

CHAPTER II

REVIEW OF RELATED LITERATURE

A study of different literature pertaining to the topics is very essential to get a clear view of the various research work done. This study would enable the researcher to go deeper into the subject with the work already done forming a base and also helps in working on newer dimensions.

The researcher has gathered different types of research work like abstracts from Dissertation, thesis, journals, magazines and relevant books on yoga both on cultural asana and suryanamaskar.

A series of relevant studies related to the problem under study and views expressed by various personalities have been presented in this chapter.

YOGA AND POLICE

YOGA – PHYSIOLOGICAL VARIABLES

Pulse Rate

Vital Capacity

Blood pressure

YOGA - BIO-CHEMICAL VARIABLES

Total Cholesterol

Blood Sugar

Liver function

YOGA - PSYCHOLOGICAL VARIABLES

Job Involvement

Stress

Organizational Climate

2.1 STUDIES ON YOGA AND POLICE

Cronin S, et.al. (2013) studied that evaluation of the benefits of a kripalu yoga program for police academy trainees at Wilmer Eye Institute, Johns Hopkins University. This pilot study evaluated the effects of Kripalu yoga on perceived stress, mood, and mindfulness during police academy training. Forty-two recruits participated in a 6-class yoga intervention. Participants completed the Profile of Mood States-Short Form, Perceived Stress Scale, and the Five Facet Mindfulness Questionnaire prior to and immediately following completion of the yoga program, as well as an exit survey. As a result paired samples t-tests revealed significant post intervention changes in perceived stress and mood, reductions in tension and fatigue, and a trend toward reduced anger. Changes in mindfulness were not detected. The exit survey indicated perceived benefits of yoga for some participants. It was concluded that yoga may be beneficial for reducing stress, tension, and fatigue among police academy trainees.

Bhavanani AB, et.al. (2013) did a comparative study of the effects of asan, pranayama and asan-pranayama training on neurological and neuromuscular functions of Pondicherry police trainees at Department of Physiology, Mahatma Gandhi Medical College and Research Institute, Pondicherry, India. Eighty male

trainees from Pondicherry Police Training School were randomly divided into asan, pranayama, and asan-pranayama groups who received a training of 4 days a week for 6 months and a control group. Electroencephalogram (EEG), nerve conduction (NC), electromyogram (EMG), visual evoked potentials (VEP), and auditory reaction time (ART) were recorded before and after the study period. NC, EMG, and VEP data were obtained from 28 subjects; EEG data from 48 subjects; and RT from 67 subjects. Intergroup differences were assessed by AVOVA/Kruskal-Wallis and intragroup differences by Student's t-test. As a result Police trainees showed beneficial effects of yoga training, although they were undergoing intensive police training and the yoga training was relatively less intense. Alpha, theta, and total power of EEG increased as a result of asan training. A shortening of visual reaction time and a decrease in red-green discriminatory reaction time signifies an improved and faster processing of visual input. They also showed a decrease in resting EMG voltage, signifying better muscular relaxation following pranayama training. Beta, theta and total power of EEG increased. ART and red-green discriminatory reaction times decreased in the trainees, signifying a more alert state as well as improved central neural processing. A combination of asan and pranayama training for 6 months produced an improvement in motor and sensory nerve conduction. Total power of EEG, alpha and theta power as well as delta % increased, while reaction time decreased signifying an alert and yet relaxed state of the neuromuscular system. It was concluded that the present study has shown that 6 months training in asan, pranayama as well as their combination is effective in improving physiological functions of police trainees. They showed beneficial effects of yoga training,

although they were undergoing intensive police training and the yoga training was relatively less intense.

2.2 STUDIES ON PHYSIOLOGICAL VARIABLES IN YOGA

Nalini A, et.al. (2013) studied about Assessment of cardiac autonomic function in patients with Duchenne muscular dystrophy using short term heart rate variability (HRV) measures at National Institute of Mental Health and Neurosciences, Bangalore, India. One hundred and twenty-four genetically confirmed boys with DMD and 50 age matched controls were recruited. Error-free, electrocardiogram was recorded in all subjects at rest in the supine position. HRV parameters were computed in time and frequency domains. Time domain measures included standard deviation of NN interval (SDNN), and root of square mean of successive NN interval (RMSSD). Frequency domain consisted of total, low frequency and high frequency power values. Ratio of low frequency and high frequency power values (LF/HF) was determined using customized software. As result HRV parameters were significantly altered in DMD children as compared to healthy controls. Following parameters [mean (SD)] were reduced in DMD as compared to controls; RMSSD (in ms) [52.14 (33.2) vs 64.64 (43.2); $p = 0.038$], High frequency component (nu) [38.77 (14.4) vs 48.02 (17.1); $p = 0.001$] suggesting a loss of vagal tone. In contrast, measure of sympathovagal balance LF/HF [1.18 (0.87) vs 0.89 (0.79); $p = 0.020$] was increased in DMD group.

Goshvarpour A, et.al. (2013) studied that Comparison of higher order spectra in heart rate signals during two techniques of meditation: Chi and Kundalini meditation at department of Biomedical Engineering, Mashhad Branch, Islamic Azad University, Mashhad, Iran. The human heart beat is one of the important examples of complex physiologic fluctuations. For the first time in this

study higher order spectra of heart rate signals during meditation have explored. Specifically, the aim of this study was to analysis and compares the contribution of quadratic phase coupling of human heart rate variability during two forms of meditation: (1) Chinese Chi (or Qigong) meditation and (2) Kundalini Yoga meditation. For this purpose, Bispectrum was estimated by using biased, parametric and the direct (FFT) method. The results show that the mean Bispectrum magnitude of heart rate signals increased during Kundalini Yoga meditation, but it decreased significantly during Chi meditation. However, in both meditation techniques phase-coupled harmonics are shifted to the higher frequencies during meditation. In addition, it has shown that not only there are significant differences between rest and meditation states, but also heart rate patterns appear to be influenced by different types of meditation.

Subramanian SK, et.al. (2013) studied the effect of yoga on autonomic functions and psychological status during both phases of menstrual cycle in young healthy females at Department of Physiology, ESI Dental College, New Delhi-110085,India . Fifty apparently healthy females in the age group of 18-20 years were randomized into two groups: Group I (n=25) consisted of subjects who practiced yoga 35-40 minutes per day, six times per week for the duration of three menstrual cycles. Training was given by qualified yoga instructor. Group II (n=25) subjects acted as controls. Following parameters were recorded at the beginning and after completion of three menstrual cycles in all the subjects: Height, weight (BW), Resting Heart Rate (HR), Resting Systolic (SBP) and Diastolic Blood Pressure (DBP), parasympathetic reactivity tests including Expiration-Inspiration Ratio (E: I ratio) and 30:15 ratio, sympathetic reactivity tests including BP changes due to Isometric Hand Grip (IHG) exercise, and Cold

Pressor Test (CPT). Assessment of psychological status was done by administering DIPAS (Defense Institute of Physiology and Allied Sciences) inventories of Anger self report scale, Trait Anxiety, Sense of well-being and Depression scale. Statistical Analysis shows Intra-group comparison of physiological parameters was done by using paired 't' test, whereas intra-group comparison of non-parametric data such as scores of anxiety, depression, anger and sense of well-being was done by Wilcoxon signed-rank test. Inter-group comparisons of parameter were done by Students 't' test for parametric tests and Mann-Whitney 'U' test for non-parameteric tests. As a results there was significantly higher BW, resting SBP, DBP, sympathetic activity and blunting of parasympathetic reactivity and also, significantly higher scores of anger, depression, anxiety and decreased score of well-being in premenstrual phase as compared to postmenstrual phase in both the groups in initial cycle. There was significantly higher percentage decrease in BW, HR, SBP & DBP in yoga group as compared to control group in both the phases from initial to second and onwards between second and third menstrual cycle. Also, decrease in anger, depression and anxiety and increase in well-being score was significant in yoga group as compared to control group from initial to second and third cycle in premenstrual phase while the change was significant only in depression score in postmenstrual phase.

Satin JR, et.al. (2013) studied on Yoga and Psychophysiological Determinants of Cardiovascular Health: Comparing Yoga Practitioners, Runners, and Sedentary Individuals at Department of Psychology, University of British Columbia, Vancouver, Canada. The present cross-sectional study examined cardiovascular health markers in long-term practitioners of yoga (yogis), runners,

and sedentary individuals. We compared physiological, psychological, and lifestyle variables associated with cardiovascular health across groups. As a result Yogis (n = 47) and runners (n = 46) showed favorable profiles compared to sedentary individuals (n = 52) on heart rate, heart rate variability, depression, perceived stress, and cigarette smoking. Runners and male yogis showed superior aerobic fitness compared to the sedentary group. Runners reported greater social support compared to other groups. Yogis demonstrated a lower respiration rate compared to sedentary individuals and were more likely to refrain from eating meat compared to other groups. It was concluded that Yogis and runners demonstrated several cardiovascular health advantages over sedentary individuals. Our findings raise the possibility that yoga may improve aerobic fitness in men but not women.

Minvaleev RS, et.al. (2013) studied that Hemodynamic Observations of Tumo Yoga Practitioners in a Himalayan Environment at Saint Petersburg State University, Saint Petersburg, Russia . This study was to evaluate the hemodynamic effects of the mysterious Buddhist practice of tumo. Tumo is a meditative practice that produces inner heat through the alleged cultivation of body energy-channels. This study was performed by members of an international expedition to the Himalayan Mountains in the Republic of India. The study was performed in an unpopulated outdoor mountainous area at an altitude of 16,400ft with ambient temperatures between -10 and -15^oC. Two (2) cohorts of subjects were studied: healthy non-yogi volunteers and tumo practitioners. All of the subjects were stripped down to their underclothes and exposed to the subzero

atmospheric temperatures for 5 minutes. The volunteers were then passively rewarmed while the tumo practitioners performed tumo for up to 10 minutes.

Blood pressure, heart rate, and stroke volume index (SVI) and cardiac index were measured noninvasively using a NICOM™ hemodynamic monitor, while carotid blood flow and biventricular performance were determined echocardiographically at each stage of the experiment. The total peripheral resistance index (TPRI), left ventricular ejection fraction (LVEF), and tricuspid annular plane systolic excursion (TAPSE) were determined using standard formula. As a result Fourteen (14) subjects (six volunteers and eight tumo practitioners) completed the study. There was one female subject in each group. With cold exposure, the SVI and carotid blood flow decreased while the TPRI increased significantly in both groups. In the volunteer group, these changes returned to baseline with rewarming. Following tumo, the cardiac index (4.8 ± 0.6 versus $4.0 \pm 0.5 \text{ l/m}^2$; $p < 0.01$), carotid blood flow (445 ± 127 versus $325 \pm 100 \text{ mL/min/m}^2$, $p < 0.01$), LVEF (68 ± 5 versus $64 \pm 7\%$; $p < 0.05$) and TAPSE (2.9 ± 0.4 versus $2.4 \pm 0.5 \text{ cm}$; $p < 0.01$) were significantly higher when compared with baseline, while the TPRI was significantly lower (1786 ± 189 versus 2173 ± 281 ; $p < 0.01$). It was concluded that Tumo was associated with a hyperdynamic vasodilated state with increased biventricular performance. We postulate that tumo results in a massive increase in sympathetic activity with activation of brown adipose tissue and marked heat production. The increased heat production may explain the paradoxical vasodilatation in tumo practitioners exposed to subzero temperatures.

