Chapter II

Review of Related Literature

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"The literature in any fields forms the foundation upon which all future work will be built." 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 the study. Such a review brings about a deep insight and clear prospective of the overall field. The literatures relevant to the present study which have been collected from different sources of references are described in this chapter. The reviews of the literature have been classified under the following headings:

1. Studies related to yogic practices on motor fitness variables.
2. Studies related to yogic practices on physiological variables.
3. Studies related to yogic practices on psychological variables.
4. Studies related to yogic practices on bio-chemical variables.
5. Summary of the literature.

2.1 Studies on Motor fitness Variables

Bal, et. al., (2009), conducted a study on effects of selected asanas in hatha yoga on agility and flexibility level. The subjects for the study were selected on the basis of random group design. Thirty (N=30) male students were selected as subject for the present study from D.A.V. Institute of Engineering and Technology, Jalandhar (Punjab), INDIA. All the subjects ranged between the chronological age of 18-25 years. The selected subjects were further divided into two groups. Experimental treatment was assigned to group "A" while group "B" acts as control. "Hexagonal Obstacle Test" was used to measure Agility whereas "Sit and Reach Test" was used to

measure Flexibility. The subjects were subjected to the six week yogasanas training programme that includes Swastikasana, Mayurasana, Matsyendrasana, Paschimottanasana and Gomukhasana. The difference in the mean of each group for selected variable was tested for the significance of difference by "t" test. The treatment of six week yogasanas training programme was shown significant improvement in flexibility and agility.

Mark and Tran, (2001), studied the effects of Hatha Yoga Practice on the Health-Related Aspects of Physical Fitness, to achieve this purpose, ten healthy, untrained volunteers (nine females and one male), ranging in age from 18–27 years, were studied to determine the effects of hatha yoga practice on the health-related aspects of physical fitness, including muscular strength and endurance, flexibility, cardio respiratory 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. Each yoga session consisted of 10 minutes of pranayamas (breath-control exercises), 15 minutes of dynamic warm-up exercises, 50 minutes of asanas (yoga postures), and 10 minutes of supine relaxation in savasana (corpse pose). The findings of the study indicate that regular hatha yoga practice can elicit improvements in the health-related aspects of physical fitness.

Chan, et al.,(2009), designed to find out the effect of yoga exercise intervention on health related physical fitness in school-age asthmatic children, The study employed a quasi-experimental research design in which 31 voluntary children (exercise group 16; control group15) aged 7 to 12 years were purposively sampled from one public elementary school in Taipei County. The yoga exercise program was practiced by the exercise group three times per week for a consecutive 7 week period.

Each 60-minute yoga session included 10 minutes of warm-up and breathing exercises, 40 minutes of yoga postures, and 10 minutes of cool down exercises. Fitness scores were assessed at pre-exercise (baseline) and at the seventh and ninth week after intervention completion. A total of 30 subjects (exercise group 16; control group 14) completed follow-up. The Results showed that 1. Compared with children in the general population, the study subjects (n = 30) all fell below the 50th percentile in all five physical fitness items of interest. There was no significant difference in scores between the two groups at baseline (i.e., pre-exercise) for all five fitness items. 2. Research found a positive association between exercise habit after school and muscular strength and endurance among asthmatic children. 3. Compared to the control group, the exercise group showed favorable outcomes in terms of flexibility and muscular endurance. Such favorable outcomes remained evident even after adjusting for age, duration of disease and steroid use, values for which were unequally distributed between the two groups at baseline. 4. There was a tendency for all item-specific fitness scores to increase over time in the exercise group. And they concluded that the yoga exercise indeed improved BMI, flexibility, and muscular endurance. After 2 weeks of self-practice at home, yoga exercise continued to improve BMI, flexibility, muscular strength, and cardiopulmonary fitness.

Chen, at al., (2008), aimed to test older adults' physical fitness after a 24-week silver yoga exercise programme and to examine whether the programme could be further shortened to fit senior activity centers' programme designs. Convenience samples of 204 subjects were recruited from eight senior activity centers and 176 subjects completed the study. Subjects were randomly assigned into three groups based on the centers: (1) Experiment I: complete silver yoga with stretching and meditation, (2) Experiment II: shortened silver yoga without the guided imaginary

meditation and (3) Wait-list control. It was concluded that, the physical fitness of older adults I both the 70-minute complete silver yoga group and the 55-minute shortened silver yoga group had significantly improved after the interventions.

