisted of 20 subjects. One Group includes participants with no yoga experience (Control group). Subjects in the control group asked to maintain their routine activities and second group includes individuals practicing yoga (Yoga group).

All 20 volunteers of study group were trained under the guidance of a certified "yoga" teacher for three months in the Department of Physiology, B.R.D. Medical College. They carried out "Yogasanas, Pranayama, and Meditation" 60 minutes daily.

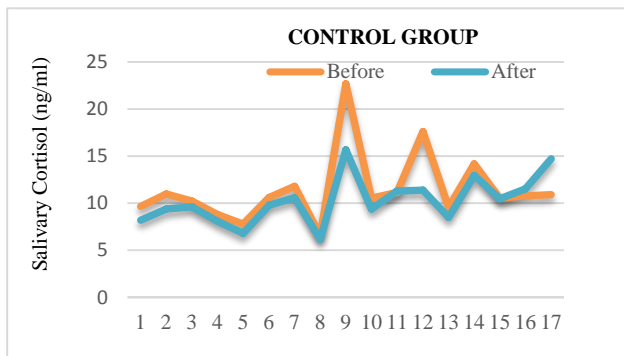
### ***Collection of saliva sample for salivary cortisol levels***

Saliva samples were collected via plastic salivates. Subjects were instructed to provide saliva samples immediately upon awakening on two different mornings

(pre-yoga test and post-yoga test). Subjects returned samples on the same days that they collected them, and the samples were immediately stored in a freezer. Cortisol measured using a high sensitivity Diametra Cortisol Saliva ELISA kit. After 3 month of yoga practice from the start of study second saliva sample taken in both study groups. We used independent-sample *t*-test for both variables comparisons and paired *t*-test for within one variable comparisons. To get the result Mean, Standard deviation difference and *t*'-test were calculated.

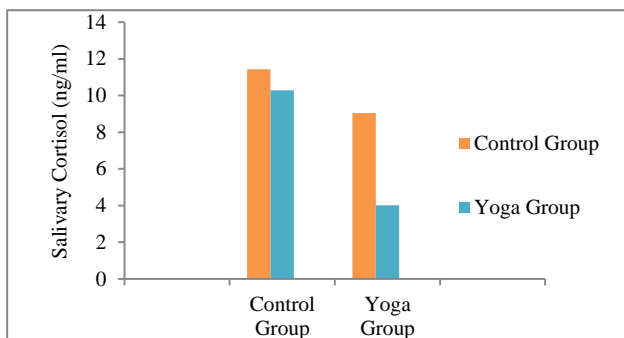
**RESULTS**

The 40 healthy medical student volunteers were comparable as regards salivary cortisol before doing yoga (control group: 11.43±3.768 ng/ml; yoga group: 9.03±2.38 ng/ml; P=0.02). After practicing yoga for three months the total salivary cortisol dropped significantly in test group (n=20; control: 10.27±2.54 ng/ml; yoga group: 4.023±1.82 ng/ml; P=0.00). However, the drop in salivary cortisol level was not statistically significant in control group (n=20; 3-month: 10.27±2.54 ng/ml; P=0.06) (Figure 1).



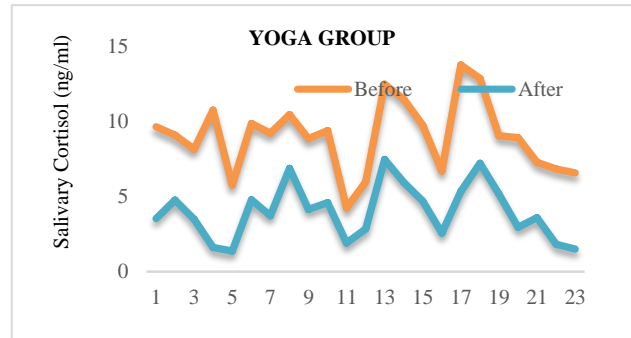
**Figure 1: Salivary cortisol level before and after yoga in control group.**

In all subjects who received yoga (n=20), the change in salivary cortisol level was significant (10.27±2.54 ng/ml; 4.023±1.82ng/ml; P= 0.00); it was not so in those who were not practicing yoga (11.43±3.77ng/ml; 10.27±2.54 ng/ml; P=0.06) (Figure 2).



**Figure 2: Salivary cortisol level correlation in both yoga and control group.**

There was a significant direct correlation between the drops in salivary cortisol in yoga group in comparison to control group.



**Figure 3: Marked decrease in salivary cortisol level after yoga.**

There was a reduction of salivary cortisol level in 20 subjects after 3 months of yoga practicing (mean±SD =4.023±1.82ng/ml).

**DISCUSSION**

From the result of this study, it observed that healthy control group which was not practicing yoga had higher levels of salivary cortisol than the healthy yoga group. It is due to regular practices of yoga, mean salivary cortisol decreased (p<0.000) due to autonomic equilibrium between sympathetic and parasympathetic nervous system & were statistically highly significant. In the present study, we observed that there was statistically more significant decrease in salivary cortisol after practicing “yoga” indicates decrease in sympathetic activity and increase in parasympathetic activities, which is mainly due to increase in vagal tone.<sup>15-17</sup> “On Transcendental Meditation, the cortisol levels was a significant drop in the yoga group, mainly due to decrease release of stress hormone “cortisol” from adrenal cortex.<sup>18-22</sup>

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.<sup>23</sup> Combined practice of physical posture, breathing exercises, and meditation, needs of society, thus yoga to stop the stress response.<sup>24</sup> In a tension-filled society, yoga, pranayama, and meditation alone will bring solace from problems and hence they are essence of the life.<sup>22</sup>

**CONCLUSION**

The effort of comparing the effects of yoga on salivary cortisol seem to indicate that, in both healthy and diseased populations, yoga may be as effective as or

better than any other non-pharmacological therapy at improving a variety of health-related measures.