Adhana R, et.al.(2013) studied that the influence of the 2:1 yogic breathing technique on essential hypertension at Department of Physiology, Himalayan Institute of Medical Sciences (HIMS), HIHT University, Swami Ram Nagar, Dehradun. In 2:1 breathing exhalation is twice of inhalation. The study was performed to study the influence of 2:1 yogic breathing technique on patients

of essential hypertension. 30 patients of essential hypertension between ages of 20-50 years were selected. After a rest of 15-20 minutes in a comfortable sitting posture their baseline physiological parameters recorded on a digital polygraph were, Electromyogram (EMG), Galvanic skin response (GSR), Finger tip temperature (FTT), Heart rate (HR) and Respiratory rate(RR). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded by automated digital Sphygmomanometer. Then they were guided to do 2:1 breathing maintaining respiratory rate of around 6/min. Subjects were then instructed to do 2:1 breathing twice a day for 5-7 minutes for next 3 months. Subjects reported back weekly for recording of BP. The physiological parameters of the subjects were assessed again by polygraph at the end of three months of practicing 2:1 yogic breathing. The mean fall of SBP over 12 weeks was 12 mm Hg (8%) and DBP was 7 mm Hg (7%). P value < 0.001 in both. After practicing 2:1 breathing for 3 months there was statistically significant reduction of SBP, DBP, HR RR, EMG, GSR and rise in FTT. The study showed that 2:1 breathing technique caused a comprehensive change in body physiology by altering various parameters that are governed by the autonomic nervous system. It is an effective modality for management of essential hypertension.

Sharma VK, et.al. (2013) studied the effect of fast and slow pranayama on perceived stress and cardiovascular parameters in young health-care students at Department of Physiology, JIPMER, Pondicherry, India. Present study was carried out in Departments of Physiology and Advanced Centre for Yoga Therapy Education and Research, JIPMER, Pondicherry. Ninety subjects (age 18-25 years) were randomized to fast pranayama (Group 1), slow pranayama (Group 2) and control group (Group 3). Group 1 subjects practiced Kapalabhati, Bhastrika and

Kukkuriya Pranayama while Group 2 subjects practiced Nadishodhana, Savitri and Pranav Paranayama. Supervised pranayama training was given for 30 min, 3 times a week for the duration of 12 weeks to Groups 1 and 2 subjects by certified yoga trainer. Following parameters were recorded at the baseline and after 12 weeks of training; perceived stress scale (PSS), heart rate (HR), respiratory rate, systolic blood pressure and diastolic blood pressure (DBP), mean arterial pressure (MAP), rate pressure product (RPP), and double product (Do P). As a result there was a significant decrease in PSS scores in both Group 1 and Group 2 subjects but percentage decrease was comparable in these groups. Significant decrease in HR, DBP, RPP, and Do P was seen in only Group 2 subjects. It was concluded that both types of pranayama practice are beneficial in reducing PSS in the healthy subjects but beneficial effect on cardiovascular parameters occurred only after practicing slow pranayama.

Phatak MS, et.al. (2012) studied the effect of short-term and long-term Brahmakumaris Raja Yoga meditation on physiological variables at Department of Preventive and Social Medicine, Indira Gandhi Government Medical College, Nagpur, India. Effect of short-term and long-term Brahmakumaris Raja Yoga meditation on physiological variables like heart rate (HR), respiratory rate (RR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) was evaluated in 100 subjects practicing Raja Yoga meditation. All 100 subjects (33 men and 67 women) were aged 30 years and above (mean age 52.06 +/- 12.76 years). Short-term meditators (STM) (n = 27) practiced Raja Yoga meditation for duration of six months to five years (mean duration 3.37 +/- 1.67 years) and long-term meditators (LTM) (n = 73) practiced Raja Yoga meditation for more than five years (mean duration 11.19 +/- 5.13 years). The participants

were asked to meditate and the physiological variables (HR, RR, SBP and DBP) were recorded twice (15 minutes and 30 minutes) after beginning of meditation. Also, the fasting blood sugar was estimated by glucometer. The study subjects did not differ significantly in age and various anthropometric characteristics such as body weight, body mass index, waist-hip ratio and fasting blood sugar. Comparison between STM and LTM showed that the changes from baseline values (from premeditation to post-meditation at 15 and 30 minutes) in LTM were not statistically significant with those in STM ($P > 0.05$). However, within group differences in LTM revealed that changes in the physiological variables were statistically significant when compared between pre and post meditation both at 15 and 30 minutes. The study suggests that the long-term practice of Raja Yoga meditation improves basic cardio-respiratory functions due to shifting of the autonomic balance in favor of parasympathetic instead of sympathetic system.

Patel SB, et.al. (2013) studied the effects of slow breathing exercise on cardiovascular functions, pulmonary functions & galvanic skin resistance in healthy human volunteers - a pilot study at Department of Pharmacology, Govt Medical College, Nagpur, India. Eleven normal healthy volunteers were randomized into Pranayama group (n=6) and a non-Pranayama control group (n=5); the pranayama volunteers were trained in pranayama, the technique being Anuloma-Viloma pranayama with Kumbhak. All the 11 volunteers were made to sit in similar environment for two sessions of 20 min each for seven days, while the pranayama volunteers performed slow breathing under supervision, the control group relaxed without conscious control on breathing. Pulse, galvanic skin resistance (GSR), blood pressure (BP) and pulmonary function tests (PFT) were

measured before and after the 7-day programme in all the volunteers. As a result while no significant changes were observed in BP and PFT, an overall reduction in pulse rate was observed in all the eleven volunteers; this reduction might have resulted from the relaxation and the environment. Statistically significant changes were observed in the Pranayama group volunteers in the GSR values during standing phases indicating that regular practice of Pranayama causes a reduction in the sympathetic tone within a period as short as 7 days. It was concluded that beneficial effects of pranayama started appearing within a week of regular practice, and the first change appeared to be a reduction in sympathetic tone.

Madanmohan, et.al. (2012) conducted the study on immediate cardiovascular effects of pranava pranayama in hypertensive patients at ACYTER, JIPMER, Puducherry--605 006. Slow, deep, pranayama-based breathing training has been shown to be effective in reducing blood pressure (BP). The present study was undertaken to determine immediate effects of performing pranava pranayama on cardiovascular parameters in hypertensive patients. 29 hypertensive patients who were on medical treatment and also attending yoga sessions were recruited for the present study. Supine heart rate (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 systolic pressure (SP) and a more significant ($P < 0.01$) reduction in HR, pulse pressure and double product (Do P). The reduction in rate-pressure product (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 blood pressure 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 hypertension.

Mason H, et.al. (2013) studied the Cardiovascular and respiratory effect of yogic slow breathing in the yoga beginner at Department of Neuroscience, Roehampton University, London, UK. Slow breathing increases cardiac-vagal baroreflex sensitivity (BRS), improves oxygen saturation, lowers blood pressure, and reduces anxiety. Within the yoga tradition slow breathing is often paired with a contraction of the glottis muscles. This resistance breath "ujjayi" is performed at various rates and ratios of inspiration/expiration. To test whether ujjayi had additional positive effects to slow breathing, we compared BRS and ventilatory control under different breathing patterns (equal/unequal inspiration/expiration at 6 breath/min, with/without ujjayi), in 17 yoga-naive young healthy participants. BRS increased with slow breathing techniques with or without expiratory ujjayi ($P < 0.05$ or higher) except with inspiratory + expiratory ujjayi. The maximal increase in BRS and decrease in blood pressure were found in slow breathing with equal inspiration and expiration. This corresponded with a significant improvement in oxygen saturation without increase in heart rate and ventilation. Ujjayi showed similar increase in oxygen saturation but slightly lesser

improvement in baroreflex sensitivity with no change in blood pressure. The slow breathing with equal inspiration and expiration seems the best technique for improving baroreflex sensitivity in yoga-naive subjects. The effects of ujjayi seems dependent on increased intrathoracic pressure that requires greater effort than normal slow breathing.

Melville GW, et.al. (2013) studied the effect of an office worksite-based yoga program on heart rate variability: outcomes of a randomized controlled trial at School of Science and Health, University of Western Sydney, Penrith, NSW 2751, Australia. Thirty-seven adults employed in university-based office positions were randomized upon the completion of baseline testing to an experimental or control group. The experimental group completed a 10-week yoga program prescribed three sessions per week during lunch hour (50 min per session). An experienced instructor led the sessions, which emphasized asanas (postures) and vinyasa (exercises). The primary outcome was the high frequency (HF) power component of heart rate variability (HRV). Secondary outcomes included additional HRV parameters, musculoskeletal fitness (i.e. push-up, side-bridge, and sit & reach tests) and psychological indices (i.e. state and trait anxiety, quality of life and job satisfaction). As a result all measures of HRV failed to change in the experimental group versus the control group, except that the experimental group significantly increased LF:HF ($p = 0.04$) and reduced pNN50 ($p = 0.04$) versus control, contrary to our hypotheses. Flexibility, evaluated via sit & reach test increased in the experimental group versus the control group ($p < 0.001$). No other adaptations were noted. Post hoc analysis comparing participants who completed $\geq 70\%$ of yoga sessions ($n = 11$) to control ($n = 19$) yielded the same findings, except that the high adherers also reduced state anxiety ($p = 0.02$)

and RMSSD ($p = 0.05$), and tended to improve the push-up test ($p = 0.07$) versus control. It was concluded that a 10-week hatha yoga intervention delivered at the office worksite during lunch hour did not improve HF power or other HRV parameters. However, improvements in flexibility, state anxiety and musculoskeletal fitness were noted with high adherence.

Raghavendra B, et.al. (2013) studied the Voluntary heart rate reduction following yoga using different strategies at Department of Yoga and Biosciences, Swami Vivekananda Yoga Anusandhana Samsthana, Bengaluru, India. Fifty volunteers (group mean age \pm S.D., 25.4 ± 4.8 years; 25 males) were assessed in two trials on separate days. Each trial was for 12 minutes, with a 'pre' state and 'during' state of 6 minutes each. For both trials the 'pre' state was relaxation with eyes closed. In the 'during' state of Trial I, subjects were asked to voluntarily reduce their heart rate using a strategy of their choice. From their responses to specific questions it was determined that 22 out of 50 persons used breath regulation as a strategy. Hence, in the 'during' state of Trial II, subjects were asked to voluntarily reduce their heart rate by breath regulation. As a result heart rate was reduced by an average of 19.6 beats per minute and in the second trial (with breath regulation exclusively) an average decrease of 22.2 beats per minute was achieved.

Dhananjai S, et.al. (2013) conducted the study on Reducing psychological distress and obesity through Yoga practice at Department of Physiology, CSM Medical University, Lucknow, India. Patients were recruited from the Department of Physiology, C.S.M. Medical University (erstwhile KGMU), Lucknow, Uttar Pradesh, India. A total of 272 subjects were divided into two groups: 1) group of 205 subjects (with yogic practice) and 2) a control group

of 67 subjects (with aerobic exercise). Assessment of anxiety and depression were done by Hamilton Rating Scale. As a result yoga is an effective tool with no diet restriction to improve anxiety and depression symptoms as well as obesity in obese subjects. It was concluded that incorporating yogic asana in the treatment protocol of patients suffering from anxiety and depression may prove beneficial in the long run.

Haden SC, et.al. (2013) conducted the study on randomized controlled trial on the effects of yoga on stress reactivity in 6th grade students at Department of Physical Therapy, Long Island University, Brooklyn Campus, One University Plaza, Brooklyn, NY 11201, USA. There is an increasing interest in developing school programs that improve the ability of children to cope with psychosocial stress. Yoga may be an appropriate intervention as it has demonstrated improvements in the ability of children to manage psychosocial stress. Yoga is thought to improve the control of reactivity to stress via the regulation of the autonomic nervous system. The current study examined the effects of yoga compared to a physical education class on physiological response (blood pressure (BP) and heart rate (HR)) to behavioral stressor tasks (mental arithmetic and mirror tracing tasks). Data analysis of BP and HR was performed using a $2 \times 2 \times 4$ repeated measures ANOVA (time \times group \times stressor time points). 30 (17male) 6th graders participated in the study. Yoga did not provide significant differences in stress reactivity compared to a physical education class (group \times time: systolic ($F(1, 28) = .538, P = .470$); diastolic ($F(1, 28) = .1061, P = .312$); HR ($F(1,28) = .401, P = .532$)). The lack of significant differences may be due to the yoga intervention failing to focus on stress management and/or the stressor tasks not adequately capturing attenuation of stressor response.

