



## PROSPECTIVE STUDY OF EFFECT OF YOGA IN HYPERTENSIVE DIABETICS AND NORMAL SUBJECTS

### Physiology

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### ABSTRACT

We aim to study degree of effect that yoga brings in normal subjects (Group I) as compared to hypertensive diabetics (Group II) in terms of various cardio-respiratory parameters observed every 30 days for 90 days and biochemical parameters at end of study. In Group I significant reduction in all parameters was observed. In Group II, significant reduction in weight, BMI, PR, RR, SBP, DBP, MBP, PP and TC, TG, LDL, VLDL, TC/HDL ratio, LDL/HDL ratio and highly significant reduction in FBS, PMBS along with significant increase in HDL were observed after 90 days of yoga practices. The results indicate that yoga when given in normal person and in hypertensive diabetics causes shifting of the physiological and biochemical parameters towards favorable side of the normal range.

### KEYWORDS

Yoga, Hypertension, Diabetes.

### INTRODUCTION

Recent times show a tremendous increase in non - communicable diseases like hypertension and diabetes. Along with other conditions these are also included under psychosomatic diseases.<sup>[1]</sup> Stress is found to be an important factor in the etiology or precipitation of these conditions.

Etiologically Hypertension is multifactorial. Arterial hypertension with no definable cause is known as essential or primary hypertension.<sup>[2]</sup> Emotional stress plays a consequential role in predisposition, precipitation and perpetuation of hypertension.<sup>[3]</sup>

Diabetes is a group of metabolic diseases with hyperglycemia resulting from defects in insulin secretion, insulin action or both.<sup>[4]</sup> with comorbid Hypertension and abnormalities of lipoprotein metabolism. Studies have identified stressors triggering the onset of diabetes, both Type I and Type 2<sup>[5,6]</sup>.

Independent risk factors associated with development of atherosclerosis e.g. elevated serum cholesterol, enhance the effect of hypertension on mortality rate regardless of age, gender and race.<sup>[7,21]</sup> Total cholesterol to HDL cholesterol ratio is the most efficient prediction of dyslipidemic atherosclerotic potential at old ages.<sup>[8]</sup>

Yogic practices induce a coordinated psycho-physiological response. We aim to study degree of effect that yoga brings in normal subjects as compared to hypertensive diabetics in terms of various physiological cardio-respiratory parameters and biochemical parameters.

### AIM AND OBJECTIVES-

- To study impact of yoga on physiological parameters like weight, Body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), pulse pressure (PP) and biochemical parameters like total cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL), TC/HDL ratio, LDL/HDL ratio, fasting blood sugar (FBS) and post meal blood sugar (PMBS) levels in normal subjects.
- To study impact of yoga on same parameters in previously diagnosed hypertensive diabetics and taking medication.
- To compare effect of yoga between normal subjects and that of previously diagnosed hypertensive diabetics on medications.

### MATERIAL AND METHODS

Present trial was carried out in Department of Physiology Government Medical College and Hospital (GMCH), Nagpur, India and biochemical analysis was done in laboratory of department of

Biochemistry, GMCH, and Nagpur. Subjects were trained in yogic practices at Shree Janaradan Swami Yogabhyasi Mandal, Ramnagar, Nagpur.

This was prospective, follow up, multiple comparison groups, non-cross over 90 days trial.

**Group I** included normal healthy adult volunteers above 40 years of age, Non-smoker, non-alcoholic, not doing yoga previously, not on any medication.

**Group II** included Hypertensive diabetics diagnosed within last 5 yrs, above 40 yrs age, not doing Yoga previously, Non-alcoholic and non-smokers.

### Exclusion criteria -

- Subjects with Stage-2 hypertension.
- Hypertension with cardiovascular or cerebral complications.
- Secondary hypertension.
- Subjects already practicing yoga.
- Subjects on medication altering lipid profile.
- Pregnant women.

Trial began after approval of ethics committee and informed consent from subjects divided in 2 groups (30 in each).

Session began with Awayawa-dhyana and short prayer followed by various asanas, pranayama, meditation and ended with a short prayer. Physiological parameters were assessed at 0, 30, 60, 90 days. Biochemical parameters were assessed at 0 and 90 days.

Statistical calculations were done using statistical software STATA version 8.0 by one way ANOVA followed by Bonferroni's multiple comparison test or unpaired t-test for continuous variables. Continuous variables were presented as mean  $\pm$  SD. Two tailed p value of less than 0.05 was judged statistically significant.

