REVIEW OF RELATED LITERATURE
CHAPTER II

REVIEW OF RELATED LITERATURE

A study of relevant literature plays an important role to get a full picture of what has been done with regard to the problem under study. Such a review brings out the foundation upon which all future work will be built.

The research scholar has attempted in this chapter to locate the literature related to this study. The relevant studies from various sources which the research scholar has come across are cited below.

2.1. PHYSIOLOGICAL VARIABLES

2.1.1. PULSE RATE

'Clay et al., (2005)' attempted to determine the metabolic and heart rate (HR) responses of hatha yoga, 26 women (19-40 years old) performed a 30-minute hatha yoga routine of supine lying, sitting and standing asanas. During the 30-minute hatha yoga routine, mean absolute oxygen consumption (VO$_2$), relative VO$_2$, percentage maximal oxygen consumption (%VO$_2$R), metabolic equivalents (METs), energy expenditure, HR and percentage maximal heart rate (%MHR) were 0.45 L min$^{-1}$, 7.59 ml kg$^{-1}$ min$^{-1}$, 14.50%, 2.17 METs, 2.23 kcal min$^{-1}$, 105.29 b min$^{-1}$ and 56.89%, respectively. When compared to resting in a chair, hatha yoga required 114% greater O$_2$ (L min$^{-1}$), 111% greater O$_2$ (ml kg$^{-1}$ min$^{-1}$), 4.294% greater %VO$_2$R, 111% greater METs, 108% greater kcal min$^{-1}$, 24% greater HR and 24% greater %MHR. When compared to walking at 93.86 m min$^{-1}$, hatha yoga required 54% lower O$_2$ (L min$^{-1}$),
53% lower $O_2 (\text{ml kg}^{-1} \text{min}^{-1})$, 68% lower $\%VO_2R$, 53% lower METs, 53% lower kcal min$^{-1}$, 21% lower HR and 21% lower $\%MHR$. The hatha yoga routine in this study required 14.50% $VO_2R$, which can be considered a very light intensity and significantly lighter than 44.8% $VO_2R$ for walking at 93.86 m min$^{-1}$ (3.5 mph). The intensity of hatha yoga may be too low to provide a training stimulus for improving cardiovascular fitness. Although previous research suggests that hatha yoga is an acceptable form of physical activity for enhancing muscular fitness and flexibility, these data demonstrate that hatha yoga may have little, if any, cardiovascular benefit.

'Pawlow and Jones (2002)' had investigated to measure the impact of progressive muscle relaxation on salivary cortisol. 46 subjects were led through an abbreviated progressive relaxation training (APRT) during two sessions spaced one week apart. 15 control subjects were asked to sit quietly in the laboratory for an equal length of time. Heart rate, state anxiety, perceived stress and salivary cortisol were measured pre and post treatment. Subjects in the experimental group had significantly lower heart rate, state anxiety, perceived stress and salivary cortisol than control subjects. They reported higher levels of relaxation. The results of this study may have implications for the use of relaxation training in enhancing immune function.

P. Arambula, E. Peper, M. Kawakami and K. H. Gibney (2001) conducted a study which explores the physiological correlates of a highly practiced Kundalini Yoga meditator. Thoracic and abdominal breathing patterns, heart rate (HR), occipitalparietal electroencephalograph (EEG), skin conductance level (SCL) and blood volume Pulse (BVP) were monitored during prebaseline, meditation
and postbaseline periods. Visual analyses of the data showed a decrease in respiration rate during the meditation from a mean of 11 breaths/min for the pre and 13 breaths/min for the postbaseline to a mean of 5 breaths/min during the meditation, with a predominance of abdominal/diaphragmatic breathing. There was also more alpha EEG activity during the meditation (M = 1.71 microV) compared to the pre (M = .47 microV) and postbaseline (M = .78 microV) periods and an increase in theta EEG activity immediately following the meditation (M = .62 microV) compared to the pre-baseline and meditative periods (each with M = .26 microV). These findings suggest that a shift in breathing patterns may contribute to the development of alpha EEG and those patterns need to be investigated further.

Bhargava, R., M. G. Gogate and J. F. Mascarenhas (1988) had opined in their study "autonomic responses to breath holding", a study involving twenty healthy young men. After taking initial recordings, all the subjects practised Nadi-Shodhana Pranayama for a period of 4 weeks. At the end of 4 weeks, same parameters were again recorded and the results compared. Baseline heart rate and blood pressure showed a tendency to decrease and both these autonomic parameters were significantly decreased at breaking point after pranayamic breathing. Although the GSR was recorded in all subjects, the observations made were not conclusive. Thus, pranayama breathing exercises appear to alter autonomic responses to breath holding probably by increasing vagal tone and decreasing sympathetic discharges.

Carroll, J. A. Blansit, R. M. Otto and J. W. Wygand (2003) designed a study to determine hemodynamic and metabolic demand of
Ashtanga Vinyasa Yoga and compare the heart rate/oxygen consumption relationship of yoga to a maximal treadmill GXT, thirteen yoga practitioners (age 36.7 ± 6.5 yrs, body mass 62.1±13.2 kg, height 166.1 ± 9.4 cm, max VO2 46.6±4.5 mL/kg-min) with yoga experience of 3-36 months, participated in the study. Despite the lack of relationship between HR and VO2 and the mild blood lactate level, Ashtanga Vinyasa Yoga can provide a moderate cardiovascular stimulus through a combination of anaerobic and aerobic energy requirements. The anaerobic exercise and isometric muscle actions involved in Vinyasa Yoga may, in part, be responsible for the disproportionate HR/VO2 response and thus preclude the use of HR to estimate exercise intensity. The 6.7 MET energy cost of Vinyasa Yoga is similar to the moderate exercise intensity required by aerobic dance and walking.

Peng, C. K., J. E. Mietus, Y. Liu, G. Khalsa, P. S. Douglas, H. Benson and A. L. Goldberger (1999) in their study investigated that extremely prominent heart rate oscillations is associated with slow breathing during specific traditional forms of Chinese Chi and Kundalini Yoga meditation techniques in healthy young adults. They applied both spectral analysis and a novel analytic technique based on the Hilbert transform to quantify these heart rate dynamics. The amplitude of these oscillations during meditation was significantly greater than in the pre-meditation control state and also in three non-meditation control groups: i) elite athletes during sleep, ii) healthy young adults during metronomic breathing and iii) healthy young adults during spontaneous nocturnal breathing. This finding, along with the marked variability of the beat-to-beat heart rate dynamics
during such profound meditative states, challenges the notion of meditation as only an autonomically quiescent state.

A. G. Ramakrishnan, H. R. Nagendra and S. Telles (1998) had investigated that HRV during two yoga practices that had previously been found to have opposite effects: sympathetic stimulation (kapalabhati, or breathing at high frequency, i.e., 2 breaths per second for several seconds) and reduced sympathetic activity (nadi shodana, or alternate-nostril breathing). All 12 male volunteers (age range = 21-33 years) were assessed before and after each practice on separate days. Following kapalabhati, low-frequency power and the ratio of low to high frequency increased significantly, whereas high-frequency power fell significantly. There were no significant changes following nadi shodana. According to Raghuraj and colleagues, these results suggest that (1) kapalabhati modifies cardiac autonomic control (nervous system regulation of heart function) by increasing sympathetic activity and reducing vagal (primary parasympathetic nerve) activity and (2) HRV is a more useful psychophysiological measure than heart rate alone. HRV is an up-and-coming measure of cardiovascular function in clinical cardiology. HRV cannot be discerned by heart rate palpitation or wrist-worn cardiotachometers; it must be measured using very expensive electrocardiographic spectral analysis equipment, such as that found in university-based cardiovascular research institutions.