Chung UL, et.al. (2013) conducted the study on the effects of Hatha yoga on stress in middle-aged women at Department of Nursing, Mackay Memorial Hospital. We used a quasi experimental design and recruited 63 female community residents in New Taipei City aged 40-60 years. Participants were randomly divided into an experimental group (n = 30) and a control group (n = 33). The experimental group received the 8-week Hatha yoga course. The control group received no intervention. The Perceived Stress Scale (PSS) and heart rate variability (HRV) assessed stress reduction effectiveness. Chi-square, independent t test, paired t test, and generalized estimating equations were used for data analysis. As a result after a single 90-minute class of Hatha yoga, experimental group PSS scores were significantly less than those of the control group (p = .001). Although experimental group HRV (low-frequency norm and high-frequency norm) had improved, these changes were not statistically significant (p = .059). PSS scores for the single 90-minute class and 8-week course did not significantly differ (p = .157) and HRV of statistics is significant (p = .005). Generalized estimating equations analyzed changes in the effectiveness over time of stress reduction (HRV and PSS) after the Hatha yoga intervention. Results showed the post-intervention HRV and PSS of the experimental group decreased significantly (p < .001) more than the control group. Our findings support the position that regular, long-term practice of Hatha yoga provides clear and significant health benefits. Participation in a single 90-minute Hatha yoga class can significantly reduce perceived stress. Doing Hatha yoga regularly can reduce perceived stress even more significantly.

Storck N, et.al. (2013) conducted the study on increased heart rate variability but no effect on blood pressure from 8 weeks of hatha yoga at

Centre for Family Medicine, Karolinska Institutet, Huddinge, Sweden. Twelve healthy women and men took part in an 8-week yoga program (60 min once a week). BP was measured with an automatic Omron mx3 oscillometric monitoring device and heart rate variability (HRV) with a Holter 24-hour ECG at baseline and 8 weeks after the intervention. As a result there was no significant effect of inversion postures on BP. Nine out of 12 participants showed a significant increase in HRV ($p < 0.05$) at night (2 hours) on pNN50% (12.7 ± 12.5 to 18.2 ± 13.3). There were no significant changes in other HRV measures such as NN50, LF, HF, LF/HF ratio, LF normalized units (n.u.), HF n.u. and RMSSD. It was concluded that Eight weeks of hatha yoga improved HRV significantly which suggests an increased vagal tone and reduced sympathetic activity.

Monika, et.al. (2012) conducted the study on the effect of Yoga Nidra on physiological variables in patients of menstrual disturbances of reproductive age group at Department of Obstetrics and Gynecology, Chhatrapati Sahuji Maharaj Medical University (Erstwhile KGMU), U.P. The subjects for the study were 150 females with menstrual irregularities, 28.08 ± 7.43 years of mean age, referred from department of Obstetrics and Gynecology CSMMU, UP, Lucknow. Subjects were divided randomly in to two groups' intervention and in control groups - seventy five (75) in each group. Out of these, one hundred twenty six (126) completed the study protocol. The yogic intervention consisted of 35-40 minutes/day, five days in a week till six months. An autonomic function testing was done in both the groups at zero time and after six months. A significant positive effect was observed when yoga therapy was used as an adjunct in the patients of menstrual disturbances. There were significant improvements in the

blood pressure, postural hypotension and sustained hand grip, heart rate expiration inspiration ratio and 30:15 beat ratios of the subjects after yogic practice.

Atkins D, et.al. (2013) conducted the study on the effect of yoga on arrhythmia burden, anxiety, depression, and quality of life in paroxysmal atrial fibrillation at Division of Cardiovascular Diseases, Cardiovascular Research Institute, University of Kansas Hospital & Medical Center, Kansas City, Kansas. This single-center, pre-post study enrolled patients with symptomatic paroxysmal atrial fibrillation (AF) with an initial 3-month noninterventional observation period followed by twice-weekly 60-min yoga training for next 3 months. AF episodes during the control and study periods as well as SF-36, Zung self-rated anxiety, and Zung self-rated depression scores at baseline, before, and after the study phase were assessed. As a result Yoga training reduced symptomatic AF episodes (3.8 ± 3 vs. 2.1 ± 2.6 , $p < 0.001$), symptomatic non-AF episodes (2.9 ± 3.4 vs. 1.4 ± 2.0 ; $p < 0.001$), asymptomatic AF episodes (0.12 ± 0.44 vs. 0.04 ± 0.20 ; $p < 0.001$), and depression and anxiety ($p < 0.001$), and improved the quality of life (QoL), parameters of physical functioning, general health, vitality, social functioning, and mental health domains on SF-36 ($p = 0.017$, $p < 0.001$, $p < 0.001$, $p = 0.019$, and $p < 0.001$, respectively). There was significant decrease in heart rate, and systolic and diastolic blood pressure before and after yoga ($p < 0.001$). It was concluded that inpatients with paroxysmal AF, yoga improves symptoms, arrhythmia burden, heart rate, blood pressure, anxiety and depression scores, and several domains of QoL.

Hunter SD, et.al. (2013) conducted the study on Arterial blood pressure and cardiovascular responses to yoga practice at Department of Kinesiology and Health Education, University of Texas, Austin, TX, USA. Thirty-six apparently

healthy, nonobese, sedentary or recreationally active individuals from the community participated in the study. Intervention The intervention comprised one session of yoga practice, in which participants followed a custom made instructional video providing a yoga routine that consisted of a series of 23 hatha-based yoga postures. As a result Systolic, mean, and diastolic blood pressures increased significantly during the yoga practice. The magnitude of these increases in blood pressure was greatest with standing postures. Heart rate and cardiac output increased significantly during yoga practice, especially with standing postures. Overall, no differences existed in cardiovascular responses between the novice and advanced practitioners throughout the yoga testing session; cfPWV velocity was significantly and inversely associated with lumbar flexion but not with sit-and-reach test scores. It was concluded that the research team concluded that a variety of hatha yoga postures, especially standing postures, evoked significant increases in blood pressure. The elevation in blood pressure due to yoga practice was associated with increases in cardiac output and heart rate, which are responses similar to those observed in isometric exercise. The lack of obvious differences in blood pressure and other cardiovascular responses between novice and advanced yoga practitioners suggests that long-term yoga practice does not attenuate acute yoga responses.

Williams JS, et.al. (2013) studied the effects of regular yoga practice on pulmonary function in healthy individuals: a literature review at Department of Health and Human Performance, Texas State University-San Marcos, San Marcos, TX 78666, USA. Using the Alternative Health Watch, the Physical Education Index, Medline and the SPORT discus databases; and the keywords yoga, respiration, and pulmonary function, a comprehensive search was conducted that

yielded 57 studies. Of these studies selections were made to include only experimental studies written in English, published in peer-reviewed journals after 1980, and investigating the effects of regular yoga practice on pulmonary function in healthy individuals participating in the studies. As a result Yoga improved pulmonary function, as measured by maximum inspiratory pressure, maximum expiratory pressure, maximum voluntary ventilation, forced vital capacity, forced expiratory volume in 1 second, and peak expiratory flow rate, in all (N=9), but 1, study. It was concluded that pulmonary function appears to improve with a minimum of 10 weeks of regular yoga practice, and the magnitude of this improvement is related to fitness level and/or the length of time the subjects spend practicing pranayama (i.e., breathing exercises). In other words, greater improvements in pulmonary function are more likely to be seen in less-fit individuals and/or those that engage in longer periods of pranayama. Additional studies examining various yoga practices are warranted to gain a more comprehensive understanding of the effects of yoga techniques on pulmonary functions.

Edgren L, et.al. (2000) studied that Hatha yoga-improved vital capacity of college students at School of Physical Education, Ball State University, Muncie, USA. A total of 287 college students, 89 men and 198 women subjects were taught yoga poses, breathing techniques, and relaxation in two 50-minute class meetings for 15 weeks. As a result the study showed a statistically significant ($P < .001$) improvement in vital capacity across all categories over time. It was concluded that it is not known whether these findings were the result of yoga poses, breathing techniques, relaxation, or other aspects of exercise in the subjects' life. The subjects' adherence to attending class was

99.96%. The large number of 287 subjects is considered to be a valid number for a study of this type. These findings are consistent with other research studies reporting the positive effect of yoga on the vital capacity of the lungs.

Cooper S, et.al. (2003) conducted the study on effect of two breathing exercises (Buteyko and pranayama) in asthma: a randomized controlled trial at Division of Respiratory Medicine, City Hospital, Nottingham NG5 1PB, UK. Ninety patients with asthma taking an inhaled corticosteroid were randomized after a 2 week run in period to Eucapnic Buteyko breathing, use of a Pink City Lung Exerciser (PCLE) to mimic pranayama, or a PCLE placebo device. Subjects practiced the techniques at home twice daily for 6 months followed by an optional steroid reduction phase. Primary outcome measures were symptom scores and change in the dose of methacholine provoking a 20% fall in FEV₁ (PD(20)) during the first 6 months. As a result Sixty nine patients (78%) completed the study. There was no significant difference in PD(20) between the three groups at 3 or 6 months. Symptoms remained relatively stable in the PCLE and placebo groups but were reduced in the Buteyko group. Median change in symptom scores at 6 months was 0 (interquartile range -1 to 1) in the placebo group, -1 (-2 to 0.75) in the PCLE group, and -3 (-4 to 0) in the Buteyko group (p=0.003 for difference between groups). Bronchodilator use was reduced in the Buteyko group by two puffs/day at 6 months; there was no change in the other two groups (p=0.005). No difference was seen between the groups in FEV₁, exacerbations, or ability to reduce inhaled corticosteroids. It was concluded that the Buteyko breathing technique can improve symptoms and reduce bronchodilator use but does not appear to change bronchial responsiveness or lung function in patients with asthma. No benefit was shown for the Pink City Lung Exerciser.

Copur AS, et.al. (2012) conducted the study on effect of yoga in chronic obstructive pulmonary disease at Pulmonary Division, Department of Medicine, Rosalind Franklin University of Medicine and Science/ The Chicago Medical School, North Chicago, IL 60064, USA. Thirty-three patients with documented chronic obstructive pulmonary disease (COPD), per Global Initiative for Obstructive Lung Disease criteria, were recruited. All patients received standard COPD care. The quality of life (QOL) was assessed by the St. George Respiratory questionnaire. Standard spirometry and maximum inspiratory (maximal inspiratory pressure) and expiratory pressure (maximal expiratory pressure) were measured. Patients were taught selected yoga exercises including breathing exercises, meditation, and yogapostures for 1 hour, thrice a week for 6 weeks by a certified yoga therapist. The quality of life and lung function were again assessed at the end of 6 weeks. Twenty-two patients completed the study. Differences in pre yoga versus post yoga scores were evaluated using paired t-tests. Statistically significant improvements ($P < 0.05$) were observed for the St. George Respiratory questionnaire [95% confidence interval (CI) 43.13-58.47], vital capacity (95% CI 2.53-7.65), maximal inspiratory pressure (95% CI 6.62-23.64), and maximal expiratory pressure (95% CI 1.63-13.81). Yoga when practiced by patients with COPD results in improvement in the QOL and lung function on a short-term basis. Additional research is needed to confirm these findings in a randomized controlled trial and in the longer term.

