REVIEW OF RELATED LITERATURE

*****************************************************************************
CHAPTER – II

REVIEW OF RELATED LITERATURE

Literature survey comprises locating, reading and evaluating reports of research as well as reports of casual observation and opinion that are related to the individuals planned as research report. A study of relevant literature is an essential step to get a full picture of what has been done with regard to the problem under study. The investigator has made an attempt to bring a brief review of research related to the present study to form the background for the present study and presented the same with appropriate headings. In this section the studies related to effects of yogic exercise and physical exercise on variables related to the present study are presented.

2.0. Studies on Effect of Yoga and Physical Exercises on Psychological Aspects

Telles et al., (1993) conducted a study to find out the effect of yoga on steadiness of subjects on children aging 9 to 13 years. Subjects were assessed on a steadiness test, at the beginning and again at the end of a 10-day period during which one group received training in yoga, while the other group did not. The steadiness test required insertion of and holding for 15 sec. a metal stylus without touching the sides of holes of decreasing sizes in a metal plate. The contacts were counted as 'errors'. During the 10-day period, one group ('Yoga' group) received training in special physical postures (asana), voluntary regulation of breathing (pranayama), maintenance of silence, as well as visual focusing exercises (tratakas) and games to improve the attention span and memory. The other group (control) carried out their usual routine. After 10 days, the 'Yoga' group showed a significant improvement.
Oken et al., (2006) found that the yoga intervention produced significant improvements in physical measures as well as a number of quality-of-life measures related to sense of well-being and energy and fatigue compared controls.

Campbell et al., (2004) conducted a study on yoga as a preventative and treatment for symptoms of mental illness. With the dual aims of better understanding the contribution of yoga to positive mental health and exploring links between yogic philosophy and psychological theory, the yoga classes were designed for a six-week program incorporating breathing techniques (Pranayama), exercises for strength, vitality, and flexibility (asana), guided relaxation (yoga-indri), and meditation. At the end of the six weeks it was observed that the yoga beginners group showed lower average levels of symptoms of depression, anxiety, and stress than at commencement, but levels were stable for regular yoga practitioners and people who did not practice yoga.

Ray et al., (2001) conducted a study to observe any beneficial effect of yogic practices during training period on the young trainees. 54 trainees of 20-25 years age group were divided randomly in two groups i.e., yoga and control group. Yoga group (23 males and 5 females) was administered yogic practices for the first five months of the course while control group (21 males and 5 females) did not perform yogic exercises during this period. From the 6th to 10th month of training both the groups performed the yogic practices. Physiological parameters like heart-rate, blood pressure, oral temperature, skin temperature in resting condition, responses to maximal and sub maximal exercise, body flexibility were recorded. Psychological parameters like personality, learning, arithmetic and psychomotor ability, mental well being was also recorded. Various parameters were taken before and during the 5th and 10th month of training
period. Initially there was relatively higher sympathetic activity in both the groups due to the new work/training environment but gradually it subsided. Later on at the 5th and 10th month, yoga group had relatively lower sympathetic activity than the control group. There was improvement in performance at sub maximal level of exercise and in anaerobic threshold in the yoga group. Shoulder, hip, trunk and neck flexibility improved in the yoga group. There was improvement in various psychological parameters like reduction in anxiety and depression and a better mental function after yogic practices.

Malathi et al., (2000) conducted a study using forty eight healthy volunteers who participated in the practice of yoga over a period of 4 months, were assessed on the Subjective Well Being Inventory the SWBI, before and after the course in order to evaluate the effect of yoga on subjective feelings of well-being and quality of life. A significant improvement in 9 of the 11 factors of the SWBI was observed at the end of 4 months in these participants.

Udupa et al., (2002) in their study they planned to determine if shavasana could modulate the physiological response to stress induced by cold presser test (CPT) and the possible mechanisms involved. Ten normal adults were taught shavasana and practiced the same for a total duration of seven days. RR interval variation (RRIV), deep breathing difference (DBD), and heart-rate, blood pressure and rate-pressure-product (RPP) response to CPT were measured before and immediately after shavasana. Shavasana produced a significant increase in DBD and an appreciable but statistically insignificant increase in RRIV suggesting an enhanced parasympathetic activity. Significant blunting of cold pressorinduced increase in heart rate, blood pressure and RPP by shavasana was seen during and even five minutes after CPT suggesting that Shavian reduces the
load on the heart by blunting the sympathetic response. It is concluded that shavasana can enhance one’s ability to withstand stress induced by CPT and this ability can be achieved even with seven days of Shavian training.

King et al., (1997) reviewed the psychological roots of classical yoga and the application of yoga-based therapy techniques to clinical populations. Yoga therapy is differentiated from both insight-mindfulness methods and cognitively based dialectical behavior therapy. Based on effectiveness studies on biological correlates of yoga meditation. They then describe a model yoga treatment group in a partial hospitalization program and propose that a yoga-based therapy group may be helpful in developing coping skills for reducing anxiety and anger in a largely personality-disordered population in an ambulatory setting.

