REPORT ON

YOGA RESEARCH STUDIES AT

ACYTER, JIPMER : 2008 - 2012

Under the direction of

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ADVANCED CENTRE FOR YOGA THERAPY, EDUCATION AND RESEARCH (ACYTER)

(A collaborative venture between Morarji Desai National Institute of Yoga (MDNIY), New Delhi and Jawaharlal Institute of Post Graduate Medical Education and Research (JIPMER), Pondicherry)
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgments</td>
<td>1</td>
</tr>
<tr>
<td>A review of selected yoga research findings from ACYTER, JIPMER from June 2008- August 2012</td>
<td>2</td>
</tr>
<tr>
<td>Effect of yoga therapy on reaction time, biochemical parameters and wellness score of peri and post menopausal diabetic patients</td>
<td>15</td>
</tr>
<tr>
<td>Effects of a comprehensive eight week yoga therapy programme on cardiovascular health in patients of essential hypertension</td>
<td>31</td>
</tr>
<tr>
<td>Immediate effect of sukha pranayama on cardiovascular variables in patients of hypertension</td>
<td>47</td>
</tr>
<tr>
<td>Immediate cardiovascular effects of pranava pranayama in hypertensive patients</td>
<td>55</td>
</tr>
<tr>
<td>Immediate effect of chandra nadi pranayama (left unilateral forced nostril breathing) on cardiovascular parameters in hypertensive patients</td>
<td>64</td>
</tr>
<tr>
<td>Suryanadi pranayama (right unilateral nostril breathing) may be safe for hypertensives</td>
<td>72</td>
</tr>
<tr>
<td>Immediate cardiovascular effects of pranava relaxation in patients of hypertension and diabetes</td>
<td>79</td>
</tr>
<tr>
<td>Effect of yoga on subclinical hypothyroidism: a case report</td>
<td>89</td>
</tr>
<tr>
<td>Results of a survey of participant feedback</td>
<td>96</td>
</tr>
<tr>
<td>Report of ACYTER activities</td>
<td>101</td>
</tr>
</tbody>
</table>
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Most of these studies have been published in part or full / are under publication in International Journal of Yoga, International Journal of Yoga Therapy, Indian Journal of Physiology and Pharmacology, Indian Journal of Traditional Knowledge, Biomedical Human Kinetics, Yoga Mimamsa, Journal of Yoga and Physical Therapy and Yoga Life.
A REVIEW OF
SELECTED YOGA RESEARCH
FINDINGS
FROM ACYTER, JIPMER
IN 2008-12
INTRODUCTION:

In recent times, the therapeutic potential of Yoga has captured the imagination of researchers worldwide and numerous studies are being done on the benefits of Yoga in various medical conditions (1-5). Yoga is a popular means of relieving stress and improving fitness as it decreases stress and anxiety and improves health status. The application of Yoga as a therapy is simple and inexpensive and can be easily adopted in most patients without any complications (6). It must be emphasized that Yoga therapy or more correctly Yoga Chikitsa, encompasses the use of asana, pranayama and relaxation techniques along with dietary advice and Yogic counseling that address the root cause of the problem rather than merely providing symptomatic relief (7).

The Advanced Centre for Yoga Therapy Education and Research (ACYTER), a collaborative venture between JIPMER, Puducherry and Morarji Desai National Institute of Yoga (MDNIY), New Delhi was established by an MOU between JIPMER and MDNIY in June 2008 and is focusing primarily on the role of Yoga in the prevention and management of cardiovascular disorders (CVD) and diabetes mellitus (DM). More than 24,000 patients have benefited from Yoga therapy consultation and attended therapy individual and group sessions in the past three years. A detailed survey has also been published based on feedback from patients (8). With the active collaboration of MDNIY, New Delhi many research projects are being conducted at JIPMER as collaborative efforts between ACYTER and the Departments of Physiology, Medicine, Biochemistry and Cardiology. This paper summarizes some of the important findings from research works at ACYTER between 2008 and 2012.

REVIEW OF SELECTED STUDIES:

Study-1: Immediate effect of sukha pranayama on heart rate and blood pressure of patients with hypertension (9). Hypertension (HT) is one of the most common health disorders and Yoga has been shown to be an effective adjunct therapy in its management. Earlier studies from our laboratories have demonstrated heart rate (HR) and blood pressure (BP) lowering effects of slow, deep breathing after 3 weeks and 3 months of training. Beneficial effects of deep breathing in reducing premature ventricular complexes have also been reported by us. With this background, the present study was undertaken to determine the immediate effects of sukha pranayama on cardiovascular parameters in hypertensive...
patients. 23 hypertensive patients attending our Yoga OPD were instructed to perform sukha pranayama for five minutes at the rate of 6 breaths/minute. Sukha pranayama is a slow and deep pattern of breathing where inhalation and exhalation are of equal duration. HR and BP were recorded before and immediately after the intervention. Rate-pressure product (RPP) and double product (Do P) were derived by formulae. Sukha pranayama produced a significant (p<0.05) reduction in HR from 79.5 ± 3.09 to 78 ± 3.24 beats/min and a highly significant (p<0.001) reduction in systolic pressure (SP) from 132.5 ± 5.45 to 123 ± 3.83 mmHg. Pulse pressure (PP) decreased from 61.5 ± 3.39 to 52.5 ± 2.21 mm Hg, mean pressure (MP) from 91.5 ± 3.19 to 88 ± 2.35 mm Hg, RPP from 107.28 ± 8.43 to 97.37 ± 6.97 units and Do P from 73.88 ± 53.72 to 69.52 ± 46.94 units, all these changes being statistically significant (P<0.001). It is concluded that sukha pranayama breathing at the rate of 6 breaths/minute can reduce HR and BP in hypertensive patients within five minutes of the practice. This may be due to normalization of autonomic cardiovascular rhythms as a result of increased vagal modulation and/or decreased sympathetic activity. Further studies are required to understand the possible mechanisms underlying this beneficial effect in hypertensive patients.

Study-2: Effect of Yoga therapy on reaction time, biochemical parameters and wellness score of peri and post menopausal diabetic patients (10). Yogic practices may aid in the prevention and management of DM and reduce cardiovascular complications in the population. 15 peri and post menopausal patients receiving standard medical treatment for type 2 DM were recruited and reaction time (RT) and biochemical investigations were done before and after a comprehensive Yoga therapy programme comprising of thrice weekly sessions for 6 weeks. A post intervention, retrospective wellness questionnaire compiled by ACYTER was used to evaluate the comparative feelings of the patients after the therapy programme. Yoga training reduced auditory reaction time (ART) from right as well as left hand, the decrease being statistically significant (p < 0.05) for ART from the right hand. There was a significant (p < 0.01) decrease in fasting and postprandial blood glucose levels as well as low density lipoprotein (LDL). The decrease in total cholesterol (TC), triglycerides (TG), and very low density lipoprotein (VLDL) and increase in high density lipoprotein (HDL) was also statistically significant (p< 0.05). All the lipid ratios showed desirable improvement with a decrease (p<0.01) of TC/HDL and LDL/HDL ratios and increase (p<0.05) in the HDL/LDL ratio. Shortening of RT implies an improvement in
the information processing and reflexes and is the first such report in diabetic patients. This has clinical significance and is worth further exploration with wider, well controlled, randomized studies in the diabetic population. Changes in blood glucose levels may be due to improved insulin sensitivity, decline in insulin resistance and increased sensitivity of the pancreatic β cells to glucose signals. Yoga improved the ‘heart friendly’ status of lipid profile in our subjects and as our participants were peri and post menopausal, the decrease in cardiovascular risk profile is of greater significance. A comprehensive Yoga therapy programme has the potential to enhance the beneficial effects of standard medical management of DM and can be used as an effective complementary or integrative therapy programme.

Study-3: Effect of Yoga on subclinical hypothyroidism: a case report (11). Complementary and Alternative Medical (CAM) therapies such as Yoga are being increasingly used as adjuncts to modern medicine. Though it has been suggested that Yoga may have a role in revitalizing thyroid function there are few studies on the effects of Yoga on thyroid disorders. A 36 year old female with elevated TSH level and low normal T4 levels was diagnosed as having primary subclinical hypothyroidism and advised to start replacement therapy. She came for consultation to our Yoga OPD and was given appropriate Yogic counseling and taught a series of techniques potentially beneficial to patients of thyroid conditions. She continued the practices for a year and reported back at the end of the year with her biochemical investigations. After one year of therapy, there was a fall in TSH and a normalization of free T4 values. A third biochemical analysis three months later showed that TSH and FT4 further stabilized at normal levels. As the anti TPO antibodies were positive both before and after the Yoga intervention, the patient was advised to continue the Yoga practices on a regular basis as long as possible with regular six-monthly follow up. It is suggested that Yoga can be an effective adjunct therapy in thyroid conditions and further studies in larger samples are needed to confirm these findings and to better understand the mechanisms behind such beneficial effects in patients of thyroid disorders.

Study-4: Immediate effect of suryanadi and chandranadi on short term heart rate variability in healthy volunteers (12). Heart rate variability (HRV) has come to be widely used as a non-invasive tool to assess autonomic function in a variety of physiological as well as disease states. Different types of pranayams are known to
improve autonomic function by changing sympathetic or parasympathetic activity. In view of this, the present study was aimed to study the effect of suryanadi (SNP) and chandranadi (CNP) pranayams on HRV in healthy young volunteers. The present study was conducted on 11 male volunteers 20-30yrs who were taught both SNP and CNP and made to practice under direct supervision. The procedures and recordings were carried out in lying down posture for all volunteers between 4-6.30 pm in the ACYTER research lab. HRV was recorded by using BIOHARNESS AcqKnowledge 4.1 version and analyzed by Kubios HRV 2.00 software. Basal resting parameters and HRV were recorded for 5 minutes after that. SNP was performed in six cycles per minute (each cycle consists of 5 seconds for each inspiration and expiration) for 5 minutes followed by 5 min rest. Three such sessions (before, during and after) HRV were recorded. The same procedure and recording were followed for CNP. Appropriate statistical analysis was done using SPSS version 16 (Repeated measures of ANOVA followed by post hoc analysis with Benferroni adjustment) and the level of statistical significance is considered at a p value < 0.05. The results of our study were much in accordance with the previous studies. The time domain analysis of SNP revealed an increased HR with decreased RMSSD, the index of short term HRV. However SDNN which is considered the index of long term HRV increased. In frequency domain analysis there was an increased LF power and decreased HF power. The index of sympathovagal balance as reflected by LF/HF ratio increased (from 1.8 to 2.2) after the intervention. All the observation showed that SNP is sympathomimetic. In CNP, the time domain analysis of HRV revealed a decreased HR and an increased pNN50. The frequency domain analysis revealed an increased HF power with decreased LF/HF ratio i.e. from 2.1 to 1.5. We conclude that SNP increases sympathetic activity while CNP increases parasympathetic activity and hence they can be appropriately advocated in many chronic CVD where autonomic imbalance is one of the primary derangements.

Study-5: Immediate effect of Shavasanaa on short term heart rate variability in heart failure patients. In this cross sectional study, we recruited 20 heart failure patients (EF: 30% - 40%) stabilized on standard medical therapy. HRV was recorded by using BIOHARNESS AcqKnowledge 4.1 version and analyzed by Kubios HRV 2.00 software. Five minutes of baseline HRV was recorded before and after the practice of 15 minutes of Shavasana. In time domain analysis there were increases in mean of RR intervals (from 1100.83 to 1184.41, p=0.017), SDNN (from 29 to 30.45), RMSSD (from 23.92 to 28.74)
while mean HR/1min decreased from 55.44 to 51.14 (p=0.018). In frequency domain analysis there was a decrease in LF/HF (from 4.04 to 2.34) and LF (from 71.43 to 67.12) with increase in HF (from 28.67 to 32.69) and Total power (from 794.90 to 842.95). The increase in SDNN, RMSSD, HF, Total power with decrease in Mean HR, LF and LF/HF in short term HRV suggests an increase in cardiac parasympathetic activity with decrease in cardiac sympathetic activity. We conclude that Shavasana can be used as an add-on therapy for maintenance of sympathovagal balance in heart failure patients.

**Study-6: Effects of eight week Yoga therapy programme on cardiovascular health in hypertensives** (14). The present study was undertaken to validate the usage of Yoga as an adjunct therapy in HT by evaluating the effects of a comprehensive eight week Yoga therapy programme in such patients. Fifteen hypertensives receiving standard medical treatment were recruited and anthropometric, cardiovascular and biochemical investigations were done before and after a comprehensive Yoga therapy programme comprising of three times a week sessions for 8 weeks. A post intervention, retrospective wellness questionnaire was used to evaluate the comparative feelings of the patients after the therapy programme. There was a statistically significant decrease in weight, BMI and all resting HR and BP indices. TC, TG, LDL and VLDL reduced significantly while HDL increased significantly. All cholesterol based ratios showed improvements. Post intervention overall wellness scores of the participants indicated that the majority were satisfied with their wellbeing after the programme. It is concluded that a comprehensive Yoga therapy programme has potential to enhance the beneficial effects of standard medical management of essential HT and can be used as an effective complementary or integrative therapy programme.

**Study-7: Immediate cardiovascular effects of pranava pranayama in hypertensive patients** (15). Slow, deep, pranayama - based breathing training has been shown to be effective in reducing BP. The present study was undertaken to determine immediate effects of performing pranava pranayama on cardiovascular parameters in hypertensive patients. Twenty nine hypertensive patients who were on medical treatment and also attending Yoga sessions were recruited for the present study. Supine HR and BP were recorded before and after performance of pranava pranayama for five minutes. Post intervention statistical analysis revealed a significant (p <0.05) reduction in SP and a more significant (p < 0.01)
reduction in HR, PP and Do P. The reduction in RPP was highly significant (p< 0.001). Pranava pranayama is effective in reducing HR and SP in hypertensive patients within five minutes of the practice. This may be due to a normalization of autonomic cardiovascular rhythms as a result of increased vagal modulation and / or decreased sympathetic activity and improved baroreflex sensitivity along with an augmentation of endogenous nitric oxide production. Our findings have potential therapeutic applications in day-to-day as well as clinical situations where BP needs to be brought down at the earliest. The significant fall in RPP and Do P signifies a reduction in oxygen consumption and work done by the heart. It is concluded that pranava pranayama, a simple and cost effective technique can be used in the management of hypertensive patients in addition to the regular medical management. Further studies are required to enable a deeper understanding of the mechanisms involved and its usefulness in the long term management of HT.

Study-8: Immediate effect of chandra nadi pranayama (left unilateral forced nostril breathing) on cardiovascular parameters in hypertensive patients. Yoga therapists routinely use CNP to help reduce BP in hypertensive patients. This is attributed to its stress lowering effects that have been documented by previous studies. Though there are some studies on the long term effect of CNP, there are no studies on its immediate effect on cardiovascular parameters in hypertensive patients. Twenty six hypertensive patients attending our Yoga OPD were recruited and taught CNP. They were then instructed to perform the same for five minutes in sitting position. HR and BP were recorded with non-invasive automatic BP apparatus before and immediately after the practice. RPP and Do P were derived by formulae. There was a significant (p < 0.001) reduction in HR from 75.5 ± 2.78 to 70 ± 2.72 beats/min, RPP from 106.15 ±4.53 to 96.06 ± 4.24 units and Do P from 76.36 ± 33.90 to 72.66 ± 33.36 units. A significant reduction (p < 0.01) occurred in SP from 140 ± 3.26 to 137 ± 3.12 mmHg and PP from 58.5 ± 2.78 to 50 ± 2.39 mmHg. There was a statistically insignificant rise in MP from 101 ± 1.97 to 103.67 ± 2.01 mmHg and DP from 81.5 ± 1.76 to 87 ± 1.76 mm Hg. CNP produced a significant decrease in HR and SP signifying a normalization of cardiovascular reflex mechanisms within 5 minutes. It also produced a significant fall in RPP and Do P signifying a reduction in oxygen consumption and work done by the heart. However the rise in DP and MAP is difficult to explain. Further studies with more subjects and control groups are required to understand the possible mechanisms underlying this immediate effect of CNP in hypertensive patients.
Study-9: Immediate cardiovascular effects of pranava relaxation in patients of hypertension and diabetes \(^{(17)}\). Relaxation therapy has been reported to be useful in management of HT and DM. Pranava pranayama is part of our comprehensive Yoga therapy schedules and hence this study planned to determine its immediate cardiovascular effects in supine position in patients with concomitant HT and DM. Twenty nine patients of HT and DM attending regular therapy sessions were recruited and randomly allotted to pranava or control groups. HR and BP were recorded before and after 10 minutes of “sham relaxation” in control group and 10 minutes of pranava pranayama in study group. Intra group comparison showed significant changes (p<0.05) in all parameters following pranava pranayama whereas this was only significant with respect to fall in HR (p=0.010) and rise in PP (p=0.016) in control group. Inter group comparison showed no significant differences between groups at baseline (p> 0.05). However post comparisons showed significant differences between groups with regard to SP (p=0.015), PP (p=0.018), MP (p=0.035) and RPP (p=0.047). Cardiovascular changes following pranava may be as a result of the prolonged exhalation phase producing a mild Valsalva like effect with decreased pre-load. Prolonged, audible chanting may improve baroreflex sensitivity and normalize autonomic cardiovascular rhythms. Reduction in RPP is representative of enhanced HRV power implying better autonomic regulation of the heart in our subjects. We conclude that pranava pranayam in the supine posture produces an integrated relaxation response, clinically valuable in patients with HT and DM.

Study-10: Suryanadi pranayama (right unilateral nostril breathing) may be safe for hypertensives \(^{(18)}\). Previous studies have suggested that exclusive right uni-nostril breathing known as SNP has sympathomimetic effects and hence, the present study was designed to determine immediate effects of 27 rounds of SNP on cardiovascular parameters in patients of essential HT. This has clinical significance in determining whether such a potentially sympathomimetic practice is safe in such a population. Twenty hypertensive patients on standard medical management were taught to perform SNP by qualified Yoga instructors. HR and BP were recorded after 5 minutes of rest in sitting posture and after 27 rounds of SNP. All data passed normality testing and hence was analyzed using Students t test for paired data. Statistical analysis revealed no statistically significant changes in any of the parameters following SNP. Gender based sub analysis of ∆% following SNP revealed no significant differences between male and female subjects. The absence of any significant
increase in HR or BP following SNP goes against earlier theories that it may be dangerous for hypertensive patients due to its sympathomimetic nature. SNP may not be increasing HR and BP in our subjects because they already had reached a certain threshold of reactivity. The goal of Yoga is to restore homeostasis. Hence, if sympathetic reactivity of a subject is already higher than normal, Yogic techniques will not further increase such a hyper reactivity but rather bring it back to normal. The small 1-2% decrease in most parameters in our study gives a hint of this possibility. In conclusion, our study offers evidence that exclusive right nostril breathing as performed in SNP may be safe in patients of HT. We also conclude that the cardiovascular effects of SNP in hypertensives are different than those reported by previous studies done in normal subjects.

Study-11: Effect of 12 week Yoga therapy as a lifestyle intervention in patients of type 2 diabetes mellitus with distal symmetric polyneuropathy – a randomized controlled study. Distal symmetric polyneuropathy, the commonest form of diabetic neuropathy (DN) is associated with significant morbidity and mortality. The only proven disease modifying treatment is a strict glycaemic control though there are emerging evidences that lifestyle modifications in the form of exercise and diet can modify the natural history of DN. We have attempted to evaluate the effect of 12 week Yoga therapy as a lifestyle intervention on the clinical outcome, neurophysiologic derangements and indices of glycaemic control in type 2 diabetic patients with distal symmetric polyneuropathy.

The Yoga therapy included Yogic counseling, breath-body coordination practices, static postures (asana), breathing practices (pranayama) and relaxation techniques. Patients were randomized to either Yoga or control group by block randomization and both the groups received standard medical care in the form of individualized drug therapy, diet and exercise counseling. Patients in the Yoga group underwent 3 supervised Yoga therapy sessions per week for 12 weeks. Compliance of patients to daily brisk walking was also good in both the groups. Patients were followed up rigorously by weekly telephonic conversations. Despite these efforts, drop-out rates reached 40%. Family obligations, change in work schedule and lack of motivation were the usual reasons for dropping out. A total of 25 patients in the Yoga group and 22 in the control group were successfully followed up. Among the anthropometric parameters, the only significant finding was an improvement in waist circumference in the Yoga group. Among biochemical parameters, there was no significant improvement in the Yoga group but there was a significant worsening of FG and HbA1c% in
the control group. No significant results were obtained with respect to HOMA-IR and lipid profile. Among the clinical parameters, there were significant improvements with respect to DNS score, DNE score and visual analogue score for pain in Yoga group. Vibration perception at great toe and ankle reflex also improved significantly.

Among the cardiovascular parameters, although SP decreased significantly in both groups, reductions with respect to DP and MP were exclusive to the Yoga group. Although short-term HRV and cardiovascular reflex tests did not yield significant results, there were trends of improvement in Yoga group and there was a significant deterioration of 30/15 ratio in the control group. The results of electrodiagnostic tests are interesting because there were improvements in both groups with respect to certain parameters. Since exercise can improve NCSs, this could be due to a very good adherence of control patients to daily brisk walking. However improvements with respect to tibial DML, and ulnar and median SNAP amplitudes were exclusive to Yoga. There were 2 instances in Yoga group where H-reflex appeared after follow-up period despite absent recordings at baseline. Thus Yoga therapy showed an additive effect to standard medical care by providing more benefits with respect to electrodiagnostic studies.

The results of our study provide preliminary evidence that Yoga when combined with standard medical care provides additional benefits in terms of improving clinical outcome, glycaemic control, resting cardiovascular parameters, cardiovagal modulation of heart and peripheral neurophysiologic derangements. These results may provide directions for further in-depth research evaluating efficacy of Yoga as a complementary therapy for DN.

Study-12: Effect of Yoga therapy on cardiac autonomic function in patients of essential hypertension – a randomized controlled study. HT is an asymptomatic chronic disorder prevalent throughout the world. The magnitude of the burden of HT not only needs an increase in awareness and treatment, but also lifestyle modification. Prior studies have shown that autonomic imbalance occurs in patients with HT and Yoga training restores the sympathovagal balance. In spite of growing popularity regarding the role of Yoga in the management of HT, relatively few rigorous, controlled studies have been conducted to study the therapeutic potential of Yoga. Patients with essential HT from JIPMER outpatient department satisfying study criteria, after obtaining a written informed consent, were randomly divided into two groups: Yoga group, n=34 (who underwent Yoga training along
with antihypertensive drugs as prescribed in OPD) and control group, n=36 (on antihypertensive drugs only). Yoga therapy consisting of static postures, breathing and relaxation techniques was given for a period of 12 weeks, thrice weekly at ACYTER. Lifestyle modifications like dietary pattern, physical activity, cessation of smoking and alcohol were advised to both groups.