Rzesutko, K. M., D. M. Jay, W. J. Picconatto, M. Stuart and R. E. Nelson (2002), designed a study to determine whether participants in a beginning power yoga class could attain a level of intensity to achieve ACSM recommended target heart rate (THR) levels (55-90% HRmax) for aerobic training. Thirteen active college aged individuals
with no prior yoga experience participated in the study. Participants met for three consecutive 45 minute testing sessions with a 48 hour rest interval between sessions. Time to achievement of THR levels varied among participants but there was no significant difference ($P = .05$) within a participant across sessions ($Power = .145$). The amount of time participants were in the target heart rate zone during the 20 minute work segment varied but there was no significant difference ($P = .05$) within a participant across sessions ($Power = .48$). Heart rate and perceived exertion during the work segment showed poor correlation ($r < 0.58$) in each of the three sessions. The results indicate that power yoga does not consistently provide heart rate intensities that meet ACSM recommendations for aerobic training in beginning power yoga participants. In addition, the use of perceived exertion during power yoga does not appear to be an accurate correlation with heart rate.

David M. Houghton (1996), in his study, opined that autogenic therapy was taught to a group of teachers attending a stress management course as a means to their achieving physiological change in the form of reduced pulse rates. Autogenic exercises enabled all the teachers to reduce their pulse rates with significant consistency during a 14-week period ($P < 0.0001$). There were no differences between females and males in the magnitude of changed pulse rates. The teachers' successes in using autogenic therapy were not influenced by behaviour characteristics such as A-type behaviours, speed and impatience, job involvement or hard driving as revealed by the Jenkins Activity Survey or by behaviours identified by a schedule that measured self-perceptions of life-management skills.
Pawlow LA and Jones GE (2002), in their study, 46 subjects were led through an abbreviated progressive relaxation training (APRT) during two sessions spaced one week apart. 15 control subjects were asked to sit quietly in the laboratory for an equal length of time. Heart rate, state anxiety, perceived stress and salivary cortisol were measured pre and post treatment. Subjects in the experimental group had significantly lower heart rate, state anxiety, perceived stress and salivary cortisol than control subjects. They reported higher levels of relaxation. The results of this study may have implications for the use of relaxation training in enhancing immune function.

2.1.2. DIASTOLIC AND SYSTOLIC BLOOD PRESSURE

Barnes, Davis, Murzynowski and Treiber (2004) had investigated the effects of meditation on blood pressure and heart rate in youth. 73 middle school students (age 12.3 +/- 0.6 years) were randomly assigned to either a meditation group (N = 34) or a health education control group (N = 39 group). The meditation group meditated for 10 minutes at school and after school (at home) every day for 3 months. Blood pressure and heart rate were measured pre-test (pre-meditation training) and post-test (after the 3 months). Researchers took both resting (seated) and ambulatory (walking around in everyday life) measures of blood pressure and heart rate. Resting blood pressure and heart rate were measured on three consecutive school days (to increase reliability of the measurements). Ambulatory measurements were recorded over 24-hour periods at pretest and posttest every 20 minutes during self-reported normal waking hours and every 30 minutes during self-reported normal sleep hours. Compared to students in the control group, students in the meditation group showed a significant decrease
in resting blood pressure, daytime ambulatory blood pressure after school and daytime ambulatory heart rate after school. "These findings demonstrate the potential beneficial impact of meditation on blood pressure and heart rate in the natural environment in healthy normotensive youth."

Barnes, V. A., F. A. Treiber and H. Davis (2001) in their study analyzed the impact of the Transcendental Meditation (TM) program on cardiovascular (CV) reactivity in adolescents with high normal BP. Thirty-five adolescents, 1 Caucasian American (CA); ages 15-18 years with resting systolic blood pressure (SBP) between the 85th and 95th percentile for their age and gender on three consecutive occasions, were randomly assigned to either TM (n=17) or health education control (CTL, n=18) groups. The TM group engaged in 15 minutes meditation twice each day for 2 months including sessions during school lunch break. Primary CV outcome measures were changes in blood pressure (BP), heart rate (HR) and cardiac output (CO) at rest and in response to two laboratory stressors, a simulated car driving stressor and an interpersonal social stressor interview. The TM group exhibited greater decreases in resting SBP (P < .03) from pre to post intervention, compared to the CTL group. The TM group exhibited greater decreases from pre to post intervention in SBP, HR and CO reactivity (P's < .03) to the simulated car driving stressor and in SBP reactivity (P < .03) to the social stressor interview. The TM program appears to have a beneficial impact upon CV functioning at rest and during acute laboratory stress in adolescents at-risk for hypertension.

Cusumano, Jerome A. and Sharon E. Robinsonb (1992), had investigated the effects of hatha yoga and progressive relaxation on
heart rate, blood pressure, physical self-efficacy and self-esteem. Ninety-five female Japanese undergraduates participated in the three weekly treatment sessions. Results showed that both treatments were effective in lowering heart rate and blood pressure and increasing self-esteem; however, perceptions of physical self-efficacy declined over time. No significant differences were found between the treatments.

U. C. Rai, V. Balavittal, D. P. Thombre and Swami Gitananda (1983) conducted a study in trained (n=7) and untrained (n=7) volunteers to determine the effect of savitri pranayam and shavasan on O2 consumption, heart rate and blood pressure. In trained subjects we found a consistent and significant (P<0.01) reduction in O2 consumption within a few minutes of starting savitri pranayam. During shavasan, there was significant reduction in O2 consumption (P <0.05), heart rate (P<0.001) and diastolic blood pressure (P <0.05). In untrained subjects, the changes in the above mentioned parameters were statistically insignificant.

Schell, F. J., B. Allolio and O. W. Schonecke (1994) in their study opined that Hatha yoga has become increasingly popular in western countries as a method for coping with stress. However, little is known about the physiological and psychological effects of yoga practice. We measured heart rate, blood pressure, the hormones cortisol, prolactin and growth hormone and certain psychological parameters in a yoga practicing group and a control group of young female volunteers reading in a comfortable position during the experimental period. There were no substantial differences between the groups concerning endocrine parameters and blood pressure. The course of heart rate was significantly different; the yoga group had a decrease during the yoga
practice. Significant differences between both groups were found in psychological parameters. In the personality inventory, the yoga group showed markedly higher scores in life satisfaction and lower scores in excitability, aggressiveness, openness, emotionality and somatic complaints. Significant differences could also be observed concerning coping with stress and the mood at the end of the experiment. The yoga group had significantly higher scores in high spirits and extravertedness.

'Srivastava and Niraj (2003)' conducted a study to evaluate some of the beneficial effects of yogic practices on cardiovascular/respiratory parameters, viz., blood pressure, heart rate, electrocardiogram and various pulmonary functions. Since in some earlier studies yogic practices have been shown to reduce not only blood pressure levels but also mitigate "electrocardiographic heterogenicity." The present study assessed the overall influence of yogic practices on cardiovascular and respiratory parameters in normal human subjects.

'Daini (1999)' in his study mentioned that autogenic training, a method of self-hypnosis, lowers the extent of within-day variation of systolic blood pressure assessed by the circadian double amplitude. The blood pressure and heart rate of ten patients, conventionally diagnosed as having hypertension or white-coat hypertension, were automatically monitored at 30-minutes intervals for 7 days before autogenic training and again for 7 days, at 1 or 2 months after the start of autogenic training (practiced three times daily). The circadian double amplitude of systolic blood pressure of the patients investigated was 3 to 17 mm Hg lower on autogenic training. In 5 patients, reductions by 7 to 17 mm Hg were statistically significant. These results are regarded as
provisional statistics, the utility of which depends on replication. By contrast, the over-all group reduction of the circadian double amplitude of systolic blood pressure by 8 mm Hg on the average can be taken at face value. Autogenic training also lowered the circadian double amplitude of diastolic blood pressure, but the effect was small as was the effect of autogenic training upon the MESOR (a rhythm adjusted mean) and acrophase (a measure of the timing of over-all high values recurring each day). The effect of autogenic training upon the circadian double amplitude of systolic blood pressure suggests its trial as first-line treatment of patients with excessive circadian blood pressure amplitude, a condition which, even in the absence of an elevated 24-hr. Average of blood pressure, is associated with a large increase in the risk of developing ischemic stroke or nephropathy.