Grossman P, et.al. (2006) conducted the study on reliability of respiratory tidal volume estimation by means of ambulatory inductive plethysmography at Psychosomatic and Internal Medicine, University of Basel Hospital, Basel, Switzerland. Ambulatory monitoring of ventilatory parameters in everyday life,

field research and clinical situations may offer new insights into respiratory functioning in health and disease. Recent technological advances that employ ambulatory inductive plethysmography could make monitoring of respiration outside the clinic and laboratory feasible. Inductive plethysmography provides a method for nonintrusive assessment of both timing (e.g. respiration rate) and volumetric parameters (e.g. tidal volume and minute ventilation), by which tidal volume is initially calibrated to direct measures of volume. Estimates of tidal volume assessed by this technique have been validated in laboratory investigations, usually examining within-individual relations to direct measures over a large range of tidal volume variation. However, the reliability of individual differences in tidal volume or other breathing parameters has not been tested under naturalistic measurement conditions using inductive plethysmography. We examined the test-retest reliability of respiration rate, tidal volume and other volumetric parameters of breathing over a period of six weeks of repeated measurements during baseline conditions and breathing exercises with 16 healthy freely moving volunteers in a Yoga course. Reliability of measurement was evaluated by calculating the average week-to-week between-subject correlation coefficients for each physiological measure. Additionally because body-mass index has been previously positively correlated to tidal volume, we also assessed this relationship as an external criterion of validity of tidal volume estimation. Regarding the latter, similar correlations to those previous studies were found ($r = 0.6$). Furthermore, reliability estimates were high and consistent across respiratory measures (typically r 's = 0.7-0.8). These results suggest the validity of ambulatory inductive plethysmographic measurement of respiration, at least under relatively

sedentary conditions. Findings also point to the stability of individual differences in respiratory parameters over consecutive weeks.

Prasad R, et.al. (2004) conducted the study on the Effects of Hatha yoga and Omkar meditation on cardio respiratory performance, psychologic profile, and melatonin secretion at Defence Institute of Physiology and Allied Sciences, Timarpur, Delhi, India. Thirty healthy men in the age group of 25-35 years volunteered for the study. They were randomly divided in two groups of 15 each. Group 1 subjects served as controls and performed body flexibility exercises for 40 minutes and slow running for 20 minutes during morning hours and played games for 60 minutes during evening hours daily for 3 months. Group 2 subjects practiced selected yogic asanas (postures) for 45 minutes and pranayama for 15 minutes during the morning, whereas during the evening hours these subjects performed preparatory yogic postures for 15 minutes, pranayama for 15 minutes, and meditation for 30 minutes daily, for 3 months. Orthostatic tolerance, heart rate, blood pressure, respiratory rate, dynamic lung function (such as forced vital capacity, forced expiratory volume in 1 second, forced expiratory volume percentage, peak expiratory flow rate, and maximum voluntary ventilation), and psychologic profile were measured before and after 3 months of yogic practices. Serial blood samples were drawn at various time intervals to study effects of these yogic practices and Omkar meditation on melatonin levels. As a result Yogic practices for 3 months resulted in an improvement in cardiorespiratory performance and psychologic profile. The plasma melatonin also showed an increase after three months of yogic practices. The systolic blood pressure, diastolic blood pressure, mean arterial pressure, and orthostatic tolerance did not show any significant correlation with plasma melatonin. However, the maximum

night time melatonin levels in yoga group showed a significant correlation ($r = 0.71$, $p < 0.05$) with well-being score. It was concluded that these observations suggest that yogic practices can be used as psychophysiologic stimuli to increase endogenous secretion of melatonin, which, in turn, might be responsible for improved sense of well-being.

Joshi LN, et.al. (1992) conducted the study on the effect of short term 'Pranayam' practice on breathing rate and ventilatory functions of lung at Department of Physiology, L.T.M. Medical College, Bombay. Thirty three normal male and forty two normal female subjects, of average age of 18.5 years, underwent six weeks course in 'Pranayam' and their ventilatory lung functions were studied before and after this practice. They had improved ventilatory functions in the form of lowered respiratory rate (RR), and increases in the forced vital capacity (FVC), forced expiratory volume at the end of 1st second (FEV1%), maximum voluntary ventilation (MVV), peak expiratory flow rate (PEFR-lit/sec), and prolongation of breath holding time.

Gupta HC, et.al. (1988) studied the effect of short term yoga practice on ventilatory function tests at Department of Physiology, M.G.M. Medical College, Indore. Twenty five normal male volunteers undergoing a ten weeks course in the practice of yoga have been studied by some parameters of ventilatory functions tests. The observations recorded at the end of ten weeks of the course have shown improved ventilatory functions in the form of lowered respiratory rate, increased forced vital capacity, FEV1, maximum breathing capacity and breath holding time, while tidal volume and %FEV1, did not reveal any significant change. Thus, a combined practice of yoga seems to be beneficial on respiratory efficiency.

Marks GB, et.al. (2002) conducted the study on Sahaja yoga in the management of moderate to severe asthma: a randomized controlled trial at Natural Therapies Unit, Royal Hospital for Women, NSW, Australia. A parallel group, double blind, randomized controlled trial was conducted. Subjects were randomly allocated to Sahaja yoga and control intervention groups. Both the yoga and the control interventions required the subjects to attend a 2 hour session once a week for 4 months. Asthma related quality of life (AQLQ, range 0-4), Profile of Mood States (POMS), level of airway hyper responsiveness to methacholine (AHR), and a diary card based combined asthma score (CAS, range 0-12) reflecting symptoms, bronchodilator usage, and peak expiratory flow rates were measured at the end of the treatment period and again 2 months later. As a result Twenty one of 30 subjects randomized to the yoga intervention and 26 of 29 subjects randomized to the control group were available for assessment at the end of treatment. The improvement in AHR at the end of treatment was 1.5 doubling doses (95% confidence interval (CI) 0.0 to 2.9, $p=0.047$) greater in the yoga intervention group than in the control group. Differences in AQLQ score (0.41, 95% CI -0.04 to 0.86) and CAS (0.9, 95% CI -0.9 to 2.7) were not significant ($p>0.05$). The AQLQ mood subscale did improve more in the yoga group than in the control group (difference 0.63, 95% CI 0.06 to 1.20), as did the summary POMS score (difference 18.4, 95% CI 0.2 to 36.5, $p=0.05$). There were no significant differences between the two groups at the 2 month follow up assessment. It was concluded that this randomized controlled trial has shown that the practice of Sahaja yoga does have limited beneficial effects on some objective and subjective measures of the impact of asthma. Further work is required to understand the mechanism underlying the observed effects and to establish

whether elements of this intervention may be clinically valuable in patients with severe asthma.

Panda AK and Doddanagali SR, (2011) have done a study on the Clinical efficacy of herbal Padmapatradi yoga in bronchial asthma (Tamaka Swasa) at Department of Ayurveda Research, PG Department of Kayachikitsa, Ayurveda Regional Research Institute, Gangtok, Sikkim, India. Ayurveda refers to bronchial asthma as Tamaka Swasa and it is well explained in Charaka Samhita. It contributes several modalities of the treatment for Swasa roga(asthma). Among all modalities of treatment, polyherbal combinations are said to be well-accepted, safe and effective in asthma. A study was carried out in 40 patients of either sex in between the age of 15-65 years to assure the clinical response of Padmapatradiyoga in bronchial asthma (Tamaka Swasa) at P.G. department of Kayachikitsa, D.G.M. Ayurvedic Medical College, Gadag, Karnataka. The sum total properties of Padmapatradi yoga is tikta katu rasa, laghu and tikna guna (light and penetrating properties), ushna virya (hot potency) and vatakaphagna (decrease vata and kapha dosa) Padmapatradi yoga is effective in increased peak expiratory flow rate, breath holding time, and reduces the absolute eosinophil count of studied cases and also found statistically highly significant at $p < 0.001$ level. The drug is quite safe and acts as a bronchodilator, antihistaminic and anti-inflammatory.

Prakash S, et.al. (2007) conducted the study on Athletes, yogis and individuals with sedentary lifestyles; do their lung functions differ at Govt. Medical College, Nagpur. Buffalo health study concluded that pulmonary function is a long-term predictor for overall survival rates. It is essential to be involved in physical activity or sports which help in achieving better lung function. Cross

sectional observation study was conducted to determine if yoga and athletic activity (running) are associated with better lung functions as compared to subjects with sedentary lifestyles and how does athletes and yogis differ in lung function. Spirometric parameters were assessed in randomly selected 60 healthy male, non-smoking; non-obese subjects-athletes, yogis and sedentary workers. The groups differed significantly in FEV1 and PEFr. The highest mean FEV1 and PEFr were observed in yogis. Both yogis and athletes had significantly better FEV1 as compared to sedentary workers. Yogis also had significantly better PEFr as compared to sedentary workers and athletes. Yogis and athletes had similar lung functions except for better PEFr amongst yogis. Involvement in daily physical activity or sport preferably yoga can help in achieving better pulmonary function.

Sharma HO, et.al. (2009) conducted the study on immediate effect of slow pace bhastrika pranayama on blood pressure and heart rate at Department of Physiology, Nepal Medical College, Kathmandu, Nepal. Heart rate and blood pressure of volunteers (n = 39, age = 25-40 years) was recorded following standard procedure. First, subjects had to sit comfortably in an easy and steady posture (sukhasana) on a fairly soft seat placed on the floor keeping head, neck, and trunk erect, eyes closed, and the other muscles reasonably loose. The subject is directed to inhale through both nostrils slowly up to the maximum for about 4 seconds and then exhale slowly up to the maximum through both nostrils for about 6 seconds. The breathing must not be abdominal. These steps complete one cycle of slow pace bhastrika pranayama (respiratory rate 6/min). During the practice the subject is asked not to think much about the inhalation and exhalation time, but rather was requested to imagine the open blue sky. The pranayama was

conducted in a cool, well-ventilated room (18-20 degrees C). After 5 minutes of this breathing practice, the blood pressure and heart rate again were recorded in the aforesaid manner using the same instrument. The other group (n = 10) took part in another study where their blood pressure and heart rate were recorded following half an hour of oral intake of hyoscine-N-butylbromide 20 mg. Then they practiced the breathing exercise as stated above, and the abovementioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. It was concluded that Vagal cardiac and pulmonary mechanisms are linked, and improvement in one vagal limb might spill over into the other. Baroreceptor sensitivity can be enhanced significantly by slow breathing (supported by a small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure). Slow pace bhastrika pranayama (respiratory rate 6/min) exercise thus shows a strong tendency to improving the autonomic nervous system through enhanced activation of the parasympathetic system.

Ramana YV, et.al. (2005) conducted the study on Influence of socioeconomic status on lung function and prediction equations in Indian children at Government Vemana Yoga Research Institute, Ameerpet, Hyderabad, India. The present study was carried out to assess the influence of socioeconomic status on lung functions and to suggest prediction equations for Indian children. For this purpose, 2,616 normal, healthy schoolchildren aged between 5-15 years were recruited. Boys were classified into three groups, i.e., high-income (HIG), middle-income (MIG), and low-income (LIG), while girls were classified into HIG and LIG groups, based on socioeconomic status (SES). Height, weight, chest circumference, body surface area (BSA), fat-free mass (FFM), and body fat were

assessed. Forced expiratory volume in 1 sec (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, and peak expiratory flow rate (PEFR) were measured. The results, before and after adjustment of physical characteristics, showed that anthropometry, body composition, and lung functions were significantly higher in HIG compared to MIG and LIG children, while in girls, no differences were observed in physical characteristics after adjustments. Multiple linear regression equations were developed to predict FEV1, FVC, and PEFR, using independent variables like age, height, fat-free mass, and SES. It is opined that these equations could be used as Indian reference equations for healthy children based on the SES.