Samraj (1991) conducted a study on the effect of practice of asana alone and a combination of Asanas, Pranayama and Meditation on anxiety and aggression. In this study ninety school boys were selected at random by lots. Subjects were tested on anxiety and aggression before and after ten weeks of yogic training. From the results, he observed that anxiety level was significantly reduced but there was no significant decrease in aggression after practicing yoga.

Cummings and Vincent Thomson (1984) conducted a study to evaluate the effectiveness of six weeks endurance training, progressive relaxation-meditation and their combinations of changing stress levels as reflected by change in heart-rate, state anxiety levels, urinary catecholamine’s at rest and after twenty minutes of examination stress. The effects of the treatment on trait anxiety levels and resting systolic and diastolic blood pressure were also determined. Thirty seven healthy female subjects were randomly assigned to one of four treatment groups success control and specific training, exercise (20 min/day, 3 days/week at 75%
of age related max heart rate, meditation 20min/day,3days/4week). A combination of exercise and meditation. The result showed that trait any that resting systolic pressure and stress heart rate were significantly reduced in the exercise, among the meditation combination groups. The groups trained in progressive relaxation meditation the meditation and showed a greater effect on heart rate and blood pressure than the exercise group. The exercise group on the other hand had its greater effect on trait anxiety scores and urinary catecholamine concentrations.

Norton et al., (1983) investigated the effectiveness of two different relaxation procedures [progressive relaxation training and Agni-Yoga] was compared in treating snake anxious people who expressed anxiety primarily in a somatic or a cognitive manner. The results provided tentative evidence that the two relaxation procedures produced differential effects according to whether subjects expressed anxiety somatically or cognitively.

Karwande (1981) made a study on the comparative effect of yogic and physical exercises on anxiety level and mental fatigue of children. This study was carried with sixty male students from VII and VIII standards. The average age of the subjects was 12 years. The test of anxiety level and the test of mental fatigue were taken as criteria measures for the purpose of the study. The tests were taken before and after the experimental period of six weeks. He concluded that anxiety level can be reduced either by training in selected asana or related physical exercises. Mental fatigue can be reduced either by training in selected asana or in related physical exercise and the training in selected asana was superior to the training in physical exercise for both variables though the difference was not statistically significant.

Kocher (1973) made a study on yoga practices as a variable in neuroticism, anxiety and hostility. He concluded that significant
reduction in total neuroticism, anxiety level and general hostility were observed in twenty subjects of experimental group in comparison with seventeen subjects of control group after eight months of training programme in yoga.

*Gharote (1971)* concluded that yogic training tends to contribute to calmness of mind and stability of emotional behavior. He further stated that the effect of training was retained at least for an another period of two months even when the practices were discontinued. It led to the assumption that a continued practice of yogic exercise may contribute to established pattern of emotional stability.

### 2.1. Studies on Yoga and Psychomotor

*Michalsen et al., (2005)* conducted a study on twenty-four self-referred female subjects who perceived themselves as emotionally distressed. Subjects were made to participate in one of two 3-month yoga programs. Group 1 participated in the first class and group 2 served as a waiting list control. During the yoga course, subjects attended two-week 90-min yoga classes. Outcome was assessed on entry and after three months by Cohen Perceived Stress Scale, State-Trait Anxiety Inventory, Profile of Mood States, CESD-Depression Scale, Bf-S/Bf-S' Well-Being Scales, Freiburg Complaint List and ratings of physical well-being. Salivary cortical levels were measured before and after an evening yoga class in a second sample. Compared to waiting-list, women who participated in the yoga-training demonstrated significant improvements in perceived stress, State and Trait Anxiety, well-being, vigor, fatigue and depression. Physical well-being also increased, and those subjects suffering from headache or back pain reported marked pain relief. Salivary cortical decreased significantly after participation in a yoga class.
Clay et al., (2005) made a study 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 (i.e., postures). Subjects followed identical videotaped sequences of hatha yoga asana. Mean physiological responses were compared to the physiological responses of resting in a chair and walking on a treadmill at 93.86 m.min⁻¹ [3.5 miles per hour (mph)]. During the 30-minute hatha yoga routine, mean absolute oxygen consumption (VO₂), relative (VO₂), percentage maximal oxygen consumption (%VO₂R), metabolic equivalents (METs), energy expenditure, are studied. He observed that 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.