### RESULTS AND OBSERVATIONS

**Table 1: Change in weight and BMI at 90 Days.**

Groups	Parameters	Day		P
		0	90	
I	Weight (kg)	70.68 $\pm$ 6.57	69.4 $\pm$ 5.19	<0.05
	BMI (Kg/m <sup>2</sup> )	25.34 $\pm$ 1.82	24.92 $\pm$ 1.49	>0.05
II	Weight (kg)	74.55 $\pm$ 10.03	72.29 $\pm$ 10.25	<0.0001
	BMI (Kg/m <sup>2</sup> )	27.10 $\pm$ 3.11	26.27 $\pm$ 3.15	<0.0001

**Table 2: Change in physiological parameters.**

Group	Parameters	Day				p ANOVA
		0	30	60	90	
Group I	PR	70.8±3.23	70.5±3.91	70.1±3.13	68.3±3.49	<0.05
Group II		77.92±4.48	77.69±3.20	76.27±3.73	74.92±3.71	<0.01
Group I	RR	14.56±1.92	14.06±2.16	13.4±1.71	12.86±2.55	<0.05
Group II		16.69±2.74	16.64±2.74	15.36±2.28	14.61±1.92	<0.001
Group I	SBP	116.67±2.42	115.06±2.86	113.86±2.77	111.6±2.57	<0.001
Group II		138.61±7.85	135.64±8.82	131.38±7.64	128.2±7.26	<0.001
Group I	DBP	77.06±2.91	76.8±1.94	75.06±2.21	74.6±2.47	<0.001
Group II		90.61±4.84	87.44±6.19	85.16±5.52	84.02±4.79	<0.001
Group I	MBP	90.27±2.05	89.55±1.76	87.99±1.79	86.93±2.11	<0.001
Group II		106.61±4.22	103.57±5.62	100.57±4.76	98.76±4.04	<0.001
Group I	PP	39.6±3.91	38.27±3.09	38.8±3.42	37.0±2.81	<0.05
Group II		48.00±9.09	48.19±9.47	46.22±8.77	44.11±8.62	<0.05

**Table 3: Change in biochemical parameters.**

Groups	Parameters	Day		p ANOVA
		0	90	
Group I	TC	150.76±19.9	146.4±16.93	<0.01
Group II		189.6±40.28	178.6±33.46	<0.001
Group I	TG	93.06±17.92	89.63±17.78	<0.05
Group II		146.8±58.67	132.9±45.44	<0.01
Group I	HDL	52.96±7.42	55.3±7.75	>0.05
Group II		47.36±13.22	53.50±10.42	<0.05
Group I	LDL	79.18±17.24	73.17±14.76	<0.01
Group II		112.9±36.21	98.51±29.41	<0.001
Group I	VLDL	18.61±3.58	17.92±3.57	<0.05
Group II		29.35±11.73	26.57±9.09	<0.01
Group I	TC/HDL	2.89±0.48	2.68±0.37	<0.01
Group II				
Group I	LDL/HDL	1.53±0.43	1.35±0.34	<0.01
Group II		2.58±1.10	1.93±0.74	<0.001
Group I	FBS	92.76±11.75	87.93±9.62	<0.05
Group II		140.67±14.64	124.80±14.32	<0.001
Group I	PMBS	118.3±17.06	110.73±12.03	<0.05
Group II		236.08±53.82	210.14±43.77	<0.001

## RESULTS-

Significant reduction in mean weight and BMI in group II was seen at 90 days. While Group I showed significant reduction only in weight at 90 days. [Table 1]

As seen in table 2, significant reduction at 30 days was observed in SBP in group I and SBP, DBP, MBP in group II. At 60 days significant reduction in RR, SBP, DBP, MBP occurred in group I; in group II all parameters decreased except PP. At 90 days, significant decrease in all parameters seen in both groups.

As seen in table 3, increase in HDL level was found in both groups at 90 days; but it was significant in Group II. All other biochemical parameters decreased significantly in both groups.

## DISCUSSION

In accordance to our findings, Murugesan et al<sup>[8]</sup> showed decrease in body weight after yoga in normal subjects though the results were statistically not significant. Bharshankar et al<sup>[9]</sup> did not find significant difference in weight and BMI. While Khare KC et al<sup>[10]</sup>, found significant decrease in the weight as in Group II. Modest weight loss can lead to blood pressure lowering in both hypertensive and normotensive patients even without reaching ideal weight.<sup>[11]</sup> Various mechanisms may play a role to cause this effect.<sup>[12]</sup>

Our results thus show the beneficial effect of yoga in decreasing BMI thus reducing risk for hypertension and diabetes.