Norio Mishima, Shinya Kubota, Shoji Nagata (1999) in their study, thirty-one healthy students were divided randomly into two groups: the AT group and the control group. In the first session, the physiological variables were measured for all students before and after all were asked to relax in their own way. The AT group were then taught AT for 3 months, after which time the measurements were repeated. In the second session, the AT group practised the standard AT exercise, while the control group repeated their own form of simple relaxation. Electrocardiogram, plethysmogram (PTG) and blood pressure (BP) were measured while the students carried out a breathing rate of 15 cycles/min. The R-R intervals and BP were analysed by an autoregressive model for spectral analysis and the data were compared by repeated-measures ANOVA. The AT group had a significant increase in the mean R-R interval and a significant decrease in the baseline deflection of the PTG in the second session. There were no
significant changes in sympathetic activity except for the change in the PTG, although low frequency amplitude of systolic BP decreased slightly. AT was found to induce significant changes that were independent of respiration in healthy students, although paced breathing might have operated as a mental stress. The increase in mean R-R interval and the decrease in baseline deflection of the PTG were the most robust correlates of AT.

Watanabe (2000) in his study mentioned that 10 patients with hypertension or white-coat hypertension were automatically monitored at 30-min intervals for 7 days prior to autogenic training and again for 7 days at 1 or 2 months following the start of autogenic training, practised 3 times daily. However, the overall group reduction in systolic blood pressure by 8 mm. Hg. on average can be accepted at face value. Diastolic blood pressure was also lowered following autogenic training, but the effect was small, as was the effect of autogenic training upon the MESOR (a rhythm adjusted mean) and acrophase (a measure of the timing of over-all high values recurring each day). An effect of autogenic training upon systolic blood pressure recommends a trial using autogenic training as first-line treatment for patients with excessive circadian blood pressure amplitude, a condition which, even in the absence of an elevated blood pressure, is associated with a large increased risk of developing ischaemic stroke or nephropathy.

Broota, Aruna, Varma, Ruchi, Singh and Archana (1995), in their study examined 40 male hypertension patients divided among 4 groups: Broota relaxation technique (yoga exercises combined with autosuggestion), Jacobson's progressive relaxation technique (a muscle relaxation technique), Shavasana (passive relaxation with a yogic
Results from an anxiety symptom checklist, BP and galvanic skin response measures were compared before and after the 8 days of relaxation sessions. Results show that all 3 relaxation therapies were quite effective in reducing symptoms of hypertension as compared to the control group. Shavasana was the most effective, followed by the Broota technique and then Jacobson's technique.

Janet Meininger (1998), in his study examined thirty-three women with mean age 44.8 ± 7.6 years, randomly assigned to a cognitive mediation group (n = 10), a relaxation group (n = 12), or a delayed treatment control group (n = 11). The participants in the two stress management groups participated in a 10-week intervention; the delayed treatment control group received BP monitoring during the 10-week period. Measures included BP, the state-trait anger expression inventory, personal strain and coping resources. Although no significant group x Time effects were found in BP, anger, or personal strain, several of the outcome measures appear to be sensitive and showed cell means in the hypothesized direction. Further study of the effects of stress management interventions on BP and stress, with a larger sample, is warranted.

Sabrina Robinson., R. N (2001) studied thirty one adult male runners prospectively for six months in three groups practising either meditation (n = 11) or autogenic training (n = 11) or serving as controls (n = 10). Before and after the six months relaxation intervention, indicators of reactivity to exercise and metabolism after exercise (blood lactate concentration, heart rate (HR) and oxygen consumption (VO₂), were tested immediately after and 10 minutes after exercise. Resting HR was also assessed weekly at home during the trial. State anxiety was
measured before and after the intervention. After the relaxation training, blood lactate concentration after exercise was significantly (P<0.01) decreased in the meditation group compared with the control group. No difference was observed in lactate responses between the autogenic training group and the control group. There were no significant differences among the groups with regard to HR, VO\(_2\), or levels of anxiety. Meditation training may reduce the lactate response to a standardised exercise bout.

2.1.3. PERCENT BODY FAT

Robinson. N (2001) had designed a study to compare weight loss/gain in two groups of overweight high school students: 30 students who were taught 40 minutes of yoga and pranayama four times a week for 12 weeks and 30 students who received no instruction. Neither group was instructed to diet or change food intake. Students in the yoga group showed a 5.7% decrease in average body mass index (BMI) and weight loss of six pounds, whereas students in the control showed a non-significant increase in average BMI.

Bauhofer. V (2002) in his study selected strength, endurance, flexibility and lung capacity of three yogis. Flexibility: “The yogis compare favorably with top performers who train for maximum flexibility in fields like gymnastics and ballet.” Body composition: “According to skinfold measurement taken with calipers, all three yogis had body fat ratios and body mass indices comparable to those of elite endurance athletes like top marathoners and bicyclists.” Muscular strength, endurance and balance: based on Biodex tests or elbow and knee flexion and extension, measuring maximum force exerted, muscle endurance and muscle balance—both between the right and left sides.
and between agonist and antagonist muscles, "the yogis scored mostly in or near the normal ranges." Lung capacity: Using a spirometer, two of the yogis performed within a few percentage points of the norm and one performed better than the norm. Cardiorespiratory fitness: "All three yogis produced VO\textsubscript{2} max measurements in the same range as fairly active athletes."

Satyanarayana, M., K. R. Rajeswari, N. J. Rnai, C. S. Krishna and P. V. Rao (1992), had opined in their study that eight healthy male volunteers of the age group 25.9 +/- 3 (SD) years were subjected to Santhi Kriya practice daily for 50 minutes for 30 days. The volunteer's body weight, blood pressure, oral temperature, pulse rate, respiration, ECG and EEG were recorded before and after the practice on the 1st day and subsequently on 10th, 20th and 30th day of their practice. They were also given a perceptual acuity test to know their cognitive level on the 1st day and also at the end of the study i.e., on the 30th day. Results indicate a gradual and significant decrease in the body weight from 1st to 30th day (P less than 0.001) and an increase in alpha activity of the brain (P less than 0.001) during the course of 30 days of Santhi Kriya practice. Increase of alpha activity both in occipital and pre-frontal areas of both the hemispheres of the brain denotes an increase of calmness. This study also revealed that Santhi Kriya practice increases oral temperature by 3 degrees F and decreases respiratory rate significantly (P less than 0.05) on all practice days. Other parameters were not found to be altered significantly. It is concluded that the Santhi Kriya practice for 30 days reduces body weight and increases calmness.

R. Nagarathna, H. R. Nagendra and T. Desiraju (1993) conducted a study and report shows that in a group of 40 physical education
teachers who already had an average of 8.9 years physical training, 3 months of yogic training produced significant improvement in general health (in terms of body weight and BP reduction and improved lung functions). There was also evidence of decreased autonomic arousal and more of psychophysiological relaxation (heart rate and respiratory rate reduction) and improved somatic steadiness (decreased errors in the steadiness test). The changes at the end of 3 months in volar GSR in different directions (increase/decrease/no change), depending on the initial values, suggests that practicing yoga may help to bring about a balance in different autonomic functions, so that functioning is optimised.

Kristal AR, Littman AJ, Benitez D, White E. Division (2005), conducted a study to examine whether yoga practice is associated with lower mean 10-year weight gain after age 45. Participants included 15,550 adults, aged 53 to 57 years, recruited to the Vitamin and Lifestyle (VITAL) cohort study between 2000 and 2002. Regular yoga practice was associated with attenuated weight gain, most strongly among individuals who were overweight. Although causal inference from this observational study is not possible, results are consistent with the hypothesis that regular yoga practice can benefit individuals who wish to maintain or lose weight.