Anthropometric parameters, resting BP and autonomic functions (short-term spectral analysis of HRV, HR and BP response to standing, deep breathing and handgrip) were recorded in all subjects before and after study period. There was a significant improvement in resting cardiovascular parameters like HR, BP, MP and RPP showing decrease in sympathetic activity at rest and better vagal modulation. Reduced HRV is a feature of essential HT and in our Yoga group, there was an improvement in resting HRV evidenced by increase in standard deviation of R-R interval, mean RR, total spectral power and RRi. There was an improvement in vagal modulation as evident from increase in high frequency power (HF), HF in normalized units and the ratio between highest HR during inspiration and lowest during expiration (I-E ratio) during deep breathing test. Reduction in sympathetic activity was evident from decrease in low frequency spectral power in normalized unit and $\Delta HR_{max}$ in response to standing suggesting improvement of sympathovagal balance. In reactivity tests, there was an insignificant improvement in vagal modulation and decrease in sympathetic reactivity. It is concluded that 12 weeks of Yoga therapy can improve cardiac autonomic functions in patients of essential HT if practiced regularly along with other lifestyle modifications and drugs. Therefore, Yoga therapy can be prescribed along with antihypertensive drugs to restore sympathovagal homeostasis.

**CONCLUSION:**

The selected research studies discussed above provide evidence of the therapeutic potential of Yoga in HT, DM, CVD and other disorders like hypothyroidism. These may provide the basis for further studies that can explore the physiological, psychological and biochemical mechanisms behind such beneficial effects. The strength of our work is the excellent compliance of our patients as well as the fact that these studies were been done in actual patient populations as opposed to most Yoga research studies that are done primarily in normal subjects.
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EFFECT OF YOGA THERAPY ON REACTION TIME, BIOCHEMICAL PARAMETERS AND WELLNESS SCORE OF PERI AND POST MENOPAUSAL DIABETIC PATIENTS
INTRODUCTION

The role of yoga in promoting health and preventing and managing psychosomatic disorders has been established by numerous scientific studies \(^1\). Yogic techniques produce consistent physiological changes and have sound scientific basis \(^2\). Yogic lifestyle modification produces remarkable improvements and can make an appreciable contribution to primary prevention as well as management of lifestyle diseases \(^3\).

It is now recognized that diabetes mellitus (DM) is a lifestyle and psychosomatic disorder in which factors such as sedentary habits and physical, emotional and mental stress play a major role. Modern research has focused on psycho-physiological beneficial effects of yoga as yoga is more than a mere physical exercise \(^4, 5, 6, 7, 8\). It has been reported that even a short lifestyle modification and stress management education program based on yoga reduces risk factors for cardiovascular disease and DM within a period of 9 days \(^9\) while a systematic review of 32 articles published between 1980 and 2007 found that yoga interventions are generally effective in reducing body weight, blood pressure, glucose level and high cholesterol \(^10\).

Yogic practices may have a role in prevention and management of diabetes and in comorbid conditions like hypertension and dyslipidemia \(^7\). Long term yoga practice is associated with increased insulin sensitivity and attenuation of negative relationship between body weight or waist circumference and insulin sensitivity \(^11\). With no appreciable side effects and multiple collateral benefits, yoga is safe, is simple to learn and can be practiced by even ill, elderly or disabled individuals \(^4\). Being safe, simple and economical therapy, it should be considered a beneficial adjuvant for DM patients \(^12\).

A comprehensive review by Innes and Vincent \(^4\) found beneficial changes in several risk indices, including glucose tolerance, insulin sensitivity, lipid profile, anthropometric characteristics, blood pressure, oxidative stress, coagulation profiles, sympathetic activation and pulmonary function, as well as improvement in specific clinical outcomes. They suggested that yoga may improve risk profiles in adults with non insulin dependent (NIDDM) and may have promise for the prevention and management of cardiovascular complications in this population.

Reduced ovarian function after menopause results in adverse changes in glucose and insulin metabolism with derangement of lipoprotein profile that is associated with increased risk of cardiovascular disease \(^13\). The present study was undertaken to evaluate the effects of a
comprehensive six week yoga therapy programme on reaction time, biochemical parameters and wellness score in pre, peri and post menopausal female diabetic patients.

MATERIALS AND METHODS

The present study was conducted as part of a larger study on the effects of yoga therapy on DM that had been accorded permission by the Research and Ethics Councils of the institute. 15 female patients aged 36 – 63 y (50.40 ± 2.47 SEM) receiving medical treatment for type 2 DM at JIPMER were recruited for this study by accidental sampling method and informed consent obtained from them. None of the patients had previously engaged in yoga practice. 11 of them were menopausal for more than a year and 4 were either pre or peri-menopausal. 4 of them had coexisting hypertension, 3 musculoskeletal disorders and 7 neurological disorders. Patients with history, signs and symptoms and/or laboratory reports suggestive of nephrologic and ophthalmologic complications were excluded from the study. The following parameters were tested before and after the 6 week study period.

Reaction time (RT): RT apparatus (Anand Agencies, Pune) was used for the study. The instrument has a built-in 4 digit chronoscope with a display accuracy of 1 ms. It features four stimuli, two response keys and a ready signal. Switch for selecting right or left response key for any stimulus is provided. Recordings were taken in an air-conditioned laboratory two hours after a light breakfast. To avoid the effect of lateralised stimulus, visual and auditory signals were given from the front of the subject who was instructed to use his right hand first and then left hand while responding to the signal. In the present study auditory reaction time (ART) was recorded for auditory beep tone stimulus and visual reaction time (VRT) for red light stimulus. The subjects were instructed to release the response key as soon as they perceived the stimulus. The signals were given from the front of the subjects to avoid the effect of lateralised stimulus and they used their dominant hand while responding to the signal (14, 15). All subjects were given adequate exposure to the equipment on 2 different occasions to familiarize them with the procedure of RT measurement. This was done because RT is more consistent when subjects have had adequate practice (16). RT was obtained with an accuracy of 1 ms. More than ten trials were recorded and mean of three similar observations was taken as a single value for statistical analysis.
**Biochemical investigations:** Biochemical investigations were done at the Central Lab of the institute where blood was drawn from an antecubital vein in postabsorptive state. On the day of the blood collection, subjects were asked to abstain from yoga practice. Fasting blood glucose (FBG), 2-hr postprandial blood glucose (PPBG) and lipid profile including total cholesterol (TC), triglyceride (TG), high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) were requisitioned and evaluated before and after the study period.

**Wellness questionnaire:** A post intervention, retrospective wellness questionnaire compiled by ACYTER was used to evaluate the comparative feelings of the patients after the therapy programme. Five different responses ranging from ‘worse than before’ up to “complete relief / total satisfaction’ were utilized to evaluate various physical and psychological aspects of the patient’s condition. The questionnaire was finalized in consultation with a 12 member team consisting of 3 eminent medical practitioners, 2 psychologists, 2 yoga experts, 2 eminent yoga therapy consultants, 2 educationalists and one legal anthropologist.

**Yoga therapy programme:** The patients had an initial consultation session at the ACYTER Yoga OPD and were given yogic counselling and lifestyle modification advice. They then attended the special sessions conducted at ACYTER for diabetes patients. A comprehensive yoga therapy programme was imparted to the patients by qualified yoga instructors at ACYTER for the duration of 60 min thrice a week for 6 weeks. The schedule is given in Table I. Patients were advised to practise without over straining depending on their individual capacity. There was 99.63% attendance during the 18 directly supervised sessions. Patients were also motivated to practice at home on other days. Of the 15 patients, 5 reported a home practice of 4 days/week, 4 a practice 3 days/week and 2 practiced 2 days/week at home. One patient each reported that they practiced 5, 6, and 7 days/week at home while one reported they didn’t practice at home at all. Analysis of patient feedback showed that the duration of home practice was 30 min for 9 patients, 60 min for 3 patients and 40 min for 2 patients.
Table I. Sequence and duration of yoga techniques practised by our subjects.

<table>
<thead>
<tr>
<th>Yoga technique</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Surya namaskar</td>
<td>10.0</td>
</tr>
<tr>
<td>2 Tadasan</td>
<td>0.5</td>
</tr>
<tr>
<td>3 Parivritta trikonasan</td>
<td>1.0</td>
</tr>
<tr>
<td>4 Padahastasan</td>
<td>0.5</td>
</tr>
<tr>
<td>5 Ardh-kati-chakrasan</td>
<td>1.0</td>
</tr>
<tr>
<td>6 Vakrasan</td>
<td>1.0</td>
</tr>
<tr>
<td>7 Pashchimottananasan</td>
<td>0.5</td>
</tr>
<tr>
<td>8 Pavanamuktasana</td>
<td>2.0</td>
</tr>
<tr>
<td>9 Ardha halasan</td>
<td>0.5</td>
</tr>
<tr>
<td>10 Bhujangasan</td>
<td>0.5</td>
</tr>
<tr>
<td>11 Dhanurasan</td>
<td>0.5</td>
</tr>
<tr>
<td>12 Viparitakarani</td>
<td>1.0</td>
</tr>
<tr>
<td>13 Chandranadi pranayam</td>
<td>2.0</td>
</tr>
<tr>
<td>14 Pranav pranayam</td>
<td>4.0</td>
</tr>
<tr>
<td>15 Nadi shuddhi</td>
<td>2.0</td>
</tr>
<tr>
<td>16 Savitri pranayam</td>
<td>3.0</td>
</tr>
<tr>
<td>17 Kayakriya</td>
<td>10.0</td>
</tr>
<tr>
<td>18 Shavasan</td>
<td>10.0</td>
</tr>
<tr>
<td>Rest period in-between practices</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>60 min</td>
</tr>
</tbody>
</table>
**Statistical analysis:** Data was assessed for normality using GraphPad InStat and passed normality testing by Kolmogorov-Smirnov Test. Statistical analysis was done using Students t (paired) test and p values less than 0.05 were accepted as indicating significant differences between pre and post intervention data.

**RESULTS**

**Reaction time:** Yoga training decreased ART and VRT from both right and left hands. However, the decrease was statistically significant (p = 0.0357) only for ART from the right hand (from 196.87 ± 9.25 to 178.04 ± 6.36 ms). The decrease in ART from left hand from 193.31 ± 6.19 to 179.44 ± 5.03 ms was appreciable (7.18%) but missed statistical significance (p=0.0583). The decrease in VRT from right as well as left hand was not statistically significant (Table II).

**Table II: Effect of 6 weeks yoga therapy on visual reaction time (VRT) and auditory reaction time (ART) from right and left hands of type 2 diabetes mellitus patients before (B) and after (A) the study period.**

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>A</th>
<th>% Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VRT (ms)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right hand</td>
<td>250.82</td>
<td>241.07</td>
<td>-3.89</td>
<td>0.1096</td>
</tr>
<tr>
<td></td>
<td>± 7.42</td>
<td>± 5.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left hand</td>
<td>259.80</td>
<td>251.44</td>
<td>-3.22</td>
<td>0.1931</td>
</tr>
<tr>
<td></td>
<td>± 7.72</td>
<td>± 4.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ART (ms)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right hand</td>
<td>196.87</td>
<td>178.04</td>
<td>-9.56</td>
<td>0.0357</td>
</tr>
<tr>
<td></td>
<td>± 9.25</td>
<td>± 6.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left hand</td>
<td>193.31</td>
<td>179.44</td>
<td>-7.18</td>
<td>0.0583</td>
</tr>
<tr>
<td></td>
<td>± 6.19</td>
<td>± 5.03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are mean ± SEM for 15 subjects.

**Biochemical investigations:** FBG decreased significantly (p=0.0035) by 20.62% from 160.07 ± 15.65 to 127.07 ± 10.24 mg/dl. PPBG also decreased significantly (p = 0.0012) by 14.52% from 244.20 ± 17.12 to 208.73 ± 16.07 mg/dl.
There was a statistically significant \((p = 0.016)\) decrease in TC from 161.24 ± 9.10 to 152.95 ± 7.17 mg/dl (5.14 %). The 9.89 % decrease in TG from 110.53 ± 10.56 to 99.60 ± 8.37 mg/dl was also significant \((p = 0.020)\) along with the 10.64% decrease in LDL from 96.53 ± 9.46 to 86.27 ± 7.78 mg/dl \((p= 0.0012)\) and a significant \((p=0.022)\) 9.77% decrease in VLDL from 22.11 ± 2.11 to 19.95 ± 1.67 mg/dl.

Table III: Effect of 6 weeks yoga therapy on fasting blood glucose (FBG), postprandial blood glucose (PPBG), total cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL), very low density lipoprotein (VLDL) and high density lipoprotein (HDL) in patients of type 2 diabetes mellitus before (B) and after (A) the study period.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>A</th>
<th>% Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBG (mg/dl)</td>
<td>160.07 ± 15.65</td>
<td>127.07 ± 10.24</td>
<td>-20.62</td>
<td>0.0035</td>
</tr>
<tr>
<td>PPBG (mg/dl)</td>
<td>244.20 ± 17.12</td>
<td>208.73 ± 16.07</td>
<td>-14.52</td>
<td>0.0012</td>
</tr>
<tr>
<td>TC (mg/dl)</td>
<td>161.24 ± 9.10</td>
<td>152.95 ± 7.17</td>
<td>-5.14</td>
<td>0.0161</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>110.53 ± 10.56</td>
<td>99.60 ± 8.37</td>
<td>-9.89</td>
<td>0.0203</td>
</tr>
<tr>
<td>LDL (mg/dl)</td>
<td>96.53 ± 9.46</td>
<td>86.27 ± 7.78</td>
<td>-10.64</td>
<td>0.0012</td>
</tr>
<tr>
<td>VLDL (mg/dl)</td>
<td>22.11 ± 2.11</td>
<td>19.95 ± 1.67</td>
<td>-9.77</td>
<td>0.0222</td>
</tr>
<tr>
<td>HDL (mg/dl)</td>
<td>42.60 ± 5.16</td>
<td>47.07 ± 5.08</td>
<td>+10.49</td>
<td>0.0229</td>
</tr>
<tr>
<td>TC / HDL</td>
<td>4.36 ± 0.46</td>
<td>3.60 ± 0.31</td>
<td>-17.37</td>
<td>0.0035</td>
</tr>
<tr>
<td>LDL / HDL</td>
<td>2.77 ± 0.40</td>
<td>2.15 ± 0.27</td>
<td>-22.41</td>
<td>0.0059</td>
</tr>
<tr>
<td>HDL / LDL</td>
<td>0.65 ± 0.21</td>
<td>0.77 ± 0.24</td>
<td>+19.13</td>
<td>0.0165</td>
</tr>
</tbody>
</table>

Values are mean ± SEM for 15 subjects.
On the other hand HDL increased significantly (p = 0.022) from 42.60 ± 5.16 to 47.07 ± 5.08 mg/dl, an increase of 10.49 %. There was a significant (p = 0.003) decrease of 17.37% in TC/HDL ratio from 4.36 ± 0.46 to 3.60 ± 0.31, a significant (p = 0.005) decrease of 22.41% in LDL/HDL ratio from 2.77 ± 0.40 to 2.15 ± 0.27. There was a significant (p = 0.016) increase of 19.13% in the HDL/LDL ratio from 0.65 ± 0.21 to 0.77 ± 0.24.

**Wellness questionnaire:**

The post intervention overall wellness scores of the participants are given in Fig 1 and the detailed breakup of % responses to each question is given in Table IV.

![Fig 1. Post intervention overall % responses of the participants to the wellness questionnaire](image)

The results of the total overall retrospective wellness scores indicated that 7% attained complete relief and total satisfaction after the therapy programme while 27% were much better than before. 42% were better than before while 23% reported no change in their condition. The condition of 1% was worse than before.
Table IV: Post intervention % responses of the participants to retrospective wellness questionnaire

<table>
<thead>
<tr>
<th></th>
<th>Worse than before</th>
<th>Same as before</th>
<th>Better than before</th>
<th>Much better than before</th>
<th>Complete relief / Totally satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to concentrate</td>
<td>-</td>
<td>28.57</td>
<td>50</td>
<td>21.43</td>
<td>-</td>
</tr>
<tr>
<td>Control of anger / loss of temper</td>
<td>-</td>
<td>35.71</td>
<td>28.37</td>
<td>28.57</td>
<td>7.14</td>
</tr>
<tr>
<td>Appetite</td>
<td>-</td>
<td>33.33</td>
<td>25</td>
<td>25</td>
<td>16.67</td>
</tr>
<tr>
<td>Confidence level</td>
<td>-</td>
<td>28.57</td>
<td>42.86</td>
<td>21.43</td>
<td>7.14</td>
</tr>
<tr>
<td>Ease of breathing</td>
<td>-</td>
<td>26.67</td>
<td>40</td>
<td>26.67</td>
<td>6.67</td>
</tr>
<tr>
<td>Energy levels</td>
<td>-</td>
<td>33.33</td>
<td>33.33</td>
<td>33.33</td>
<td>-</td>
</tr>
<tr>
<td>Enjoyment of life</td>
<td>-</td>
<td>20</td>
<td>60</td>
<td>6.67</td>
<td>13.33</td>
</tr>
<tr>
<td>Feeling calm &amp; fresh</td>
<td>-</td>
<td>33.33</td>
<td>33.33</td>
<td>26.67</td>
<td>6.67</td>
</tr>
<tr>
<td>Feeling of hopelessness</td>
<td>-</td>
<td>40</td>
<td>40</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Feeling of loneliness</td>
<td>-</td>
<td>6.67</td>
<td>60</td>
<td>33.33</td>
<td>-</td>
</tr>
<tr>
<td>General flexibility</td>
<td>-</td>
<td>13.33</td>
<td>53.33</td>
<td>26.67</td>
<td>6.67</td>
</tr>
<tr>
<td>General mood</td>
<td>-</td>
<td>8.33</td>
<td>50</td>
<td>33.33</td>
<td>8.33</td>
</tr>
<tr>
<td>General sense of relaxation</td>
<td>-</td>
<td>14.28</td>
<td>50</td>
<td>28.57</td>
<td>7.14</td>
</tr>
<tr>
<td>General wellbeing</td>
<td>-</td>
<td>7.69</td>
<td>38.46</td>
<td>53</td>
<td>-</td>
</tr>
<tr>
<td>Joint mobility</td>
<td>-</td>
<td>13.33</td>
<td>40</td>
<td>33.33</td>
<td>13.33</td>
</tr>
<tr>
<td>Nervousness</td>
<td>-</td>
<td>28.57</td>
<td>57.14</td>
<td>14.29</td>
<td>-</td>
</tr>
<tr>
<td>Normality of menstrual cycles</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>Pain levels</td>
<td>-</td>
<td>13.33</td>
<td>53.33</td>
<td>26.67</td>
<td>6.67</td>
</tr>
<tr>
<td>Performance of day-to-day activities</td>
<td>-</td>
<td>21.43</td>
<td>42.86</td>
<td>35.71</td>
<td>-</td>
</tr>
<tr>
<td>Sleep quality / duration</td>
<td>13.33</td>
<td>20</td>
<td>26.67</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Stress levels</td>
<td>9.09</td>
<td>27.27</td>
<td>36.36</td>
<td>27.27</td>
<td>-</td>
</tr>
<tr>
<td>Total wellbeing score</td>
<td>1.07</td>
<td>22.80</td>
<td>42.19</td>
<td>26.76</td>
<td>7.13</td>
</tr>
</tbody>
</table>
DISCUSSION

In an earlier work, we have reported that diabetic patients have a longer RT as compared to normal subjects (14). In the present work, we have demonstrated that a comprehensive 6-week yoga therapy programme produces a significant shortening in ART in diabetic patients. To the best of our knowledge, this is the first such report. Shortening of RT can be explained by increase in sensory-motor conduction velocity and/or faster information processing in the central nervous system (17). This has physiological as well as clinical significance as faster RT means better performance of sports personnel, precision surgeons and other professionals. Here, it is interesting to note that we have previously reported an immediate shortening of RT following the practice of nine rounds of mukha bhasrika, a bellows type of yoga breathing (18).

Fasting as well as post-prandial blood glucose levels decreased significantly in our subjects following the yoga therapy programme. This is consistent with earlier studies that have reported that yoga training results in a reduction in both FBG and PPBG levels and better glycaemic control (8, 19). The 20.62% reduction in FBG in our subjects is comparable with the 6.1 - 34.4% reduction reported in a review of 25 studies on yoga and diabetes by Innes and Vincent (4). Sahay (7) has reported an improvement in insulin sensitivity and decline in insulin resistance in subjects practising yoga while Manjunatha et al (20) reported that the performance of asanas leads to an increased sensitivity of the β cells of pancreas to glucose signals. It is possible that a similar mechanism is responsible for the improvements in blood sugar levels of our subjects. Increased sympathetic activity, enhanced cardiovascular reactivity and reduced parasympathetic tone have been strongly implicated in the pathogenesis of insulin resistance syndrome, atherosclerosis and cardiovascular diseases. Innes and Vincent (4) have suggested that yoga reduces this risk profile by decreasing activation of the sympatho-adrenal system and the hypothalamic-pituitary-adrenal axis and also by promoting a feeling of wellbeing along with direct enhancement of parasympathetic activity via vagus nerve. They also suggested that yoga provides a positive source of social support that is a factor associated with reduced risk for cardiovascular diseases. All these factors are applicable to our study and may explain the positive changes produced following the adherence to the comprehensive yoga therapy programme.