According to Khalsa (2004), yoga is a clinical intervention for psychological conditions that improves mental health and stress tolerance. Accordingly, a large number of research studies on yoga and meditation practice have documented the improvements possible in mood, cognitive function and mental well-being in normal healthy individuals. The last century has seen the recent evolution of what has come to be known as “yoga therapy”, the use of yoga as a clinical treatment for a variety of disorders. It is perhaps not surprising that mental and emotional disorders are among the conditions most amenable to yoga treatment. A recent review of the research literature in this area has revealed the strong proportion of this work documenting the effectiveness of yoga and meditation in the treatment of psychological conditions and psychiatric disorders such as depression, anxiety, and addictive and criminal behaviors. There has also been significant research effort recently in elucidating the basic
psychophysiology of the mind-body connection. This has provided a scientific basis for understanding the observed effectiveness of: 1) meditative yogic techniques in treating conditions which on the surface appear to be strictly physically-based such as diabetes and asthma, and: 2) physically-based yoga techniques in treating conditions which appear to be strictly mentally-based such as depression and anxiety. Research in our laboratory has been evaluating the effectiveness of yoga and meditation in the treatment of insomnia, which represents an ideal example of a disorder with both psychological and physiological contributing factors.

Woolery et al., (2004) examined the effects of a short-term Iyengar yoga course on mood among mildly depressed young adults. Young adults pre-screened for mild levels of depression were randomly assigned to a yoga course or wait-list control group, of eighteen to twenty-nine volunteers aged 18 to 29, At intake, all participants were experiencing mild levels of depression, but had received no current psychiatric diagnoses or treatments. None had significant yoga experience. Subjects in the yoga group attended two one-hour Iyengar yoga classes each week for five consecutive weeks. The classes emphasized yoga postures that were thought to alleviate depression, particularly back bends, standing poses, and inversions. Subjects who participated in the yoga course demonstrated significant decrease in self-reported symptoms of depression and trait anxiety. These effects emerged by the middle of the yoga course and were maintained by the end. Changes also were observed in acute mood, with subjects reporting decreased levels of negative mood and fatigue following yoga classes. Finally, there was a trend for higher morning cortical levels in the yoga group by the end of the yoga course, compared to controls. These findings provide suggestive evidence of the utility of yoga asanas in improving mood and support the need for future studies with larger samples and more
complex study designs to fully evaluate the effects of yoga on mood disturbances.

*Bhavanani (2003)* reported that reaction time (RT) is an index of the processing ability of [the] central nervous system and a simple means of determining sensory-motor performance. It has been reported that yoga training improves human performance including central neural processing. Earlier studies from our laboratories have shown that yoga training produces a significant decrease in visual reaction time (VRT) and auditory reaction time (ART). With this respective they had planned to determine if much bhastrika (a yogic technique in which breath is actively blasted out in “whooshes” following a deep inspiration) has any effect on central neural processing by studying its effect on RT. Twenty-two healthy schoolboys who were practicing yoga for the past three months were recruited for the present study. VRT and ART were recorded before and after nine rounds of much bhastrika Mukh. Bhastrika produced a significant (P<0.01) decrease in VRT as well as ART. A decrease in RT indicates an improved sensory-motor performance and enhanced processing ability of central nervous system. This may be due to greater arousal, faster rate of information processing, improved concentration and/or an ability to ignore extraneous stimuli. This is of applied value in situations requiring faster reactivity such as sports, machine operation, race driving and specialized surgery. It may also be of value to train mentally retarded children and older sports persons who have prolonged RT.

*Telles (2001)* investigated the effects of yogic exercise and physical training on complex tasks. Twenty girls between ten and thirteen years of age, studying at a residential school were randomly assigned to two groups. One group practiced yoga for one hour fifteen minutes per day, 7 days a week, while the other group was given physical training for the same time.
Time for planning and for execution and the number of moves required to complete the Tower of London task were assessed for both groups at the beginning and end of a month. These three assessments were separately tested in increasingly complex tasks requiring 2-moves, 4-moves and 5-moves. The pre-post data were compared using the Wilcoxon signed ranks test. The yoga group showed a significant reduction in planning time for both 2-moves and 4-moves tasks (53.9 and 59.1 percent respectively), execution time in both 4-moves and 5-moves tasks (63.7 and 60.3 percent respectively), and in the number of moves in the 4-moves tasks (20.9 percent). The physical training group showed no change. Hence yoga training for a month reduced the planning and execution time in simple (2-moves) as well as complex tasks (4, 5-moves) and facilitated reaching the target with a smaller number of moves in a complex task (4-moves).

_Telles et al., (2000)_ studied the performance on a maze learning task in thirty-one adults before and after thirty days of yoga training and in a control group of subjects who did not receive yoga training. Subjects were blind-folded and used the dominant hand to trace a path in a wooden pencil maze. At each assessment, subjects were given five trials, without a gap between them. Performance was based on the time taken to complete the maze and the number of blind alleys taken. The time and error scores of Trial 1 were significantly less after yoga. Hence the yoga group showed improved performance in maze tracing at a retest thirty days later.