Rananjay, (2006), conducted a study on combined effects of Yoga and Physical Exercise on Motor fitness in School children. A total of 120 boys participated in the study. Age-Yoga training group (YG) (13.13±0.99, Control group (CG) (12.93±0.87), physical training group (PTG) (13.03±0.96), Except for the expected control group (CG), the remaining groups completed a month of training programme involving 4 days per week of 40-minute sessions in moderate-intensity impact exercises. At baseline and follow-up, the EUROFIT tests were administered. The Results showed that all four groups (YG, CG, PTG, and YPTG) were significantly improved in all variables after a month at follow-up. However, in YG the improvement was greater in sit and reach (17.66%), standing broad-jump (7%), and handgrip (17.03%) similarly in YPTG the plate-tapping (17.1%), sit-up (24.5%), and shuttle-run tests (16.24%) compared to remaining groups, the author concluded that all three trained groups demonstrated greater increases all the tests of motor performance compared to their CG. The integrated module of Yoga and physical education needed to implement in the educational center to elicit improvements in a number of components of motor fitness.

Ray, et al., (2001), examined the effect of yogic practices during training period on the young trainees. 54 trainees of 20-25 years age groups were divided randomly in two groups i.e. Yoga and control group (23 male and 5 female) was administered yogic practices for the first five months of the course while control group (21 Males and 5 Females) did not perform yogic exercise 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, skill 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 were 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 held 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 activity and depression and a better mental function after yogic practice.

2.2 Studies on Physiological Variables

Telles, et al., (2011), conducted a study on heart rate variability changes during high frequency yoga breathing and breathe awareness. Pre and post comparison after one minute of high frequency yoga breathing (HFYB) suggested that the HFYB modifies the autonomic status by increasing sympathetic modulation, but its effect during the practice was not assessed. For this Thirty-eight male volunteers with group average age ± S.D., 23.3 ± 4.4 years were each assessed on two separate days in two sessions, (i) HFYB and (ii) breathe awareness. Each session was for 35 minutes, with 3 periods, i.e., pre (5 minutes), during HFYB or breathes awareness (15 minutes) and post (5 minutes). The result showed that There was a significant decrease in NN50, pNN50 and the mean RR interval during and after HFYB and after

breath awareness, compared to the respective 'pre' values ($p < 0.05$) (repeated measures ANOVA followed by post-hoc analysis). The LF power increased and HF power decreased during and after breath awareness and LF/HF ratio increased after breath awareness ($p < 0.05$). And they concluded the results suggest that there was reduced parasympathetic modulation during and after HFYB and increased sympathetic modulation with reduced parasympathetic modulation during and after breath awareness.

Pramanik, et al., (2010), conducted a study on immediate effect of a slow pace breathing exercise Bhramari pranayama on blood pressure and heart rate. In this study was carried out to evaluate the immediate effect Bhramari pranayama, a slow breathing exercise for 5 minutes on heart rate and blood pressure. Heart rate and blood pressure of volunteers were recorded. The subject was directed to inhale slowly up to the maximum for about 5 seconds and then to exhale slowly up to the maximum for about 15 sec keeping two thumbs on two external auditory canal, index and middle finger together on two closed eyes and ring finger on the two sides of the nose. During exhalation the subject must chant the word "O-U-M" with a humming nasal sound mimicking the sound of a humming wasp, so that the laryngeal walls and the inner walls of the nostril mildly vibrate (Bhramari pranayama, respiratory rate 3/min). After 5 minutes of this exercise, the blood pressure and heart rate were recorded again. Both the systolic and diastolic blood pressure was found to be decreased with a slight fall in heart rate. Fall of diastolic pressure and mean pressure were significant. The result indicated that slow pace Bhramari pranayama for 5 minutes, induced parasympathetic dominance on cardiovascular system.