The significant decreases in TC, TG, LDL and VLDL values coupled with significant increase in HDL in our participants implies an improved lipid profile having good prognostic value. This decrease of ‘bad’ cholesterol and a concomitant increase in ‘good’
cholesterol has significance when viewed in light of the cardiovascular risk profile of diabetic patients (4). It has been previously reported that hatha yoga exercise and conventional PT exercise may have preventative and protective effects on DM by decreasing oxidative stress and improving antioxidant status (21). A similar mechanism may be working in our patients as a systematic review also found the effects of yoga training to be more prominent with regard to fasting blood glucose level and lipid profile (22). Innes and Vincent (4) reported that all 12 studies reviewed by them suggested that yoga improves lipid profile. Reductions in TC, TG, and LDL, VLDL and increase in HDL in our subjects are comparable with the findings of their review. Upon analysis of the different relative cholesterol ratios, it is apparent that the yoga therapy programme improved the ‘heart friendly’ status of lipid profile in our subjects. Normally the ‘safe’ TC/HDL ratio should be less than 4. This was initially 4.36 ± 0.46 in our patients and after the 6-week therapy programme decreased by 17.37% to a safe level of 3.60 ± 0.31. A healthy LDL/HDL ratio should be less than 3. Though the initial pre-training level in our subjects was a higher normal value it also reduced by 22.41% to a lower normal value. HDL/LDL ratio should normally be more than 0.3 but it is preferable to maintain it above 0.4. This also increased by 19.13 % to a higher normal value implying better prognosis of cardiovascular health.

Malhotra et al (8) reported a significant decrease in waist-hip ratio and changes in insulin levels, suggesting a positive effect of yoga asanas on glucose utilization and fat redistribution in NIDDM. This is applicable in the present work as most of the practices used in both studies are the same or of similar nature. In light of the above findings, our study reiterates the conclusion made by Innes and Vincent that yoga may improve risk profiles in adults with NIDDM and has promise in preventing and managing cardiovascular complications in this population (4).

The findings of an improved lipid profile status is especially important in our study as 11 of the participants were postmenopausal while the other 4 were pre and peri-menopausal. Loss of ovarian function after menopause results in adverse changes in glucose and insulin metabolism with derangement of lipid profile that is associated with increased risk of cardiovascular disease (13). It has also been reported that heart disease increases 5 times in females who have DM and that the ‘female advantage’ over men with regard to coronary heart disease is lost after menopause (23). Hence the positive changes in lipid profile in our peri-menopausal diabetic subjects have great significance.
It has been reported that a short lifestyle modification and stress management educational program leads to remarkable improvement in the subjective wellbeing scores and can therefore make an appreciable contribution to primary prevention as well as management of lifestyle diseases (3). Majority of our patients reported an improvement in appetite, ability to concentrate, control anger, confidence levels, ease of breathing, energy level, enjoyment of life with calm and fresh feeling (Table IV and Fig 1). They also reported a reduced feeling of hopelessness, nervousness and loneliness. They reported improvements in general flexibility and joint mobility along with better general mood, sense of relaxation and wellbeing. Menstrual cycles normalized in all four patients who were pre and perimenopausal. There was a decrease in stress levels with improved quality and duration of sleep. This is similar to a recent report that yoga improves psychological outcomes in type 2 diabetes patients with improved well-being and reduced anxiety (24). Yoga may be improving mental and emotional components of the personality and subjective well being reported by our participants may be a contributing psycho-physiological factor in the desirable improvements shown by our patients. This aspect needs further exploration. Interestingly, one participant who didn’t practice at home reported that there was an increase in her medication while the one who practiced every day at home, reported that her medication had reduced. Though both had reported improvements in the well being questionnaire, responses of the one who practiced every day were in the range of ‘much better’ to ‘total relief’ while responses of the other one were mainly in the ‘same’ to ‘better’ range.

The potential benefits being contributed by the different practices in our study may be hypothesized as follows. Surya namaskar may be improving metabolic function, helping utilize excess glucose while toning up the musculoskeletal system. Tadasan evokes a sense of stability and balance both physically and mentally while asanas such as parivritta trikonasani, padahastasan, ardha-kati-chakrasan, vakrasan, paschimottanasan, pavanamuktasan, bhujangasan and dhanurasan by their twisting and compression-relaxation actions may be stimulating intra-abdominal organs such as liver and pancreas thus producing benefits in the lipid profile. Ardha halasan and viparitakarani may be harmonizing psycho-neuro-endocrine function as seen in reaction time while chandranadi pranayam may be normalizing autonomic balance. Pranav pranayam, nadi shuddhi and savitri pranayam may contribute towards a sense of calmness that enhances inherent healing
potentials while kayakriya and shavasan create a sense of mind-body harmony that corrects the psycho-somatic component of DM.

The main strength of present study is the excellent compliance and regularity of the yoga practice by the patients both during the directly supervised sessions (99.63% attendance) and at home, where all except one patient practiced regularly for an average of 4 days/week and 30-40 min per day. Hence the all-round benefits obtained can be attributed to the dedicated and regular practice of our comprehensive yoga therapy programme. As the participants were peri and post menopausal, the decrease in cardiovascular risk profile is of great significance.

The main drawback of our study is lack of a control group and the accidental sampling method used. As our participants were also receiving standard hospital medication, it is difficult to determine the relative effects of yoga and medical management. However, as there was no change in the medical management protocol that had already stabilized the clinical status of our patients, we can reasonably conclude that the additional benefits are due to the yoga therapy programme. It is suggested that further randomized control studies be done to confirm these findings and facilitate a deeper understanding of the mechanisms underlying such beneficial results.

In conclusion, our study shows that a comprehensive 6-week yoga therapy training programme produces significant improvement in reaction time, blood glucose and lipid profile of peri and post menopausal diabetes patients. A comprehensive yoga therapy programme has the potential to enhance the beneficial effects of standard medical management of DM and can be used in an effective complementary or integrative therapy programme.

REFERENCES


EFFECTS OF A COMPREHENSIVE EIGHT WEEK YOGA THERAPY PROGRAMME ON CARDIOVASCULAR HEALTH IN PATIENTS OF ESSENTIAL HYPERTENSION
INTRODUCTION

Hypertension (HT) is one of the most common health disorders prevalent worldwide and is a major risk factor for stroke, coronary artery disease and organ failure. Increased sympathetic activity, enhanced cardiovascular reactivity and reduced parasympathetic tone have been strongly implicated in the pathogenesis of atherosclerosis, cardiovascular disease and insulin resistance which are leading causes of death and disability worldwide.1

Yoga can be an effective adjunct therapy in HT and various studies have demonstrated the scientific basis of using it as a therapy and as an effective lifestyle modification measure.2,3,4 Yoga is a popular means of relieving stress and improving fitness as it decreases stress and anxiety and improves health status. Yoga as a therapy is simple and inexpensive and can be easily adopted in most patients without any complications.5 Yoga therapy encompasses the use of asans, pranayams and relaxation techniques along with dietary advice and yogic counseling that address the root cause of the problem rather than merely providing symptomatic relief.6

Multiple simultaneous modifications of lifestyle are seen to provide the greatest lowering of blood pressure (BP) coupled with a reduced overall cardiovascular risk status. Though it may be difficult, it is of great value as even a small persistent reduction in BP can have a major protective effect on cardiovascular disease.7

It has been reported that autonomic deregulation underlies initiation and maintenance of HT and arterial baroreflex mechanisms operate in hypertensives albeit at a higher BP range.8 A previous study from our laboratory reported that yoga training optimizes sympathetic response to stressful stimuli like isometric handgrip and restores autonomic regulatory reflex mechanisms in hypertensive patients and that this occurs with just 4 weeks of training.5

With the above in mind, the present study was undertaken to evaluate the effects of a comprehensive eight week yoga therapy programme on anthropometric, cardiovascular and biochemical parameters in patients of essential HT.

MATERIALS AND METHODS

This study was conducted as part of a larger study on the effects of yoga therapy on essential HT that had been accorded permission by the Research and Ethics Councils of the
institute. 15 (9 male, 6 female) patients aged 25 – 65y ($M = 46.60$, $SEM=2.95$) receiving standard medical treatment at JIPMER were recruited for this study by accidental sampling method and informed consent obtained from them. None of the patients had previously engaged in yoga practice. 7 of them had coexisting diabetes mellitus, 3 were suffering from respiratory disorders, 2 from musculoskeletal disorders and one from peptic ulcer. Patients with history, signs, symptoms and/or laboratory reports suggestive of nephrologic and ophthalmologic complications were excluded from the study. The following parameters were tested before and after the 8 week study period.

**Anthropometry:** Anthropometric measurements were made prior to BP recording. Subjects were weighed in normal clothing to the nearest 0.1 kg (Krups, New Delhi). Their height was measured to the nearest 0.1 cm on a calibrated stature meter (Nisco, Delhi). Body mass index (BMI) was calculated as weight (Kg) / height (m$^2$).

**Cardiovascular parameters:** Recordings were taken in an air-conditioned laboratory two hours after a light breakfast. Basal recordings were taken in sitting posture after 5 minutes of rest in a chair. Systolic pressure (SP) and diastolic pressure (DP) and heart rate (HR) were measured with non-invasive semi-automatic BP monitor (Omron Inc., Japan). Rate-pressure product ($RPP = SP \times HR \times 10^{-2}$) and double product ($DoP = HR \times MP \times 10^{-2}$) were calculated for each recording.

**Biochemical investigations:** Biochemical investigations were done at the JIPMER Central Laboratory where blood was drawn from an antecubital vein in post-absorptive state. On the day of the blood collection, subjects were asked to abstain from yoga training. Lipid profile including total cholesterol (TC), triglyceride (TG), high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) were requisitioned and evaluated.

**Wellness questionnaire:** A post intervention, retrospective wellness questionnaire compiled by ACYTER team was used to evaluate the comparative feelings of the patients after the therapy programme. Five different responses ranging from ‘worse than before’ to “complete relief / totally satisfied” were utilized to evaluate various physical and psychological aspects of the patient’s condition. The questionnaire was finalized in consultation with a 12 member team consisting of 3 eminent medical practitioners, 2
psychologists, 2 yoga experts, 2 eminent yoga therapy consultants, 2 educationists and one legal anthropologist.

**Yoga therapy programme:** The patients had an initial consultation session at the ACyTER Yoga OPD and were given yogic counseling and lifestyle modification advice including increased physical activity, reduction of dietary sodium, increased dietary consumption of potassium through fresh fruits and vegetables along with a diet rich in fiber.

They then attended the special yoga practice sessions conducted at ACyTER for HT patients. A comprehensive yoga therapy programme was imparted to the patients by qualified yoga instructors for the duration of 60 min thrice a week for 8 weeks.

There was 99.17% attendance during the 24 directly supervised sessions. Patients were also motivated to practice the yoga therapy schedule at home on other days. Of the 15 patients, 5 reported a home practice of 3 days/week, 3 practiced 2 days/week and 2 practiced 4 days/week and 1 day/week at home.

One patient each reported that they practiced 6 and 7 days/week at home while one reported they didn’t practice at home at all. Analysis of patient feedback showed that the duration of home practice was 30 min for 7 patients, 20 min for 4 patients and 60 min for 2 patients and 40 min for one. Patients were advised to do the practices without over straining depending on their individual capacity. The schedule is given in Table I.

**Statistical analysis:**

Statistical analysis of pre and post intervention data was done using GraphPad InStat version 3.06 for Windows 95, GraphPad Software, San Diego California USA, www.graphpad.com. Data that passed normality testing by Kolmogorov-Smirnov Test was analyzed using Students paired t test.

Data that failed normality testing was analyzed using Wilcoxon Matched-Pairs Signed-Ranks test. \( P \) values less than 0.05 were accepted as indicating significant differences between pre and post intervention data.
Table I. Sequence and duration of yoga techniques practised by our subjects.

<table>
<thead>
<tr>
<th>Yoga technique</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Talasan</td>
<td>0.5</td>
</tr>
<tr>
<td>2  Ardhkati chakrasan</td>
<td>1.0</td>
</tr>
<tr>
<td>3  Ushtrasan</td>
<td>0.5</td>
</tr>
<tr>
<td>4  Balasan</td>
<td>0.5</td>
</tr>
<tr>
<td>5  Sashasan</td>
<td>0.5</td>
</tr>
<tr>
<td>6  Matsyasan</td>
<td>0.5</td>
</tr>
<tr>
<td>7  Pashchimottanasan</td>
<td>0.5</td>
</tr>
<tr>
<td>8  Pavanamuktasan</td>
<td>3.0</td>
</tr>
<tr>
<td>9  Dwipad uttanasan</td>
<td>0.5</td>
</tr>
<tr>
<td>10 Bhujangasan</td>
<td>0.5</td>
</tr>
<tr>
<td>11 Chandranadi pranayam</td>
<td>3.0</td>
</tr>
<tr>
<td>12 Vibhag pranayam</td>
<td>3.0</td>
</tr>
<tr>
<td>13 Pranav pranayam</td>
<td>5.0</td>
</tr>
<tr>
<td>14 Nadi shuddhi</td>
<td>3.0</td>
</tr>
<tr>
<td>15 Vyagrah pranayam</td>
<td>1.0</td>
</tr>
<tr>
<td>16 Bhramari pranayam</td>
<td>3.0</td>
</tr>
<tr>
<td>17 Savitri pranayam</td>
<td>3.0</td>
</tr>
<tr>
<td>18 Kayakriya</td>
<td>6.0</td>
</tr>
<tr>
<td>19 Shavasan</td>
<td>15.0</td>
</tr>
<tr>
<td>Rest period in-between practices</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>60 min</td>
</tr>
</tbody>
</table>
RESULTS

The results are given in Tables II, III, IV and Figure 1. All data are expressed as $M \pm SEM$.

Resting cardiovascular parameters: Students paired t test showed significant reductions in HR, $t (14) = 3.03$, $p = 0.0089$, SP, $t (14) = 7.78$, $p < 0.001$, DP, $t (14) = 4.25$, $p < 0.001$, PP $t (14) = 2.70$, $p = 0.0174$, MP $t (14) = 6.86$, $p < 0.001$, RPP, $t (14) = 7.28$, $p < 0.001$, DoP, $t (14) = 6.77$, $p < 0.001$.

Table II: Effect of 8 weeks yoga therapy programme on heart rate (HR), systolic pressure (SP), diastolic pressure (DP), pulse pressure (PP), mean pressure (MP), rate-pressure product (RPP) and double product (DoP) in patients of essential hypertension. B: before and A: after the 8 week study period.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>A</th>
<th>% Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beats/min)</td>
<td>84.13</td>
<td>80.53</td>
<td>-4.28</td>
<td>0.0089</td>
</tr>
<tr>
<td></td>
<td>± 2.79</td>
<td>± 2.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP (mmHg)</td>
<td>149.60</td>
<td>132.60</td>
<td>-11.36</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>± 3.13</td>
<td>± 2.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP (mmHg)</td>
<td>95.60</td>
<td>86.27</td>
<td>-9.76</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>± 3.10</td>
<td>± 1.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP (mmHg)</td>
<td>54.00</td>
<td>46.33</td>
<td>-14.20</td>
<td>0.0174</td>
</tr>
<tr>
<td></td>
<td>± 3.75</td>
<td>± 2.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP (mmHg)</td>
<td>113.60</td>
<td>101.71</td>
<td>-10.47</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>± 2.56</td>
<td>± 1.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPP (units)</td>
<td>125.95</td>
<td>106.79</td>
<td>-15.21</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>± 5.04</td>
<td>± 4.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DoP (units)</td>
<td>95.90</td>
<td>82.07</td>
<td>-14.42</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>± 4.40</td>
<td>± 3.47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are $M \pm SEM$ for 15 subjects.
Biochemical parameters: Wilcoxon Matched-Pairs Signed-Ranks test showed a statistically significant decrease in TC, $p=0.0084$ and TG, $p < 0.001$. Students paired t test showed significant reductions in LDL, $t (14) = 2.29$, $p = 0.038$, VLDL, $t (14) =4.27$, $p <0.001$ and significant increase in HDL, $t (14) =2.19$, $p= 0.046$.

Table III: Effect of 8 weeks yoga therapy programme on total cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL), very low density lipoprotein (VLDL), high density lipoprotein (HDL), TC/HDL ratio, LDL/HDL ratio, HDL/LDL ratio, weight, height and body mass index (BMI) in patients of essential hypertension. B: before and A: after the 8 week study period.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>A</th>
<th>% Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TC (mg/dl)</strong></td>
<td>173.67</td>
<td>161.07</td>
<td>- 7.26</td>
<td>0.0084</td>
</tr>
<tr>
<td></td>
<td>± 10.23</td>
<td>± 9.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TG (mg/dl)</strong></td>
<td>142.33</td>
<td>125.00</td>
<td>- 12.18</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>± 15.57</td>
<td>± 13.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LDL (mg/dl)</strong></td>
<td>108.87</td>
<td>101.73</td>
<td>- 6.56</td>
<td>0.0381</td>
</tr>
<tr>
<td></td>
<td>± 8.75</td>
<td>± 8.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VLDL (mg/dl)</strong></td>
<td>30.80</td>
<td>26.80</td>
<td>- 12.99</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>± 3.08</td>
<td>± 2.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HDL (mg/dl)</strong></td>
<td>39.00</td>
<td>41.87</td>
<td>+ 7.36</td>
<td>0.0459</td>
</tr>
<tr>
<td></td>
<td>± 2.24</td>
<td>± 2.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TC/HDL</strong></td>
<td>4.67</td>
<td>3.95</td>
<td>- 15.50</td>
<td>0.0214</td>
</tr>
<tr>
<td></td>
<td>± 0.39</td>
<td>± 0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LDL/HDL</strong></td>
<td>2.97</td>
<td>2.50</td>
<td>- 15.88</td>
<td>0.0181</td>
</tr>
<tr>
<td></td>
<td>± 0.35</td>
<td>± 0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HDL/LDL</strong></td>
<td>0.40</td>
<td>0.45</td>
<td>+ 13.75</td>
<td>0.0062</td>
</tr>
<tr>
<td></td>
<td>± 0.046</td>
<td>± 0.048</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>66.60</td>
<td>65.60</td>
<td>- 1.50</td>
<td>0.0039</td>
</tr>
<tr>
<td></td>
<td>± 1.98</td>
<td>± 1.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Height (m)</strong></td>
<td>1.62</td>
<td>1.62</td>
<td>0.00</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>± 0.02</td>
<td>± 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>25.54</td>
<td>25.16</td>
<td>- 1.49</td>
<td>0.0039</td>
</tr>
<tr>
<td></td>
<td>± 1.02</td>
<td>± 1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are $M \pm SEM$ for 15 subjects.
Wilcoxon Matched-Pairs Signed-Ranks test showed a statistically significant decrease in LDL/HDL, $p=0.018$ while Students paired $t$ test showed significant decrease in TC/HDL, $t(14) = 2.59$, $p = 0.021$ and increase in HDL/LDL, $t(14) = 3.21$, $p = 0.006$.

**Anthropometry:** Wilcoxon Matched-Pairs Signed-Ranks test showed a statistically significant ($p=0.0039$) decrease in both weight and BMI (Table III).

**Wellness questionnaire:** The post intervention overall wellness scores of the participants are given in Fig 1 and the detailed breakup of % responses to each question is given in Table IV.

![Pie chart](image)

**Fig 1. Post intervention overall % responses of the participants to the wellness questionnaire**

Overall responses to the retrospective wellness scores indicated that our patients felt a sense complete relief and total satisfaction (9%), they were much better than before (29%), they were better than before (36%) or felt no change in their condition (25%). The condition of 1% was reported to be worse than before the therapy programme.
Table IV: Post intervention % responses of the participants to retrospective wellness questionnaire

<table>
<thead>
<tr>
<th></th>
<th>Worse than before</th>
<th>Same as before</th>
<th>Better than before</th>
<th>Much better than before</th>
<th>Complete relief / Totally satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to concentrate</td>
<td>-</td>
<td>33.34</td>
<td>40</td>
<td>26.67</td>
<td>-</td>
</tr>
<tr>
<td>Control of anger / loss of temper</td>
<td>-</td>
<td>20</td>
<td>46.67</td>
<td>26.67</td>
<td>6.64</td>
</tr>
<tr>
<td>Appetite</td>
<td>-</td>
<td>23.07</td>
<td>46.15</td>
<td>23.07</td>
<td>7.69</td>
</tr>
<tr>
<td>Confidence level</td>
<td>-</td>
<td>20</td>
<td>26.67</td>
<td>20</td>
<td>6.64</td>
</tr>
<tr>
<td>Ease of breathing</td>
<td>-</td>
<td>20</td>
<td>40</td>
<td>26.67</td>
<td>13.34</td>
</tr>
<tr>
<td>Energy levels</td>
<td>-</td>
<td>38.46</td>
<td>23.07</td>
<td>30.76</td>
<td>7.69</td>
</tr>
<tr>
<td>Enjoyment of life</td>
<td>-</td>
<td>33.34</td>
<td>26.67</td>
<td>26.67</td>
<td>13.34</td>
</tr>
<tr>
<td>Feeling calm &amp; fresh</td>
<td>-</td>
<td>26.67</td>
<td>33.34</td>
<td>26.67</td>
<td>13.34</td>
</tr>
<tr>
<td>Feeling of hopelessness</td>
<td>-</td>
<td>20</td>
<td>40</td>
<td>33.34</td>
<td>6.64</td>
</tr>
<tr>
<td>Feeling of loneliness</td>
<td>-</td>
<td>33.34</td>
<td>26.67</td>
<td>33.34</td>
<td>6.64</td>
</tr>
<tr>
<td>General flexibility</td>
<td>-</td>
<td>20</td>
<td>53.34</td>
<td>13.34</td>
<td>13.34</td>
</tr>
<tr>
<td>General mood</td>
<td>-</td>
<td>14.28</td>
<td>35.71</td>
<td>35.71</td>
<td>14.28</td>
</tr>
<tr>
<td>General sense of relaxation</td>
<td>-</td>
<td>13.34</td>
<td>40</td>
<td>33.34</td>
<td>13.34</td>
</tr>
<tr>
<td>General wellbeing</td>
<td>-</td>
<td>14.28</td>
<td>42.85</td>
<td>42.85</td>
<td>-</td>
</tr>
<tr>
<td>Joint mobility</td>
<td>-</td>
<td>28.57</td>
<td>35.71</td>
<td>28.57</td>
<td>7.14</td>
</tr>
<tr>
<td>Nervousness</td>
<td>9.09</td>
<td>14.28</td>
<td>50</td>
<td></td>
<td>9.09</td>
</tr>
<tr>
<td>Pain levels</td>
<td>-</td>
<td>46.15</td>
<td>30.76</td>
<td>15.38</td>
<td>7.69</td>
</tr>
<tr>
<td>Performance of day-to-day activities</td>
<td>-</td>
<td>35.71</td>
<td>35.71</td>
<td>28.57</td>
<td>-</td>
</tr>
<tr>
<td>Sleep quality / duration</td>
<td>6.64</td>
<td>26.67</td>
<td>13.34</td>
<td>33.34</td>
<td>20</td>
</tr>
<tr>
<td>Stress levels</td>
<td>-</td>
<td>26.67</td>
<td>26.67</td>
<td>40</td>
<td>6.64</td>
</tr>
<tr>
<td><strong>Total wellbeing score</strong></td>
<td><strong>0.79</strong></td>
<td><strong>25.41</strong></td>
<td><strong>35.67</strong></td>
<td><strong>28.68</strong></td>
<td><strong>8.67</strong></td>
</tr>
</tbody>
</table>
DISCUSSION

**Anthropometric parameters:** The yoga therapy programme resulted in a small yet significant ($p=0.0039$) reduction of weight and BMI. The lesser magnitude of change may be attributed to a lower initial BMI of our participants ($25.54 \pm 1.02 \text{ kg/m}^2$) and gentle and relaxed practice schedule appropriate for patients of HT. This provides an insight into a positive trend towards normalcy even though the magnitude of change may not be great. The reduction of $0.38 \text{ kg/m}^2$ in the present study (Table III) is comparable to other studies that have reported significant reductions in BMI following yoga training. Recent studies have reported reductions of $0.5 \text{ kg/m}^2$ after 3 months $^9$ and $0.57 \text{ kg/m}^2$ after a 6-day residential yoga programme in patients whose initial BMI was $> 30 \text{ kg/m}^2$. $^10$ A reduction of a greater magnitude ($0.62 \text{ kg/m}^2$) was reported in patients whose initial BMI was $> 30 \text{ kg/m}^2$. $^11$ A normalization of BMI is significant since it has been reported that women over 18 with an initial BMI of 24 developed diabetes five times more often and HT twice more often than women with BMI $\leq 21$. $^7$

**Cardiovascular parameters:** Increased sympathetic activity, enhanced cardiovascular reactivity and reduced parasympathetic tone have been strongly implicated in the pathogenesis of atherosclerosis and cardiovascular diseases. $^{12}$ Innes and Vincent suggested that yoga reduces this risk profile by decreasing activation of the sympatho-adrenal system and the hypothalamic-pituitary-adrenal axis and also by promoting a feeling of wellbeing along with direct enhancement of parasympathetic activity via the vagus nerve. $^{12}$ Balasan, matsyasan and sashasan may be altering the hemodynamics in the thoracic cavity and thus influencing the vagus nerve. In an earlier study from our laboratory, we have reported that 3 months of pranayam training results in modulation of ventricular performance by increasing parasympathetic activity and decreasing sympathetic activity. $^{13}$ As nadishuddhi, pranav and savitri pranayams were part of that study as well as the present study, they may have produced a similar effect in our subjects. In their review, Innes and Vincent have suggested that yoga provides a positive source of social support that may also be one of the factors reducing risk for cardiovascular diseases. $^{12}$ All of the above factors are applicable in our study and may explain the positive changes produced following strict adherence to the comprehensive yoga therapy programme.