_Wood (1993)_ investigated the effects of relaxation, visualization and yogic breathing and stretch on perceptions of physical and mental energy and on positive and negative mood states in a group of seventy-one normal volunteers. Stretching produced a significantly greater increase in perceptions of mental and physical energy and feelings of alertness and
enthusiasm than the other two procedures. Relaxation made subjects significantly more sleepy and sluggish immediately after the session than stretching. Visualization made them more sluggish but less content than stretching and more upset than relaxation after the second session. Various studies reported by Kocher et al., (1973) showed favorable results of short term yogic training on mental health. Psycho physiological conditioning due to effects of short term yogic training programme on the working of the autonomic nervous system, using a sophisticated and elaborate battery of Wenger's Autonomic Balance, brought evidence about the utility of Yogic exercises toward improvement of emotional stability. Gharote (1971).

2.2. Studies on Yoga and Physiology

Madanmohan et al., (2004) reported that the effects of yoga training on cardiovascular response to exercise and the time course of recovery after the exercise. Cardiovascular response to exercise was determined by the Harvard step test using a platform of 45 cm height. The subjects were asked to step up and down the platform at a rate of 30/min for a total duration of five minutes or until they fatigued. Heart rate (HR) and blood pressure response to exercise were measured in the supine position before exercise and at 1, 2, 3, 4, 5, 7 and 10 minutes after the exercise. Exercise produced a significant increase in HR, systolic pressure and a significant decrease in diastolic pressure. After two months of yoga training, exercise-induced changes in these parameters were significantly reduced.

Telles et al., (2004) conducted a study to determine whether yoga reduced heart rate and whether the reduction would be more after thirty days of yoga training. Two groups (yoga and control, n = 12 each) were assessed on Day 1 and on Day 30. During the intervening 30 days, the yoga group received training in yoga techniques while the control group carried
on with their routine. At each assessment the baseline heart rate was recorded for a minute. This was followed by a six-minute period during which participants were asked to attempt to voluntarily reduce their heart rate, using any strategy. Both the baseline heart rate and the lowest heart rate achieved voluntarily during the six-minute period were significantly lower in the yoga group on the Day thirty compared to the Day one by a group average of 10.7 beats per minute (i.e., bpm) and 6.8 bpm, respectively. Contrast, there was no significant change in either the baseline heart-rate or the lowest heart-rate achieved voluntarily in the control group on the Day thirty compared to Day 1.

Carroll et al., (2003) carried out a study to quantify the hemodynamic and metabolic demand of Ashtanga Vinyasa Yoga (aka power yoga), and compared the heart rate/oxygen consumption relationship of yoga to a maximal treadmill GXT, thirteen yoga practitioners (aged 36.7 ± 6.5 yrs, body mass of 62.1±13.2 kg, height of 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. Methods: Open circuit spirometer was continuously employed during both a maximal Bruce protocol GXT and while subjects mimicked a fifteen-minute video displayed yoga sequence. The video included six yoga positions repeated in several sequences with verbal cueing. All participants were familiarized with the yoga sequence prior to testing. Results: The following mean data were obtained during the yoga trial: VO2: 23.4±2.2mL/kg-min (~50% max VO2), HR: 143±14 b/min (~77% max HR), Lactate: 4.16±1.3 mMol/L, RER: .89±.04, caloric expenditure 7.15±1.3 kcal/min. The correlation of HR versus VO2 was r=.90 and r=.05 for the Bruce protocol and yoga, respectively. Conclusion: 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 Vinnitsa 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 Vinnitsa Yoga is similar to the moderate exercise intensity required by aerobic dance and walking.

Bowman et al., (1997) investigated the effects of aerobic exercise training and yoga, a non-aerobic control intervention, on the bar reflex of elderly persons. Bar reflex sensitivity was quantified by the alpha-index, at high frequency (reflecting parasympathetic activity) and mid-frequency (reflecting sympathetic activity as well), derived from spectral and cross-spectral analysis of spontaneous fluctuations in heart rate and blood pressure. Twenty-six sedentary, healthy, normotensive elderly subjects were studied. Fourteen of the sedentary elderly subjects completed six weeks of aerobic training, while the other twelve subjects completed six weeks of yoga. The results showed that heart-rate decreased following yoga but not aerobic training. VO2 max increased by 11% following yoga and by 24% following aerobic training. No significant change in alpha MF or alpha HF occurred after aerobic training. Following yoga, alpha HF but not alpha MF increased.

Kuna et al., (1991) studied cardiovascular and respiratory changes during yogic breathing exercise kapalabhati (KB) in seventeen advanced yoga practitioners. The exercise consisted in fast shallow abdominal respiratory movements at about two Hertz frequency. Blood pressure, ECG and respiration were recorded continuously during three 5 min periods of KB and during pre- and post-KB resting periods. The beat-to-beat series of systolic blood pressure (SBP) and diastolic blood pressure (DBP), R-R intervals and respiration were analyzed by spectral analysis of time series.
The mean absolute power was calculated in three frequency bands—band of spontaneous respiration, band of 0.1 Hz rhythm and the low-frequency band greater than 15 s in all spectra. The mean modulus calculated between SBP and R-R intervals was used as a parameter of bar receptor-cardiac reflex sensitivity (BRS). Heart rate increased by 9 beats per min during KB. SBP and DBP increased during KB by 15 and 6 mmHg respectively. All frequency bands of R-R interval variability were reduced in KB. Also the BRS parameter was reduced in KB. The amplitude of the high-frequency oscillations in SBP and DBP increased during KB. The low-frequency blood pressure oscillations were increased after KB. The results point to decreased cardiac vigil tone during KB which was due to changes in respiratory pattern and due to decreased sensitivity of arterial bar reflex. Decreased respiratory rate and increased SBP and low-frequency blood pressure oscillations after KB suggest a differentiated pattern of vegetative activation and inhibition associated with KB exercise.