Rajakumar, (2010), analyze the impact of yogic practices and physical exercises on selected physiological variables among the intercollegiate soccer players. To achieve this purpose, sixty (60) male intercollegiate soccer players from the various colleges; Chennai were selected at random. Their age ranged between17 to 22. The selected subjects were divided into three equal groups of 20 each, namely yogic practice group (Group A), physical exercises group (Group B) and control group (Group C). The experimental groups have underwent 12 weeks of training namely; yogic practices and physical exercises respectively, whereas the control group (Group C) maintained their daily routine activities and no special training was given. The subjects of the three groups were tested using standardized tests and procedures on selected physiological variables before and after the training period to find out the training efforts in the following test items: Resting pulse rate through stethoscope, Breath holding time through digital stop watch, Peak flow rate through Wright's peak flow meter. The collected data were analyzed statistically through Analysis of Co-variance (ANACOVA) and Schiff's post hoc test to find out the pre and post training performances, compare the significant difference between the adjusted final means and the better group. The yogic practice group showed significant improvement due to 12 weeks training on resting pulse rate, breath holding time and peak flow rate compared to the physical exercise and control group. In the overall training effects in terms of improved number of physiological variables and their magnitude of improvement through training, yogic practice group is found to be the better group when compared to the other two groups.

Pramanik, et al., (2009), conducted a study on immediate effect of slow pace bhastrika pranayama on blood pressure and heart rate. In this Heart rate and blood pressure of volunteers (n = 39, age = 25-40 years) was recorded following standard

procedure. First, subjects had to sit comfortably in an easy and steady posture (sukhasana) on a fairly soft seat placed on the floor keeping head, neck, and trunk erect, eyes closed, and the other muscles reasonably loose. The subject is directed to inhale through both nostrils slowly up to the maximum for about 4 seconds and then exhale slowly up to the maximum through both nostrils for about 6 seconds. The breathing must not be abdominal. These steps complete one cycle of slow pace bhastrika pranayama (respiratory rate 6/min). During the practice the subject is asked not to think much about the inhalation and exhalation time, but rather was requested to imagine the open blue sky. The pranayama was conducted in a cool, well-ventilated room (18-20 degrees C). After 5 minutes of this breathing practice, the blood pressure and heart rate again were recorded in the aforesaid manner using the same instrument. The other group (n = 10) took part in another study where their blood pressure and heart rate were recorded following half an hour of oral intake of hyoscine-N-butyl bromide 20 mg. Then they practiced the breathing exercise as stated above, and the abovementioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. The results showed that it was noted that after slow bhastrika pranayamic breathing (respiratory rate 6/min) for 5 minutes, both the systolic and diastolic blood pressure decreased significantly with a slight fall in heart rate. No significant alteration in both blood pressure and heart rate was observed in volunteers who performed the samc breathing exercise for the same duration following oral intake of hyoscine-N-butyl bromide.

Kapoor, et al., (2008), studied 50 shooters of the Indian Army (age 20-30 years). Out of them, 30 shooters were given training in the techniques of pranayama and kriya for 3 weeks. The rest served as control. Breath-holding time, lung function status and shooting performance were measured before and after the training in both

the groups. Authors found highly significant improvement ($p<0.001$) in all the three variables. So we concluded that pranayama and kriya are efficacious for better performance of shooters.

Danucalov, et al., (2008), investigated the changes in cardio respiratory and metabolic intensity brought about by the practice of pranayamas (breathing exercises of yoga) and meditation during the same hatha-yoga session. The technique applied was the one advocated by the hatha-yoga system. Nine yoga instructors-five females and four males, mean age of 44+/-11, 6, were subjected to analysis of the gases expired during three distinct periods of 30 min: rest, respiratory exercises and meditative practice. A metabolic open circuit computerized system was applied (VO2000, Med Graphics-USA). The oxygen uptake (VO (2)) and the carbon dioxide output (VCO (2)) were statistically different (P <or= 0.05) during meditation and pranayama practices when compared with rest. The heart rate also suffered relevant reductions when results at rest were compared with those during meditation. A smaller proportion of lipids were metabolized during meditation practice compared with rest. The results suggest that the meditation used in this study reduces the metabolic rate whereas the specific pranayama technique in this study increases it when compared with the rest state.

Fondran and Kristine Marie, (2008), determined the effects of a twice daily Surya Namaskar yoga practice on resting heart rate (GH) and blood pressure (BP), flexibility, upper body muscle endurance, and perceived well-being in low to moderately active adult males and females. It can be concluded that Surya Namaskar is effective in increasing flexibility and improving upper body muscle endurance.