It has been reported earlier that yogic training including inverted posture produces an improvement of baroreflex sensitivity and attenuation of the sympathetic and renin angiotensin activity. $^{14}$ The reduction in HR and BP seen in our study, may be attributed to a
similar mechanism as we have included “head below the heart” postures like balasan, sashasan and dwipad uttanasan in our yoga therapy schedule. Reduction in RPP and Do P implies a reduced load on the heart due to reduced oxygen consumption and this correlates with a previous study in our laboratory that reported a consistent and significant reduction in oxygen consumption and psychosomatic relaxation with shavasan and savitri pranayam that is one of the practices used in our therapy programme.

Sympathetic activation is known to increase HR and RPP and decrease overall HRV and this is evident in our pre-training values. The RPP provides a simple measure of overall HRV in hypertensive patients and is a surrogate marker in situations where HRV analysis is not available. It has been previously reported that standard deviation of normal-to-normal RR intervals (SDNN), an index of overall HRV is reduced in hypertensive patients. It has also been shown that SDNN and total power of HRV are inversely correlated with mean HR and RPP. Hence the significant post-training decrease in HR and RPP in our study indicates a better autonomic regulation of the heart with decreased oxygen consumption and load. This can be attributed to the pranayam practices used in our study.

Biochemical investigations: The significant decreases in TC, TG, LDL and VLDL values coupled with significant increase in HDL in our participants implies a better lipid profile having good prognostic value. A study on yogic practises on lipid profile and body fat composition in patients of coronary artery disease reported insignificant reductions of TC, TG and LDL after 6 months. However Innes and Vincent reported that all 12 studies reviewed by them suggested that yoga improves lipid profile. Reductions in TC, TG, LDL and VLDL and an increase in HDL in our subjects are comparable with the findings of their review. Upon analysis of the different relative cholesterol ratios, it is apparent that the yoga therapy programme improved the ‘heart friendly’ status of lipid profile in our subjects. Normally the ‘safe’ TC/HDL ratio should be less than 4. This was initially 4.67 ± 0.39 in our patients and decreased (16%) to a safe level of 3.95 ± 0.25 after the 8-week yoga therapy programme. A healthy LDL/HDL ratio should be less than 3. Though the initial pre-training level in our subjects was a higher normal value it also reduced (16%) to a lower normal value. HDL/LDL ratio should normally be more than 0.3 but it is preferable to maintain it above 0.4. This also increased (14%) to a higher normal value implying better prognosis of cardiovascular health.

These positive changes in lipid profile may be attributed to the twisting and compression-relaxation effects of postures such as paschimottanasan, pawanamuktasan and bhujangasan.
The decrease of ‘bad’ cholesterol and increase in ‘good’ cholesterol has significance when viewed in light of the cardiovascular risk profile of diabetic patients as 7 participants had concomitant DM. It has been previously reported that hatha yoga decreases oxidative stress and improves antioxidant status and this could also be the mechanism behind the positive changes in lipid profile of our subjects. It has been reported that a short lifestyle modification and stress management education program leads to favorable metabolic effects and that yoga reduces risk factors for cardiovascular disease and DM. The improved healthier ‘heart friendly’ lipid profile evidenced in our study may be the biochemical mechanism by which such risk profiles are reduced.

Wellness questionnaire: It has been reported that a short lifestyle modification and stress management educational program leads to remarkable improvement in subjective wellbeing scores and can therefore make an appreciable contribution to primary prevention as well as management of lifestyle diseases. A majority of the patients in our study reported an improvement in ability to concentrate, control of anger, appetite, confidence levels, ease of breathing, energy level, enjoyment of life with calm and fresh feeling (Table IV and Fig I). They also reported a reduced feeling of hopelessness, nervousness and loneliness. They reported improvements in general flexibility and joint mobility along with improved general mood, sense of relaxation and well being. There was decrease in pain with improvement in their ability to perform their day-to-day activities. They also felt a reduction in their stress levels with improved quality and duration of sleep. Yoga may be improving mental and emotional components of the personality and the subjective well being reported by our participants may be a contributing psycho-physiological factor in the healthy improvements shown by our patients and this aspect needs further exploration.

Our findings can be correlated with those of an earlier study on patients with mild to moderate essential HT that reported decreased VMA catecholamine and MDA levels suggestive of decreased sympathetic activity and oxidant stress after three months of yoga training. They also reported decreased BP, TC and TG with overall improvement in subjective wellbeing and quality of life.

The main strength of the present study is the excellent compliance and regularity of the yoga practice by our participants both during the directly supervised sessions (99%) and at home, where all expect one patient practiced regularly for an average of 3 days/week for a minimum duration of 30 min. Hence, the all round benefits obtained in our study can be attributed to the dedicated and regular practice of the comprehensive yoga therapy...
programme. Very few yoga studies have reported such excellent compliance and hence our study stands out as a special case.

The main drawback of our study is the accidental sampling method used and the lack of a control group. As all of our participants were simultaneously also receiving medication, it is difficult to determine ‘actual’ benefits of the therapy intervention and differentiate them from the benefits of better medical management in the same period. However as there was no change in the medical management protocol that had already stabilized their clinical status, we can reasonably conclude that any additional benefits were due to the yoga therapy programme. It is suggested that further randomized control studies be done to confirm these findings and facilitate a deeper understanding of the mechanisms underlying these beneficial results.

In conclusion, our study shows that a comprehensive 8-week yoga therapy programme produces significant improvement in anthropometric and cardiovascular parameters and lipid profile in patients of essential HT. It is concluded that a comprehensive yoga therapy programme has potential to enhance the beneficial effects of standard medical management of essential HT and can be used as an effective complementary or integrative therapy programme.

REFERENCES:


IMMEDIATE EFFECT OF
SUKHA PRANAYAMA ON
CARDIOVASCULAR VARIABLES
IN PATIENTS OF
HYPERTENSION
INTRODUCTION:

One of the most common health disorders prevalent today is hypertension or high blood pressure (BP). This is a health challenge affects millions of people all over the world and is a major risk factor for stroke, coronary artery disease and organ failure.

Lifestyle modifications are universally accepted, not only as the first step in the management of hypertension but also a way to prevent hypertension. Lifestyle modifications may obviate the need for drug therapy in borderline hypertension while it may decrease the dosage and / or reduce the number of drugs needed in established hypertension. It may also decrease the risk of cardiovascular diseases directly and indirectly.

Yoga has been found to be an effective adjunct therapy for hypertension and the use of yoga practices as a therapy in increasing world over. Yoga is a true lifestyle intervention that may include practices such as asana (postures), pranayama (breathing), meditation, relaxation, dietary changes and other techniques that have been shown to aid in reducing cardiovascular risk and high BP.

For example, a recent study by Pramanik et al has reported reduction in HR and BP following 5 minutes of slow paced bhastrika pranayama. Earlier studies from our laboratory have shown the HR and BP lowering effects of slow deep breathing after 3 weeks and 3 months of training. Beneficial effects of deep breathing in reducing premature ventricular complexes have also been reported. Joseph et al demonstrated a decrease in blood pressure after 2 minutes of slow breathing at the rate of 6 breaths / minute while Kaushika et al demonstrated that even a single session of slow breathing of 10 minutes could produce a temporary fall in BP. Grossman et al reported a clinically significant reduction in BP after 8 weeks of slow deep breathing for 10 minutes a day with a Breathe with Interactive Music (BIM) apparatus.

However, none of these studies on timed deep breathing have used the concepts of pranayama that involves a conscious internal awareness of the whole breathing process. Further, most research on the immediate effects of pranayama has used a nonclinical, healthy sample, while research on the therapeutic benefits of pranayama has focused on long-term benefits from regular practice.

Pranayama is one of the important limbs of yoga and is increasingly being used in yoga therapy. Sukha pranayama is a simple type of yogic breathing that is done by consciously
regulating the inspiration and expiration to an equal ratio with internal awareness of the complete breathing process involving all sections of the lungs (Gitananda). This pranayama can be done at the rate of 6 breaths/ min by using a timed count of five for inspiration and expiration. Keeping the above in mind, this study was undertaken to determine immediate effects of five minutes of sukha pranayama on cardiovascular parameters in hypertensive patients attending the Yoga OPD at JIPMER, Pondicherry, India.

METHODS:

This study was conducted at the Advanced Centre for Yoga Therapy Education and Research (ACYTER). ACYTER is a collaborative venture between the Morarji Desai National Institute of Yoga (MDNIY), New Delhi and JIPMER, Puducherry with funding from Department of AYUSH in the Ministry of Health and Family Welfare, Government of India. Ethical approval was obtained by ACYTER from the Institutional Ethics Committee for studies on the effect of yoga therapy on hypertension and diabetes. The present study was conducted as a pilot study as part of this larger study on the effects of yoga therapy in patients of hypertension.

Twenty three patients of essential hypertension attending the Yoga OPD run by ACYTER were selected for this study by accidental sampling. 11 of the subjects were male and 12 female with their age ranging from 45 to 70 (55.13 ± 1.54) years. Patients of secondary hypertension and those with history / signs and symptoms / laboratory reports suggestive of nephrologic, neurologic and ophthalmologic complications were excluded from the study.

All of the subjects were suffering from hypertension for more than 5 years and were under regular medical management with one or more antihypertensive medications at the Medicine OPD in JIPMER. None of them had any previous experience of yoga training. Informed consent was obtained by one of the investigators and then HR and BP were recorded after 5 minutes of rest in sitting posture using non-invasive semi-automatic blood pressure monitor.

The subjects were then taught to perform sukha pranayama as per the Gitananda tradition in an individual based manner by a qualified yoga teacher working as a yoga instructor in ACYTER. An overview of the practice was given to the patients and then they were instructed to take up an erect sitting position with palms on their thighs. They were asked to keep their eyes closed to facilitate the development of an internal awareness.
The pranayama was done through both nostrils in a calm and regular manner with a conscious effort to use the low, mid and upper parts of the lungs in a sequential manner for both inspiration and expiration. They were instructed to breathe in and out for an equal count of 5 that was given by the instructor throughout the period in tune with a stop watch. A regularity of counts at the rate of 6 breaths / minute was maintained by the instructor for the entire duration of 5 minutes. HR and BP measurements were again recorded at the end of the five minutes of sukha pranayama. Pulse pressure (PP) was calculated as SP-DP, mean arterial pressure (MAP) as DP + 1/3 PP, rate-pressure product (RPP) as HR × SP / 100 and double product (Do P) as HR × MAP / 100. Statistical analysis was done using Students t (paired) test and p values less than 0.05 were accepted as indicating significant differences between the groups.

RESULTS:

All values are given as mean ± SEM. Immediately following 5 minutes of deep breathing, there was a statistically significant (p < 0.05) fall in HR from 79.3 ±2.86 to 76.57 ±2.69 beats /min.

![Effect of Sukha Pranayama on Cardiovascular Variables In Hypertensives](image)

* p < 0.05, ** p < 0.01, *** p < 0.001

Fig 1. Immediate effect os sukha pranayama on heart rate (HR), systolic pressure (SP), diastolic pressure (DP), pulse pressure (PP), mean pressure (MP), rate-pressure product (RPP) and double product (DoP) in patients of essential hypertension. B: before and A: after 5 minutes of the technique.
The SP fell from 136.13 ± 3.32 to 126.96 ± 2.54 mm Hg (p < 0.001), MAP from 97.26 ± 1.78 to 92.81±1.49 mm Hg (p < 0.001), RPP from 108.50 ± 5.25 to 97.82 ±4.58 units (p < 0.001) and Do P from 77.34 ± 3.31 to 71.34 ± 3.04 units (p < 0.001). PP showed a significant fall from 58.3 ± 2.95 to 51.22 ± 2.22 mm Hg (p < 0.01) while there was a statistically insignificant fall in DP from 77.83 ±1.48 to 75.74 ± 1.32.

**DISCUSSION:**

In the present study, the practice of sukha pranayama for 5 minutes at a rate of 6 breaths / min was found to reduce the HR and BP in patients of hypertension. Although both SP and DP dropped, only the reduction in SP was significant (p < 0.001). This may be because SP values were initially already higher than in considered healthy. On the other hand, DP didn’t change much and this may be attributed to the fact that it was already within normal range. Because Sukha pranayama aims to produce a balanced state, further drops would not be expected.

The cardiovascular effects were more pronounced with regard to the MAP, RPP and Do P due to the cumulative benefits occurring as result of reduction in both HR and BP. RPP and Do P are especially significant as they are indicators of myocardial oxygen consumption and load on the heart. The decrease observed following sukha pranayama implies a lowering of strain on the heart itself. The observed changes may in part be due to an increase in parasympathetic activity and decrease in sympathetic activity, which has been previously reported in a study of pranayama ‘s effects on ventricular performance by Udupa et al.13

The beneficial cardiovascular effects seen in this study may be also because of the breathing at the rate of 6 breaths / minute. Studies by Prakash et al and Ravindra et al have shown the therapeutic benefits of deep breathing at the rate of 6 breaths / min on reducing premature ventricular complexes.6,14 They had suggested that this was possibly due to the increased vagal modulation of sinoatrial (SA) and atrioventricular (AV) nodes.

The increase in vagal modulation of the SA and AV nodes may be responsible for the reduction in HR seen in this study and may be also responsible for the subsequent fall in SP too. It has been previously suggested that slow breathing at 6 breaths / min has the effect of entraining all RR interval fluctuations, thereby causing them to merge at the rate of respiration and to increase greatly in amplitude. This increase in RR interval fluctuations enhances baroreflex efficiency and may have contributed towards lowering the BP.7
The slow, deep, conscious breathing done in sukha pranayama may be also helping normalise autonomic cardiovascular rhythms that have been described by Mayer more than a century ago. These rhythms occur as a 10 second cycle in blood pressure that is related to both vagal and sympathetic activity.

Luciano Bernardi et al have shown beneficial effects of rosary prayer and yoga mantras in restoring these autonomic cardiovascular rhythms. They reported an increase in baroreflex sensitivity following such chanting and concluded that rhythm formulas that involve breathing at 6 breaths / minute induce favourable psychological and possibly physiological effects. A previous study by Joseph et al has reported a normalisation of baroreflex sensitivity in hypertensive patients following just 2 minutes of slow breathing at the rate of 6 /min.

We conclude that sukha pranayama when performed at the rate of 6 breaths / minute is effective in reducing HR and BP in hypertensive patients after just 5 minutes of practice. This finding has potential therapeutic applications in day-to-day as well as clinical situations where blood pressure needs to be brought down at the earliest. It is simple, cost effective and may be added to the management protocol for hypertensive patients in addition to the regular medical management of such situations.

Further studies are required to enable a deeper understanding of the mechanisms involved. We plan to further investigate how long such a BP lowering effect persists as this will provide more information about its usefulness in the long term management of hypertension.

REFERENCES:


IMMEDIATE EFFECT OF CHANDRA NADI PRANAYAMA (LEFT UNILATERAL FORCED NOSTRIL BREATHEING) ON CARDIOVASCULAR PARAMETERS IN HYPERTENSIVE PATIENTS
INTRODUCTION:

The science of swara (nasal cycle) that has recently caught interest of scientists all over the world, had been analyzed extensively by Indian yogis of lore. Though they lacked the equipment available to modern science, these yogis through their dedicated practice (abhyasa), inner vision (antar drishti) and self-analysis (swadhyaya) had made extensive observations on this concept. The Vedic science of understanding the function of the nasal cycle is known as Swarodaya Vijnan (swara = sonorous sound produced by the airflow through the nostrils in the nasal cycle, udaya = functioning state, and vigjnan = knowledge).  

The Shivaswarodaya, an ancient treatise advises quieter, passive activities (soumya karya) when left nostril (ida / chandra swara) is dominant and engage in challenging and exertional activities (roudra karya) when right nostril (pingala / surya swara) is dominant and to relax or meditate when flow through both nostrils is equal (sushumna swara).  

The nasal cycle is dependent upon tonic activity of the limbic autonomic nervous system with hypothalamus as the control centre, as well as levels of circulating catecholamines and other neuro-hormones.  

Recent studies have reported differential physiological and psychological effects produced by exclusive right and left nostril breathing. However, these studies have only evaluated the effects on normal subjects and though potential health benefits of unilateral forced nostril breathing (UFNB) have been postulated, further clinical research is required to prove immediate and sustained efficacy of these techniques in various psychosomatic conditions such as hypertension (HT) and diabetes mellitus (DM).

With the above in mind, the present study was designed to determine immediate effects of 27 rounds of exclusive left nostril breathing, a yogic UFNB pranayama technique known as chandra nadi pranayama (CNP) on cardiovascular parameters in patients of essential HT.

MATERIALS AND METHODS:

This study was conducted at the Advanced Centre for Yoga Therapy Education and Research (ACYTER) that has been established as a collaborative venture between the Morarji Desai National Institute of Yoga, New Delhi and JIPMER, Puducherry with funding from Department of AYUSH in the Ministry of Health and Family Welfare, Government of India. Ethical approval has been obtained by ACYTER from the Institutional Ethics Committee for studies on the effect of yoga therapy on HT and DM. The
present study was conducted as a pilot study as part of this larger study on the effects of yoga therapy in patients of HT.

22 patients of essential HT attending the Yoga OPD run by ACYTER were selected for this study by accidental sampling. Patients whose SP was less than 120 mm Hg with medication, patients of secondary HT, and those with history / signs and symptoms / laboratory reports suggestive of nephrologic, neurologic and ophthalmologic complications were excluded from the study. 12 of the patients were male and 10 female with an average age of 58.14 ± 1.69 (SEM) years. All of the subjects were under regular standard medical management for more than five years with antihypertensive medications at JIPMER. Sub classification of the subjects according to JNC VII revealed that based on either systolic pressure (SP) or diastolic pressure (DP) values, 16 were in the prehypertensive range, 4 in stage I HT and 2 in stage II HT even with regular medication. None of them had any previous experience of yoga training. Informed consent was obtained by one of the investigators. Pre intervention heart rate (HR) and blood pressure (BP) were recorded after 5 minutes of rest in sitting posture using non-invasive semi-automatic BP monitor (CH–432, Citizen Systems, Tokyo, Japan).

The subjects were individually taught to perform CNP by a qualified yoga instructor. An overview of the practice was given to the patients and then they were instructed to take up an erect sitting position with palms on their thighs. They were asked to keep their eyes closed to facilitate the development of inner awareness. The subject was instructed to perform nasika mudra with their right hand by touching the tip of their index finger to the base of their thumb. The right thumb was then used to close their right nostril with gentle pressure. The pranayama was then performed though the unblocked left nostril in a calm and regular manner with a conscious effort to use low, mid and upper parts of the lungs in a sequential manner for both inspiration and expiration. Subjects were instructed to breathe in and out for an equal count of 5 that was given by the instructor throughout the period in tune with a stop watch. A regularity of counts at the rate of 6 breaths / minute (BPM) was maintained by the instructor for the entire duration of nearly 5 minutes taken to complete 27 rounds of CNP.

Post intervention HR and BP measurements were recorded again at the end of the 27 rounds of CNP. Pulse pressure (PP) was calculated as SP-DP, mean pressure (MP) as DP + 1/3 PP, rate-pressure product (RPP) as HR × SP / 100 and double product (Do P) as HR × MP / 100.
Statistical analysis of pre and post intervention data was done using GraphPad InStat version 3.06 for Windows 95, GraphPad Software, San Diego California USA, www.graphpad.com. All data passed normality testing by Kolmogorov-Smirnov Test and hence was analyzed using Students t test for paired data. $P$ values less than 0.05 were accepted as indicating significant differences between pre and post intervention data.

**RESULTS:**

Results of the pre and post intervention comparisons are given in Table I.