Wilson and Robert (1997) in their study opined that combining yoga and breathing exercises helped teens shed unwanted pounds. The study included 60 overweight high school girls and boys who were divided into two groups. One group received 40 minutes of yoga and pranayama (quiet, deep and forced breathing) four times a week for 12 weeks, while those in the control group did their normal activities.
After 12 weeks, the average body mass index (BMI) in the yoga/pranayama group went from 22.8 to 21.5 (5.7 percent decrease), while the average BMI in the control group increased from 22.3 to 22.4. The decrease in the pranayama group could be attributed to two factors: the pranayama and yoga exercises themselves and a possible decrease in daily caloric intake by the participants in the pranayama group because of decreased stomach size.

American Heart Association (2006) conducted a study to compare weight loss/gain in two groups of overweight high school students: 30 students who were taught 40 minutes of yoga and pranayama four times a week for 12 weeks and 30 students who received no instruction. Neither group was instructed to diet or change food intake. Students in the yoga group showed 5.7 percent decrease in average body mass index (BMI) and weight loss of six pounds, whereas students in the control showed a non-significant increase in average BMI.

2.1.4. VITAL CAPACITY

Sarang, PS and Telles, S. (2006) in their study examined the consumption of oxygen, breath rate and breath volume in 50 male participants during two yogic practices: (1) cyclic meditation (CM), which combined yoga postures and restful awareness and (2) relaxation in shavasana. The participants were assigned to one of the two conditions on alternate days, so that data was collected for both conditions for all 50 participants. In the cyclic meditation condition, participants alternated the practice of yoga poses with supine rest. In this condition, participants were guided by audiotape and instructed to keep their eyes closed. The instructions emphasized carrying out the practice slowly, with awareness and relaxation. The total practice lasted
22 minutes and 30 seconds. The authors compare these results to the established finding that oxygen consumption increases the following traditional aerobic exercise. The reduced oxygen consumption following the cyclic yoga suggests that there is no such rebound effect for moderately active yoga when the poses are practiced with rest periods. During the shavasana condition, oxygen consumption, breath rate and breath volume decreased; however, the decrease in oxygen consumption after shavasana was only 4.8%. The results suggest that a combination of yoga postures with supine rest reduces oxygen consumption more than for relaxation alone. The reduction in oxygen consumption was maintained for 30 minutes after the practice of cyclic meditation and shavasana. The authors also point out that there are no well-understood consequences for long-term reduced oxygen consumption, there are possible implications for anxiety levels.

Cysarz, D., & Bussing, A (2005) in their study examined the effects of meditation on a specific aspect of breathing: (respiratory sinus arrhythmia, RSA). RSA is a natural pattern of heart rate variability - the heart beats faster during inhalation and slower during exhalation. Researchers measured this pattern of heart rate variability as 9 inexperienced meditators practiced two kinds of meditation: seated Zen meditation (breath and thought awareness) and Kinhin (walking) meditation. During both types of meditation, breathing rate lowered, the highest heart rate (during inhalation) lowered and the lowest heart rate (during exhalation) increased, but the basic pattern of RSA was strengthened. This outcome is potentially interesting because reduced RSA has been associated with depression, the physical changes of aging and even predicts death; higher RSA is often considered a sign of cardiovascular health.
Czamara, Joli Michele (2003) designed a study to determine whether a 10-week yoga practice of postures, breathing and relaxation can increase a person's strength, balance, functional flexibility and mental and physical quality of life. A sample of 16 volunteers was recruited from a community-based yoga center. A quasi-experimental, one-group within subject control, pre-post-test design was used for this study. Data were analyzed at the significance level of $p < .05$ for one group pre- and post-test of two data sets. The first set generating physical performance data of five tests. The second set, a survey measuring mental and physical health. The Mann-Whitney showed significance at the $p < .01$ for the sit-to-stand physical test. A West showed significance at the $p < .05$ for the mental component of the questionnaire. This study suggests that, even a relatively short (10-weeks) program of yoga will result in improvements of lower limb strength and selfperception of mental well-being of community-dwelling adults (mean age = 46.81) who are novice yoga practitioners.

Joshi, L. N., V. D. Joshi and L. V. Gokhale (1993) studied 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.

yoga asanas if practiced regularly are known to have beneficial effects on the human body. These yoga practices might be interacting with various somatoneuro-endocrine mechanisms to have therapeutic effects. The present study done in twenty four NIDDM patients 30 to 60 years old provides metabolic and clinical evidence of improvement in glycemic control and pulmonary functions. These middle aged subjects were type II diabetics on antihyperglycemic and dietary regimen. Their baseline fasting and postprandial blood glucose and glycosylated Hb were monitored along with pulmonary function studies. The expert gave these patients training in yoga asanas [and they were practiced] 30-40 min/day for 40 days under guidance. These findings suggest that better glycemic control and pulmonary functions can be obtained in NIDDM cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with somatoneuro-endocrine mechanism affecting metabolic and pulmonary functions remains to be worked out.

Raju, P. S., K. A. Kumar, S. S. Reddy, S. Madhavi, K. Gnanakumari, C. Bhaskaracharyulu, M. V. Reddy, N. Annapurna, M. E. Reddy, D. Girijakumari (1986) in their study, took twelve normal healthy volunteers (6 males and 6 females) undergoing yoga training for 90 days were studied for the effect of yoga on exercise tolerance. Their ages ranged from 18 to 28 years. The volunteers were taught only pranayama for the first 20 days and later on yogic asanas were added. Sub-maximal exercise tolerance test was done on a motorized treadmill by using Balke's modified protocol, initially, after 20 days (Phase-I) and after 90 days of yoga training (Phase-II). Minute ventilation and oxygen consumption were estimated before and during the test. Post exercise blood lactate was elevated significantly during initial and Phase-I, but
not in Phase-II. There was significant reduction of minute ventilation and oxygen consumption only in males in Phase-I and II at the time when the volunteers reached their 80% of the predicted heart rate. Female volunteers were able to go to higher loads of exercise in Phase-I and II.

Ray, U. S., B. Sinha, O. S. Tomer, A. Pathak, T. Dasgupta and W. Selvamurthy (2001) in their study examined the effect of yogic exercises on aerobic capacity. Forty men from the Indian army (aged 19-23 yr) were administered maximal exercise on a bicycle gometer in a graded work load protocol. The oxygen consumption, carbon dioxide output, pulmonary ventilation, respiratory rate, heart rate (HR) etc., at maximal exercise and PE score immediately thereafter were recorded. The subjects were divided into two equal groups. Twelve subjects dropped out during the course of study. One group (yoga, n = 17) practiced Hatha yogic exercises for 1 hour every morning (6 days in a week) for six months. The other group (PT, n = 11) underwent conventional physical exercise training during the same period. Both groups participated daily in different games for 1 hour in the afternoon. In the 7th month, tests for maximal oxygen consumption (VO2Max) and PE were repeated on both groups of subjects. Absolute value of VO2Max increased significantly (P < 0. 05) in the yoga group after 6 months of training. The PE score after maximal exercise decreased significantly (P < 0. 001) in the yoga group after 6 months but the PT group showed no change. The practice of hatha yogic exercises along with games helps to improve aerobic capacity like the practice of conventional exercises (PT) along with games. The yoga group performed better than the PT group in terms of lower PE after exhaustive exercise.
Stetter and Kupper, (2002) in their study opined that autogenic training is a self-relaxation procedure eliciting a psychophysiological relaxation response. 73 controlled outcome studies were found published between 1952 and 1999. 60 studies, of which 36 were randomized controlled trials (RCTs), were qualified for inclusion in this meta-analysis. Medium to large effect sizes were found in pre-treatment/post-treatment comparisons, with the RCTs showing larger effects. When autogenic training was compared to real control conditions, medium effects were found. Comparison of autogenic training to other psychological treatments mostly resulted in no effects or small negative effects. Unspecific autogenic training affects such effects on mood, cognitive performance, quality of life and physiological variables, tends to be larger than main effects. A separate meta-analysis for different disorders revealed a significant reduction of the heterogeneity of effect sizes. Positive effects of autogenic training in the meta-analysis of at least 3 studies were found for tension headache/migraine, essential hypertension, coronary heart disease, bronchial asthma, somatoform pain disorder, Raynaud’s disease, anxiety disorders, depression and functional sleep disorders closed circuit method of breathing oxygen through the Benedict-Roth spirometer. Each subject was tested in several repeat sessions. Values of oxygen consumption of the period of pranayamic breathing and of post-pranayamic breathing period were compared to control value of oxygen consumption of the prepranayamic breathing period of each test session. The results revealed that the short kumbhak pranayamic breathing caused a statistically significant increase (52%) in the oxygen consumption (and metabolic rate) compared to the pre-pranayamic base-line period of breathing. In contrast to the above, the long
kumbhak pranayamic breathing caused a statistically significant lowering (19%) of the oxygen consumption.