*Rai et al., (1983)* conducted a study on trained (n=7) and untrained (n=7) volunteers to determine the effect of savitri pranayama and savasana on O₂ consumption, heart rate and blood pressure. In trained subjects they found a consistent and significant (p<0.01) reduction in O₂ consumption within a few minutes of starting savitri pranayama. During shavasana, there was significant reduction in O₂ consumption (p<0.05), heart rate in above mentioned parameters were statistically insignificant.

*Shridharan et al., (1981)* carried out a study on ten healthy subjects to evaluate the effect of yogic training on some autonomic responses and biochemical indices. Physiological and biochemical responses were assessed before and after the three month training. 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-hydroxyls (DBH) activity, monoamine oxidizes (MAO), and adrenal steroids along with the physiological parameters indicated a shift in the autonomic balance towards relative parasympathodominance. Udupa (1975) observed that average systolic blood pressure decreased after three months of Hatha yoga practice but returned to the pre-experiment value after six months. The average changes involved were small.

Gopal (1973) found a mean heart rate of about 71 beats per minute for a group which had been trained in yoga for six months and for a group which regularly engaged in long walks and light games. Afterwards both group did twenty jumps and sit ups. The yoga group's mean heart rate increased to 100 and 7 less than that of the light exercises group. A group with at least six weeks of certain Hatha Yoga practices followed strenuous exercises with one minute sitting and then three minutes of either sitting, mild exercises or Shavasan a (Corpse Posture) relaxation. Just after the exercises, heart rate averaged over 180 and after one minute of sitting it had dropped to about 130. After three more minutes of sitting, it had dropped 17 more beats per minute, a lesser drop than that following 3 minutes of Shavasan relaxation. This suggests that Shavasan relaxation facilitates pulse declaration following exercises.

Griffin (1968) made a study of the heart rates of women in the field-hockey and basketball. He concluded that the playing of field hockey was more demanding in terms of heart-rates of the subjects participating than in the playing of basketball. Significant changes occur in the dynamics of the cardiovascular, cardio respiratory and blood tissue systems due to physical training. Training increased physical working capacity and decreased heart-rate, blood pressure and work of the heart at
rest, although women seem to profit in a similar manner as a result of training.

2.3. Studies on Effect of Yogic and Physical Exercises on Psycho-Physiology

*Harinath et al., (2004)* evaluated effects of Hatha yoga and Omkar meditation on cardio respiratory performance, psychologic profile, and melatonin secretion. Thirty healthy men in the age group of 25-35 years volunteered for the study. They were randomly divided in two groups of fifteen each. Group one subjects served as controls and performed body flexibility exercises for forty minutes and slow running for twenty minutes during morning hours and played games for sixty minutes during evening hours for three months. Group two subjects practiced selected yogic asanas (postures) for forty-five minutes and Pranayama for fifteen minutes during the morning, whereas during the evening hours these subjects performed preparatory yogic postures for fifteen minutes, Pranayama for fifteen minutes, and meditation for thirty minutes, for three months. Orthostatic tolerance, heart rate, blood pressure, respiratory rate, dynamic lung function (such as forced vital capacity, forced expiratory volume in a 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. Yogic practices for 3 months resulted in an improvement in cardio respiratory 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, in turn, might be responsible for improved sense.
Christopher et al., (2000) made a study a. to determine the physical, physiological and psychological effects of practicing Iyengar Yoga. b. To determine the reason and motivation of practitioners to continue yoga practice. c. To evaluate perception of “stress” and coping mechanisms amongst Iyengar Yoga practitioners. d. To compare the personality characteristics of Iyengar Yoga Practitioners with the “normal” adults who did not practice Iyengar Yoga. Significant benefits were seen with reference to the respiratory, genitourinary, circulatory and digestive systems. There was a very significant improvement with relation to emotional disorders especially those pertaining to mood disorders and substance abuse. As for reasons and motivation to continue yoga practice is concerned although a majority of practitioners started their yoga practice to seek physical benefit it is the psychological benefits especially mental control and stress/tension control which now motivates them to continue their practice. Perception of Stress and Coping Mechanisms: The awareness of stress among yoga practitioners was similar to that of a normal population. Coping methods, however, were more active and varied than a typical person. The management of stress by those practicing yoga was characterized by heightened self-control, using difficulties as a means to enhance personal growth and the ability to detach oneself from tension and anxiety. The results of the study also revealed that those who adopted a playful and optimistic approach to problem solving, significantly reduced perceived stress. Interestingly, those primarily involved in the teaching of yoga had the lowest perceived stress.