Sarang PS and Telles S (2006) conducted the study on Oxygen consumption and respiration during and after two yoga relaxation techniques at Swami Vivekananda Yoga Research Foundation, #19, Eknath Bhavan, Gavipuram Circle, K. G. Nagar, Bangalore 560 019, India. Cyclic meditation (CM) is a technique which combines "stimulating" and "calming" practices, based on a statement in ancient yoga texts suggesting that such a combination may be especially helpful to reach a state of mental equilibrium. The oxygen consumption, breath rate and breath volume of 50 male volunteers (group mean age \pm SD, 27 \pm 6.3 years) were assessed before, during, and after sessions of CM and sessions of supine rest in the corpse posture (shavasana, SH). The sessions were one day apart and the order was alternated. The oxygen consumption, breath rate and breath volume increased during the "stimulating" practices of CM, returned to the baseline during the "calming" practices, and the oxygen consumption decreased by 19.3 percent below baseline values after CM. During the SH session the oxygen consumption, breath rate and breath volume reduced; however the decrease in oxygen consumption after SH was less than after CM

(i.e., 4.8 percent). The results support the idea that a combination of yoga postures with supine rest (in CM) reduces the oxygen consumption more than resting supine alone does.

Spasojević N, et.al. (1990) conducted the study on the effect of Hatha yoga on poor posture in children and the psycho physiologic condition in adults at Medicinski fakultet, Institut za zdravstvenu zastitu majke i deteta, Novi Sad. Hatha Yoga's effects on the posture of 15 ten year-old children and also its effects on the psychophysical condition of 15 grown-ups were studied. The condition of all the children was remarkably better after six months of practice, some of the symptoms having completely disappeared (head protrusion, asymmetry of the shoulders, mamillas and hips, shortening of the pectoralis and back extensors), 9 children still had slight to medium relaxation of the frontal abdominal wall, 8 children still had bent shoulders, and 1 child still had shortened calf and thigh extensors. The adults were in a weak or very weak psychophysical condition, they tired easily, they complained of sleep disturbances, fluctuation of emotional state and irritability. After 3 months of practice, the vital capacity of 8 of the adults tested (53.3%) had increased by 435 ml. The time duration of apnoea had lengthened for all of the practicing adults, but with a truly large variation among them (a median of 14%). The deep waist-bend length of all the practicing adults had lengthened by an average of 9.5 cm, and the average length increase for the 3-minute running test was 42 m. All those who practiced, had experienced an alleviation of psychic difficulties.

Singh S, et.al. (2012) conducted the study on the effect of yoga practices on pulmonary function tests including transfer factor of lung for carbon monoxide (TLCO) in asthma patients at Department of Physiology, University College of

Medical Sciences & Guru Teg Bahadur Hospital, Dilshad Garden, Delhi, India. Sixty stable asthmatic-patients were randomized into two groups i.e group 1 (Yoga training group) and group 2 (control group). Each group included thirty patients. Lung functions were recorded on all patients at baseline, and then after two months. Group 1 subjects showed a statistically significant improvement ($P < 0.001$) in Transfer factor of the lung for carbon monoxide (TLCO), forced vital capacity (FVC), forced expiratory volume in 1st sec (FEV1), peak expiratory flow rate (PEFR), maximum voluntary ventilation (MVV) and slow vital capacity (SVC) after yoga practice. Quality of life also increased significantly. It was concluded that pranayama & yoga breathing and stretching postures are used to increase respiratory stamina, relax the chest muscles, expand the lungs, raise energy levels, and calm the body.

2.3 STUDIES ON BIO-CHEMICAL VARIABLES IN YOGA

Gupta V, et.al. (2005) conducted the study on a brief but comprehensive lifestyle education program based on yoga reduces risk factors for cardiovascular disease and diabetes mellitus at Integral Health Clinic, Department of Physiology, All India Institute of Medical Sciences, New Delhi, India. The study is based on data collected on 98 subjects (67 male, 31 female), ages 20-74 years, who attended one of our programs. The subjects were a heterogeneous group of patients with hypertension, coronary artery disease, diabetes mellitus, and a variety of other illnesses. The intervention consisted of asanas (postures), pranayama (breathing exercises), relaxation techniques, group support, individualized advice, lectures and films on the philosophy of yoga and the place of yoga in daily life, meditation, stress management, nutrition, and knowledge about the illness. As a result Fasting plasma glucose, serum total cholesterol, low-

density lipoprotein (LDL) cholesterol, very-low-density lipoprotein (VLDL) cholesterol, the ratio of total cholesterol to high density lipoprotein (HDL) cholesterol, and total triglycerides were significantly lower, and HDL cholesterol significantly higher, on the last day of the course compared to the first day of the course. The changes were more marked in subjects with hyperglycemia or hypercholesterolemia. It was concluded that the observations suggest that a short lifestyle modification and stress management education program leads to favorable metabolic effects within a period of 9 days.

Gordon L, et.al. (2012) conducted the study on the effect of exercise therapy on lipid parameters in patients with end-stage renal disease on hemodialysis at Kingston Public Hospital, North Street, Kingston, Jamaica. This prospective randomized study consisted of 33 end-stage renal disease (ESRD) patients in the Hatha yoga exercise group that was matched with 35 ESRD patients in the control group. Serum total cholesterol, triglycerides, low-density lipoprotein (LDL)-cholesterol, and high-density lipoprotein (HDL)-cholesterol were determined at baseline (0 month) and after 4 months. As a result comparing values after 4 months versus baseline in the prehemodialysis Hatha yoga exercise group, there was found a significant decrease in total cholesterol from 5.126 ± 0.092 mmol/l to 4.891 ± 0.072 mmol/l (-4.58%; $P = 0.0001$), triglycerides from 2.699 ± 0.078 mmol/l to 2.530 ± 0.063 mmol/l (-6.26%; $P = 0.0001$), LDL-cholesterol from 2.729 ± 0.083 mmol/l to 2.420 ± 0.066 mmol/l (-11.32%; $P = 0.0001$), and total cholesterol/HDL-cholesterol ratio from 5.593 ± 0.119 mmol/l to 4.907 ± 0.116 mmol/l (-12.26%; $P = 0.047$). For patients in the Hatha yoga exercise group, 51.5% had normal total cholesterol at 0 month while 70.0% had normal total cholesterol ($P < 0.05$) after 4 four months and

54.5% of patients had normal LDL-cholesterol at 0 month while 84.9% had normal LDL-cholesterol after 4 months ($P < 0.05$). It was concluded that these findings suggest that Hatha yoga exercise has preventive and beneficial effects and may be a safe therapeutic modality in ESRD patients.

Gordon LA, et.al. (2008) conducted the study on the effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type 2 diabetes at Department of Medicine, University of the West Indies, Kingston 7, Jamaica. This prospective randomized study consisted of 77 type 2 diabetic patients in the Hatha yoga exercise group that were matched with a similar number of type 2 diabetic patients in the conventional physical training (PT) exercise and control groups. Biochemical parameters such as fasting blood glucose (FBG), serum total cholesterol (TC), triglycerides, low-density lipoprotein (LDL), very low-density lipoproteins (VLDL) and high-density lipoprotein (HDL) were determined at baseline and at two consecutive three monthly intervals. The oxidative stress indicators (malondialdehyde - MDA, protein oxidation - POX, phospholipase A2 - PLA2 activity) and oxidative status [superoxide dismutase (SOD) and catalase activities] were measured. As a result the concentrations of FBG in the Hatha yoga and conventional PT exercise groups after six months decreased by 29.48% and 27.43% respectively ($P < 0.0001$) and there was a significant reduction in serum TC in both groups ($P < 0.0001$). The concentrations of VLDL in the managed groups after six months differed significantly from baseline values ($P = 0.036$). Lipid peroxidation as indicated by MDA significantly decreased by 19.9% and 18.1% in the Hatha yoga and conventional PT exercise groups respectively ($P < 0.0001$); whilst the activity of SOD significantly increased by 24.08% and 20.18% respectively ($P = 0.031$). There was no

significant difference in the baseline and 6 months activities of PLA2 and catalase after six months although the latter increased by 13.68% and 13.19% in the Hatha yoga and conventional PT exercise groups respectively ($P = 0.144$). It was concluded that the study demonstrate the efficacy of Hatha yoga exercise on fasting blood glucose, lipid profile, oxidative stress markers and antioxidant status in patients with type 2 diabetes and suggest that Hatha yoga exercise and conventional PT exercise may have therapeutic preventative and protective effects on diabetes mellitus by decreasing oxidative stress and improving antioxidant status.

Hunter SD, et.al. (2013) conducted the study on the effect of bikram yoga on arterial stiffness in young and older adults at Cardiovascular Aging Research Laboratory, Department of Kinesiology and Health Education, The University of Texas at Austin , Austin, TX. Twenty-four young (mean age standard deviation, 30 ± 1 years) and 18 middle-aged and older (mean age, 53 ± 2 years) adults completed an 8-week Bikram yoga intervention. Bikram yoga classes were performed for 90 minutes per session, three times per week, in a room heated to 40.5°C with 40%--60% relative humidity. As a result Body mass, body fat percentage, blood pressure, and fasting blood glucose and triglyceride concentrations did not significantly change as a result of the intervention in either the young or the older group. Trunk flexibility, as measured by the sit-and-reach test, increased in both groups ($p < 0.01$). Total ($p < 0.05$) and low-density lipoprotein cholesterol ($p < 0.05$) levels, plasma insulin concentrations ($p < 0.01$), and scores on the homeostatic model of the assessment of insulin resistance ($p < 0.01$) decreased in older adults, whereas total and high-density lipoprotein cholesterol concentrations were reduced in young adults (all $p < 0.05$).

Carotid artery compliance ($p < 0.05$) was increased and β -stiffness index decreased in young ($p < 0.05$) but not in older adults. Carotid pulse pressure did not significantly change in either group. It was concluded that a relatively short-term Bikram yoga intervention improved arterial stiffness in young but not older adults and significantly reduced insulin resistance index in older but not young adults.

Lee JA, et.al. (2012) conducted the study on the effects of yoga exercise on serum adiponectin and metabolic syndrome factors in obese postmenopausal women at Department of Physical Education, Kyungsoong University, Busan, South Korea. Sixteen healthy postmenopausal women aged 54.50 ± 2.75 years with more than 36% body fat were randomly assigned to either a yoga exercise group ($n = 8$) or to a "no exercise" control group ($n = 8$). The variables of body composition, visceral fat, serum adiponectin, and metabolic syndrome factors were measured in all the participants before and after the 16-week study. As a result Body weight, percentage of body fat, lean body mass, body mass index, waist circumference, and visceral fat area had significantly decreased. High-density lipoprotein cholesterol and adiponectin had significantly increased, but total cholesterol, triglyceride, low-density lipoprotein cholesterol, blood pressure, insulin, glucose, and homoeostasis model assessment-insulin resistance had significantly decreased. Serum adiponectin concentrations were significantly correlated with waist circumference, high-density lipo-protein cholesterol, diastolic blood pressure, and homoeostasis model assessment-insulin resistance in the post yoga exercise group. In conclusions our findings indicate that yoga exercise improves adiponectin level, serum lipids, and metabolic syndrome risk factors in obese postmenopausal women.

Consequently, yoga exercise will be effective in preventing cardiovascular disease caused by obesity in obese postmenopausal Korean women.