Tran MD, Holly RG, Lashbrook J, Amsterdam EA. (2001) studied, ten healthy, untrained volunteers (nine females and one male), ranging in age from 18-27 years, to determine the effects of hatha yoga practice on the health-related aspects of physical fitness, including muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition and pulmonary function. Subjects were required to attend a minimum of two yoga classes per week for a total of 8 weeks. Isokinetic muscular strength for elbow extension, elbow flexion and knee extension increased by 31%, 19% and 28% (p<0.05), respectively, whereas isometric muscular endurance for knee flexion increased 57% (p<0.01). Ankle flexibility, shoulder elevation, trunk extension and trunk flexion increased by 13% (p<0.01), 155% (p<0.001), 188% (p<0.001) and 14% (p<0.05), respectively. Absolute and relative maximal oxygen uptake increased by 7% and 6%, respectively (p<0.01). These findings indicate that regular hatha yoga practice can elicit improvements in the health-related aspects of physical fitness.

Birkel and Edgren (2000) studied 287 college students (89 men and 198 women) practicing yoga for 50 minutes twice a week for 15 weeks. Except for 68 participants who were either asthmatic or smokers, there were no known lung ailments among the group. Lung capacity was measured before the study and again at the end of the 15-week period by the use of a hand-held spirometer. At the end of the 15 weeks, vital lung capacity had improved significantly. It is hard to say, however, whether these findings were the result of yoga poses, breathing exercises, relaxation, or some other aspect of participants'
lives. Further research on yoga may be able to clarify this for us so that we can better understand just what it is about yoga that has this effect.

2.2. PSYCHOLOGICAL VARIABLES

2.2.1. ANXIETY

Kanji (2004) in his study opined that autogenic training is a method of autosuggestion with some potential for reducing anxiety. This study tests whether AT lowers anxiety levels experienced by patients undergoing coronary angioplasty. Fifty-nine patients were randomly assigned to receive regular AT or no such therapy as an adjunct to standard care for 5 months. The primary outcome measure was State Anxiety at 2 months. Qualitative information was generated by face-to-face interviews. State Anxiety showed a significant intergroup difference both at 2 and 5 months. This finding was corroborated by secondary outcome measures, for example, quality of life and by qualitative information about patients' experiences. The results do not allow us to determine whether the observed effects are specific to AT or of a nonspecific nature. Our results suggest that AT may have a role in reducing anxiety of patients undergoing coronary angioplasty.

Stetter, F. and Kupper, S. (2002) conducted 73 controlled outcome studies (1952-1999) and sixty studies qualified for inclusion in a meta-analysis. Medium-to-large effect sizes (ES) were found for pre-post comparisons of disease-specific AT effects, with RCT's having larger ES. Unspecific AT effects such as effects on mood, quality of life, physiological variables and cognitive performance tended to be even larger than main effects. Meta-analyses for different disorders found a significant reduction of the heterogeneity of ES. Positive effects in the
medium range for AT and AT compared with a control condition were found for at least 3 studies for: tension headache/migraine; mild-to-moderate essential hypertension; coronary heart disease; asthma, somatoform pain disorder; Raynaud's disease, anxiety disorders, mild-to-moderate depression and functional sleep disorders.

Robert Edelberg (1979) in his study opined that autogenic training and progressive relaxation are widely used relaxation techniques and little research has been conducted on their comparative effects. Twenty-two normal subjects received five sessions of instruction in either progressive relaxation or autogenic training over a 5-week period. Both types of training, when compared to the control group, significantly decreased SCL-90 scores on four scales: anxiety, depression, number of symptoms and intensity of symptoms. Also, autogenic training appeared to produce specific effects on self-perception of heaviness and warmth in the limbs and depth of breathing. However, there were no significant differences between groups in pretest versus posttest changes in heart rate or skin conductance. These results are consistent with the results of other recent research on nonanxious individuals in this laboratory.

Stetter and Kupper (1999) in their study found that medium to large effect sizes were found in pre treatment/post treatment comparisons, with the RCTs showing larger effects. When autogenic training was compared to real control conditions, medium effects were found. Comparison of autogenic training to other psychological treatments mostly resulted in no effects or small negative effects. Unspecific autogenic training effects such effects on mood, cognitive performance, quality of life and physiological variables, tended to be
larger than main effects. A separate meta-analysis for different disorders revealed a significant reduction of the heterogeneity of effect sizes. Positive effects of autogenic training in the meta-analysis of at least three studies were found for tension headache/migraine, essential hypertension, coronary heart disease, bronchial asthma, somatoform pain disorder, Raynaud’s disease, anxiety disorders, depression and functional sleep disorders.

Sakai. M (1995) in his study found that the autogenic training was successful. 28 patients (51%) were cured; 14 (25%) were much improved; 8 (15%) improved and 5 (9%) were unchanged at the end of the treatment. 46 patients (76%) were evaluated as having been successfully treated. Pretreatment variables, including patients' clinical characteristics, were not a useful predictor of outcome. Four treatment variables had a bearing upon outcome: 1) Practising the second standard autogenic training exercise was a satisfactory predictor of better outcome; 2) practising generalisation training was a useful predictor; 3) The use of other behavioural treatment techniques was positively associated with outcome; 4) Longer treatment periods were associated with improved outcome. Autogenic training may be of significant benefit in the treatment of anxiety disorders.

Khasky. A. D and J. C. Smith (1999), in their study 114 participants in four groups practiced 25 minutes of progressive muscle relaxation, yoga stretching, imagery, or a control task. Before and after training, participants took state versions of the Smith Quick Stress Test (which measures Somatic Stress, Negative Affect and Worry) and the Smith R-State Inventory. After training, all took both the verbal and picturial forms of the torrance tests of creative thinking. At post test,
groups' scores did not differ on creativity; however, when compared with yoga stretching, imagery trainees had lower post test scores on Negative Affect. Both yoga stretching and imagery trainees displayed higher scores on self-reported physical relaxation than did controls. Progressive muscle relaxation trainees had lower scores on somatic stress than controls. Paradoxically, for all relaxation trainees, disengagement correlated positively with both Negative Affect and Physical Relaxation, suggesting that disengagement in relaxation may not lead to relaxation-induced anxiety but may help one cope with such anxiety.