Baldwin (1999) explored the psychological and physiological differences between adult exercisers who added a weekly yoga class to their regular exercise program and those who did not. Subjects were pre tested
and post tested for mood state, stress response, recovery heart rate, and spinal/hamstring flexibility. Over a period of eight weeks, subjects in both groups continued their normal exercise habits and maintained exercise logs. Subjects in the Yoga Group added a weekly yoga class. Subjects in the control group received a yoga class at a later time. At the end of eight weeks, exercise logs were collected and post tests were conducted. The results suggested more positive mood change in the yoga group over eight weeks, more immediate positive affect from yoga than from cardiovascular or resistance training activities, more compliance with yoga than with cardiovascular or resistance training activities, comparable perceived exertion ratings for 'moderate' hatha Yoga and routine aerobic exercise an 8% gain in spinal and hamstring flexibility in the yoga group over eight weeks, and decreased vulnerability to stress in the Yoga Group, at the same time sources of stress for that group increased.

Sengupta and Banerjee (1994) measured body flexibility, resting heart-rate at rest and blood pressure, physical fitness index by Harvard step test, state and trait anxiety, and performance on digit symbol substitution test before and after six weeks of supervised training in two groups of male healthy volunteers. The yoga group (n = 60) performed one hour yogic exercise scheduled for five days a week and the other group (n = 35) played volley-ball during the same period. The pre-training scores of Harvard step test indicated a physically active sample population. Pre and post training assessments indicated significant reduction in heart-rate at rest and blood pressure, significant improvements in trunk flexion ability and performance in digit symbol substitution score in the yoga group. The volley-ball group showed significant improvement in all four measures of body flexibility. The Harvard step test score of physical fitness remained unchanged in both the groups. The observed altered autonomic balance towards parasympathetic dominance in the yoga group is considered useful in
relation to tolerance to certain stresses of military significance. Yoga; Exercise/PH; Stress, Psychological; Psychophysiology; Human; Male; Adolescence

References: were recorded.

Schell et al., (1994) measured heart-rate, blood pressure, and the hormones cortial, prolactin and growth hormone of yoga group and a control group of young female volunteers reading by being in a comfortable position during the experimental period. The yoga group had decreased heart-rate during the yoga exercises. The yoga group had higher scores in life satisfaction and lower scores in excitability, aggressiveness, openness, emotionality and somatic complaints and coping with stress and mood by the end of the experiment. The yoga group also had higher scores in high spirits and extroversion.

Satyanarayana et al., (1992) examined the effect of Santhi Kriya, on certain psycho-physiological parameters. Eight healthy male volunteers of the age group of 25.9 +/- 3 (SD) years were subjected to Santhi Kriya practice daily for fifty minutes for thirty days. The volunteers’ body weight, blood pressure, oral temperature, pulse rate, respiration, ECG and EEG were recorded before and after the practice on the first day and subsequently the tenth, twentieth and thirtieth days of their practice. They were also given a perceptual acuity test to know their cognitive level on the first day and also at the end of the study i.e., on the thirtieth day. Results indicate a gradual and significant decrease in the body weight from first to the thirtieth day (P less than 0.001) and an increase in alpha activity of the brain (P less than 0.001) during the course of thirty days of Santhi Kriya practice. An Increase in alpha activity both in occipital and pre-frontal areas of both the hemispheres practice increases oral temperature by three degrees Farenheit 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 thirty days reduces body weight and increases calmness.

*Arambula et al., (2001)* explored the physiological correlates of a highly practiced Kundalini Yoga meditator. Thoracic and abdominal breathing patterns, heart-rate (HR), occipital parietal electroencephalograph (EEG), skin conductance level (SCL), and blood volume pulse (BVP) were monitored during pre-baseline, meditation, and post baseline 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 post baseline to a mean of 5 breaths/min during the meditation, with a predominance of abdominal/diaphragmatic breathing.

*Aslan and Livanelioglu (2002)* carried out a study with the aim of investigating whether Hatha Yoga (HY) training affects aerobic and anaerobic power in healthy young adults. Results: Aerobic and anaerobic power increased by 9.8%, 5.5% following HY and by 6.6%, 2.3% following aerobic training respectively. A significant increase was found in aerobic power and anaerobic power (p < 0.001) in HYG. There was a significant increase in aerobic power (p < 0.01) in AEG, while anaerobic power of subjects in AEG were consistently higher compared to that of before training, statistically the difference was not significant (p > 0.05). Although there was no substantial differences between the groups concerning cardiovascular endurance (p > 0.05), anaerobic power was significantly higher (p < 0.05) in the HYG. The results of this study suggest that HY training has positive effects on cardiovascular aerobic and anaerobic power. Therefore HY could be an exercise option for enhancing aerobic and anaerobic power in young adults.
Barnes et al., (2001) examined the impact of the Transcendental Meditation (TM) program on cardiovascular (CV) reactivity in adolescents with high normal BP. Thirty-five adolescents [34 African Americans (AAs), 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 fifteen minute meditation twice each day for two 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 decrease in resting SBP (P<.03) from pre- to post intervention, compared to the CTL group. The TM group exhibited greater decrease 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.

