

based on 'Art of living' knowledge points. It has shown promise in reducing blood glucose levels in diabetics in our earlier study (4). Recently, we have also demonstrated betterment of antioxidant status and anxiety levels by practice of SKY in apparently healthy adults (5). The present investigation is focused on effect of two months' practice of SKY on diastolic and systolic blood pressure as well as blood urea levels and oxidative stress and other biochemical tests in mild hypertensives and apparently healthy controls.

METHODS

Subjects

55 mild hypertensive patients and 58 apparently healthy adults (30-60 yr) attended a SKY training of 6 days organized at *Kothrud* and *Sinhagad* Road areas of Pune city with the help of Jehangir Hospital, Pune. All the subjects participated voluntarily in the study. Exclusion criteria were pregnancy for women, any major illness other than hypertension i.e. cancer, heart disease, arthritis, asthma, ulcer. An informed written consent was taken from participants for blood testing and SKY training. The entire protocol was approved by the Human Ethics committee of HCJMRI, the funding agency.

All the participants underwent the course of 6 days duration by Art of Living Foundation for training of SKY by trained teacher. All the hypertensive persons were on antihypertensive medications. Observations about clinical examination, biochemical tests were recorded before

undergoing the course. Out of 113 participants, 52 participants which followed SKY practice for 2 months and gave the second observation have been considered for the present investigation. Same set of observations was repeated after 2 months' practice of SKY on these 26 hypertensive patients (10 men, 16 women), and 23 apparently healthy adults (10 men and 13 women).

Clinical examination

Blood pressure in duplicate was measured by doctor using a stethoscope and a sphygmomanometer. Morbidity during last one month, current complaints were also recorded by the same medical doctor. Weight, height, waist and hip circumference (WHR) for all the participants was also noted. The subjects had been classified as hypertensives based on their own clinicians diagnosis. They were on prescribed drugs for the hypertension before and also during the study period. Therefore even if their baseline values of B.P. were in the prehypertensive range (SBP between 120 and 139, & DBP between 80 and 89 according to INC classification), they had to be considered under the hypertensive group.

Blood biochemistry

Fasting blood samples were drawn and analyzed for levels of glucose, lipid profile (serum total cholesterol, triglycerides) and kidney function tests (serum urea and creatinine) using kits (Enzokit, India). Moreover, lipid peroxidation as malondialdehyde (MDA) were estimated as previously described (6).

Statistical methods

All the estimations were done in duplicates. Data were analyzed using Microsoft Excel 2003. Differences between means were tested by one way ANOVA and computation of critical difference (C.D.). Results were considered significant at $P < 0.05$.

RESULTS

Baseline characteristics of the subjects

are given in Table I. Age and BMI were comparable between controls and patients ($P > 0.1$). WHR was comparable in men but hypertensive women had significantly higher WHR than controls ($P < 0.01$). Hypertensive patients, in spite of their medications, had higher SBP/DBP ($P < 0.01$) except DBP for women.

Table II shows the mean and S.D. values of DBP and SBP before and after the practice of SKY. One way ANOVA indicated

TABLE I: Age, anthropometric and blood pressure of study subjects.

Parameters	Normal Men (n=10)	Hypertensive Men (n=16)	P value	Normal Women (n=13)	Hypertensive Women (n=13)	P value
Age	48±2.6	51.6±9.7	>0.1	50±8.1	49.5±9.5	>0.1
BMI (kg/m ²)	25.6±2.4	27.9±5.1	>0.1	26.4±4.4	26.4±3.1	>0.1
WHR	0.90±0.05	0.91±0.07	>0.1	0.78±0.06	0.83±0.05	0.001***
SBP (mm Hg)	116.1±5.03	132.2±13.6	0.01	112.1±12.1	126.1±11.6	0.01*
DBP (mm Hg)	79.0±2.6	88.2±7.8	0.001	76.6±7.1	85.2±9.7	>0.1

Data presented are Mean±SD. Analysis of data was done by one-way ANOVA.

* $P < 0.05$; ** $P < 0.001$

TABLE II: Effect of SKY in controls and hypertensive subjects.