Kanjin and White. A (2006) studied 50 nursing students and found that the number of certified days off sick was reduced by autogenic training compared with no treatment and a second trial with only 18 students reported greater improvement in Trait Anxiety, but not State Anxiety, compared with untreated controls. A randomized controlled trial with three parallel arms was completed in 1998 with 93 nursing students aged 19-49 years. The setting was a university college in the United Kingdom. The treatment group received eight weekly sessions of autogenic training, the attention control group received eight weekly sessions of laughter therapy and the time control group received no intervention. The outcome measures were the State-Trait Anxiety Inventory, the Maslach Burnout Inventory, blood pressure and pulse rate completed at baseline, 2 months (end of treatment) and 5, 8 and 11 months from randomization. Autogenic training has at least a short-term effect in alleviating stress in nursing students. In a multicentre trial coordinated by Maher-Loughnan, the effect of hypnosis on asthma symptoms was examined over the period of 1 year in 252 children and adults with moderate, persistent, or severe asthma.
Participants were randomised either to monthly hypnosis sessions and daily autohypnosis or to daily relaxation and breathing exercises (control group). Hypnosis significantly increased FEV\textsubscript{1} compared with baseline (p<0.05) but only by 4.3%. No significant change in FEV\textsubscript{1} occurred in the control group. The results from the daily wheeze and medication diaries for both groups showed an improvement but overall this was not significant.

### 2.2.2. STRESS

Granath, J., Ingvarsson, S., Von Thiele, U. and Lundberg, U (2006) in their study compared the psychological and physiological benefits of a Kundalini yoga program and a stress management program based on cognitive behavioral therapy principles. 33 employees at a large Swedish company were randomly assigned to one of the two programs. Each program included 10 sessions over 4 months. Participants in both groups showed significant improvements in both psychological and physiological outcomes. There was no significant difference between groups. The authors conclude that both “cognitive behaviour therapy and yoga are promising stress management techniques.”

Johnson, RL and Johnson, HC (1994), in their study examined 15 college students who reported having test-taking anxiety and were randomly assigned to an experimental or a control group. The experimental group received hypnotic training to reduce anxiety prior to taking a learning and reading-comprehension test. No significant difference was found between the experimental and the control group on the simple-recall task. However, on the reading-comprehension test, the experimental group scored significantly higher than the control group. Further examination of the total score revealed that the
experimental group difference was due to superior performance on the inference items. There was no difference between groups on items that required the recall of information from the passage. Findings support the notion that, hypnotic training may be useful to reduce anxiety and improve test performance.

Michalsen, A., Grossman, P., Acil, A., Langhorst, J., Esch, T., Stefano, G. B. and Dobos, G. J (2005) conducted a controlled prospective non-randomized trial. The participants were 24 self-referred women who identified themselves as having high levels of stress, but did not have a psychiatric diagnosis (i.e., clinical depression or anxiety disorder). 16 women participated in the intervention first, while the 8 remaining women served as a wait-list control. The yoga intervention consisted of two weekly 90-min Iyengar yoga classes with a certified and experienced Iyengar instructor. Participants were also encouraged to practice at home. Compared to the wait-list control group, the yoga group showed significant reductions in stress, anxiety, fatigue, depression, headaches and back pain. The yoga group showed significant increases in well-being.

Sagula, D. and Rice, K. G (1996) studied 39 individuals with chronic pain who attended eight weekly mindfulness sessions and practiced at home daily. Sessions and home practices included breath meditation, body awareness and gentle hatha yoga. 18 individuals with chronic pain served as a control group and did not participate in any sessions or home practice. Although there were no differences between these two groups at the beginning of the study, the meditation and yoga group reported significantly less depression and anxiety at the end of the eight weeks. Meditation and yoga may help individuals face and
come to terms with, the emotional and practical losses associated with chronic pain. Researchers concluded that mindfulness practices can be an important part of chronic pain treatment. These findings are consistent with other studies that have shown meditation and yoga to be helpful at reducing anxiety and depression. By showing us how to accept the present moment, mindfulness practices may reduce the psychological costs of any major loss.

Waelde, Thompson and Gallagher-Thompson. J Clin Psychol, (2004) in their study mentioned that the participants were 12 older female caregivers who were currently caring for a family member with dementia. Pre/post comparisons showed statistically significant reductions in depression and anxiety and improvements in perceived self-efficacy. The amount of time spent in weekly yoga-meditation practice was significantly associated with improvements in depression. The participants also reported subjective improvements in physical and emotional functioning. No control group was included, making comparison of the yoga-meditation program to other interventions impossible.

Zonierczyk-Zreda (2002) in his study examined the importance of helping an employee to better cope with occupational stress as the aim of stress management interventions is presented. It particularly concerns the employees who have the poorest temperamental and personality potential for effective coping and should be the target of primary stress intervention and prevention. According to evidence, Type A workers are at risk of occupational stress and disease, especially when some personality features of Type A are accompanied by high reactivity. The concept of pathological Type A is introduced. The
already existing programmes of modifying Type A and the framework of a programme based on the elements that have been established to be the most therapeutic for pathological Type A are presented.

Swami Vivekananda Yoga Research Foundation (2002) in their study, examined 35 male volunteers whose ages ranged from 20 to 46 years and were studied in two sessions of yoga-based guided relaxation and supine rest. Assessments of autonomic variables were made for 15 subjects, before, during and after the practices, whereas oxygen consumption and breath volume were recorded for 25 subjects before and after both types of relaxation. A significant decrease in oxygen consumption and increase in breath volume were recorded after guided relaxation (paired t test). There were comparable reductions in heart rate and skin conductance during both types of relaxation. During guided relaxation the power of the low frequency component of the heart-rate variability spectrum reduced, whereas the power of the high frequency component increased, suggesting reduced sympathetic activity. Also, subjects with a baseline ratio of LF/HF > 0.5 showed a significant decrease in the ratio after guided relaxation, while subjects with a ratio < or = 0.5 at baseline showed no such change. The results suggest that sympathetic activity decreased after guided relaxation based on yoga, depending on the baseline levels.

Majumdar (2000) examined 21 participants with chronic physical, psychological, or psychosomatic illness and were examined in a longitudinal pre test and post treatment design with a 3 months follow-up. These findings warrant controlled studies to evaluate the efficacy and cost effectiveness of mindfulness-based stress reduction as an intervention for chronic physical and psychosomatic disorders. These
are impressive results for a treatment which is probably unknown outside of the cognoscenti in the psychological world. Positive effects of autogenic training for such serious conditions such as hypertension, heart disease, asthma, Raynaud's disease and depression need to become more widely known in the clinical world, to provide patients with real choice in their treatment.

Farne M; Corallo A (1992) had investigated the autogenic training (AT) effects, analyzing the emotional and somatic distress symptoms of patients during their learning of the AT standard exercises (N = 79). An improvement was observed even before the beginning of the course, thus demonstrating the Balint effect of the drug-doctor phenomenon. The control subjects, entered in a waiting list, showed no further improvements from this phase of the study; the experimental ones, who had begun their AT exercises, continued to show significant improvement.