Yoga is a promising modality for stress management. Everyone should practice yoga for stress management to improve their day today life because yoga as one of the approaches of stress reduction.

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## REFERENCES

- Kirschbaum C, Pirke KM, Hellhammer DH. The "Trier Social Stress Test"-A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology.* 1993;28:76-81.
- Gatti R, Palo EFD. An update: salivary hormones and physical exercise. *Scand J Med Sci Sports.* 2011;21:157-69.
- Hines EA Jr, Brown GE. A Standard Stimulus for Measuring Vasomotor Reactions; Its Application in the Study of Hypertension. *Proc Staff Meet Mayo Clin.* 1932;7:332.
- Sterling P. Principles of allostasis: Optimal design, predictive regulation, pathophysiology, and rational therapeutics. In: Schulkin J, ed. *Allostasis, Homeostasis, and the Costs of Physiological Adaptation.* Cambridge: Cambridge University Press, 2004:17-64.
- Uddupa KN, Sing RN, Yadav RA. Certain studies on physiological and biochemical responses to the practice of hatha yoga in normal volunteers. *Ind J Med Res.* 1973;61:237-44.
- Udupa KN. *Stress and its management by yoga* 2<sup>nd</sup> ed. Narendra Prakash Jain, Delhi, 1985.
- Potey GG. Effect of yoga practices on serum cortisol level & cardiovascular parameters in hyper reactors to cold pressure test in young healthy medical students. *IJSR* 2016;2277-8179.
- Woolery A, Myers H, Stemlieb B, Zeltzer L. A yoga intervention for young adults with elevated symptoms of depression. *Altern Ther Health Med.* 2004;10(2);60-3.
- Pruessner JC, Wolf OT, Hellhammer DH, Buske-Kirschbaum A, von AK, Jobst S, et al. Free cortisol levels after awakening: a reliable biological marker for the assessment of adrenocortical activity. *Life Sci.* 1997;61:2539-49.
- Akerstedt T, Levi L. Circadian rhythms in the secretion of cortisol, adrenaline and noradrenaline. *Eur J Clin Invest.* 1978;8:57-8.
- Stewart JS, Seeman T, San Francisco CA, John D, Catherine T. Salivary cortisol measurement. Available from. In: MacArthur research network on socioeconomic status and health <http://www.macses.ucsf.edu/Research/Allostatic/notebook/salivarycort.html>; 2000 Jun 9 [cited 2009 Apr 1].
- Sharma KN, Selvamurthy W, Battacharya N. *Brain and psychophysiology of stress.* Indian Council of Medical Research. 1983.
- Iyengar BKS. *Light on yoga.* 7<sup>th</sup> ed. New Delhi: Harpercollins Publishers. 2002.
- McEwen BS. Allostasis and allostatic load: Implications for neuropsychopharmacology. *Neuropsychopharmacology.* 2000;22:108-24.
- Gharote ML. Effect of yogic training on physical fitness. *Yoga mimansa.* 1973;15:31-5.
- Gopal KC, Bhatnagar OP, Subramanian N, Nishith SD. Effect of ypgasanas & pranayamas on blood pressure, pulse rate & some respiratory functions. *Indian J Physiol Pharmacol.* 1973;17(3):273-6.
- Vyas, Rashmi, Dikshit N. Effect of meditation on respiratory system, cardiovascular system and lipid profile. *Ind J Phy Pharmacol.* 2002;46(4):487-91.
- Michaels RR, Parra J, McCann DS, Vander AJ. Renin, cortisol, and aldosterone during transcendental meditation. *Psychosom Med.* 1979;41(1):50-4.
- Walton KG, Fields JZ, Levitsky DK, Harris DA, Pugh ND, Schneider RH. Lowering cortisol and CVD risk in postmenopausal women: a pilot study using the transcendental meditation program. *Annals of the New York Academy of Sciences.* 2004;1032:211-5.
- MacLean CR, Walton KG, Wenneberg SR, Levitsky DK, Mandarino JP, Waziri R, et al. "Effects of the transcen-dental meditation program on adaptive mechanisms: changes in hormone levels and responses to stress after 4 months of practice," *Psychoneuroendocrinology.* 1997;22(4):277-95.
- Maclean CRK, Walton KG, Wenneberg SR, Levitsky DK, Mandarino JV, Waziri R, et al. "Altered responses of cortisol, GH, TSH and testosterone to acute stress after four months' practice of transcendental meditation (TM)," *Ann New York Acad Sci.* 1994;746:381-4.
- Potey GG. Effect of yoga practices on serum cortisol level & cardiovascular parameters in hyper reactors to cold pressure test in young healthy medical students: *IJSR.* 2016;2277-8179.ue : 4.
- Vatve M, Sahoo KD, Patil VV. Effect of specific "yogasanas" on cardiovascular autonomic function test. *Pravara Med Rev.* 2010;5(1).
- Anita H, Sanjeev K, Surekharani C. Effect of yoga on cardio-vascular and mental status in normal subjects above 30 years of age. *Al Ameen J Med Sci.* 2010;3(4):337-44.

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