Frank et al., (1988) studied autonomic responses. To breath holding were studied in twenty healthy young men. Breath was held at different phases of respiration and parameters were recorded of Breath holding time, heart-rate, systolic and diastolic blood pressure and galvanic skin resistance (GSR). After taking initial recordings all the subjects practiced Nadi-Shodhana Pranayama for a period of four weeks. At the end of four week period, same parameters were again recorded and the results compared. Baseline heart-rate and blood pressure (systolic and diastolic) 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.

Bhaskaracharyulu et al., (2003) Reaction time (RT) is an index of the processing ability of [the] central nervous system and a simple means of determining sensory-motor performance. It has been reported that yoga training improves human performance including central neural processing. Earlier studies from our laboratories have shown that yoga training produces a significant decrease in visual reaction time (VRT) and auditory reaction time (ART). The present work was planned to determine if mukh bhasrika (a yogic technique in which breath is actively blasted out in “whooshes” following a deep inspiration) has any effect on central neural processing by studying its effect on RT. Twenty-two healthy schoolboys who were practicing yoga for the past three months were recruited for the present study. VRT and ART were recorded before and after nine rounds of mukh bhasrika. Mukh bhasrika produced a significant (P<0.01) decrease in VRT as well as ART. A decrease in RT indicates an improved sensory-motor performance and enhanced processing ability of central nervous system. This may be due to greater arousal, faster rate of information processing, improved concentration and/or an ability to ignore extraneous stimuli. This is of applied value in situations requiring faster reactivity such as sports, machine operation, race driving and specialized surgery. It may also be of value to train mentally retarded children and older sports persons who have prolonged RT.

Birkel and Edgren (2000) conducted a study to determine the effects of yoga postures and breathing exercises on vital capacity. Using the Spiropet spirometer, researchers measured vital capacity. Vital capacity
determinants were taken at the beginning and at the end of two seventeen-week semesters. No control group was used but the Midwestern university yoga classes were taken for college credit. A total of two hundred and eighty seven college students, eighty nine men and one hundred and ninety-eight women. Subjects were taught yoga poses, breathing techniques, and relaxation in two fifty-minute class meetings for fifteen weeks. Vital capacity over time for smokers, asthmatics, and those with no known lung disease. The study showed a statistically significant (P < .001) improvement in vital capacity across all categories over time. 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 two hundred and eighty-seven 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.

Czamara and Joli Michole (2002) carried out a study to determine whether a ten-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 sixteen volunteers was used from a community-based yoga center. A quasi-experimental, one-group within subject control, pre test-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 is 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 self perception of mental well-being of community-dwelling adults (mean age = 46.81) who are novice yoga practitioners.

**Jella and Shannahoff-Khalsa (1992)** studied the effects of thirty minutes of unilateral forced nostril breathing on cognitive performance in fifty-one right-handed undergraduate psychology students (25 males and 26 females). A verbal analogies task modeled after the Miller Analogies and SAT Tests was used as a test of left-hemispheric performance and mental rotation tasks based on the Vandenburg and Kruse adaptation of Shepard and Metzler's tests were used as spatial tasks for testing right-hemispheric performance. Spatial task performance was significantly enhanced during left nostril breathing in both males and females, p = .028. Verbal task performance was greater during right nostril breathing, but not significant p = .14. These results are discussed in comparison to other cognitive and physiological studies using unilateral forced nostril breathing. This yogic breathing technique may have been a useful application in treating psycho physiological disorders with hemispheric imbalances and disorders with autonomic abnormalities.

**Konar et al., (2000)** reported that the results of the first systematic investigation on SVGN employing echocardiography analysis in eight healthy male subjects before and after a practice of this asana twice daily for two weeks. The heart-rate (HR) at rest and left ventricular end diastolic volumes (LVEDV) were significantly reduced (P < 0.02, P < 0.01 respectively) after practicing this asana. A tendency toward a mild regression of the left ventricular mass was noticed, though it was not statistically significant. The CV responses to acute 45 degrees head-down tilt (HDT) in a tilt table was not altered after practicing this asana. Also there was no orthostatic intolerance during the 3-5 min period of 70 degrees head-up tilt (HUT). These results strongly indicate that further studies of
this asana performed for a longer period is most likely to yield very significant observations of applied value.