George. F (1997) designed a study to determine the effect of yogic breathing exercises (pranayama) on oxidatives stress. The study group consisted of 30 young male volunteers, trained for the purpose of this study and an equal number of controls were used. Blood studies were done to measure free radicals and superoxide dismutase levels before the study and at the end of the one month study. The free radicals were decreased significantly in the yoga study group and the SOD was increased insignificantly compared to the control group. The authors conclude that yogic breathing exercises not only help in relieving the stresses of life but also improve the antioxidant status of the individual.
2.3. BIOCHEMICAL VARIABLES

2.3.1. HEMOGLOBIN

Bernd Pelster and Warren W. Burggren (1996) in their study mentioned that "Embryonic hemoglobin circulated by the developing heart in the early vertebrate embryo is widely assumed (without substantiation) to perform the same vital role of O\textsubscript{2} carriage that it does in fetuses and adults. In order to challenge this assumption, we measured highly O\textsubscript{2} dependent physiological variables like O\textsubscript{2} consumption, cardiac performance and initial swim bladder filling in the presence and absence of functional hemoglobin in the embryos and early larvae of the zebra fish. Functional ablation of hemoglobin by carbon monoxide or phenylhydrazine did not reduce whole-animal O\textsubscript{2} consumption, which was \approx 85 to 90 \text{ \mu mol \cdot g}^{-1} \cdot \text{h}^{-1}. Similarly, no differences in heart variables like ventricular pressure development or heart rate, which increased from 135 to 175 bpm between stages 36h and 96h (indicating developmental stages 36 and 96 hours after fertilization, respectively), were observed in these experiments. Initial opening of the swim bladder was not influenced in the presence of co-occupied hemoglobin but was significantly impaired when the embryonic hemoglobin was chemically modified by incubation with phenylhydrazine. That aerobic process continues without hemoglobin O\textsubscript{2} transport indicates the adequacy in the embryo of simple O\textsubscript{2} diffusion alone even in developmental stages with extensive convective blood circulation generated by the heart."
2. 3. 2. LOW DENSITY LIPOPROTEIN (LDL) AND HIGH DENSITY LIPOPROTEIN (HDL)

Prasad. K. V., Sunita. M., Raju. P. S., Reddy. M. V., Sahay. B. K. and Murthy. K. J. Y (2006) in their study, examined 41 men and 23 women participating in a three months training programme for 30 days, the pranayama sequence was practiced. This combined pranayama and asana practice was continued for 60 days. Women and men showed different metabolic responses to the pranayama and asana practices. However, in general, the responses of both women and men were positive (improvements/reductions in risk factors for metabolic and cardiovascular diseases). Men showed reduced levels of serum triglycerides and VLDL-cholesterol at the end of the first 30 days (pranayama practice only) and increased levels of HDL-cholesterol and free fatty acids at the end of both the first 30 days (pranayama practice only) and at the end of the 3-month session. There was no change in LDL-cholesterol. Women showed reduced levels of serum free fatty acids at the end of both the first 30 days (pranayama only) and the 3-month session and also showed reduced levels of total cholesterol, triglycerides, LDL-cholesterol and VLDL-cholesterol by the end of the 3-month session. There were no changes in HDL-cholesterol.

Winter (1985) in his study mentioned that research findings on biochemical responsivity to meditation are reviewed. Although there are some contradictory and inconclusive outcomes, there is nevertheless sufficient evidence of interest to warrant further investigation of this area. However, in the meantime, there is no compelling basis to conclude that meditation practice is associated with special state or trait effects at the biochemical level. Biochemical markers examined included: blood lactate and blood flow; cortisol, testosterone, growth
hormone, thyroxine and triiodothyronine; plasma rennin, aldosterone and dopamine—betahydroxylase; catecholamines; serum cholesterol; plasma phenylalanine; neuro-transmitter metabolites; prolactin; salivary translucency, proteins, minerals and pH.

K. Shridharan, S. K. B. Patil, M. L. Kumaria, W. Selvamurthy, N. T. Joseph and H. S. Nayar. (1981) conducted a study on 10 healthy subjects [male soldiers; mean age 24.9 years] to evaluate the effect of yogic training on some autonomic responses and biochemical indices. Yogic training was administered daily in the morning hours for one hour under the supervision of qualified yoga. Physiological and biochemical responses were assessed before and after three months of training instructors. A significant decrease in heart rate, blood pressure and elevation of mean skin temperature and alpha index of EEG were recorded, followed by reduction in blood glucose and plasma cholesterol level. Changes in the dopamine-beta-hydroxylase (DBH) activity, monoamine oxidase (MAO) and adrenal steroids along with the physiological parameters indicated a shift in the autonomic balance towards relative rasympathodominance.

Vyas, Rashmi and Nirupama Dikshit. (2002) conducted a study that respiratory functions, cardiovascular parameters and lipid profile of those practicing Raja Yoga meditation were compared with those of nonmeditators. Vital capacity, tidal volume and breath holding were significantly higher in short and long term meditators than nonmeditators. Long term meditators has significantly higher vital capacity and expiratory pressure than short and long term meditators than nonmeditators. Long term meditators had significantly higher vital capacity and expiratory pressure than short term meditators. Diastolic
blood pressure was significantly lower in both short and long term meditators as compared to nonmeditators. Heart rate was significantly lower in long term meditators than in short term meditators and nonmeditators. Lipid profile showed a significant lowering of serum cholesterol in short and long term meditators as compared to nonmeditators. Lipid profile of short and long term meditators was better than the profile of nonmeditators inspite of similar physical activity. This shows that the Raja Yoga meditation provides significant improvements in respiratory functions, cardiovascular parameters and lipid profile.

Manchanda S. C., Narang R, Reddy K. S., Sachdeva U, Prabhakaran D, Dharmanand S, Rajani M, Bijlani R. (2000) in their study mentioned that prospective, randomized, controlled trial, on 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. 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 were less frequently required in the yoga group 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. 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.

Rajmohan, T and Rajesh, N (2002) in their study examined 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 to and following period of three months of yoga practices, biochemical parameters included, blood glucose, lipid profile, catecholmines, 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. Yoga can play an important role in risk modification for cardiovascular diseases in mild to moderate hypertension.

Lindberg, G., Larsson, G., Setterlind, S., Råstam, L., (1994) in their study investigated the link between serum cholesterol and suicide by investigating the relation between serum lipids and depressive symptoms. This was a cross sectional study of the relation between serum cholesterol, low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol and triglycerides on the one hand and depressive symptoms as expressed in a questionnaire on the other.
An organisational development programme was organized in industry with assistance from occupational health care. A total of 644 male and 261 female employees participated. Total cholesterol and LDL cholesterol values were lower in those men who, sometimes, often or very often, had experienced low mood or glumness during the past month compared with those who had not. Serum triglyceride concentrations did not differ between the groups. In women, however, the serum triglyceride value, but not the total cholesterol or LDL cholesterol, was lower in those who reported low mood, depression, or anxiety during the past six months. Decreasing appetite as a consequence of depression in men would probably lead to both decreasing cholesterol and triglyceride concentrations. Thus, these data indicate the presence of some other explanation for the relation between the level of LDL cholesterol and depressive symptoms in men.

2.3.3. BLOOD SUGAR

Turtz JS (1986) in his study analysed the effects of stress management training on stress level, death anxiety for persons with type II diabetes mellitus. This study examined the effects of stress management training on stress level, general anxiety, diabetic control, mental health and death anxiety for persons with Type II diabetes. This study also sought to determine the relationships among the dependent variables. The 21 subjects who completed the study were female Type II diabetics ranging in age from 51.94 years to 77.50 years. The subjects were randomly assigned to either the experimental group (n=10) or the waiting list control group (n=11). The treatment given to the members of the experimental group consisted of an 8-week stress management course. The findings indicated that the only dependent variable that
was significantly affected by the treatment was state anxiety. Although no significant increase in diabetic control was found, a trend toward lowered glycosylated hemoglobin values in the experimental group was observed. Significant correlations among the dependent variables at the time of pretesting occurred between stress level and general anxiety, stress level and diabetic control, state anxiety and diabetic control, frequency of hassles and mental health and general anxiety and mental health.