Table I: Immediate effect of chandra nadi pranayama on heart rate (HR), systolic pressure (SP), diastolic pressure (DP), pulse pressure (PP), mean pressure (MP), rate-pressure product (RPP) and double product (Do P) in 22 patients of essential hypertension. B: before and A: after the intervention.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>A</th>
<th>% Change</th>
<th>t Value</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beats/min)</td>
<td>75.77 ± 3.15</td>
<td>73.45 ± 3.12</td>
<td>-3.06</td>
<td>4.23(21)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SP (mmHg)</td>
<td>134.68 ± 3.17</td>
<td>130.27 ± 3.16</td>
<td>-3.27</td>
<td>3.61(21)</td>
<td>0.0016</td>
</tr>
<tr>
<td>DP (mmHg)</td>
<td>78.77 ± 1.74</td>
<td>78.05 ± 1.89</td>
<td>-0.91</td>
<td>0.74(21)</td>
<td>0.467</td>
</tr>
<tr>
<td>PP (mmHg)</td>
<td>55.91 ± 2.99</td>
<td>52.23 ± 2.56</td>
<td>-6.58</td>
<td>2.95(21)</td>
<td>0.0076</td>
</tr>
<tr>
<td>MP (mmHg)</td>
<td>97.41 ± 1.84</td>
<td>95.45 ± 2.06</td>
<td>-2.01</td>
<td>2.20(21)</td>
<td>0.0395</td>
</tr>
<tr>
<td>RPP (units)</td>
<td>101.87 ± 4.66</td>
<td>95.58 ± 4.59</td>
<td>-6.17</td>
<td>5.07(21)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DoP (units)</td>
<td>73.94 ± 3.56</td>
<td>70.35 ± 3.69</td>
<td>-4.85</td>
<td>4.55(21)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Values are $M \pm SEM$ for 22 subjects.
All values are given as mean ± SEM. 27 rounds of CNP produced an immediate decrease in all the measured cardiovascular parameters with the decrease in HR, SP, PP, MP, RPP and Do P being statistically significant while the fall in DP missed statistical significance. Students paired t test showed significant reductions in HR, \( t (21) = 4.23, p < 0.001 \), SP, \( t (21) = 3.61, p = 0.002 \), PP \( t (21) = 2.59, p = 0.0076 \), MP \( t (21) = 2.20, p = 0.039 \), RPP, \( t (21) = 5.07, p < 0.001 \), Do P, \( t (21) = 4.55, p < 0.001 \).

Further, gender based sub-analysis of our data revealed that the male participants evidenced significant reductions in HR, \( t (11) = 2.48, p = 0.03 \) and SP, \( t (11) = 2.97, p = 0.013 \) from 73.17 ± 3.78 to 71.25 ± 3.70 beats/min and 132.75 ± 4.55 to 128.08 ± 4.71 mm HG respectively. The decrease in DP from 77.91 ± 3.04 to 75.58 ± 2.99 mm HG just missed significance \( t (11) = 2.09, p = 0.06 \). On the other hand in female participants, only HR decreased significantly from 78.90 ± 5.28 to 76.10 ± 5.31 beats/min, \( t (9) = 3.56, p = 0.006 \) while the decrease in SP from 137.00 ± 4.46 to 132.90 ± 4.14 mm HG just missed significance, \( t (9) = 2.05, p = 0.07 \). There was a statistically insignificant rise in DP in female participants 79.80 ± 1.33 to 81.00 ± 1.87 mm HG.

**DISCUSSION:**

The immediate decrease in all cardiovascular parameters in our patients can be explained by changes in the autonomic balance as it has been previously reported that sympathetic activity is lower during left nostril breathing.\(^5\) It has also been reported that exclusive left nostril breathing, repeated 4 times a day for a month reduced sympathetic activity.\(^7\)

We have earlier reported that the practice of sukha pranayama for 5 minutes at a rate of 6 BPM reduces HR and BP in patients of hypertension.\(^9\) In both that study as well as the present study we have found significant reduction in SP values that were on the higher side despite regular medication. However we have found in both studies that DP didn’t change much and this may be attributed to the fact it was already stabilized within the normal range with medication.

The cardiovascular effects in the present study as well as our previous one are more pronounced with regard to the RPP and Do P due to the cumulative benefits occurring as a result of reduction in HR as well as BP. RPP and Do P are especially important in patient care as they are indirect indicators of myocardial oxygen consumption and load on the heart, thereby signifying a lowering of strain on the heart.\(^10\) The RPP also provides a simple
measure of overall heart rate variability (HRV) in hypertensive patients and is a surrogate marker in situations where HRV analysis is not available. Hence, the reduction in RPP in our study implies better autonomic regulation of the heart in hypertensive patients. A previous study from our laboratories reported that pranayama training of three months duration modulates ventricular performance by increasing parasympathetic activity and simultaneously decreasing sympathetic activity. This may explain significant decreases in HR and BP observed in the present study with pronounced effects on the heart.

Our findings are in agreement with those of a previous report that left UFNB at the rate of 6 BPM lowers HR with compensatory increase in stroke volume and end diastolic volume. Another study done on normal volunteers reported a significant decrease in SP and MP following 30 minutes of exclusive left nostril breathing while the small reduction in DP in that study also missed significance as in ours. This shows that similar beneficial effects can be obtained in hypertensive patients even after less than 5 minutes of pranayama practice.

Interestingly Raghuraj and Telles reported a significant increase in HR whereas we have found a significant decrease in HR in the present study. They suggested that the fall in SP may have been influenced by changes in cardiac output (CO), peripheral vascular resistance and humoral factors. However the rise in HR in their study doesn’t support the contention of changes in CO and if there was change in peripheral vascular resistance, it should have been reflected in the DP changes. As the HR reduced significantly in our study, it is more plausible that the fall in SP is related to CO. They had not used timed breathing rates in their study whereas our subjects were breathing at the rate of 6 BPM and this may have harmonized respiratory and cardiovascular Meyer rhythms, resulting in changes in HR as well as BP.

Breathing at the rate of 6 BPM increases vagal modulation of sinoatrial (SA) and atrioventricular (AV) nodes and enhances baroreceptor sensitivity by entraining all RR interval fluctuations, thereby causing them to merge at the rate of respiration and to increase greatly in amplitude. This increase in RR interval fluctuations enhances baroreflex efficiency and may have contributed towards lowering the BP. Increase vagal modulation of SA and AV nodes along with enhancement of baroreceptor sensitivity may be responsible for reduction in HR and subsequent fall in SP evidenced in our study.
Interestingly the gender based sub-analysis of our data reveals that our male participants evidenced significant reductions in HR and SP with an insignificant decrease in DP while in female participants only the HR decreased significantly with an insignificant decrease in SP. The statistically insignificant increase in DP in our female participants as opposed to its decrease in our male participants seems to have influenced the overall result with regard to DP. Similar differences between genders following UFNB have been reported suggesting that there may be a nostril laterality affecting the autonomous nervous system differentially in males and females. The differential effect on BP between genders as evidenced by our study is in agreement with another previous study in normal healthy volunteers that reported significant reduction in HR, SP and DP after 15 minutes of left nostril breathing in males while the reduction in females was significant only with regard to HR. The different response of our female participants may also be due to the fact that most of them were peri and postmenopausal and this may have influenced their autonomic status.

It is concluded that CNP is effective in reducing HR and SP in hypertensive patients on regular standard medical management. To the best of our knowledge, there is no previous published report on immediate effects of left UFNB in patients of HT and ours is the first to report on this beneficial clinical effect. This may be due to a normalization of autonomic cardiovascular rhythms with increased vagal modulation and / or decreased sympathetic activity along with improvement in baroreflex sensitivity.

Further studies are required to enable a deeper understanding of the mechanisms involved as well as determine how long such a BP lowering effect persists. We recommend that this simple and cost effective technique be added to the regular management protocol of HT and utilized when immediate reduction of BP is required in day-to-day as well as clinical situations.

REFERENCES:


IMMEDIATE CARDIOVASCULAR EFFECTS OF PRANAVA PRANAYAMA IN HYPERTENSIVE PATIENTS
INTRODUCTION:

Hypertension is one of the most common health disorders prevalent worldwide and is a major risk factor for stroke, coronary artery disease and organ failure. Yoga has been shown to be an effective adjunct therapy in hypertension and many studies have demonstrated the scientific basis of using it as a therapy and also as an effective lifestyle modification measure (1, 2).

Yoga as a therapy is simple and inexpensive and can be easily adopted in most patients without any complications (3). Yoga therapy encompasses the use of asana, pranayama and relaxation techniques along with dietary advice and yogic counselling that attempts to address the root cause of the problem rather than merely providing a symptomatic relief (4).

Pranayama is an integral component of holistic yoga therapy schedule and involves slowing down of the normal breathing rate along with an awareness based, conscious inner focus on respiration. Slow, deep, pranayama based breathing training has been shown to be effective in reducing blood pressure (BP) after 3 weeks and 3 months (5, 6). Jerath et al have reported that slow deep breathing in pranayama results in decreased oxygen consumption, heart rate (HR) and BP (7). They postulated that the performance of voluntary slow breathing functionally resets the autonomic nervous system via stretch-induced inhibitory signals coupled with synchronization of neural elements in limbic system and cortex.

Pranavaprana pranayama is an important technique of the Gitananda Yoga tradition and Vibrational Breath Therapy (VBT) modules propounded by Sri Bala Rathnam of Melbourne, Australia (www.vbt.com.au). It involves slow and deep inhalation with conscious use of complete yogic breathing (mahat yoga pranayama) followed by the audible vibratory resonance of a prolonged AUM chant. This technique is one of the practices taught in the comprehensive yoga therapy schedule used for hypertensive patients at ACYTER, JIPMER, Puducherry, India. Keeping this in mind, the present study was undertaken to determine immediate effects of performing pranava pranayama on cardiovascular parameters in hypertensive patients.

MATERIALS AND METHODS:

This study was conducted as part of a larger study on the effects of yoga therapy on hypertensive patients that had been accorded permission by the research and ethics councils of the institute. 29 subjects (16 male and 13 female, 49.34 ± 2.36 y) attending yoga therapy
sessions at ACYTER and able to perform pranava pranayama in a competent manner were recruited and informed consent obtained from them. All of them were receiving medical treatment for their hypertension at the Medicine OPD.

Sub classification of the subjects according to JNC VII revealed that based on systolic pressure (SP) values, 11 of them were in the normal range, 14 in the prehypertensive range, two in stage I hypertension and two in stage II hypertension. Based on diastolic pressure (DP) values, 24 were in normal range, four in prehypertensive range and one in stage II hypertension. Patients of secondary hypertension and those with history, signs and symptoms or laboratory reports suggestive of nephrologic, neurologic and ophthalmologic complications were excluded from the study.

HR and BP were recorded in the supine position using a digital BP monitor, (CH – 432, Citizen Systems, Tokyo, Japan). The pre-intervention recording was done after 5 minutes of supine rest. Post-intervention recording was also done in the supine position immediately after the performance of 3 rounds of pranava pranayama in sitting position that took approximately 5 minutes. Rate-pressure product (RPP) was calculated as HR × SP / 100 and double product (Do P) as HR × mean arterial pressure (MAP) / 100.

The technique of pranava pranayama is as follows. The subject sits in a comfortable sitting position such as sukhasana, ardha padmasana or vajrasana. He/she then performs three rounds of slow and deep yogic breathing into low chest, mid chest and upper chest followed by the prolonged audible rendition of the akara, ukara and makara nada (Aaa, Uuu and Mmm sounds) respectively during exhalation phase. Following this, he/she performs three rounds of the complete yogic breathing (mahat yoga pranayama) technique with an audible rendition of omkara nada (AUM sound) during exhalation phase. Appropriate hasta mudras (hand gestures) are used during each part of the four part practice. The time taken for the exhalation with nada is approximately three times the time taken for each inhalation, thus maintaining a ratio of 1:3.

After completing the performance of pranava pranayama that took approximately 5 minutes, the subject lay down in the supine position and post intervention HR and BP were recorded.

Data was assessed for normality using GraphPad InStat and passed normality testing by Kolmogorov-Smirnov Test. Statistical analysis was done using Students t (paired) test and p values less than 0.05 were accepted as indicating significant differences between pre and post intervention data.
RESULTS:

The values are given as mean ± SEM. Post intervention statistical analysis revealed a significant (p < 0.05) reduction in SP from 126.86 ± 3.03 to 124.07 ± 3.09 mmHg and a more significant (p < 0.01) reduction in HR from 75.24 ± 2.34 to 72.96 ± 2.22 beats/min, pulse pressure (PP) from 52.79 ± 2.24 to 50.06 ± 2.23 mm Hg, and Do P from 69.07 ± 2.75 to 66.26 ± 2.65 units. The reduction in RPP from 95.31 ± 3.66 to 90.43 ± 3.49 units was statistically highly significant (p < 0.001).

Upon analysis of subgroups based on JNC VII (13) criteria, the maximum % decrease in HR (5.1%) and Do P (6%) was in patients who were in the normotensive range while maximum % decrease in SP (3.4%), PP (10.2%) and RPP (7.21%) was in those who were in the range of stage I and II hypertension. The least % fall in HR (1.31%), SP (1.85%), PP (3.6%), RPP (3.3%) and Do P (2.6%) was in patients in the prehypertensive range.
DISCUSSION:

Our finding that pranava pranayama produces an immediate decrease in HR and SP is similar to earlier studies that have reported on the immediate effects of slow and deep breathing (8, 9). In a recent study, we have reported that sukha pranayama involving equal periods of inhalation and exhalation at the rate of 6 breaths / min can reduce HR and BP in hypertensive patients within five minutes. We have postulated that this could be attributed to normalization of autonomic cardiovascular rhythms due to either improved vagal modulation, and / or decreased sympathetic activity and improved baroreflex sensitivity (10).

In one of our pilot studies on 19 hypertensive patients, we have found that 15 minutes of shavasana with pranava pranayama reduces SP, DP, PP and MAP in hypertensive patients (11). There was also a significant fall in RPP and Do P signifying a reduction in \( \text{O}_2 \) consumption and work done by the heart. However, as that study was done in shavasana, the cardiovascular effects of pranava pranayama may have been influenced by the supine position. There are two major differences between these two studies. The first is that the decrease in HR was not statistically significant when pranava pranayama was performed in the supine position in our earlier study whereas in the present study it is highly significant. The second major difference is that the decrease in DP was significant in our earlier pilot study whereas there is no change in DP in the present study. This may be attributed to a reduction in perceived stress, peripheral vasodilatation as a result of decrease in sympathetic tone and the normalization of cardiac autonomic regulatory processes. These may be more apparent in the supine position as compared to the sitting postures that may be preventing a fall in peripheral resistance.

Conscious deep breathing with prolonged exhalation and audible chanting during pranava pranayama may be contributing towards the normalization of autonomic cardiovascular rhythms. These rhythms first described by Mayer more than a century ago occur as a 10 second cycle in BP and are co-related to both vagal and sympathetic activity. Bernardi et al have reported the beneficial effects of rosary prayer and yoga mantras in restoring these autonomic cardiovascular rhythms (12). They reported an increase in baroreflex sensitivity following such chanting and concluded that rhythm formulas involving breathing at 6 breaths / min induce favourable psychological and possibly physiological effects. The audible chanting of the pranava in the present study may be having a similar effect on baroreflex sensitivity as Joseph et al reported a fall in BP and normalisation of baroreflex
sensitivity in hypertensive patients following just 2 minutes of slow breathing at 6 breaths /min (13). Pramanik et al studied the immediate effect of 5 minutes of bhramari pranayama using a 1:3 ratio, similar to the time cycle used in our present study (14). They reported a decrease in SP, DP, MP and HR that was significant with respect to DP and MP and concluded that bhramari pranayama induced parasympathetic dominance. Pranava pranayama like bhramari, is also a nada pranayama employing audible sounds during exhalation, hence these findings are comparable with our findings.

It has been postulated that pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors as in Hering Bruer reflex (8). Withdrawal of sympathetic tone to skeletal muscle blood vessels leads to widespread vasodilatation decreasing peripheral resistance, hence reducing DP. This could be a mechanism by which DP decreased in our earlier pilot study when pranava was done in shavasana and that the sitting position adopted by the subjects in the present study was a confounding factor.

Valsalva manoeuvre produces an increased intrathoracic pressure and decreased pre-load to the heart. Humming shares many physiological similarities to Valsalva and is equally effective for distending the jugular and common femoral veins (15). The prolonged exhalation phase of pranava pranayama mimicked Valsalva manoeuvre resulting in a decrease in venous return, cardiac output and SP. The absence of reflex tachycardia may be due to a simultaneous blunting of the sympathetic component by pranava -induced relaxation.

It has been reported that the stimulation of endogenous Nitric Oxide (NO) pathways might enhance parasympathetic protection against adverse influences of cardiac sympathetic over activity (16). NO appears to play a tonic facilitatory role in baroreflex control of cardiac parasympathetic activity and acts at a postsynaptic level to facilitate cardiac responses to muscarinic stimulation when back ground levels of adrenergic activity are high. As low pitch humming increases tissue nasal NO production, it is possible that pranava is stimulating endogenous production of NO, and thus producing a cardio protective benefit (17).

The effects in our study were more pronounced with regard to RPP and Do P due to cumulative benefits occurring as result of reduction in HR, SP and MAP. RPP and Do P are
especially significant as they are indicators of myocardial oxygen consumption and load on
the heart and therefore imply a lowering of strain on the heart (5).

It is concluded that the practice of pranava pranayama is effective in reducing HR and SP in
hypertensive patients. This may be due to a normalization of autonomic cardiovascular
rhythms as a result of increased vagal modulation and / or decreased sympathetic activity
and improved baroreflex sensitivity along with an augmentation of endogenous NO
production. Our findings have potential therapeutic applications in day-to-day as well as
clinical situations where BP needs to be brought down at the earliest. This simple and cost
effective technique may be added to the management protocol of hypertension in addition to
regular medical management. Further studies are required to enable a deeper understanding
of the mechanisms involved. We plan to further investigate how long such a BP lowering
effect persists as this will provide more information about its usefulness in the long term
management of hypertension.

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nearal respiratory elements may provide a mechanism that explains how slow deep


SURYANADI PRANAYAMA (RIGHT UNILATERAL NOSTRIL BREATHING) MAY BE SAFE FOR HYPERTENSIVES
INTRODUCTION:
Ancient Rishis of India have intuitively analyzed all aspects of human life and one such example is swarodaya vijnan, the ultradian nasal cycle as codified in the Shivaswarodaya.\(^{(1)}\) This has captured the imagination of scientists in recent times with numerous reports on differential physiological and psychological effects of exclusive right or left nostril breathing.\(^{(2, 3, 4, 5, 6, 7, 8)}\) However, these studies have evaluated only the physiological effects on normal subjects and although potential health benefits of unilateral forced nostril breathing (UFNB) have been postulated, clinical research is required to prove immediate and sustained efficacy of these techniques in psychosomatic conditions like hypertension (HT) and diabetes mellitus (DM).

Previous studies have suggested that exclusive right uni-nostril breathing known as suryanadi pranayama (SNP) or surya anuloma viloma pranayama (SAVP) has sympathomimetic effects including increase in metabolism, baseline oxygen consumption, systolic pressure (SP) and heart rate (HR).\(^{(6)}\) These effects have been demonstrated after a month-long training\(^{(3)}\) as well as immediately after 45 minutes of the practice\(^{(4)}\). A recent study also has reported significant increase in SP, diastolic pressure (DP) and mean pressure (MP) after 30 minutes of the practice.\(^{(8)}\)

With the above in mind, the present study was designed to determine immediate effects of 27 rounds of SNP on cardiovascular parameters in patients of essential HT. This has clinical significance in determining whether such a potentially sympathomimetic practice is safe in such a population.

MATERIALS AND METHODS:
Twenty patients of essential HT attending the Yoga OPD run by ACYTER at JIPMER, Pondicherry were selected for this study by convenience sampling. Ethical approval has been obtained by ACYTER from the Institutional Ethics Committee for studies on the effect of yoga therapy on HT and DM. The present study was conducted as a pilot study as part of this larger study on the effects of yoga therapy in patients of HT. Patients of secondary HT and those with history / signs and symptoms / laboratory reports suggestive of nephrologic, neurologic and ophthalmologic complications were excluded from the study. Ten patients were male and 10 female with an average age of 57.10 ± 2.47 (SEM) years. All of the subjects were under standard medical management and taking antihypertensive medications
for more than five years. Sub classification of the subjects based on JNC VII guidelines revealed that 10 of them were in stage I HT range, 7 in prehypertensive range and three had blood pressure (BP) in normotensive range even though they were on regular medication. None of them had any previous experience of yoga training. Informed consent was obtained by one of the investigators.

Pre-intervention HR and BP were recorded after 5 minutes of rest in sitting posture using non-invasive semi-automatic BP monitor (CH – 432, Citizen Systems, Tokyo, Japan) with an instrumental accuracy of ± 5% for HR and ± 3 mm Hg for BP.

The subjects were individually taught to perform SNP by a qualified yoga instructor. An overview of the practice was given to the patients and then they were instructed to take up an erect sitting position with palms on their thighs. They were asked to keep their eyes closed to facilitate the development of inner awareness. The subject was instructed to perform nasika mudra with their right hand by touching the tip of their index finger to the base of their thumb. The right ring finger was then used to close their left nostril with gentle pressure.

The pranayama was then performed through the unblocked right nostril in a calm and regular manner with a conscious effort to use low, mid and upper parts of the lungs in a sequential manner during inspiration as well as expiration. Subjects were instructed to breathe in and out for an equal count of 5 that was given by the instructor with the help of a stop watch. A regularity of counts at the rate of 6 breaths / minute (BPM) was maintained by the instructor for the entire duration of nearly 5 minutes taken to complete 27 rounds of SNP.

Post intervention HR and BP measurements were recorded again at the end of the 27 rounds of SNP. Pulse pressure (PP) was calculated as SP-DP, mean pressure (MP) as DP + 1/3 PP, rate-pressure product (RPP) as HR × SP / 100 and double product (Do P) as HR × MP / 100.

Statistical analysis of pre and post intervention data was done using GraphPad InStat version 3.06 for Windows 95 (GraphPad Software, San Diego California USA, www.graphpad.com).