Madanmohan, et.al. (2012) conducted the study on the effect of yoga therapy on reaction time, biochemical parameters and wellness score of peri and post-menopausal diabetic patients at Professor and Head, Department of Physiology and Program Director, ACYTER, JIPMER, Puducherry, India. 15 peri and post-menopausal patients receiving standard medical treatment for type 2 diabetes mellitus (DM) were recruited and reaction time and biochemical investigations were done before and after a comprehensive yoga therapy program comprising of three times a week sessions for six weeks. A post-intervention, retrospective wellness questionnaire compiled by ACYTER was used to evaluate the comparative feelings of the patients after the therapy program. As a result 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. The decrease in total-cholesterol, triglycerides, and very low density lipoprotein and increase in high density lipoprotein 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. In conclusion, Shortening of RT implies an improvement in the information processing and reflexes and is the first such report in diabetic patients. 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 program has the potential to enhance the beneficial effects of standard medical management of diabetes mellitus and can be used as an effective complementary or integrative therapy program.

Manchanda SC, et.al. (2000) studied that Retardation of coronary atherosclerosis with yoga lifestyle intervention at All India Institute of Medical Sciences, New Delhi, India. In this prospective, randomized, controlled trial, 42 men with angiographically proven coronary artery disease (CAD) were randomized to control (n = 21) and yoga intervention group (n = 21) and were followed for one year. The active group was treated with a user-friendly program consisting of yoga, control of risk factors, diet control and moderate aerobic exercise. The control group was managed by conventional methods i.e. risk factor control and American Heart Association step I diet. As a result at one year, the yoga groups showed significant reduction in number of anginal episodes per week, improved exercise capacity and decrease in body weight. Serum total cholesterol, LDL cholesterol and triglyceride levels also showed greater reductions as compared with control group. Revascularisation procedures (coronary angioplasty or bypass surgery) were less frequently required in the yoga group (one versus eight patients; relative risk = 5.45; P = 0.01). Coronary angiography repeated at one year showed that significantly more lesions regressed (20% versus 2%) and less lesions progressed (5% versus 37%) in the yoga group (chi-square = 24.9; P < 0.0001). The compliance to the total program was excellent and no side effects were observed. In conclusion, yoga lifestyle intervention retards progression and increases regression of coronary

atherosclerosis in patients with severe coronary artery disease. It also improves symptomatic status, functional class and risk factor profile.

Marshall DA, et.al. (2006) studied that the role of exercise in modulating the impact of an ultralow-fat diet on serum lipids and apolipoproteins in patients with or at risk for coronary artery disease at Walter Reed Army Medical Center Cardiology Service, Washington, DC 20307-5001, USA. We performed a 3-month, prospective, nonrandomized lifestyle intervention study (< or = 10% dietary fat; aerobic exercise [180 min/wk], group support, and yoga [60 min/day]) in 120 subjects with or at risk for coronary artery disease. As a result after 3 months, dietary fat intake was reduced to 8.7% +/- 2.6% of total intake and the median weekly exercise time was 194 minutes. High-density lipoprotein cholesterol levels (HDL-C) decreased by 8.3 +/- 11.3 mg/dL (P < .001), and triglyceride levels increased by 17.6 +/- 102.7 mg/dL (P = .026). A small dense low-density lipoprotein cholesterol (LDL-C) phenotype emerged indicated by a 13.8% LDL-C reduction accompanied by only a 2.3% reduction in apolipoprotein B levels (P = .064). Among subjects with exercise amounts less than those of the group median, HDL-C reductions were greater in those with more than (-13.5 +/- 16.0 mg/dL) versus less than (-2.5 +/- 7.5 mg/dL) the median reductions in fat intake (P = .026). Even among subjects who exercised > 194 min/wk, HDL-C was reduced compared with baseline (-7.4 +/- 7.9 mg/dL, P < .001). In conclusion an ultralow-fat diet as a component of a comprehensive lifestyle intervention induces reductions in HDL-C and the emergence of a dyslipidemic lipid profile. Aerobic exercise only partially mitigates this effect.

Mizuno J and Monteiro HL, (2013) conducted the study on an assessment of a sequence of yoga exercises to patients with arterial hypertension

at Department of Physical Education, Institute of Biosciences, Rio Claro, São Paulo State University, Av. 24A, No. 1515, Bela Vista, Rio Claro, São Paulo, Brazil. Thirty-three volunteers participated in the study (control = 16 and yoga = 17) for four months. Blood pressure measurements, cardiac and respiratory rate were collected monthly, while the biochemical profile was taken at the beginning and end of the program. To analyze the data, Student's t test and repeated measures analyses were performed. The yoga group showed a significant reduction of systolic blood pressure, heart and respiratory rate ($p < 0.05$). As for the biochemical profile, the yoga group showed correlation coefficients between initial values and final responses greater than the control of fasting glucose, total cholesterol, LDL-cholesterol and triglycerides. The elaborated sequence practice promoted significant cardiovascular and metabolic benefits. The yoga exercises performed in the proposed sequence constitute complementary non-pharmacological control of blood pressure in patients with hypertension.

Pal A, et.al. (2011) conducted the study on the effect of yogic practices on lipid profile and body fat composition in patients of coronary artery disease at Department of Physiology, Chhatrapati Shahuji Maharaj Medical University, Uttar Pradesh, India. In this study one hundred seventy (170) subjects, of both sexes having coronary artery disease were randomly selected from Department of Cardiology. Subjects were divided in to two groups randomly in yoga group and in non-yoga group, eighty five (85) in each group. Out of these (170 subjects), one hundred fifty four (154) completed the study protocol. The yogic intervention consisted of 35-40 min/day, five days in a week till six months in the Department of Physiology CSMMU UP Lucknow. Body fat testing and estimation of lipid profile were done of the both groups at zero time and after six months of yogic

intervention in yoga group and without yogic intervention in non yoga group. As a result in present study, BMI ($p<0.04$), fat % ($p<0.0002$), fat free mass ($p<0.04$), SBP ($p<0.002$), DBP ($p<0.009$), heart rate ($p<0.0001$), total cholesterol ($p<0.0001$), triglycerides ($p<0.0001$), HDL ($p<0.0001$) and low density lipoprotein ($p<0.04$) were changed significantly. It was concluded that reduction of SBP, DBP, heart rate, body fat%, total cholesterol, triglycerides and LDL after regular yogic practices is beneficial for cardiac and hypertensive patients. Therefore yogic practices included in this study are helpful for the patients of coronary artery disease.

Wall-Medrano A, et.al. (2009) conducted the study on Cardiovascular and metabolic effects of intensive Hatha Yoga training in middle-aged and older women from northern Mexico at Departments of Basic Sciences, Biomedical Sciences Institute, Autonomous University of Ciudad Juarez, Av. Hermanos Escobar y Plutarco Elías Calles s/n, Cd. Juárez Chih, Mexico. In this prospective quasi-experimental design, four middle-aged and nine older conventional Hatha Yoga (CHY) practicing females (yoginis) were enrolled into an 11-week intensive Hatha Yoga (IHY) program consisting of 5 sessions/week for 90 min (55 sessions). The program adherence, asana performance, and work intensity were assessed along the intervention. Anthropometric [body mass index (BMI), % body fat and Σ skin folds], cardiovascular fitness [maximal expired air volume (VE(max)), maximal O₂ consumption (VO₂(max)), maximal heart rate (HR(max)), systolic (BPs) and diastolic blood pressure (BPd)], biochemical [glucose, triacylglycerols (TAG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol(LDL-C)], and dietary parameters were evaluated before and after IHY. As a result Daily caloric

intake (~1,916 kcal/day), program adherence (~85%), and exercising skills (asana performance) were similar in both middle-aged and older women. The IHY program did not modify any anthropometric measurements. However, it increased VO₂ (max) and VE(max) and HDL-C while TAG and LDL-C remained stable in both middle-aged and older groups (P < 0.01). In conclusion the proposed IHY program improves different cardiovascular risk factors (namely VO₂ (max) and HDL-C) in middle-aged and older women.

Schmidt T, et.al. (1997) conducted the study on Changes in cardiovascular risk factors and hormones during a comprehensive residential three month kriya yoga training and vegetarian nutrition at Department of Epidemiology & Social Medicine, Hannover Medical University, Germany. In participants of a comprehensive residential three month yoga and meditation training programme living on a low fat lacto-vegetarian diet changes in cardiovascular risk factors and hormones were studied. Substantial risk factor reduction was found. Body mass index, total serum and LDL cholesterol, fibrinogen, and blood pressure were significantly reduced especially in those with elevated levels. Urinary excretion of adrenaline, noradrenaline, dopamine, aldosterone, as well as serum testosterone and luteinizing hormone levels were reduced, while cortisol excretion increased significantly.

Kim HK, et.al. (2012) studied that Yoga training improves metabolic parameters in obese boys at National Research Laboratory for Mitochondrial Signaling, Department of Physiology, College of Medicine, Cardiovascular and Metabolic Disease Center, Inje University, Busan 614-735, Korea. The purpose of the present study was to test the effect of an 8-week of yoga-asana training on body composition, lipid profile, and insulin resistance (IR) in obese adolescent

boys. Twenty volunteers with body mass index (BMI) greater than the 95th percentile were randomly assigned to yoga (age 14.7 ± 0.5 years, $n=10$) and control groups (age 14.6 ± 1.0 years, $n=10$). The yoga group performed exercises three times per week at 40~60% of heart-rate reserve (HRR) for 8 weeks. IR was determined with the homeostasis model assessment of insulin resistance (HOMA-IR). After yoga training, body weight, BMI, fat mass (FM), and body fat % (BF %) were significantly decreased, and fat-free mass and basal metabolic rate were significantly increased than baseline values. FM and BF % were significantly improved in the yoga group compared with the control group ($p < 0.05$). Total cholesterol (TC) was significantly decreased in the yoga group ($p < 0.01$). HDL-cholesterol was decreased in both groups ($p < 0.05$). No significant changes were observed between or within groups for triglycerides, LDL-cholesterol, glucose, insulin, and HOMA-IR. Our findings show that an 8-week of yoga training improves body composition and TC levels in obese adolescent boys, suggesting that yoga training may be effective in controlling some metabolic syndrome factors in obese adolescent boys.

Shantakumari N, et.al. (2013) conducted the study on the effects of a yoga intervention on lipid profiles of diabetes patients with dyslipidemia at Department of Physiology, Gulf Medical University, Ajman, P.O. Box 4184, UAE. The present study was conducted to assess the effectiveness of yoga in the management of dyslipidemia in patients of type 2 diabetes mellitus. This randomized parallel study was carried out in Medical College Trivandrum, Kerala, India. Hundred type 2 diabetics with dyslipidemia were randomized into control and yoga groups. The control group was prescribed oral hypoglycemic drugs. The yoga group practiced yoga daily for 1 h duration along with oral

hypoglycemic drugs for 3 months. The lipid profiles of both the groups were compared at the start and at the end of 3 months. After intervention with yoga for a period of 3 months the study group showed a decrease in total-cholesterol, triglycerides and LDL, with an improvement in HDL. It was concluded that Yoga, being a lifestyle incorporating exercise and stress management training, targets the elevated lipid levels in patients with diabetes through integrated approaches.

Smith J, et.al. (2008) conducted the study on Promoting healthy lifestyles in children: a pilot program of be a fit kid at Department of Health and Physical Education at Southern Oregon University, Oregon, USA. Be a Fit Kid is a 12-week program aimed at improving physical activity and nutritional habits in children. The physical activity component of the program emphasized cardiovascular fitness, flexibility, muscular strength, and bone development through running, yoga, jumping, and strength exercises. All activities were individualized and noncompetitive. The nutrition component focused on current dietary guidelines that emphasize a diet rich in vegetables, fruits, unsaturated fats, and whole grains, and low in saturated fat and sugar. Following the 12-week intervention, significant improvements were observed in body composition, fitness, nutrition knowledge, dietary habits, and in those who participated 75% of the time, significant reductions in total cholesterol and triglyceride levels were observed. Findings from the pilot trial suggest that health promotion programs can be well received by children and may favorably alter overweight and the development of adult lifestyle-related diseases.