Parameters		Control group		Hypertensive group	
		Women 13	Men 10	Women 13	Men 16
DBP	Before	76.6±7.1	79±2.6	85.2±9.7	88.2±7.8
	After	77.7±5.8	77.6±5.2	81.7±5.8	83.4±6.6
	P value	NS	NS	<0.01	<0.01
SBP	Before	112.1±12.1	116.1±5.03	126.1±11.6	132.2±12.4
	After	111.7±10	120.6±12.4	127±14.1	130±12.4
	P value	NS	<0.05	NS	NS
MDA	Before	6.2±3.1	7.2±4.1	6.7±2.4	6.9±2.1
	After	6.0±3.0	6.5±4.3	5.2±0.8	5.6±0.9
	P value	NS	<0.01	<0.01	<0.01
TG	Before	110.8±43.6	124.2±28.8	137.2±74.3	132.3±66.1
	After	118.7±52.4	155.5±91.1	109.7±29.9	102.2±25.1
	P value	NA	NA	NA	NA
Urea	Before	24.5±4.8	32.9±8.5	27.6±5.3	32.9±13.7
	After	25.6±4.8	30.2±2.8	23.3±4.8	26.6±4.5
	P value	NS	NS	<0.01	<0.01

Data presented are Mean±SD.

NA: not applicable due to non significant value of F; NS: non significant.

DBP and SBP: mm of Hg; plasma TG and serum Urea: mg/dL; MDA: nM/L.

significant differences between the groups ($F=3.86$, $P=0.01$ for DBF and $F=5.44$, $P=0.002$ for SBP). There was a significant decrease of DBF for both men and women in hypertensive group ($P<0.01$) but the changes in control group were non-significant. SBP values were comparable in hypertensive group and control women ($P>0.1$).

As a result of SKY practice, MDA values were significantly reduced in control men and both hypertensive groups. Serum urea levels were also significantly reduced in both hypertensive groups ($P<0.01$). For other biochemical indices viz. total cholesterol, fasting glucose, hemoglobin, the differences were not significant statistically ($P>0.1$). But these values were within normal range for the participants. In case of serum triglycerides ANOVA indicated non significant differences due to large variability within each group. But, the direction of change in hypertensives was towards lowering the values.

The values of before and after SKY practice were compared, by arranging the values before SKY in increasing order. The most appealing observation common in majority of the study parameters was that higher values were lowered, normal values were unaltered and lower values were increased up to normality. This indicated a counteractive action of SKY especially on DBF, plasma MDA and kidney function.

DISCUSSION

Many hypertensive patients try complementary/alternative medicine for blood pressure control. Numerous herbal remedies, non-herbal remedies like yoga

have been tested and some seem to have antihypertensive effects. Yoga has been shown to be a simple and economical therapeutic modality that may be considered as a beneficial adjuvant. SKY is a highly standardized package of yoga based intervention applied across entire globe in the same form by the skilled teachers and a need was felt to study its effect in hypertension.

The study involving one minute of Kapalabhati, a fast-breathing technique of Hatha Yoga (120 respiratory strokes/min) conducted on twelve normal healthy male subjects showed decrease in blood urea, increase in creatinine and tyrosine (7). Some studies suggest that yoga can decrease oxidative stress (8-10). An Overview of Clinical Applications of Therapeutic Yoga has suggested that yoga as therapy in clinical practice is an emerging field but scope and boundaries have yet to be defined (11).

The SKY package incorporates a powerful rhythmic breathing process, the Sudarshan Kriya which is a combination of slow, medium and fast breaths.

Our results have demonstrated positive effect of SKY on health of hypertensives as well as normal controls in terms of maintenance of normal levels of blood pressure, urea, triglycerides, and keeping the oxidative stress (MDA) at minimum. Thus present results, add further evidence to the effects of yoga on antioxidant status and health. Yogic breathing exercises not only help in relieving the stresses of life but also improve the antioxidant status of the individual. This small sample study seems

to be a promising technique for management of hypertension as complementary therapy and requires confirmation through multi centre study.

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Author disclosure statement

No commercial associations that might create a conflict of interest in connection with submitted manuscripts are applicable. VVA was the senior investigator as well as teacher of the SKY workshop. She planned the entire study, supervised the observations recorded, analyzed the data and drafted the manuscript. Both MJ and KT were junior investigators and participated in SKY workshop as well as taking on site observations and laboratory analysis. KT also contributed in writing the manuscript. There are no other competing financial interests of all authors which have not been appropriately disclosed.

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