All data passed normality testing by Kolmogorov-Smirnov Test and hence was analyzed using Students t test for paired data. \( P \) values less than 0.05 were accepted as indicating significant differences between pre and post intervention data.
RESULTS:

Results of the pre and post SNP comparisons are given in Table I. Statistical analysis revealed no statistically significant changes in any of the parameters following 27 rounds of SNP though there was a trend of 1-2% reduction in HR, SP, PP, MP, RPP and Do P with a slight rise of 0.34% in DP. Gender based sub analysis of Δ% following SNP revealed no significant differences between male and female subjects.

Table I: Immediate effect of suryanad pranayama on heart rate (HR), systolic pressure (SP), diastolic pressure (DP), pulse pressure (PP), mean pressure (MP), rate-pressure product (RPP) and double product (Do P) in patients of essential hypertension. B: before and A: after five minutes of the practice.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>A</th>
<th>% Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beats/min)</td>
<td>76.15 ± 3.31</td>
<td>75.25 ± 3.11</td>
<td>-1.18</td>
<td>0.453</td>
</tr>
<tr>
<td>SP (mmHg)</td>
<td>128.10 ± 2.52</td>
<td>127.20 ± 3.02</td>
<td>-0.70</td>
<td>0.472</td>
</tr>
<tr>
<td>DP (mmHg)</td>
<td>73.35 ± 1.89</td>
<td>73.60 ± 1.65</td>
<td>+0.34</td>
<td>0.837</td>
</tr>
<tr>
<td>PP (mmHg)</td>
<td>54.75 ± 2.26</td>
<td>53.60 ± 3.29</td>
<td>-2.10</td>
<td>0.602</td>
</tr>
<tr>
<td>MP (mmHg)</td>
<td>91.60 ± 1.83</td>
<td>91.47 ± 1.56</td>
<td>-0.15</td>
<td>0.838</td>
</tr>
<tr>
<td>RPP (units)</td>
<td>97.13 ± 4.06</td>
<td>95.31 ± 3.90</td>
<td>-1.87</td>
<td>0.339</td>
</tr>
<tr>
<td>DoP (units)</td>
<td>69.80 ± 3.29</td>
<td>68.81 ± 3.00</td>
<td>-1.42</td>
<td>0.364</td>
</tr>
</tbody>
</table>

Values are $M \pm SEM$ for 20 subjects with $p$ values from Students t test for paired data.
DISCUSSION:

The absence of any significant increase in HR or BP following SNP goes against earlier theories that it may be dangerous for hypertensive patients due to its sympatho mimetic nature. Though earlier studies in normal subjects have reported significant increase in HR and/or BP following exclusive right nostril breathing, our study shows that such a rise doesn’t occur in patients of essential HT.

Our findings are in agreement with those of Jain et al who reported no significant change in HR and a significant reduction in BP in healthy male subjects with no significant changes in female subjects after 15 minutes of SNP. Enhanced sympathetic activity has been reported in essential HT. Hence it is plausible that SNP may not be increasing HR and BP in our subjects because they already had reached a certain threshold of reactivity. The goal of yoga is to restore homeostasis. Hence, if sympathetic reactivity of a subject is already higher than normal, yogic techniques will not further increase such a hyper reactivity but rather bring it back to normal. The small 1-2% decrease in most parameters in our study gives a hint of this possibility.

In earlier studies we have report that both sukha pranayama and chandra nadi pranayama (CNP) at the rate of 6 BPM reduces HR and BP in hypertensive patients within five minutes of practice. We have suggested that this may be due to a normalization of autonomic cardiovascular rhythms as a result of increased vagal modulation and/or decreased sympathetic activity and improved baroreflex sensitivity. It is possible that in our present study, a similar effect due to breathing at the rate of 6 BPM is overriding the sympathomimetic effect of SNP and hence HR and BP did not change.

Jain et al have suggested that sympathetic activation produced by right nostril breathing may be masked by vagally mediated lung baroreceptor activity that is enhanced by voluntary breathing efforts. As an earlier study on normal subjects reported increased HR following right UFN at 6 BPM, it is possible that this difference is due to the fact that cardiovascular regulatory mechanisms are altered in hypertensives.

This is substantiated by an earlier study from JIPMER reporting that vasoconstrictor and cardiac acceleratory responses to isometric handgrip test are subnormal in hypertensive patients and that yoga training improves these reflex regulatory mechanisms. The above may explain the differential effects of SNP in normal subjects and in hypertensive patients.
Upon gender based sub analysis of the Δ% changes of HR and BPs, we found no differences between male and female subjects following the practice of SNP. Again, this is in contradiction to an earlier report of gender differences in HR and BP responses to UFNB in healthy subjects.\(^{(5)}\) They have suggested a nostril laterality affecting the autonomic nervous system differentially in males and females.

Though we found this to be true in our recent study on exclusive left nostril breathing of CNP in hypertensive patients\(^{(12)}\), this is not found to be true in our present study on SNP. Even the study by Jain et al has not reported any significant gender differences between healthy male and female subjects after 15 minutes of SNP.\(^{(7)}\)

In conclusion, our study offers evidence that exclusive right nostril breathing as performed in SNP may be safe in patients of HT. We also conclude that the cardiovascular effects of SNP in hypertensives are different than those reported by previous studies done in normal subjects. Further studies may throw light on possible mechanisms involved and also whether there is any difference produced by long term training in SNP.

**REFERENCES:**


IMMEDIATE CARDIOVASCULAR EFFECTS
OF PRANAVA RELAXATION IN PATIENTS OF
HYPERTENSION AND DIABETES
INTRODUCTION:

Comprehensive reviews have reported that Yoga is potentially beneficial for patients of hypertension (HT) and diabetes mellitus (DM) and that it reduces the risk profile in such population.\textsuperscript{1,2} Another review on relaxation therapy concluded that relaxation therapy is useful in the clinical management of HT, especially for those individuals with high BP despite pharmacological treatment.\textsuperscript{3} Earlier studies from our laboratories have demonstrated that shavasan, a yogic relaxation technique reduces load on the heart in normal subjects by blunting sympathetic responses with enhanced parasympathetic activity\textsuperscript{4} while yogic relaxation training for a month reduces blood pressure (BP) and restores autonomic regulatory reflex mechanisms in hypertensive patients.\textsuperscript{5} We have recently reported immediate beneficial effects of sukha pranayama on cardiovascular parameters in patients of HT after just five minutes of the technique.\textsuperscript{6}

Pranava pranayama is an important technique of the Gitananda tradition, involving slow and deep inhalation with conscious use of complete yogic breathing (mahat yoga pranayama), followed by an audible vibratory resonance of a prolonged AUM chant. This technique is usually done in the sitting position and is one of the practices taught in the comprehensive yoga therapy schedules imparted for HT and DM patients at ACYTER, JIPMER, Puducherry, India. As the supine position is normally used for relaxation, the present study was planned to determine immediate cardiovascular effects of pranava pranayama while resting in the supine position.

MATERIALS AND METHODS:

The present study was conducted at the Advanced Centre for Yoga Therapy Education and Research (ACYTER), established in JIPMER, Puducherry, India. Ethical approval has been obtained by ACYTER from the Institutional Ethics Committee for studies on the effect of yoga therapy on HT and DM. The present pilot study was conducted as part of this larger study on the effects of yoga therapy in patients of HT and DM.

Twenty nine patients receiving standard medical care for both essential HT and type 2 DM, who were attending regular Yoga therapy sessions for more than a month at ACYTER were selected for this study by accidental sampling. Patients of secondary HT and those with history / signs and symptoms / laboratory reports suggestive of nephrologic, neurologic and ophthalmologic complications due to HT or DM were excluded from the study. Fifteen of
the patients were male and 14 female with an average age of 56.66 ± 2.02 (SEM) years and an average BMI of 25.99 ± 0.65 (SEM).

All subjects were receiving standard medical management for more than three years with antihypertensive and oral antidiabetic medications under supervision of the consultants in the department of medicine at JIPMER. Patients on medication were selected as it has been previously suggested that the combination of relaxation and medication has the maximum effect.\(^7\)

Sub classification of the subjects according to JNC VII\(^8\) revealed that based on either systolic pressure (SP) or diastolic pressure (DP) values, 16 were in the prehypertensive range, seven in Stage I HT and one in Stage II HT even with regular medication. This is pertinent as a previous review had concluded that relaxation therapy is useful in the clinical management of HT, especially for individuals with high BP despite pharmacological treatment.\(^3\) (Jacob 1977)

Informed consent was obtained by one of the investigators and the subjects were then randomly allotted to either the pranava or control groups. There were 8 males and 7 females in the pranava group with an average age of 53.47 ± 3.22 (SEM) years. The control group consisted of 7 males and 7 females with an average age of 60.07 ± 2.12 (SEM) years. The difference in age between groups was statistically insignificant (p = 0.103)

Subjects were familiarized with the study protocol and then given 5 minutes of supine rest. Heart rate (HR) and BP was then recorded from their left upper arm in the supine position using non-invasive semi-automatic BP monitor (CH – 432, Citizen Systems, Tokyo, Japan) with an instrumental accuracy of ± 5% for HR and ± 3 mm Hg for BP.

It has been previously suggested that one needs sham treatment group rather than a mere nonspecific relaxation or ‘no treatment’ control group when studying and comparing effects of psycho-physiologic therapies.\(^9\) Hence in the present study we have used a “sham relaxation” control group that performed 10 min of simple supine resting for the first and last 2 minutes while they were given verbal commands suggesting relaxation of different body parts from feet to head for the intervening 6 minutes. HR and BP were recorded again at the end of the 10 minutes of “sham relaxation”.

![Diagram](attachment:image.png)
On the other hand the pranava group performed 10 min of supine rest that included simple conscious resting in shavasana for the first and last 2 minutes with a performance of pranava pranayama for the intervening 6 minutes.

The technique of pranava pranayama involves the performance of three rounds of slow and deep yogic breathing into low chest, mid chest and upper chest followed by the prolonged audible rendition of the akara, ukara and makara nada (Aaa, Uuu and Mmm sounds) respectively during exhalation phase. Following this, he/she performs three rounds of the complete yogic breathing (mahat yoga pranayama) technique with an audible rendition of omkara nada (AUM sound) during exhalation phase. The time taken for the exhalation with nada is approximately three times the time taken for each inhalation, thus maintaining a ratio of 1:3.

After completing pranava pranayama that took approximately 6 minutes, the subject continued to rest in the supine position for another 2 minutes, before the post intervention HR and BP were recorded. Pulse pressure (PP) was calculated as the difference between systolic pressure (SP) and diastolic pressure (DP), mean pressure (MP) as DP + 1/3 PP, rate-pressure product (RPP) as HR × SP / 100 and double product (DoP) as HR × MP / 100.

Statistical analysis of pre and post intervention data was done using GraphPad InStat version 3.06 for Windows 95, GraphPad Software, San Diego California USA, www.graphpad.com. All data passed normality testing by Kolmogorov-Smirnov Test and hence was analyzed using Students t test for paired data for pre-post, intra-group comparisons and Students t test for unpaired data to compare values between the groups. P values less than 0.05 were accepted as indicating significant differences between pre-post study data.

**RESULTS:**

The mean ± SEM values of HR, SP, DP, PP, MP, RPP and DoP before and after performance of pranava pranayama and “sham relaxation” control as well as the intra and inter group statistical comparisons are given in Table 1.
Table 1. Immediate effect of pranava pranayama in supine position on heart rate (HR), systolic pressure (SP), diastolic pressure (DP), mean pressure (MP), pulse pressure (PP), rate-pressure-product (RPP) and double product (Do P) in patients having concomitant hypertension and diabetes. Before (B) and after (A) the pranayama.

<table>
<thead>
<tr>
<th></th>
<th>Pranava Group (n=15)</th>
<th>Control Group (n=14)</th>
<th>Comparison between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>A</td>
<td>p value</td>
</tr>
<tr>
<td>HR (beats /min)</td>
<td>77.53 ± 3.32</td>
<td>75.33 ± 3.08</td>
<td><strong>0.044</strong></td>
</tr>
<tr>
<td>SP (mm Hg)</td>
<td>134.27 ± 3.79</td>
<td>124.73 ± 3.16</td>
<td><strong>&lt; 0.001</strong></td>
</tr>
<tr>
<td>DP (mm Hg)</td>
<td>77.20 ± 1.29</td>
<td>74.87 ± 1.21</td>
<td><strong>0.016</strong></td>
</tr>
<tr>
<td>PP (mm Hg)</td>
<td>57.07 ± 3.72</td>
<td>49.87 ± 2.97</td>
<td><strong>&lt; 0.001</strong></td>
</tr>
<tr>
<td>MP (mm Hg)</td>
<td>96.22 ± 1.67</td>
<td>91.49 ± 1.53</td>
<td><strong>0.002</strong></td>
</tr>
<tr>
<td>RPP (units)</td>
<td>104.49 ± 5.95</td>
<td>94.20 ± 4.86</td>
<td><strong>0.002</strong></td>
</tr>
<tr>
<td>Do P (units)</td>
<td>74.78 ± 3.72</td>
<td>69.09 ± 3.25</td>
<td><strong>0.004</strong></td>
</tr>
</tbody>
</table>

Values are given as mean ± SEM. All baseline comparisons between groups were insignificant with p > 0.05.

Intra group comparison of pre-post data showed significant changes (p<0.05) in all parameters following pranava pranayama whereas this was only significant with respect to fall in HR (p=0.010) and rise in PP (p=0.016) in the control group.
Inter group comparison showed no significant differences between groups at baseline (p>0.05). However comparisons following pranava and “sham relaxation” showed significant differences between groups with regard to SP (p=0.015), PP (p=0.018), MP (p=0.035), RPP (p=0.047).

**DISCUSSION:**
Enhanced cardiac parasympathetic tone is postulated to be an important mechanism underlying beneficial effects of the relaxation response.\(^\text{10}\) It has also been suggested that a holistic and complete sympathovagal homeostatic development is possible only by the practice of yoga in its true form and spirit.\(^\text{11}\) A previous study from our laboratories reported significant blunting of cold pressor-induced increase in HR, BP and RPP following the practice of shavasan giving evidence that shavasan reduces load on the heart by blunting the sympathetic response along with an enhanced parasympathetic activity.\(^\text{4}\)

A review of relaxation therapy in the treatment of HT reported that task awareness adds to the treatment effect and suggested that relaxation therapy is useful in the clinical management of HT, especially for individuals whose BP remain high despite pharmacological treatment.\(^\text{3}\) Most yogic relaxation practices have a task awareness element associated with them and as the performance of pranava pranayama while relaxing in the supine position is done with conscious awareness, it may be producing its beneficial effects in a similar manner to those of task awareness.

A study by Goldstein et al concluded that relaxation without drugs although somewhat more effective than self monitoring alone, did not reduce BP as much as the combination of relaxation and medication.\(^\text{7}\) Interestingly as in our present study they also found no significant changes in HR between groups. The significant decrease of HR in our control group may be due to a reduction in physiological arousal that has been previously reported to occur from both guided relaxation and supine rest in a previous study.\(^\text{12}\)

In the pranava group, there was a significant decrease in all cardiovascular parameters. On the other hand in the control group, only HR decreased significantly while PP increased significantly. Inter group comparisons revealed that these changes were statistically significant only with regard to the decrease in SP, PP, MP and RPP in pranava group as compared to the control group.
This may be due to a decrease in venous return and resultant decrease in cardiac output occurring as a result of the prolonged exhalation phase in pranava pranayama producing a mild Valsalva like effect due to the increased intrathoracic pressure and decreased pre-load to the heart. A previous study from our laboratories has also reported that pranayama training of three months duration modulates ventricular performance by increasing parasympathetic activity and simultaneously decreasing sympathetic activity.\textsuperscript{13}

We have previously suggested that conscious deep breathing with prolonged exhalation and audible chanting during pranava pranayama may contribute towards a normalization of autonomic cardiovascular rhythms.\textsuperscript{14} The beneficial effects of audible chanting in restoring these autonomic cardiovascular rhythms has been reported earlier.\textsuperscript{15} It is plausible that the prolonged, audible chanting of the pranava in the present study may be producing a similar improvement in baroreflex sensitivity resulting in the normalizing of such autonomic cardiovascular rhythms.

Intra group comparison revealed a significant reductions in RPP and DoP only in pranava group that was absent in the control group. Further inter group comparisons however, revealed this to be significant only with regard to RPP even though the actual difference in DoP was greater in pranava group (7.2\%) as opposed to control group (4.7\%). This shows a trend that suggests, further statistical significance between groups could be achieved with a larger sample size. RPP and Do P are especially important in patient care as they are indirect indicators of myocardial oxygen consumption and load on the heart, thereby signifying a lowering of strain on the heart.\textsuperscript{16} RPP also provides a simple measure of overall heart rate variability (HRV) in hypertensive patients and is a surrogate marker in situations where HRV analysis is not available.\textsuperscript{17}

Reduction in RPP is thus representative of enhanced HRV power, implying better cardiac autonomic regulation in our subjects having concomitant DM and HT that are both major risk factors implicated in the causation of cerebro-vascular accidents as well as other cardiovascular and neurological complications. Hence this technique can be considered a means of primary prevention in this high risk population as we may be preventing the occurrence of future untoward and adverse events of high mortality and morbidity.

Pranava pranayama involves the audible chanting of the aaa, uuu and mmm sounds and when performed in the supine position is strikingly similar to the deep relaxation technique (DRT) popularized by SVYASA University, Bangalore.\textsuperscript{12} A previous study from SVYASA
reported that DRT improves sustained attention and reduces state anxiety\textsuperscript{18} while another reported a decrease in sympathetic activity with significant reduction in O\textsubscript{2} consumption, HR, and skin conductance along with decreased low-frequency (LF) power and increased high-frequency HF power of HRV spectrum.\textsuperscript{12} Satyapriya et al reported increased HF band of HRV spectrum along with decreased LF band and LF/HF ratio during and after a guided relaxation period in pregnant women indicating improved sympathovagal balance.\textsuperscript{19}

This improvement in sympathovagal balance following similar yogic relaxation techniques such as DRT is possibly one of the mechanisms behind the positive changes seen in our subjects. Hence, the reduction in RPP in our subjects having concomitant HT and DM implies a better autonomic regulation of the heart that is clinically valuable from both a qualitative and quantitative perspective.

Performance of pranava pranayama in the supine position may be inducing an integrated relaxation response similar to that suggested by Benson et al to be a wakeful hypometabolic state induced by simple, non-cultic mental techniques or by traditional meditational practices.\textsuperscript{20} This was attributed by them to an integrated hypothalamic response ("relaxation response") consistent with a state of decreased sympathetic-nervous-system activity. They have also reported that regular elicitation of the relaxation response is useful in the management of hypertensive subjects who are already on drug therapy.

Based on our findings we suggest that pranava pranayama in the supine position can achieve the same benefits in those having concomitant HT and DM.

REFERENCES:


EFFECT OF YOGA ON SUBCLINICAL
HYPOTHYROIDISM: A CASE REPORT
INTRODUCTION:
In recent times there is a shift in paradigm and Complementary and Alternative Medical (CAM) therapies such as yoga are being increasingly used as adjuncts to modern medicine. It has been suggested that yoga may have a role in revitalizing thyroid function as well as improving psycho-neuro-endocrine function on the whole.\textsuperscript{1,2} Though numerous studies have shown the psycho-physiological benefits and therapeutic potential of Yoga, there are few studies on the effects of yoga on thyroid disorders.\textsuperscript{3}

Hypothyroidism refers to a condition where the thyroid gland is not producing sufficient amounts of hormones. As there are intricate feedback mechanisms between the thyroid and anterior pituitary, hypothyroidism is classified as primary when thyroxin (T4) and triiodothyronine (T3) levels are low but levels of thyroid stimulating hormone (TSH) secreted by anterior pituitary high. It is classified as secondary when TSH is low and T4 and T3 levels are high.

Subclinical hypothyroidism is a condition where TSH levels are elevated but T\textsubscript{4} and T\textsubscript{3} levels are usually found to be in the normal laboratory reference ranges. Prevalence in the US adult population ranges from 4 to 8.5\% with an increase with age. It is also more common in women. Subclinical hypothyroidism may manifest without any major thyroid related symptoms as cellular metabolic rates may not be affected in many cases. Approximately 2 to 5 \% of these patients will progress to overt hypothyroidism per year.\textsuperscript{4} Opinion is divided on the biochemical and symptomatic point at which to start replacement therapy with levothyroxine that is the usual management of clinical hypothyroidism. One needs to be cautious as there is always the risk of iatrogenic hyperthyroidism.

HISTORY:
A 36 year old female, working in Kuwait presented to her clinician with the complaints of hair fall and a feeling of general lethargy. There were no other major thyroid related symptoms through she was anxious about her condition. As her blood tests revealed an elevated TSH level and low normal T4 levels she was diagnosed as having primary hypothyroidism and advised to start replacement therapy with levothyroxine as she tested positive for anti TPO antibodies. The patient put off starting the medication as she was visiting Pondicherry to visit her father for a short holiday with family. As she wished to avoid lifelong replacement therapy, on the suggestion of her father who is a YOGA
enthusiast she came for consultation to the ACYTER Yoga OPD that is functioning since June 2009 at JIPMER, Pondicherry. She had no apparent thyroid enlargement and her vitals were within normal limits. However she was anxious about her condition and the necessity of taking levothyroxine life long. She was given appropriate yogic counseling and dietary advice and taught a series of techniques that are potentially beneficial to patients of thyroid conditions. She continued the practices for one year and reported back at the end of the year with her biochemical investigations. Her biochemical results showed a fall in TSH and a normalization of free T4 values. She also reported less hair fall and a sense of well being. In fact she commented that many of her colleagues at work had noticed the positive changes in her attitude and day to day activities and were interested in what she has doing so that they could benefit themselves. As the anti TPO antibodies were positive both before and after the yoga intervention, the patient has been advised to continue the yoga practices on a regular basis as long as possible with regular six-monthly follow up.

INVESTIGATIONS:

The initial biochemical investigations detected that her TSH was 9.39 IU/ml (normal range for the laboratory is given as 0.27 to 4.20 mIU/L) and FT4 value was 12.57 pmol/L which is at the lower normal level of the range for that laboratory (12 to 22 pmol/L). Following 6 months of Yoga therapy, TSH fell to 2.66 mIU/L (normal range for the laboratory is given as 0.37 to 4 mIU/L) while FT4 was 8.98 pmol/L which is mid normal of the range for that laboratory (7.5 to 21 pmol/L). A third biochemical analysis three months later showed that TSH was 2 (normal range for the laboratory 0.27 to 4.20 mIU/L) and FT4 was 9.78 (normal range for the laboratory 7.86 to 14.4 pmol/L). Anti TPO antibodies were positive both before and after the yoga intervention.