Madanmohan et al., (1993) studied the effect of yoga training on visual and auditory reaction times (RTs), maximum expiratory pressure (MEP), maximum inspiratory pressure (MIP), 40 mmHg test, breath holding time after expiration (BHTexp), breath holding time after inspiration (BHTinsp), and hand grip seventy-nine strength (HGS). Twenty seven student volunteers were given yoga training for twelve weeks. There was a significant (P < 0.001) decrease in visual RT (from 270.0 +/- 6.20 (SE) to 224.81 +/- 5.76 ms) as well as auditory RT (from 194.18 +/- 6.00 to 157.33 +/- 4.85 ms). MEP increased from 92.61 +/- 9.04 to 126.46 +/- 10.75 mmHg, while MIP increased from 72.23 +/- 6.45 to 90.92 +/- 6.03 mmHg, both these changes being statistically significant (P < 0.05). 40 mmHg test and HGS increased significantly (P < 0.001) from 36.57 +/- 2.04 to 53.36 +/- 3.95 s and 13.78 +/- 0.58 to 16.67 +/- 0.49 kg respectively. BHTexp increased from 32.15 +/- 1.41 to 44.53 +/- 3.78 s (P < 0.01) and BHTinsp increased from 63.69 +/- 5.38 to 89.07 +/- 9.61 s (P < 0.05). Our results show that yoga practice for twelve weeks results in significant reduction in visual and auditory RTs and significant increase in respiratory pressures, breath holding times and HGS.

Bhavanani et al., (2002) carried out a study to test whether head direction has any effect on heart rate (HR) and blood pressure during supine rest. Forty-three normal healthy school children were recruited and their recordings were taken after five minutes of supine rest. The subjects were randomly assigned to lie with their head towards north, east, south and west directions on four different days. HR and blood pressure were recorded at the end of the fifth minute of supine rest. HR was lowest in north and highest in south, the difference being statistically significant by students’
paired “t” test. Systolic pressure was lowest in the north and significantly higher in the west. Lying supine with head towards north had the lowest rate-pressure-product as compared to the west. Their study demonstrates that lying supine with head in different directions has a definite effect on the HR and blood pressure. Further studies in different age groups and in hypertensive patients may help in understanding the mechanisms and implications of this phenomenon.

According to Raub (2002) yoga has become increasingly popular in Western cultures as a means of exercise and fitness training. However, it is still depicted as trendy as evidenced by an April 2001 Time magazine cover story on “The Power of Yoga.” There is a need to have yoga better recognized by the health care community as a complement to conventional medical care. Over the last 10 years, a growing number of research studies have shown that the practice of Hatha Yoga can improve strength and flexibility, and may help control such physiological variables as blood pressure, respiration and heart rate, and metabolic rate to improve overall exercise capacity. This review presents a summary of medically substantiated information about the health benefits of yoga for healthy people and for people compromised by musculoskeletal and cardio pulmonary disease.

According to Schell et al., (1994) 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. They 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 got 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 got significant[ly] higher scores in high spirits and extrovertedness.

Schmidt et al, (2004) studied the effect of a six-week yoga training and meditation program on endothelial function. “Stretching may do more than make you limber”, according to new research from Yale University School of Medicine. Findings show that people who practice yoga and meditation at least three times a week may reduce their blood pressure, pulse and—most importantly—their risk of heart disease. “Moreover, yoga improves heart health in both healthy individuals and those with diagnosed heart disease”, says Satish Sivasankaran, who conducted the study while training at Yale. He says that volunteers taking a six-week yoga-meditation program improved blood vessel function by 17%. A blood vessel function, also called endothelial function, is the way vessels contract and expand to aid blood flow and is a measure of healthy vessel function. However, the participants, who had heart diseases, had close to a 70% improvement in endothelial function. “Stress is known to increase the risk of coronary events”.

Smith et al, (2000), taken the study to evaluate a statement in ancient yoga texts, suggest that a combination of both “calming” and “stimulating” measures may be especially helpful in reaching a state of mental equilibrium. Two yoga practices, one combining “calming and stimulating” measures (cyclic meditation) and the other, a “calming”
technique (shavasan), were compared. The oxygen consumption, breath rate, and breath volume of 40 male volunteers (group mean +/- SD, 27.0 +/- 5.7 years) were assessed before and after sessions of cyclic meditation (CM) and before and after sessions of shavasan (SH). The two sessions (CM, SH) were a day apart. Cyclic meditation includes the practice of yoga postures interspersed with periods of supine relaxation. During SH the subject lies in a supine position throughout the practice. There was a significant decrease in the amount of oxygen consumed and in breath rate and an increase in breath volume after both types of sessions (2-factor ANOVA, paired t test). However, the magnitude of change on all three measures was greater after CM: (1) Oxygen consumption decreased 32.1% after CM compared with 10.1% after SH; (2) breath rate decreased 18.0% after CM and 15.2% after SH; and (3) breath volume increased 28.8% after CM and 15.9% after SH. These results support the idea that a combination of yoga postures interspersed with relaxation reduces arousal more than what relaxation alone does.