Malhotra, V., Singh, S., Tandon, O. P., & Sharma, S. B. Nepal (2005), in their study investigated the benefits of yoga asana for twenty participants with mild to moderate non-insulin dependent diabetes. All participants were on diet and medication for the control of diabetes. The study also compared the yoga group to a control group of 36 adults, also following a diet and medication plan to control diabetes, that practiced standard exercise guidelines for diabetes. Participants in the yoga group practiced yoga for 30-40 minutes every morning for 40 days. The Asana practice included: Surya Namaskar, Bhastrika Pranayama, Trikonasana, Tadasana, Sukhasana, Padmasana, Pashimottanasana, Ardhmatsyendrasana, Pawanmuktasana, Bhujangasana, Vajrasana, Dhanurasana and Savasana. Yoga participants showed the following changes after the 40-days program: reduced waist to hip ratio and a decrease in fasting blood glucose. There was also a marginally significant trend for reductions in postprandial blood glucose levels. Among obese participants; serum levels of insulin decreased. All of these changes are considered positive for the management of diabetes. The control group showed no positive changes in any of these measurements.
Malhotra, V., S. Singh, O. P. Tandon, S. V. Madhu, A. Prasad and S. B. Sharma. (2002), in their study examined twenty Type 2 diabetic subjects between the age of 30-60 years to see the effect of 40 days of Yoga asanas on the nerve conduction velocity. The duration of diabetes ranged from 0-10 years. Subjects suffering from cardiac, renal and proliferative retinal complications were excluded from the study. Yoga asanas included Suryanamskar, Tadasan, Konasan, Padmasan Pranayam, Paschimottansan, Ardhmatsyendrasan, Shavasan, Pavannmukthasan, Sarpasan and Shavasan. Subjects were called to the cardio-respiratory laboratory in the morning time and were given training by the Yoga expert. The Yoga exercises were performed for 30-40 minutes every day for 40 days in the above sequence. The subjects were prescribed certain medicines and diet. The basal blood glucose [and] nerve conduction velocity of the median nerve was measured and repeated after 40 days of [the] Yogic regimen. Another [control] group of 20 Type 2 diabetes subjects of comparable age and severity were kept on prescribed medication and light physical exercises like walking. Their basal & post 40 days parameters were recorded for comparison. Right hand and left hand median nerve conduction velocity increased from 52.81 +/- 1.1 m/sec to 53.87 +/- 1.1 m/sec and 52.46 +/- 1.0 to 54.75 +/- 1.1 m/sec respectively. Control group nerve function parameters deteriorated over the period of study, indicating that diabetes is a slowly progressive disease involving the nerves. Yoga asanas have a beneficial effect on glycemic control and improve nerve function in mild to moderate Type 2 diabetes with sub-clinical neuropathy.

Mercuri, N., E. M. Olivera, A. Souto and M. L. Guidi (2003), designed a study to evaluate the clinical and metabolic changes
observed immediately and 3 months after daily Yoga practices in a group of people with diabetes (DM). The study included sixteen women (3 with Type 1 DM, 12 with Type 2 DM and 1 with type 2 DM treated with insulin; mean age 61 ± 11 years; DM history 21 ± 14 years) attending the Physical Activity Program. Group Yoga practices consisted in asanas (postures), prânâyâma (breathing exercises), relaxation and meditation techniques performed twice a week (27 sessions in all), complemented by daily individual sessions practiced at home the remaining days of the week. Data recorded at the beginning and at the end of the study included personal information, clinical and metabolic characteristics, type of treatment and control and complications. Blood pressure (BP), heart rate (HR) and glycemia also were recorded at the beginning and end of 13 alternate sessions. Both attendance and compliance with the proposed schedule were high (> 80%), excepting 2 people who deserted but completed 50% of the study. There were no overall significant differences (beginning vs. end of the study) in BMI, HbA1, lipid profile, dietary plan, habitual physical activity practice, BP and treatment schedule. Conversely, there was a significant decrease in HR (8 sessions; p < 0.03) and glycemia (10 sessions; p < 0.03) immediately after the Yoga sessions. The immediate positive effect of Yoga practices on glycemia and HR suggests that such practices would be beneficial for the treatment of people with DM.

Malcolm I. Rose, Philip Firestone, Hans M. C. Heick and Arthur K. Faught (1995) in their study designed to determine whether diabetic control could be improved through the direct psychological management of stress and anxiety examined five poorly controlled female adolescent diabetics ranging in age from 15 to 18 years were used as subjects. All were seen on an outpatient basis over a 6-month
period. A single-subject format employing a multiple-baseline design across subjects was used. The independent variable used was a technique known as anxiety management training. Baseline, attention-control and treatment data were collected on a number of dependent measures. Subjective estimates of anxiety and tension by each subject were gathered on a bi-weekly basis using the Multifactorial Scale of Anxiety. Diabetic control was assessed daily using the Diastix method and weekly using the 24-hr quantitative glucose method. Data on the five subjects suggested that improved control of stress and anxiety had a positive effect on diabetic regulation. Lower and more stable urine glucose levels using both urine testing methods were found. However, no decreases in the subjects' personal assessment of tension and anxiety were evident.

Sahelian (2000) in his study examined that 20 type 2 diabetic subjects between the ages of 30-60 years. Their aim was to see whether Yoga asanas had any effect on nerve conduction. The Yoga asanas included Suryanamkar, Tadasana, Konasana, Padmasana, Pranayama, Shivasana, Pavanmukthasana, Sarvasana and Shavasana. The Yoga exercises were performed for 40 minutes every day for 40 days in the above sequence. The subjects continued their normally prescribed medicines and diet. Blood sugar and nerve conduction velocity of the median nerve (in the hand) were measured and repeated after 40 days of the Yogic regime. Another group of 20 type 2 diabetes subjects of comparable age and severity, called the control group, were kept on prescribed medication and light physical exercises like walking. Their initial & post 40 day’s parameters were recorded for comparison. At the end of the 40 days, those who did the yoga had improved the nerve impulse in their hands. The hand nerve conduction velocity increased
from 52.8 meters per second to 53.8 m/sec. The control group nerve function deteriorated over the period of study, indicating that diabetes is a slowly progressive disease involving the nerves. The authors conclude that Yoga asanas have a beneficial effect on blood sugar control and improve nerve function in type 2 diabetics who have mild nerve damage.

2.3.4. BLOOD UREA

Kim D. H., Moon Y. S., Kim H. S., Jung J. S., Park H. M., Suh H. W., Kim Y. H., & Song D. K. (2005) in their study mentioned that physiological risk factors for cardiovascular disease and other diseases, are related to nitric oxide activity and lipid peroxidation. Research suggests that nitric oxide is an important regulator of heart beat, blood flow and blood vessel constriction. Lipid peroxidation is a process associated with cellular damage in the body. Researchers compared 20 subjects who had practiced Zen Meditation at the Meditation Center in Seoul, South Korea, with a control group of 20 subjects who did not practice any formal stress management technique. Members of the meditation and control groups were matched according to age and sex, to reduce the impact of these variables on the comparison. The meditation group showed a significant higher level of nitric oxide production and a significantly reduced level of lipid peroxidation, compared to control group. These findings suggest that regular Zen meditators may be at reduced risk for certain diseases. However, this was not a randomized clinical trial, so researchers could not rule out other factors that may have accounted for the observed differences.

M. L. Gharote. (1990) in his study showed that twelve normal healthy male subjects showed decrease in blood urea, increase in
creatinine and tyrosine after one minute of Kapalabhati, a fast-breathing technique of Hatha Yoga. From biochemical point of view the practice of Kapalabhati seems to promote decarboxylation and oxidation mechanisms due to which quieting of respiratory centres is achieved, which is also the prerequisite for the practice of Pranayama, another important technique of Yoga.

2.4. SUMMARY

A study of relevant literature plays an important role to get a full picture of what has been done with regard to the problems under study. Such a review brings out a deep and clear perspective of the overall field. The literature in any field forms the foundation upon which all future work will be built.

The research scholar has attempted in this chapter to locate the literature related to this study. The relevant studies from various sources which the research scholar has come across are cited in this chapter. The purpose of the study was to find out the effect of the specific yogic exercises and combination of specific yogic exercises with autogenic training on the selected physiological, psychological and biochemical variables of the middle aged men.

The study conducted on physiological variables by Sri Vatsava, Niraj and study on psychological variables by Robert Edelberg and study done on biochemical variables by Rajmohan have provided early support for the study.