YOGA THERAPY:

The patient was given appropriate yogic counseling and dietary advice and taught the following techniques that may be potentially beneficial to patients of thyroid conditions. The techniques included surya namaskar, jalandhara bandha, vipareeta karani and brahma mudra in addition to asanas such as trikona, vakra, ardha matsyendra, pawana mukta and sarvanga asana. She also received training in surya nadi, pranava, ujjayi and bhramari pranayama and relaxation techniques done in shava asana.
DISCUSSION:

The consensus report generated by the Consensus Development Conference (2002) cosponsored by the American Association of Clinical Endocrinologists (AACE), the American Thyroid Association (ATA), and The Endocrine Society (TES), has suggested that the upper limit of TSH should be considered as 4.5 mIU/L. It also states that since available data do not convincingly show clear-cut benefit from early thyroxine therapy, routine T4 treatment for patients with TSH between 4.5 and 10 mIU/L is not warranted. Martin I Surks and colleagues\(^4\) concluded that data supporting associations of subclinical thyroid disease with symptoms or adverse clinical outcomes or benefits of treatment are few. They have recommended against routine treatment of patients with TSH levels ranging from 4.5-10 mIU/L, as the consequences of subclinical thyroid disease are minimal.

However the AACE Clinical Practice Guidelines for the Evaluation and Treatment of Hyperthyroidism and Hypothyroidism (2002 Update) suggests that thyroid antibodies should be measured in patients having subclinical hypothyroidism and used as a clinical tool in deciding upon treatment. AACE guidelines also recommend treatment of patients with TSH > 5mIU/L if the patient has a goiter or if thyroid antibodies are present.

Two randomized controlled trials in patients with TSH values less than 10mIU/L found no symptomatic improvement following treatment with thyroxine.\(^5,6\) However caution is advised as there is a risk of progression to overt hypothyroidism. A 20 year follow up study showed a correlation of this with TSH levels and anti TPO antibodies.\(^7\)

Yoga has great potential as an adjunct therapy as it is cost effective and may not have any complications when practised in a proper manner and under expert guidance. Many patients are nowadays also opting to try out yoga either before starting medications, or in combination with medication.

The position statement of the AACE on Subclinical Thyroid Disease clearly states that until adequate data are available, best practice combines clinical judgment with patient preferences.\(^8\) In this case, the patient’s preference was to use yoga as a method to prevent her subclinical hypothyroidism from developing into full blown hypothyroidism and to avoid taking the replacement therapy as long as possible.

Yoga therapy imparted to this patient included techniques that may stimulate the thyroid such as viparita karani, sarvanga asana and jalandhara bandha. One of the pioneers of reach
in Yoga, KN Udupa of the BHU, Varanasi reported that head-low posture reduced levels of circulating catecholamine, improved tolerance to stress hence may act as a tranquilizer. These practices may help normalize thyroid function and also improve neuro-endocrine feedback mechanisms. This may also be accentuated by the pranayama practices like bhramari and pranava that may bring about such benefit through central action on either the hypothalamus or the limbic cortex.

Forfar and colleagues reported a reduction in left ventricular ejection fraction and myocardial contractile performance in hypothyroid patients. A study of systolic time intervals in hypothyroid patients by William F Crowley and colleagues reported that pretreatment systolic time intervals were characterized by prolongation of the pre-ejection period and reduction of left ventricular ejection period. A previous study from our laboratory has demonstrated that three months of Pranayam training modulates ventricular performance by increasing parasympathetic activity and decreasing sympathetic activity.

The practice of yoga is known to educe a sense of subjective well and a study done at the Integral Health Clinic of AIIMS, New Delhi reported that state and trait anxiety scores were significantly reduced following a comprehensive but brief lifestyle intervention based on yoga. Subjects in that study included patients of thyroid disorders.

Yogic relaxation techniques may be producing psycho-somatic harmonization and inducing a sense of calm due to hypo-metabolic activity as has been described in meditation by RK Wallace. A reduction in metabolic activity could be indirectly reducing the bodily demand for thyroxin as demonstrated by SB Rawal and colleagues.

Further studies in larger samples are needed to confirm these findings and to better understand the mechanisms behind such beneficial effects of yoga in patients of thyroid disorders.

REFERENCES


RESULTS OF A SURVEY OF PARTICIPANT FEEDBACK
INTRODUCTION:

Yoga is known to improve all aspects of physical and mental health in numerous health related conditions and a healthy sense of wellbeing and harmony is a positive spinoff from the practice of Yoga. More than 26,000 patients have benefited from personal consultations and individual and group therapy sessions at ACYTER in the past 4 years. As many of them had given positive feedback about improvements in their health following Yoga, we decided to do a proper survey of such responses.

MATERIALS AND METHODS:

From March to June 2011, a survey was conducted on 100 patients who were regularly attending yoga therapy sessions at ACYTER and had completed a minimum of one month of the regular programme.

A questionnaire was given to them consisting of questions related to their age, gender and demographic characteristic in addition to their main health complaints, attendance at the yoga sessions, home practice as well as their physical and mental condition and changes in dosage of medication.

RESULTS:

Results of the survey are given in number of participants except for those questions where all 100 participants had not replied, in which case % values are reported instead.

- AGE: Age of the participants ranged from 16 to 77 years with an average age of 47.04 ± 4.85 years (SEM). The maximum participants (39) were in the age group of 40-60 y while 25 were above 60 and 24 in the age group 30-40. There were 11 in the age group 20-30 and 2 were below 20 y ears of age.
- GENDER: 49 participants were male and 51 female.
- DEMOGRAPHIC DATA: 91 of the participants were from Pondicherry town and surrounding rural areas while 9 were from adjoining areas of Tamil Nadu.
- MAIN HEALTH COMPLAINTS: The system wise break up of main health complaints was: diabetes mellitus (41), hypertension and other cardiovascular
disorders (39), musculoskeletal disorders (13), respiratory disorders (13), endocrine (12), neurological disorders (5), gastrointestinal disorders (3), obstetrics and gynecological disorders (3), dermatological disorders (1) psychiatric disorders (1) and others (11). Some of the participants had multiple complaints.

- **REGULARITY OF ATTENDANCE AT ACYTER:** 50 had attended yoga therapy sessions for 1-3 months, 26 for 3-6 months, 16 for 6-12 months and 8 for more than a year. 60 participants were attending the sessions 3 days/week, 21 of them 4 days/week while 8 were attending once/week, 7 twice/week, 2 five days/week and 2 six days/week. The regularity was attributed to a feeling of physical and mental betterment (58%), regularity of the sessions (23%) and symptomatic relief (12%). Inability to be more regular was attributed to work pressure and examinations (7%).

- **REGULARITY OF HOME PRACTICE:** 21 were practising at home on 3 days/week, 18 on 2 days, 11 on 5 days, 10 on all 7 days, 10 on 4 days, 9 on 6 days and 3 were practising at home only once/week. 14 reported that they were not practicing at home at all. The regularity of home practice was attributed by the participants to a feeling of physical and mental betterment (49%) while inability to be more regular was attributed to lack of time (18%), work and education (18%), laziness (9%) and other home circumstances (6%). 46% of the participants reported a home practice of 30 min, 17% for 40 min, 16% for 20 min, 15% for 60 min and 6% reported that they practised for more than an hour at home. This regularity was attributed to a feeling of wellbeing (47%) while the irregularity was attributed to lack of time (29%), work pressure (18%) and other factors (6%).

- **HEALTH STATUS:** 56 participants reported that their health status was better than when they started the yoga practice. 36 reported that it was much better than before while 7 said that it was the same as before. One participant reported total relief from his health complaints after starting the yoga programme.

- **DOSAGE OF MEDICATION:** 56 participants reported no change in their medication, 29 reported a decrease while 2 reported an increase in the dosage of their medication. 13 of the participants were not on any medication.

- **GENERAL SUGGESTIONS:** The majority of participants reported satisfaction with the programme as well as the teaching methods of the instructors. General suggestions included the need for more space for practice sessions, an increase in the
number of sessions as well as duration of sessions and possibility of sessions being conducted after office hours. The participants thanked the Director JIPMER and MDNIY for starting ACYTER thus enabling so many persons to benefit from the excellent yoga programmes conducted free of cost.

**POST INTERVENTION, RETROSPECTIVE WELLNESS QUESTIONNAIRE**

A post intervention, retrospective wellness questionnaire compiled by ACYTER was used to evaluate the comparative feelings of the patients after the therapy programme. Five different responses ranging from ‘worse than before’ to ‘complete relief / total satisfaction’ were utilized to evaluate various physical and psychological aspects of the patient’s condition. The questionnaire was finalized in consultation with a 12 member team consisting of 3 eminent medical practitioners, 2 psychologists, 2 yoga experts, 2 eminent yoga therapy consultants, 2 educationalists and one legal anthropologist.

The post intervention overall wellness scores of the participants are given below in fig.1 and the detailed breakup of % responses to each question is given in table.1. Results of the retrospective wellness scores indicates that 11% attained complete relief from their condition while 35% felt much better than before. 38 % were better than before while 15% had no change in their condition. The condition of 1% was worse than before.

![Fig 1: Post intervention total well being score of participant](image-url)
Table 1: Responses of the participants to retrospective wellness questionnaire

<table>
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<tr>
<th></th>
<th>Worse than before</th>
<th>Same as before</th>
<th>Better than before</th>
<th>Much better than before</th>
<th>Complete relief / Totally satisfied</th>
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<td>Ability to concentrate</td>
<td>-</td>
<td>12%</td>
<td>56%</td>
<td>30%</td>
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<tr>
<td>Control of anger / loss of temper</td>
<td>-</td>
<td>15%</td>
<td>51%</td>
<td>26%</td>
<td>8%</td>
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<tr>
<td>Appetite</td>
<td>1%</td>
<td>26%</td>
<td>37%</td>
<td>24%</td>
<td>12%</td>
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<tr>
<td>Confidence level</td>
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<td>12%</td>
<td>41%</td>
<td>37%</td>
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</tr>
<tr>
<td>Ease of breathing</td>
<td>-</td>
<td>14%</td>
<td>33%</td>
<td>41%</td>
<td>12%</td>
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<tr>
<td>Energy levels</td>
<td>-</td>
<td>18%</td>
<td>39%</td>
<td>39%</td>
<td>4%</td>
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<tr>
<td>Enjoyment of life</td>
<td>-</td>
<td>18%</td>
<td>41%</td>
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<td>Feeling calm &amp; fresh</td>
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<td>32%</td>
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<td>36%</td>
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<td>Feeling of loneliness</td>
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<td>15%</td>
<td>40%</td>
<td>30%</td>
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<td>11%</td>
<td>37%</td>
<td>42%</td>
<td>10%</td>
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<tr>
<td>General mood</td>
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<td>38%</td>
<td>47%</td>
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<td>General sense of relaxation</td>
<td>-</td>
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<td>36%</td>
<td>39%</td>
<td>15%</td>
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<td>Joint mobility</td>
<td>-</td>
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<td>36%</td>
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<td>Pain levels</td>
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<tr>
<td>Performance of day-to-day activities</td>
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<td>41%</td>
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<td>Sleep quality / duration</td>
<td>1%</td>
<td>19%</td>
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<td>Stress levels</td>
<td>-</td>
<td>17%</td>
<td>38%</td>
<td>33%</td>
<td>12%</td>
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<tr>
<td>Total well being score</td>
<td><strong>0.48 %</strong></td>
<td><strong>15.24 %</strong></td>
<td><strong>38.19 %</strong></td>
<td><strong>35.05 %</strong></td>
<td><strong>11.05 %</strong></td>
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</table>
REPORT OF ACYTER ACTIVITIES

INTRODUCTION TO ACYTER:

The Advanced Centre for Yoga Therapy Education and Research (ACYTER), a collaborative venture between JIPMER, Puducherry and Morarji Desai National Institute of Yoga (MDNIY), New Delhi was established by MOU between JIPMER and MDNIY on 7 June 2008. This advanced centre will focus primarily on the role of yoga in the prevention and management of cardiovascular disorders and diabetes mellitus. Dr Madanmohan, Professor and Head, Department of Physiology, JIPMER is the Programme Director.

AIMS & OBJECTIVES:

- To bridge the gap between yoga and modern medicine
- To introduce yoga in medical curriculum and facilitate an awareness of the therapeutic potential of yoga amongst the medical professionals
- To provide quality yoga and lifestyle consultation and standardized yoga therapy to patients of JIPMER
- To conduct collaborative research projects with MDNIY
- To conduct seminars, workshops, symposia and conferences
- To standardize yoga techniques and procedures
- To conduct yoga classes for JIPMER staff, students and general public
- To create an awareness about the art and science of yoga amongst the people of Pondicherry and surrounding regions
SERVICES OFFERED THROUGH ACYTER:

Yoga therapy OPD is functioning in Super Specialty Block of JIPMER. Yoga therapy and lifestyle consultation is given by Dr Ananda Balayogi Bhavanani, Programme co-ordinator and Dr Zeena Sanjay, SRF from 9.30 AM to 1 PM every day.

Group and individual Yoga therapy sessions for diabetes, cardiovascular diseases and other conditions are being conducted every day from 10 AM to 1 PM and 3 to 4.30 PM in the ACYTER Yoga Hall situated in 3rd floor of institute block.

A senior citizen clinic is being conducted every Thursday from 11 AM to 12 noon and Mrs. Meena Ramanathan, Guest faculty is conducting the special sessions that have been well appreciated by the senior citizens of Pondicherry.

Regular yoga classes are being conducted from 6.30 to 7.30 AM and 4.30 to 5.30 PM on Monday, Wednesday and Friday at the ACYTER Yoga Hall situated in 3rd floor of institute block. The Yoga Institutors, Sri G Dayanidy and Selvi L Vithiyalakshmi are conducting the classes for JIPMER staff, students and their family members on a regular basis.

ACYTER Yoga Research Lab is functioning in SS Block since 6 July 2011 and regular studies are being done on patients of diabetes, hypertension and heart failure along with the administration of questionnaires. Various pilot studies on patients as well as normal volunteers are being conducted by Sri E Jayasettiaseelon, SRF in coordination with Sri Harikrishna PhD Scholar and Dr Rajajeyakumar, SR, Department of Physiology.

ATTENDANCE AT YOGA OPD AND PRACTICE SESSIONS:

Yoga therapy OPD is functioning in the Super Specialty Block of JIPMER daily from 9 AM to 1 PM and yoga therapy sessions are being conducted at ACYTER yoga hall for diabetes everyday from 10 – 11 AM, for cardiovascular diseases from 11 AM – 12 noon on Mondays, Wednesdays and Fridays and from 12 noon – 1 PM everyday for other disorders. Sessions are conducted individually and in groups as per requirements of the patients and directions of therapists. Yoga classes for normal subjects are being conducted on Mondays, Wednesdays and Fridays at 6.30 AM and 4.30 PM and for senior citizens on Thursdays between 11 AM and 12 noon.
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PUBLISHED COMPILATIONS AND IEC MATERIALS:

1. ACYTER BULLETIN: 12 editions.

2. BOOKLETS:
   a. Introducing Yog to Medical students: The JIPMER experience
   b. Tamil booklets on
      i. Yogic management of diabetes mellitus
      ii. Yogic management of cardio vascular disorders

3. PROCEEDINGS:
   a. National Workshop on “Introducing Yoga in the Medical Curriculum”
   b. National workshop cum seminar on “Role of Yoga in Prevention and Management of Hypertension”.
   c. National workshop cum seminar on “Role of Yoga in Prevention and Management of Diabetes Mellitus”.

4. COMPILATIONS: Compilations of up to date research studies on yoga for distribution to medical professionals:
   a. Yoga and diabetes
   b. Yoga and hypertension.

5. IEC MATERIALS: Tamil translations of MDNIY IEC materials on Asana, Pranayama, Yoga for diabetes, Yoga for hypertension, Yoga for cardiovascular diseases and Normal healthy diet.

PUBLISHED PAPERS:


12. Importance of body mass index (BMI) and waist circumference (WC) in yoga therapy in pre empting possible complications of obesity. Bhavanani AB. Yoga Mimamsa 2012; 43: 4: 316-325


**PUBLISHED ABSTRACTS**


PAPERS IN PRESS


3. Suryanadi pranayama (right unilateral nostril breathing) may be safe for hypertensives. Ananda Balayogi Bhavanani, Madanmohan, Zeena Sanjay (Journal of Yoga and Physical Therapy).
CHRONOLOGICAL REPORT ON ACTIVITIES:

JUNE 2008: MOU signed between JIPMER and MDNIY, New Delhi. First meeting of the monitoring committee was held on 7th June 2008 and attended by:

- Dr. KSVK Subba Rao, Director, JIPMER – Chairperson
- Dr. Ishwar V Basavaraddi, Director, MDNIY - Vice-Chairperson
- Dr. AK Das, Medical Superintendent, JIPMER - Member
- Dr. S Badrinath Project Coordinator, JIPMER - Member
- Dr. KS Reddy Dean, JIPMER - Member
- Dr. J Balachander, Professor & Head, Department of Cardiology, JIPMER- Member
- Dr. Madanmohan Trakroo, Professor & Head, Department of Physiology & Programme Director ACYTER - Member-Secretary

SEPTEMBER & OCTOBER 2008: 60 hour Foundation Course in yoga conducted by Dr Madanmohan, Programme Director ACYTER at JIPMER for 100 students of first year MBBS. Report has been published in Yoga Vinjana, journal of MDNIY (Vol II: 1&2, 2008. Pg. 71- 78)

NOVEMBER 2008: ACYTER meeting was held on 6th November at Director’s Chamber. The following members were present:

- Dr. KSVK Subba Rao, Director, JIPMER – Chairperson
- Dr. Ishwar V Basavaraddi, Director, MDNIY - Vice-Chairperson
- Dr. KS Reddy Dean, JIPMER - Member
- Dr. Madanmohan Trakroo, Professor & Head, Department of Physiology & Programme Director ACYTER - Member-Secretary

JANUARY 2009: Mr. S Mourthy appointed as DEO-Cum-clerk on basis of earlier selection as communicated vide No. JIPMER/C.Lib/DEO/2008, dt. 3. 12. 08.
FEBRUARY 2009

February 16 to 22: ACYTER organized a Mass yoga awareness programme in 48 schools of Puducherry with cooperation of the Education Department, Government of Puducherry

February 27: Interview held for the posts of programme coordinator, senior research fellow, yoga instructor and general duty attendant.

MARCH 2009

March 4: Dr Ananda Balayogi Bhavanani appointed as Programme Co-ordinator.

March 12: Mr. E Jayasettiaseelon appointed as Senior Research Fellow.

March 18: Inauguration of ACYTER by Dr KSVK Subba Rao, Director JIPMER. Dr Ishwar V Basavaraddi, Director, MDNIY, New Delhi and Dr AK Das, Medical Superintendent, JIPMER were guests of honour.

March 18 to 20: ACYTER and Department of Physiology, JIPMER organized a two day National Workshop on “Introducing Yoga in the medical curriculum” at JIPMER. Booklet has been released on “Introducing Yog to Medical students: The JIPMER experience”

JUNE 2009

June 1: Dr Zeena Sanjay (Senior Research Fellow), Sri G Dayanidy (Yoga Instructor), Selvi L Vithiyalakshmi (Yoga Instructor) and Sri P Munisamy (General Duty Attendant) join duty.

June 1 to 15: Orientation programme was conducted for ACYTER staff by Dr. Madannmohan, Programme Director. Workshop on HRV methods was conducted by Dr ES Prakash from Asian institute of medicine science and technology.

June 15: Yoga therapy OPD started functioning in Super Specialty Block. Yoga therapy sessions for diabetes, cardiovascular diseases and other disorders started. Regular yoga classes were started for normal subjects. Special yoga classes for senior citizens were started. Mrs. Meena Ramanathan is assisting as guest faculty for these sessions.

June 20: Weekly academic programmes inaugurated with talk by Sri E Jayasettiaseelon, on “Yogic Diet” at ACYTER Yoga Hall.
June 27: Dr Vivek Sharma, Assistant Professor, Department of Physiology gave a talk on “Yoga - It’s applications in health and disease”. This was followed by a lecture cum demonstration on “Important asanas for health” by Dr Ananda Balayogi Bhavanani, and Sri G Dayanidy.

JULY 2009


July 18: Academic programme and talk on” Naturopathy & its applications” by Dr. Zeena Sanjay at ACYTER yoga Hall.

July 25: Academic programme and talk on “Yoga for diabetes” by Selvi L Vithiyalakshmi and “Yoga for hypertension” by Shri G Dayanidy at ACYTER yoga Hall.

AUGUST 2009

August 1: Academic programme and talk on “Music therapy” by Music researchers from Belgium was held in collaboration with SADAY special school.

August 7: Dr Madanmohan, Programme Director gave a talk on “Yoga and complementary medicine” at the JIPMER Nursing College for participants of the Nursing workshop on HIV/AIDS.

August 8: Academic programme and talk on “Introduction to siddha medicine” by Dr. Rajalakshmi at ACYTER Yoga Hall.

August 12: Talk on “Yoga for positive health” at Mahatma Gandhi Post Graduate Institute for Dental Sciences by Dr Ananda Balayogi, programme Co-ordinator.

August 15: Academic programme and talk on “Benefits of herbal medicines” by Shri Paramakethou at ACYTER Yoga Hall.


August 17 to 30: Pilot study conducted on “Immediate effect of yoga practices on blood pressure”.

August 21 & 28: Dr Ananda Balayogi Bhavanani gave a talk on “Yoga and complementary medicine” at JIPMER Nursing College for nursing workshop on HIV/AIDS.
SEPTEMBER 2009

September 4 & 18: Shri E. Jayasettiaseelon, SRF gave a talk on “Yoga and complementary medicine” at JIPMER nursing college for nursing workshop on HIV/AIDS.

September 5: Academic programme and talk on “Pranayama & its therapeutic benefits” by Shri S. Jayasettiaseelon at ACYTER yoga hall.

September 9: Delegation of yoga teachers from Australia and New Zealand visited ACYTER.

September 11: Dr Zeena Sanjay, SRF gave a talk on “Yoga and complementary medicine” at JIPMER nursing college for nursing workshop on HIV/AIDS.

September 12: Academic programme and talk on “Yoga for positive health” by Dr Zeena Sanjay at ACYTER yoga hall.