Subramanian S, et.al. (2012) conducted the study on Role of sudarshan kriya and pranayam on lipid profile and blood cell parameters during exam stress at Department of Medical Research, SRM Medical College, Hospital and

Research Centre, Kattankulathur, Tamil Nadu, India. Blood samples of 43 engineering students were collected at four intervals namely baseline (BL), exam stress (ES), three and six weeks practice of SK and P during exam stress. Lipid profile and hematological parameters were measured at all four intervals. As a result ES elevated total cholesterol (TC), triglycerides (TGL) and very low density lipoprotein (VLDL) levels. Hematological parameters affected by ES included neutrophil, lymphocytes, platelet count, packed cell volume (PCV) and mean cell volume (MCV). Three and six weeks practice of SK and P reduced the elevated lipid profile, hematological parameters and improved lymphocyte levels. In conclusion, our study indicates that sudarshan kriya (SK and P) practice has the potential to overcome ES by improving lipid profile and hematological parameters.

Kumar S, et.al. (2010) conducted the study on Short term health impact of a yoga and diet change program on obesity at Patanjali Yogpeeth, Haridwar, India. A single group of 47 persons were assessed on the first and last day of a yoga and diet change program, with 6 days of the intervention between assessments. The assessments were: body mass index (BMI), waist and hip circumferences, mid-arm circumference, body composition, hand grip strength, postural stability, serum lipid profile and fasting serum leptin levels. Participants practiced yoga for 5 hours every day and had a low fat, high fiber, vegetarian diet. Last and first day data were compared using a t-test for paired data. As a result following the 6-day residential program, participants showed a decrease in BMI (1.6 percent), waist and hip circumferences, fat-free mass, total cholesterol (7.7 percent decrease), high density lipoprotein (HDL) cholesterol (8.7 percent decrease), fasting serum leptin levels (44.2 percent decrease) and an increase in

postural stability and hand grip strength ($p < 0.05$, all comparisons). In conclusion a 6-day yoga and diet change program decreased the BMI and the fat-free mass. Total-cholesterol also decreased due to reduced HDL levels. This suggests that a brief, intensive yoga program with a change in diet can pose certain risks. Benefits seen were better postural stability, grip strength (though a 'practice effect' was not ruled out), reduced waist and hip circumferences and a decrease in serum leptin levels.

Amita S, et.al. (2009) conducted the study on the effect of yoga-nidra on blood glucose level in diabetic patients at Department of Physiology, S. S. Medical College, Rewa 486 001, MP. This study was conducted on 41, middle aged, type-2 diabetic patients, who were on oral hypoglycaemic. These patients were divided in to two groups: (a) 20 patients on oral hypoglycaemic with yoga-nidra, and (b) 21 were on oral hypoglycaemic alone. Yoga-nidra practiced for 30 minutes daily up to 90 days, parameters were recorded every 30th day. Results of this study showed that most of the symptoms were subsided ($P < 0.004$, significant), and fall of mean blood glucose level was significant after 3-month of Yoga-nidra. This fall was 21.3 mg/dl, $P < 0.0007$, (from 159 +/- 12.27 to 137.7 +/- 23.15,) in fasting and 17.95 mg/dl, $P = 0.02$, (from 255.45 +/- 16.85 to 237.5 +/- 30.54) in post prandial glucose level. Results of this study suggest that subjects on Yoga-nidra with drug regimen had better control in their fluctuating blood glucose and symptoms associated with diabetes, compared to those were on oral hypoglycaemics alone.

Cade WT, et.al. (2010) studied that Yoga lifestyle intervention reduced blood pressure in HIV-infected adults with cardiovascular disease risk factors at Department of Medicine, Washington University School of Medicine,

4940 Parkview Place, St Louis, MO 63110, USA. Sixty HIV-infected adults with mild-moderate cardiovascular disease (CVD) risk were assigned to 20 weeks of supervised yoga practice or standard of care treatment. Baseline and week 20 measures were: 2-h oral glucose tolerance test with insulin monitoring, body composition, fasting serum lipid/lipoprotein profile, resting blood pressures, CD4 T-cell count and plasma HIV RNA, and the Medical Outcomes Study Short Form (SF)-36 health-related quality of life (QOL) inventory. As a result Resting systolic and diastolic blood pressures improved more ($P=0.04$) in the yoga group (-5 ± 2 and -3 ± 1 mmHg, respectively) than in the standard of care group ($+1 \pm 2$ and $+2 \pm 2$ mmHg, respectively). However, there was no greater reduction in body weight, fat mass or proatherogenic lipids, or improvements in glucose tolerance or overall QOL after yoga. Immune and virological status was not adversely affected. It was concluded that among traditional lifestyle modifications, yoga is a low-cost, simple to administer, nonpharmacological, popular behavioural intervention that can lower blood pressure in pre-hypertensive HIV-infected adults with mild-moderate CVD risk factors.

Chaya MS, et.al. (2008) conducted the study on Insulin sensitivity and cardiac autonomic function in young male practitioners of yoga at Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore, Karnataka, India. Fifteen healthy, young, male practitioners of yoga were compared with 15 young, healthy males who did not practice yoga matched for body-mass index. Fasting insulin sensitivity was measured in the fasting state by the hyperinsulinaemic-euglycaemic clamp. As a result there were no significant differences between the groups in their anthropometry or body composition. However, the fasting plasma insulin was significantly lower in the yoga group. The yoga group was also more

insulin sensitive (yoga 7.82 [2.29] v. control 4.86 [11.97] (mg/[kg.min])/(microU/ml), $p < 0.001$). While the body weight and waist circumference were negatively correlated with glucose disposal rate in the controls, there were no similar correlations in the yoga group. The yoga group had significantly higher low-frequency power and lower normalized high-frequency power. It was concluded that long term yoga practice (for 1 year or more) is associated with increased insulin sensitivity and attenuates the negative relationship between body weight or waist circumference and insulin sensitivity.

Damodaran A, et.al. (2002) conducted the study on therapeutic potential of yoga practices in modifying cardiovascular risk profile in middle aged men and women at Bhabha Atomic Research Centre, Medical Division Mumbai. Twenty patients (16 males, 4 females) in the age group of 35 to 55 years with mild to moderate essential hypertension underwent yogic practices daily for one hour for three months. Biochemical, physiological and psychological parameters were studied prior and following period of three months of yoga practices, biochemical parameters included, blood glucose, lipid profile, catecholamine, MDA, Vit. C cholinesterase and urinary VMA. Psychological evaluation was done by using personal orientation inventory and subjective well being. Results showed decrease in blood pressure and drug score modifying risk factors, i.e. blood glucose, cholesterol and triglycerides decreased overall improvement in subjective well being and quality of life. There was decrease in VMA catecholamine, and decrease MDA level suggestive decrease sympathetic activity and oxidant stress. It was concluded that Yoga can play an important role in risk modification for cardiovascular diseases in mild to moderate hypertension.

Innes KE, et.al. (2013) conducted the study on the benefits of yoga for adults with type 2 diabetes: a review of the evidence and call for a collaborative, integrated research initiative at Department of Epidemiology, West Virginia University School of Public Health. This article summarizes evidence regarding the efficacy of yoga for T2DM management and encourages the development of an integrated research agenda and a collaborative work group to test it. We present a brief overview of the global rise in T2DM and its consequences and costs, review the evidence regarding the potential benefits of yoga for T2DM management, outline limitations in the literature, discuss possible mechanisms underlying the effects of yoga on T2DM, and suggest how a collaborative, multinational effort by yoga therapist and research communities might contribute to research and inform clinical practice. Yoga protocols that serve T2DM patients and a research framework for creating an evidence base to support the use of yoga for T2DM management are clearly needed.

2.4 STUDIES ON PSYCHOLOGICAL VARIABLES IN YOGA

Adhia H, et.al. (2010) conducted the study on the impact of yoga way of life on organizational performance at Government of Gujarat, Gulbai Tekra, Ahmedabad - 380 006, India. Organizational performance can be attributed to a number of factors. However, there are certain organizational factors, the presence or absence of which can determine the success or failure of the organization. There are different ways in which organizations try to improve their performance by working on such factors. In the research presented in this article, an attempt is made to find out whether adoption of the yoga way of Life by managers can have a positive impact on such organizational performance indicators. The five indicators are job satisfaction, job involvement, goal orientation, affective

organizational commitment and organizational citizenship behavior. Pre- and post-data was measured using self-reported questionnaire. Independent T-test (Paired) and Pearson's correlation test were conducted using SPSS. The results of the study show that yoga has a significant positive impact on four out of five of these indicators. Only job involvement does not show significant improvement. The construct used for measuring job involvement had a Chronbach alpha of 0.613, which is an indicator of moderate reliability, which could be the main reason for not getting positive result.

Jeter PE, et.al. (2013) conducted the study on Evaluation of the benefits of a kripalu yoga program for police academy trainees at Wilmer Eye Institute, Johns Hopkins University. Forty-two recruits participated in a 6-class yoga intervention. Participants completed the Profile of Mood States-Short Form, Perceived stress Scale, and the Five Facet Mindfulness Questionnaire prior to and immediately following completion of the yoga program, as well as an exit survey. As results paired samples t-tests revealed significant post-intervention changes in perceived stress and mood, reductions in tension and fatigue, and a trend toward reduced anger. Changes in mindfulness were not detected. The exit survey indicated perceived benefits of yoga for some participants. It was concluded that yoga may be beneficial for reducing stress, tension, and fatigue among police academy trainees.

Hachul H, et.al. (2012) conducted the study on Yoga decreases insomnia in postmenopausal women at Departamento de Psicobiologia, Universidade Federal de São Paulo, Sao Paulo, SP, Brazil. Postmenopausal women not undergoing hormone therapy, who were 50 to 65 years old, who had an apnea-hypopnea index less than 15, and who had a diagnosis of insomnia were randomly

assigned to one of three groups, as follows: control, passive stretching, and yoga. Questionnaires were administered before and 4 months after the intervention to evaluate quality of life, anxiety and depression symptoms, climacteric symptoms, insomnia severity, daytime sleepiness, and stress. The volunteers also underwent polysomnography. The study lasted 4 months. There were 44 volunteers at the end of the study. When compared with the control group, the yoga group had significantly lower post-treatment scores for climacteric symptoms and insomnia severity and higher scores for quality of life and resistance phase of stress. The reduction in insomnia severity in the yoga group was significantly higher than that in the control and passive-stretching groups. This study showed that a specific sequence of yoga might be effective in reducing insomnia and menopausal symptoms as well as improving quality of life in postmenopausal women with insomnia.

Jahagirdar MU, et.al. (2011) conducted the study on the effects of Sudarshan Kriya Yoga on some physiological and biochemical parameters in mild hypertensive patients at Agharkar Research Institute, G.G. Agarkar Road, Pune--411 004. An open label intervention study was undertaken on 26 mild hypertensives and 26 apparently healthy adults (30-60 y), for the effect of Sudarshan Kriya Yoga practice for two months as complementary therapy. In the hypertensives, there was a significant decrease in diastolic blood pressure ($P < 0.01$), serum urea ($P < 0.01$) and plasma MDA (malondialdehyde adducts) as oxidative stress marker ($P < 0.05$). Other parameters; viz.; plasma levels of cholesterol, triglycerides, glucose, did not change significantly ($P > 0.1$). The pattern of change in most of the study parameters was such that values above normal range were lowered but values within normal range were unaltered. The

action of Yoga on diastolic blood pressure, malondialdehyde adducts and kidney function in hypertensives was of counteractive nature and felt to be distinctly different than the effect of drugs.