Many studies depicted changes in pulse rate with yogic practices<sup>[13,3,9,14,15]</sup>. The pulse rate decreases mainly because of increased parasympathetic tone.<sup>[16]</sup> Yoga by modifying the stage of anxiety reduces stress induced sympathetic overactivity.<sup>[17,18]</sup> Present study shows that yoga causes reduction in RR. Many studies showed effect of yoga on RR<sup>[19,31]</sup> The decrease in RR shows the shift to a relative parasympathetic dominance from earlier sympathetic dominance.<sup>[3]</sup> In Pranayama, basic activity of respiratory centre is modified to a slower basal rhythm.<sup>[19]</sup>

Significant decrease in SBP was observed. [Table 2] Our findings are in consistency with many studies<sup>[13,8,3,9,14,15]</sup>. Yoga brings about behavioral change through increase in parasympathetic tone and reduction in sympathetic activity to correct imbalance in autonomic nervous system<sup>[15,20]</sup>. Pranayama and meditation are helpful in tranquilizing the mind<sup>[21]</sup>. Insulin resistance with reactive hyperinsulinemia might lead to hypertension.<sup>[11,22,23]</sup> The reduction in SBP may be due to decrease in insulin resistance and associated hyperinsulinemia.

Present study shows significant decrease in DBP [Table 2] similar to other studies.<sup>[13,8,3,9,14,15]</sup> This may be due to cognitive restructuring with sensory and motor attenuation leading to decreased arousal to external stimuli.<sup>[24]</sup> The decrease in DBP after yoga in our study can be beneficial as DBP is also related to the risk of cardiac events in hypertensive subjects.<sup>[25]</sup>

Our results of reduced MBP in hypertensive subjects after yoga training are same as seen by Madanmohan et al<sup>[21]</sup> and Vijayalakshmi et al<sup>[14]</sup>. The decrease in PP may be due to more reduction in SBP than DBP. [Table 2] While Madanmohan et al<sup>[21]</sup> stated non significant change in PP. Vijayalakshmi et al<sup>[14]</sup> found significant reduction in the PP in hypertensive subjects after yoga training. PP which is pulsatile blood pressure index is an independent risk factor for cardiac events in essential hypertension.<sup>[25,26]</sup>

**BIOCHEMICAL PARAMETERS:** - Various parameters included in lipid profile are associated with risk of cardiac events in subjects of essential hypertension.<sup>[27]</sup> As in Table 3, Yoga decreased serum cholesterol levels in normal, hypertensive and diabetic subjects in our study, while Khare et al<sup>[28]</sup> found significant decrease in diabetic subjects only.

Increased levels of plasma cortisol and blood glucose and increased levels of atherogenic lipids, serum TGs and TC occur in essential hypertension.<sup>[29]</sup> due to response of hypothalamo-pituitary axis to stress. Yoga causes balance between components of autonomic nervous system. Regular exercise reduces plasma total and

unesterified cholesterol and adipose tissue phospholipids<sup>[30]</sup> Insulin resistance associated with hypertension may cause dyslipidemia like increased TC, LDL, and Lipoprotein A. The compensatory hyperinsulinemia stimulates lipogenesis via increased production of Acetyl Co A. Our study found higher levels of TGs in Group II at baseline could be due to hydrolysis of TG rich lipoproteins that simultaneously replace intramuscular fat used during pranayama and yogic practices as seen by Prasad KVV et al<sup>[31]</sup>.

In our study, baseline values showed lower levels of HDL in-group II as compared to Group I thus showing more atherogenic risk in this group. The psychosomatic stress or oxidative stress causes decreased HDL levels due to its increased utilization in scavenging free radicals.<sup>[32]</sup> Bijalani et al<sup>[33]</sup> found significant decrease in all components of lipid profile after yoga except HDL which was elevated significantly.

Present study found reduction in FBS and PMBS levels in both groups similar to other studies.<sup>[16,34,10,15,35]</sup> The beneficial effect of yogasanas on FBS and PMBS may be due to increased glucose utilization and fat redistribution in NIDDM patients.<sup>[36]</sup> Moderate exercise improves blood sugar levels by increasing the number as well as sensitivity of insulin receptors. There may be increased levels of 2,3 DPG in RBC's with decreased Hb A1c which leads to better delivery of oxygen to the tissues.<sup>[37]</sup> Lowering of blood sugar after yoga may also be due to increased release of insulin from the pancreas. Manjunatha S et al<sup>[38]</sup> confirmed this increased release of insulin after the course of yogasanas and also increased sensitivity of  $\beta$  cells of pancreas to the glucose signal in normal healthy volunteers. Also yoga with its beneficial effect on insulin kinetics prevents  $\beta$  cell exhaustion or even helps in regeneration of islets of pancreas.<sup>[15]</sup>

## CONCLUSION

The results indicate that yoga when given in normal person causes shifting of physiological and biochemical parameters towards favorable side of normal range. In hypertensive diabetics, there is restoration of altered parameters towards normal. We recommend yoga to be introduced as a lifestyle for normal person as a primary prevention. Also in those who are already on medication for hypertension and diabetes it can be a useful adjunct.

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