September 19: Academic programme and talk on “Yoga for special children” by Mrs. Meena Ramanathan at ACYTER yoga hall.

September 26: Academic programme and talk on “Methods of yogic diagnosis” by Dr Ananda Balayogi at ACYTER yoga hall.

OCTOBER 2009

October 9: ACYTER conducted yoga and healthy lifestyle consultations for delegates attending the Regional Official Language Conference for South and South Western Zone, at JIPMER Auditorium.

October 10: Academic programme and talk on “Yoga for sleeping disorders” by Shri G Dayanidy at ACYTER yoga hall.

October 13 to 30: Pilot study conducted on “Acute effects of yoga nidra”.


October 17: Academic programme and talk on “Shatkriyas” by Selvi L Vithiyalakshmi at ACYTER yoga hall.

October 23 & 30: Shri E Jayasettiaseelon, gave a talk on “Yoga and complementary medicine” at JIPMER Nursing college for nursing workshop on HIV/AIDS.

October 29: Delegation of yoga teachers from Germany visited ACYTER.
NOVEMBER 2009

November 7: Academic programme and talk on “Review of Pilot study” by Dr Zeena Sanjay at ACYTER yoga hall.

November 10 to 20: Pilot study conducted on “Immediate effect of chandra nadi pranayama in hypertensive patients”.

November 13: Dr Zeena Sanjay gave a talk on “Yoga and complementary medicine” at JIPMER Nursing College for participants of Nursing Workshop on HIV/AIDS.

November 14: Academic programme and talk on “Review of Pilot study” by Shri S. Jayasettiaseelon at ACYTER yoga hall.

November 20 & 27: Shri E Jayasettiaseelon gave talk a on “Yoga and complementary medicine” at JIPMER Nursing College for Nursing Workshop on HIV/AIDS.

November 21: Academic programme and talk on “Review of Pilot study” by Shri G Dayanidy at ACYTER yoga hall.

November 28: Academic programme and talk on” Review of Pilot study” by Selvi L Vithiyalakshmi at ACYTER yoga hall.

DECEMBER 2009

December 11 & 18: Shri E Jayasettiaseelon gave a talk on “Yoga and complementary medicine” at JIPMER Nursing College for Nursing Workshop on HIV/AIDS.

December 1 to 31: Compilation and publication of Tamil translations of MDNIY IEC materials on asana, pranayama, yoga for diabetes, yoga for hypertension and yoga for cardiovascular diseases for free distribution. 1500 copies of each booklet were distributed.

JANUARY 2010

January 1: Workshop on “Chakra healing” by Sri Bala Ratnam of founder Vibrational Breath Therapy, Melbourne, Australia.

January 4 to 7: ACYTER participated in 17th International Yoga Festival conducted by Department of Tourism, Govt of Puducherry.
January 12 & 13: ACYTER participated in “Workshop on yoga for stress management and personality development” organized by Anandita Trust in Hotel Surguru at Pondicherry.


January 22: Shri E Jayasettiaseelon gave a talk on “Yoga and complementary medicine” at the JIPMER Nursing College for the Nursing Workshop on HIV/AIDS.


FEBRUARY 2010

February 5 & 26: Shri E Jayasettiaseelon gave a talk on “Yoga and complementary medicine” at the JIPMER Nursing college for the nursing workshop on HIV/AIDS.

February 12: Dr Zeena Sanjay gave a talk on “Yoga and Complementary medicine” at the JIPMER Nursing college for the nursing workshop on HIV/AIDS.

February 12 to18: ACYTER participated in National yoga Week 2010 organized by MDNIY at New Delhi. Programme Director, Programme Co-ordinator, Shri E Jayasettiaseelon, SRF and Shri G Dayanidy, Yoga instructor attended. Poster presentation was given on ACYTER activities.

February 23: Dr Ananda Balayogi gave a talk on “Yoga for maternal and child health” at Mother Teresa Institute of Health Science as part of the state level campaign for mother and child health organized by the Directorate of Indian Systems of Medicine and Homeopathy, Government of Pondicherry.

February 23 & 24: Special yoga classes for antenatal and postnatal health were conducted for 50 students of final year BSc Nursing at the JIPMER Nursing College.

MARCH 2010

March 5, 12 & 26: Shri E Jayasettiaseelon gave a talk on “Yoga and complementary medicine” at the JIPMER Nursing College for Nursing Workshops on HIV/AIDS.
March 18 to 20: National Workshop on “Role of yoga in prevention and management of hypertension” organized at JIPMER. Proceedings of the workshop on “Introducing yoga in the medical curriculum” was released by Dr. KSVK Subba Rao, Director, JIPMER

APRIL 2010

April 8: Compilations on “Yoga and diabetes” and “Yoga and hypertension” published and circulated amongst JIPMER doctors.


MAY 2010

May 1 to 30: Pilot studies conducted on “Immediate effect of kayakriya in normal subjects” and “Immediate effect of shavasana with savitri pranayama in hypertensive patients”.

May 1 to 30: Standardization of HRV analysis in collaboration with faculty of the department of physiology, JIPMER

May 15 to 30: Preparation of study materials and planning for conducting “Foundation course in yoga I” for medical professionals

JUNE 2010

June 2 to 30: 48 hour Foundation course in yoga conducted at ACYTER hall for 15 medical and paramedical staff of JIPMER.

June 8: Paper on “Immediate effect of deep breathing in hypertensive patients” was submitted for publication in International Journal of yoga therapy.

June 11 onwards: Pilot study on “Immediate effect of SNP on hypertensive patients”.

JULY 2010

July 2: Shri E Jayasettiaseelon gave a talk on “Yoga and complementary medicine” at the JIPMER Nursing college for participants of the nursing workshop on HIV/AIDS.
July 9: Dr Ananda Balayogi Bhavanani gave a talk on “Yoga and Complementary medicine” at the JIPMER Nursing College for the nursing workshop on HIV/AIDS.

July 10 onwards: Pilot studies in progress on “Immediate effect of pranava pranayama in hypertensive patients” and “Immediate effect of deep breathing in shavasana in normal subjects”.


July 17: Valedictory function of foundation course I was held at ACYTER and certificates issued to the participants.

July 18: Dr Ananda Balayogi Bhavanani, Programme Co-ordinator ACYTER presented a talk on “Rheumtological and Immunological aspects of aging and importance of an integrated approach of yoga in senior citizens” during “SYNERGIES IN HEALING” organized by Krishnamacharya Yoga Mandiram at GRT convention Centre, Chennai.

July 22: Meeting of the monitoring committee held in office of the Director, JIPMER. Meeting was chaired by Dr. KSVK. Subba Rao, Director, JIPMER and attended by:

Dr. KSVK. Subba Rao, Director, JIPMER – Chairperson
Dr. AK Das, Medical Superintendent, JIPMER - Member
Dr. J Balachander, Professor & Head, Department of Cardiology, JIPMER- Member
Dr. Satish R R Gaikwad, Research Officer (Scientific) & Incharge of Scientific Research Wing, MDNIY – Member
Dr. Ananda Balayogi Bhavanani, Programme Co-ordinator ACYTER– Member
Dr. Madanmohan Trakroo, Professor & Head, Department of Physiology & Programme Director, ACYTER - Member-Secretary

July 23: Shri E Jayasettiaseelon gave a talk on “Yoga and complementary medicine” at the JIPMER Nursing college for the GFATM Nursing workshop on AIDS/HIV.

July 30: A lecture-cum-practice session on yoga, meditation and spiritual healing was conducted by Shri E Jayasettieeloon, SRF for 90 students of Bsc nursing (final year).

AUGUST AND SEPTEMBER 2010

August: Compiled 5 case studies
- Effect of yoga on subclinical hypothyroidism
- Effect of yoga in newly diagnosed hypertension
- Effect of yoga in a patient of long standing diabetes and hypertension
- Case report on COAD in an adult
- Case report on bronchial asthma in a 4 year old child

**OCTOBER AND NOVEMBER 2010**

**October 15:** Seventh edition of bulletin published

**October 18 – November 20:** 48 hour Foundation course in yoga conducted for 63 medical doctors, paramedical professionals, students and staff members of JIPMER.

**November 13:** Dr Ananda Balayogi Bhavanani, Programme Coordinator ACYTER was invited to present a lecture on “yoga for women” in the 8th national conference hosted by Puducherry chapter of society on midwives.

**November 19:** Valedictory function of foundation course II was held at ACYTER and certificates issued to the participants.

**November 27 – 28:** ACYTER team participated as jury members in the 25th Pondicherry state Yogasana competition & also gave free consultation.

**DECEMBER 2010**

**December 5:** Programme Coordinator was invited to present a lecture on “Principles and practice of yoga therapy for geriatric psychiatric disorders” in the workshop on “yoga therapy for psychiatric Disorders” held at Advanced Centre for Yoga, NIMHANS.

**December 11:** A delegation of yoga teachers from Italy visited ACYTER and expressed their admiration for the programme and its activities.

**JANUARY 2011**

**January 4-7:** Staff of ACYTER also participated in the 18th International Yoga Festival Conducted by the Government of Pondicherry from 4-7 January 2011. Invited talks were
given by Programme Coordinator and free consultation on yoga and healthy living was provided to 102 delegates and members of the public in the ACYTER stall. Sri G Dayanidy, Yoga Instructor ACYTER won first place in the 25-35 age category and was selected to participate in the Final Championship Round.

**January 15:** Eighth edition of bulletin published

**January 17:** Staff of ACYTER presented talks and lecture demonstrations during the CME on Physiological Effects of yoga, organized by Department of Physiology, Sri Satya Sai Medical College and Research Institute, near Chennai. Dr Madanmohan presented an overview of “yoga and Physiology” while Dr Ananda Balayogi gave a talk on “Therapeutic potential of yoga”. Dr Zeena Sanjay, SRF gave a talk on “yoga research” that also highlighted the activities of ACYTER, while Sri G Dayanidy gave a spectacular demonstration of various yoga asanas with commentary by Dr Ananda. The CME was attended by more than a hundred members of the management, faculty, staff and students who gave positive feedback and expressed appreciation for the entire programme.

**January 20-21:** Dr Madanmohan, Programme Director and Dr Ananda Balayogi, Programme Coordinator were invited to give invited talks and workshops during the Golden Jubilee National Seminar cum Workshop cum on “Role of Yoga in Respiratory Tract Disorders”. The event was organized by the Advanced Centre for Yoga Education and Research, Gujarat Ayurved University, Jamnagar and MDNIY, New Delhi.

**January 24:** As part of the pre-hypertension research project, yoga therapy sessions are being conducted for staff members of Kendriya Vidyalaya from the second week of January. Screening of the participants for pre-hypertension was done by Mr. Ram Kumar, PhD Scholar, Dept of Physiology while Shri G Dayanidy is conducting the sessions on Tuesday, Thursday and Saturday from 3 – 4 PM at the school premises. All staff members have shown great interest in attending the sessions regularly.

**FEBRUARY 2011**

**February 12-18:** Dr Madanmohan and Dr Ananda Balayogi and Dr Zeena Sanjay attended the yoga week conducted at MDNIY New Delhi. Dr Ananda Balayogi was invited to give invited talk on “Yoga for general well being” at yoga week. Dr Madanmohan chaired the academic sessions and gave a talk at the valedictory function of yoga week.
February 20: Tamil translation of MDNIY’s booklet on diabetes and on hypertension was prepared for release during the national workshop. Tamil translation of IEC materials on diet was also prepared.

MARCH 2011

March 1-2: ACYTER conducted National workshop – cum seminar on Role of yoga in prevention & management of diabetes mellitus, organized at JIPMER. Released proceedings of previous workshop – “National workshop cum seminar on role of yoga in prevention and management of hypertension”. Also released Tamil books on “yogic management for diabetes Mellitus”, “yogic management in cardio vascular disorders” and also released a booklet on “normal healthy diet”.

March 10: Programme director conducted a workshop on yoga at Kasturba Medical College at Manipal.

March 22: Started yoga therapy sessions for pregnant ladies as part of a pre–eclampsia prevention study. Screening of the patients is being done by Dr Manikandan, Asst Professor in OBG, JIPMER and Selvi L Vithiyalakshmi is conducting the yoga sessions on Tuesdays and Thursdays from 3- 4 PM at the ACYTER yoga hall.

APRIL 2011

April 1-30: From March to June 2011, a survey was conducted on 100 patients who were regularly attending yoga therapy sessions at ACYTER and had completed a minimum of one month of the regular programme. Various details were obtained such as age, gender and demographic characteristic in addition to their main health complaints, attendance at the yoga sessions, home practice as well as their physical and mental condition and changes in dosage of medication. A post intervention, retrospective wellness questionnaire compiled by ACYTER was used to evaluate the comparative feelings of the patients after the therapy programme. The questionnaire was finalized in consultation with a 12 member team consisting of 3 eminent medical practitioners, 2 psychologists, 2 yoga experts, 2 eminent yoga therapy consultants, 2 educationalists and one legal anthropologist.

MAY 2011

May 1-31: Survey of patient’s feedback continued

May 20: Pranayam classes for post graduate students and Research scholars of Physiology department conducted at ACYTER Yoga hall from 12.00 pm to 1.00 pm. 20 participants attended the classed regularly for a month. The classes concluded on 20 June 2011. Various pranayam techniques were taught by Dr. Madanmohan, Programme director and assisted by Yoga instructors Mr. Dayanidy and Miss. Vithiyalakshmi. Relaxation techniques were instructed by Mr. Jayasettiaseelon, SRF. Various pranayamas, bandhas, and relaxation techniques were taught in the class.

JUNE 2011: Survey of patient’s feedback and retrospective wellness questionnaire was completed and analysis started.

JULY 2011

July 6: The ACYTER Yoga Research Lab was inaugurated by Dr. KSVK Subba Rao, Director, JIPMER at 9.30am in the Super Specialty Block. Dr. AK Das, Medical Superintendent and Dr. Balachander, Professor and Head, Dept. of Cardiology were special invitees. Dr. Madanmohan, Professor & Head, Dept. of Physiology and Program Director of ACYTER welcomed the gathering and explained the work being done at ACYTER since the past 2 years. The inaugural was attended by faculty, residents, research scholars and staff of the Department of physiology along with staff of ACYTER.


AUGUST 2011

August 6: Free Hypertension screening & Yoga consultation Programme conducted in Lawspet, Pondicherry. Residents and PhD scholars of the department of physiology and staff members of ACYTER, JIPMER conducted the programme in coordination with the local MLA Sri Vaithiyanathan and his colleagues.
August 7: Programme Co-ordinator ACYTER Dr Ananda Balayogi Bhavanani was an invited Guest Speaker at the CME on Obesity organized by the Woman Doctors Association (TN) at Sri Lakshminarayanan Institute of Medical Studies, Pondicherry and presented an interactive talk on “Dealing with obesity the Yoga way”. The lecture cum demonstration session was highlighted by Mr. G Dayanidy, Yoga Instructor ACYTER who gave an excellent demonstration to complement the talk.

August 18: Yoga sessions started for “Effects of slow and fast pranayams on pulmonary function, handgrip strength and endurance in young healthy volunteers – A randomized controlled trial”.

August 20: Yoga instructors started taking yoga sessions for physiotherapy students at Mother Theresa Institute of Health Sciences, Pondicherry.

SEPTEMBER 2011

September 1: Paper on “Effect Of Yoga Therapy On Reaction Time, Biochemical Parameters And Wellness Score Of Peri And Post Menopausal Diabetic Patients” was submitted for publication in IJOY.

September 7: Yoga sessions started for “Effect of yoga training on autonomic functions and reaction time in young healthy females during different phases of menstrual cycle”.

September 20: Paper on Chandra Nadi Pranayama on cardiovascular parameters in hypertensive patients was submitted for publication in IJOY.

OCTOBER 2011


October 23: Dr Madanmohan presented an invited talk on “Role of yoga in prevention and management of cardiovascular disease: the JIPMER experience” at the 24th Annual Conference, Indian Society for Atherosclerosis Research & International CME on
Atherosclerosis at JIPMER. The talk was published in the Souvenir & Abstract of the conference on pages 7-10.

**NOVEMBER 2011**

**November:** Results of a “Survey of Participant Feedback at ACYTER, JIPMER Pondicherry” published in Yoga Life 2011; 42 (Nov): 11-13.

**November:** Article on “Yogic perspective on depression and mental health” published in Yoga Mimamsa Vol. XLIII ; No. 3. pp 254-264.

**DECEMBER 2011**

**December 10-11:** IEC materials were distributed and free consultation given for general public by the ACYTER team during the 26th Pondicherry State Yogasana competition.

**December 21:** Dr Ananda Balayogi Bhavanani, Programme Coordinator ACYTER was invited to present a lecture on “Yoga and Education” in the 19th International Yoga conference at SVYASA, Bangalore.

**December:** Abstract on “Immediate effect of suryanadi and chandranadi on short term heart rate variability in healthy volunteers”. Indian J Physiol Pharmacol 2011; 55 (5 supplement) : 43-44.

**December:** Abstract on “Effect of 12 Week Yoga Therapy on Cardiac Autonomic Functions in Patients of Essential Hypertension”. Indian J Physiol Pharmacol 2011; 55 (5 supplement): 42.

**December:** Abstract on “Effect of 12 Week Yoga Therapy as a Lifestyle Intervention in Patients of Type 2 Diabetes Mellitus with Distal Symmetric Polyneuropathy”. Indian J Physiol Pharmacol 2011; 55 (5 supplement): 64.

**December:** Abstract on “Yoga and the educational process”. Souvenir of the 19th International conference on frontiers in yoga research and its applications. Organized by the VYASA, Bengaluru, India. December 2011. Pg. 122.

JANUARY 2012

January 12: Dr Madanmohan, Programme Director, ACYTER was honoured with DSc (Yoga) by SVYASA University, Bengaluru. This prestigious award was bestowed upon him in recognition of his yeoman service towards the cause of scientific validation of yoga.

January 21: Staff of ACYTER conducted a special Yoga Awareness programme for more than 50 corporate executives and invitees of the Harmany Company at Hotel Athiti.

January 24: ACYTER staff started conducting Foundation Course in Yoga for Paramedical Students at the Department of Physiotherapy, Mother Theresa Post Graduate and Research Institute of Health Sciences. 6 students of MPT course are participating in the training programme being conducted by Sri G Dayanidy and Selvi L Vithiyalakshmi.

January: Article on “Importance of body mass index (BMI) and waist circumference (WC) in yoga therapy in pre empting possible complications of obesity” published in Yoga Mimamsa 2012; 43: 4: 316-325

FEBRUARY 2012

February 4: Programme Director presented an Invited talk on “My work in yoga” at Golden Jubilee Celebrations of Kashmir Medicos Association and CME, New Delhi.

February 10: Programme Director presented an Invited talk on “Integrating naturopathy and yoga in conventional medical education” and chaired a session in the International Conference on Yoga, Naturopathy and AROGYA Expo – 2012, Bangalore.

February 12-18: Dr Madanmohan, Programme Director and Dr Ananda Balayogi Bhavanani, Programme Coordinator presented Key Note addresses and chaired scientific sessions during National Yoga Week at MDNIY, New Delhi. Poster presentation of ACYTER activities was exhibited by Sri E Jayasettiaseelon, SRF and Miss L Vithiyalakshmi.

February 12-18: Sri E Jayasettiaseelon, SRF bagged Consolation Prize in the Best Paper presentation section for his presentation on the “Acute effect of anuloma vilom pranayama on short term HRV”.

**MARCH 2012**

**March 1:** Twelfth edition of ACYTER Bulletin was published as a Special Edition with comprehensive report of all activities at ACYTER since June 2008 till February 2012.

**March:** Released proceedings of previous workshop – “National workshop cum seminar on role of yoga in prevention and management of diabetes mellitus”. Tamil translations of MDNIY IEC materials on Asana, Pranayama, Yoga for diabetes, Yoga for hypertension and Yoga for cardiovascular diseases were released.

**APRIL 2012:** Regular Yoga therapy consultations in the OPD, classes and therapy sessions at ACYTER as well as a foundation course in yoga for paramedical staff of JIPMER was conducted. 35 patients of diabetes and hypertension were recruited for various pilot studies on Yogic uninostril breathing techniques.

**MAY 2012:** Regular Yoga therapy consultations in the OPD, classes and therapy sessions at ACYTER as well as a foundation course in yoga for paramedical staff of JIPMER was conducted. 35 more patients of diabetes and hypertension were recruited for various pilot studies on Yogic uninostril breathing techniques.

**JUNE 2012**

**June 1:** Meeting of the monitoring committee of ACYTER to discuss the continuation and upgradation of ACYTER in the next 5 year plan. Meeting was chaired by Dr KS Ravikumar, Director, JIPMER and attended by Dr. S Badrinath (Project Coordinator, JIPMER), Dr. J Balachander (Professor & Head, Department of Cardiology, JIPMER), Dr Ananda Balayogi Bhavanani (Programme Coordinator ACYTER) and Dr Zeena Sanjay (SRF, ACYTER).

**June 12:** Staff of ACYTER participated as Resource Persons in the “CME-cum-workshop on HRV” organized by Department of Physiology, M GMCRI, Pondicherry. The event was organized by Dr Madanmohan with Dr ES Prakash, Dr Ananda Balayogi Bhavanani and others as invited resource persons.
**June 18:** Programme coordinator was chief guest at the inauguration of a yoga therapy course at Krishnamacharya Healing & Yoga Foundation, Chennai. He gave a presentation on “Emerging trends in yoga therapy” and presented an overview of the work being done at ACYTER that was well appreciated by more than 60 participants from all over the world.

**June 21:** World Yoga Day was celebrated with active participation of more than 50 patients who have been attending therapy sessions regularly at ACYTER. Dr AK Das, MS and acting director, JIPMER graced the occasion. Encouraging feedback was given by all participants who expressed their gratitude to JIPMER and MDNIY for continuing ACYTER thus benefiting them tremendously. Dr P Nalini, former professor of Pediatrics, JIPMER and an enthusiastic yoga participant at ACYTER presided over the event.

**JULY 2012:** Programme Co-ordinator was Guest of Honor for the Valedictory Function on July 6, to mark the completion of 6 months of yoga training for 2nd year nursing students at the Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth.

**AUGUST 2012:** Programme Co-ordinator was Guest of Honor for the Pre-conference Workshop on Yoga organized by Indian Association of Pediatrics (TN) at JIPMER as part of East Coast South Pedicon on 9 August 2012.