Albrecht TA and Taylor AG (2012) conducted the study on Physical activity in patients with advanced-stage cancer at School of Nursing, University of Pittsburgh, USA. Research focusing on the effects of physical activity, specifically for patients with advanced-stage cancer and poorer prognostic outcomes, has been addressed only recently. The purpose of this article is to examine the state of the science for physical activity in the advanced-stage disease subset of the cancer population. Exercise in a variety of intensities and forms, including yoga, walking, biking, and swimming, has many health benefits for people, including those diagnosed with cancer. Research has shown that, for people with cancer (including advanced-stage cancer), exercise can decrease anxiety, stress, and depression while improving levels of pain, fatigue, shortness of breath, constipation, and insomnia. People diagnosed with cancer should discuss with their oncologist safe, easy ways they can incorporate exercise into their daily lives.

Alexander GK, et.al. (2013) conducted the study on perceived benefits of yoga practice among older adults at risk for cardiovascular disease at Texas Christian University, Harris College of Nursing and Health Sciences, Fort Worth, TX 76129, United States. A total of 42 participants completed the intervention and met the inclusion criteria for the current qualitative study. The 8-week Iyengar yoga program included two 90-min yoga classes and five 30-min home sessions per week. Participants completed weekly logs and an exit questionnaire at the end of the study. Qualitative data from weekly logs and exit questionnaires

were compiled and conventional content analysis performed with the use of ATLAS to facilitate the process. As a result four broad themes emerged from content analysis: practicing yoga improved overall physical function and capacity (for 83% of participants); practicing yoga reduced stress/anxiety and enhanced calmness (83% of participants); practicing yoga enriched the quality of sleep (21% of participants); and practicing yoga supported efforts toward dietary improvements (14% of participants). It was concluded that yoga may have ancillary benefits in terms of improved physical function, enhanced mental/emotional state, enriched sleep quality, and improved lifestyle choices, and may be useful as a health promotion strategy in the prevention and management of chronic disease.

Anand MP (1999) conducted the study on Non-pharmacological management of essential hypertension at Lady Ratan Tata Medical Centre, Mumbai. The INTERSALT study of 52 communities worldwide showed that weight, among all measured characteristics except age, had the strongest, significant, most consistent and independent correlation with blood pressure. INTERSALT epidemiological data had demonstrated a positive association between sodium intake and level of blood pressure. A rigorous analysis of 23 randomly controlled trials showed that 100 mmol/day reductions in sodium intake was associated with a decline of 5-7 mm Hg (systolic)/2.7 mm Hg (diastolic) in hypertensive subjects. Excessive alcohol consumption is another important risk factor for hypertension and has been reported to account for 5-30% of all hypertension. Moderately intense exercise at 40 to 60% of maximum oxygen consumption e.g., 30 to 45 minutes of brisk walking on 4-5 days a week, can lower blood pressure. The incidence of stroke and coronary artery disease in

hypertensive patients who smoke is 2-3 times greater than in non-smoking patients with comparable blood pressure and stopping smoking rapidly reduces this risk. There have been several studies showing the stress reduction with various behavioral procedures, such as yoga, relaxation biofeedback, transcendental mediation and psychotherapy benefit hypertensive patients by lowering their blood pressure.

Andersen SR, et.al. (2013) studied the effect of mindfulness-based stress reduction on sleep quality at Danish Cancer Society Research Center, Survivorship, Copenhagen, Denmark. A total of 336 women operated on for breast cancer stage I-III 3-18 months previously were randomized to mindfulness-based stress reduction (MBSR) (n = 168) or treatment as usual (n = 168); both groups received standard clinical care. The intervention consisted of an eight-week MBSR program (psycho-education, meditation and gentle yoga). Sleep quality was assessed on the Medical Outcome Study sleep scale at baseline, after the intervention and at six- and 12-months' follow-up. The mean sleep problem scores were significantly lower in the MBSR group than in controls immediately after the intervention. Quantile regression analyses showed that the effect was statistically significant only for the participants represented by the lower percentile of change between baseline and post-intervention, i.e. those who had more sleep problems; the MBSR group had a significantly smaller increase in sleep problems than the control group. After the 12-month follow-up, there was no significant between-group effect of MBSR on sleep quality in intention-to-treat analyses. It was concluded that MBSR had a statistically significant effect on sleep quality just after the intervention but no long-term effect among breast cancer patients.

Anderzén-Carlsson A, et.al. (2014) conducted the study on another way of being in the world-A phenomenological study from the perspective of persons suffering from stress-related symptoms at Centre for Health Care Sciences, Örebro University Hospital, Örebro, Sweden. Five women and one man (43-51 years) participated. They were recruited from the intervention group (n=18) in a randomized control trial, in which they had participated in a medical yoga group in addition to standard care for 12 weeks. Data were collected by means of qualitative interviews, and a phenomenological data analysis was conducted. The essential meaning of the medical yoga experience was that the medical yoga was not an endpoint of recovery but the start of a process towards an increased sense of wholeness. It was described as a way of alleviating suffering, and it provided the participants with a tool for dealing with their stress and current situation on a practical level. It led to greater self-awareness and self-esteem, which in turn had an implicit impact on their life world. In phenomenological terms, this can be summarized as another way of being in the world, encompassing a perception of deepened identity. From a philosophical perspective, due to using the body in a new way (yoga), the participants had learnt to see things differently, which enriched and recast their perception of themselves and their lives.

Ando M, et.al. (2011) did a qualitative study on mindfulness-based meditation therapy in Japanese cancer patients at Faculty of Nursing, St. Mary's College, Tsubukuhonmachi 422, Kurume City, Fukuoka, Japan. The subjects were 28 patients who were undergoing anti-cancer treatment. The subjects participated in two sessions of mindfulness-based meditation therapy, including breathing, yoga movement, and meditation. Each patient was taught the program in the first session, then exercised at home with a CD, and subsequently met the

interviewer in a second session after 2 weeks. Primary physicians recruited the patients and interviews were conducted individually by nurses or psychologists with training in the program. Patients provided answers to pre- and post-intervention interviews about the meaning of their illness. As results shows Mindfulness-based meditation therapy may be effective for producing adapted coping, including positive recognition and changes for an adapted lifestyle. There were some common aspects and some differences in the themes selected by patients in this study and Western patients received mindfulness therapy in other studies.

Atkinson NL, et.al. (2009) conducted the study on Benefits, barriers, and cues to action of yoga practice at Department of Public and Community Health, University of Maryland School of Public Health, College Park, MD 20742, USA. Focus groups were conducted with persons who had never practiced yoga, practitioners of one year or less, and practitioners for more than one year. The Health Belief Model was the theoretical foundation of inquiry. All participants acknowledged a variety of benefits of yoga. Barriers outweighed benefits among persons who had never practiced despite knowledge of benefits. Positive experiences with yoga and yoga instructors facilitated practice. As a result newly identified benefits and barriers indicate the need for quantitative research and behavioral trials.

Banerjee B, et.al. (2007) conducted the study on the effects of an integrated yoga program in modulating psychological stress and radiation-induced genotoxic stress in breast cancer patients undergoing radiotherapy at Genome Stability Laboratory, Department of Physiology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore. Effects of an

integrated yoga program in modulating perceived stress levels, anxiety, as well as depression levels and radiation-induced DNA damage were studied in 68 breast cancer patients undergoing radiotherapy. Two psychological questionnaires-- Hospital Anxiety and Depression Scale (HADS) and Perceived Stress Scale (PSS)--and DNA damage assay were used in the study. There was a significant decrease in the HADS scores in the yoga intervention group, whereas the control group displayed an increase in these scores. Mean PSS was decreased in the yoga group, whereas the control group did not show any change pre- and postradiotherapy. Radiation-induced DNA damage was significantly elevated in both the yoga and control groups after radiotherapy, but the post-radiotherapy DNA damage in the yoga group was slightly less when compared to the control group. An integrated approach of yoga intervention modulates the stress and DNA damage levels in breast cancer patients during radiotherapy.

Basavaraj KH, et.al. (2011) conducted the study on Stress and quality of life in psoriasis: an update at Department of Dermatology, Venereology and Leprosy, JSS Medical College, JSS University, Mysore-570015, Karnataka, India. Psoriasis is a chronic, relapsing, cutaneous condition with 1-2% prevalence in the general population. There are many factors involved in the induction and/or exacerbation of psoriasis of which stress is a well-known trigger factor in the appearance or exacerbation of psoriasis. Stress reaction in patients with psoriasis is probably mediated by the hypothalamic-pituitary-adrenal relationship with immunologic effects. Stress response involves increased levels of neuroendocrine hormones and autonomic neurotransmitters. Psychological stress or an abnormal response to stressors has been found to modify the evolution of skin disorders such as psoriasis. It can also have substantial psychological, and psychosocial

impact on a patient's quality of life. Treatment regimens include stress-reduction strategies, such as biofeedback, meditation, yoga, and self-help approaches. This review focuses the relationship between psoriasis and stress, especially relating to psychosocial, psychological, and emotional stress aspects.

Kennedy HP, et.al.(2009) studied that the effects of mindfulness-based yoga during pregnancy on maternal psychological and physical distress at School of Nursing, Walden University, 155 Fifth Avenue South, Suite 100, Minneapolis, MN 55401, USA sixteen healthy pregnant nulliparous women with singleton pregnancies between 12 and 32 weeks gestation at the time of enrollment. Outcomes were evaluated from pre- to post-intervention and between second and third trimesters with repeated measures analysis of variance and post hoc nonparametric tests. As a result Women practicing mindful yoga in their second trimester reported significant reductions in physical pain from baseline to post-intervention compared with women in the third trimester whose pain increased. Women in their third trimester showed greater reductions in perceived stress and trait anxiety. It was concluded that preliminary evidence supports yoga's potential efficacy in these areas, particularly if started early in the pregnancy.

Beddoe AE and Lee KA (2008) studied the Mind-body interventions during pregnancy at School of Nursing, San Jose State University, CA 95192-0057, USA. Twelve out of 64 published intervention studies between 1980 and February 2007 of healthy, adult pregnant women met criteria for review. Studies were categorized by type of mind-body modality used. Progressive muscle relaxation was the most common intervention. Other studies used a multimodal psycho-education approach or a yoga and meditation intervention. The research

contained methodological problems, primarily absence of a randomized control group or failure to adequately control confounding variables. Nonetheless, there was modest evidence for the efficacy of mind-body modalities during pregnancy. Treatment group outcomes included higher birth-weight, shorter length of labor, fewer instrument-assisted births, and reduced perceived stress and anxiety. In conclusions, there is evidence that pregnant women have health benefits from mind-body therapies used in conjunction with conventional prenatal care.

2.5 SUMMARY OF THE REVIEWS

The total reviews presented were 75. The total numbers of critical reviews prevented were 54 and total numbers of allied reviews were 2. The reviews on yoga and police were two. The reviews on physiological variables were 24 (Critical reviews) and 12 (Allied reviews). The reviews on bio-chemical parameters were 18 (Critical reviews) and 4 (Allied reviews). The reviews on psychological variables were 10 (Critical reviews) and 5 (Allied reviews).

All the research studies that are presented in this section prove that yogic training methods contribute significantly for better improvement in all the criterion dependent variables among police men.

The Review of Related Literature helped the researcher from the methodological point of view too. The present study may serve as a foundation and main ingredient for future research.