Prakash, et al., (2007), conducted tests to determine if yoga and athletic activity (running) are associated with better lung functions as compared to subjects with sedentary lifestyles and how athletes do and yogis differ in lung function. Spiro metric parameters were assessed in randomly selected 60 healthy male, non-smoking non-obese subjects athletes, yogis and sedentary workers. It was concluded that, yogis and athletes had similar lung functions. Involvement in daily physical activity or sort preferably yoga can help in achieving better pulmonary function.

Clay, et al., (2005), conducted a study on the metabolic cost of hatha yoga. In this 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 asanas. 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 (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. They concluded the intensity of hatha yoga may be too low to provide a training stimulus for improving cardiovascular fitness.

Harinath, et al., (2004), determined the effect of hatha yoga and omkar meditation on cardio respiratory performance, psychological profile, and melatonin secretion. Thirty healthy men in the age group 25-35 years volunteered for the study. They were randomly divided into two groups of 15 each. Group 1 subjects served as control and performed body flexibility exercises for 40 minutes and slow running for

20 minutes during morning hours and played games for 60 minutes during evening hours daily for 3 month. Group2 subject practiced selected yogic asanas (Postures) for 45 minutes and pranayama for 15 minutes during the morning. Whereas during the evening hours these subjects performed preparatory yogic postures for 15 minutes, pranayama for 15 minutes, and meditation for 30 minutes daily, for 3 months. Orthostatic tolerance, heart rate, Blood pressure, respiratory rate, dynamic lung function (such as forced vital capacity, forced expiratory volume in 1 second, forced expiratory volume percentage, peak expiratory flow rate, and maximum voluntary ventilation), and psychological profile were measured before and after 3 months of yogic practices. Serial blood samples were drawn at various time intervals to study the effects of these yogic practices and Omkar meditation on melatonin levels. Yogic practices for 3 month resulted in an improvement in cardio respiratory performance and psychological profile. The plasma melatonin also showed an increase after three months of yogic practices. The systolic blood pressure, diastolic blood pressure, mean arterial pressure, and orthostatic tolerance did not show any significant correlation with plasma melatonin. However, the maximum night time melatonin levels in yoga group showed a significant correlation with well-being score. And they concluded these observations suggest that yogic practices can be used as psycho physiologic stimuli to increase endogenous secretion of melatonin, which, in turn, might be responsible for improved senses of well-being.

Bharshankar, et al., (April 2003), conducted a study to examine the effect of yoga on cardiovascular function in subjects above 40 years of age. Pulse rate, systolic and diastolic blood pressure and valsalva ratio were studied in 50 control subjects (not doing any kind of physical exercise) and 50 study subject who had been practicing yoga for five years. From the study it was observed that significant reduction in the

pulse rate occurs in subjects practicing yoga ($p<0.001$). The difference in the mean values of systolic and diastolic blood pressure between study group and control group was also statistically significant. The systolic and diastolic blood pressure showed significant positive correlation with age in (rl systolic=0.631 and rl diastolic=0.610) the study group as well in the control group (rl systolic=0.981 and rl diastolic=0.864). The Significant difference between the correlation coefficient was also tested with the use of Z transformation and the difference was significant (z systolic=4.041 and z diastolic=2.901). Valsalva ratio was found to be significantly higher in yoga practitioners then in controls ($p<0.001$). Our results indicate that yoga reduces the age related deterioration in cardiovascular functions.

Prasad, et al., (2001), aims at identifying the energy cost of nadi sodhana and compare it with standard physical activities such as controlled treadmill-walking and field-walking, to achieve this purpose twelve normal healthy male volunteers who have been practicing yoga and pranayama over a period of three years. The energy cost of nadi sodhana and field-walking was derived from individual regression equations using oxygen consumption and heart rates recorded during a maximal graded exercise test on treadmill carried out in a thermo neutral environment. The predicted oxygen consumption and heart rate during nadi sodhana were significantly lower than in field-walking ($p<0.05\&0.01$) and treadmill-walking ($p<0.01\& 0.01$) indicating that the energy cost for nadi sodhana is lower. Oxygen pulse during nadi sodhana was also significantly lower than field-walking ($p<0.05$) and treadmill-walking ($p<0.05$). It was also observed that during nadi sodhana blood lactate was significantly lower ($p<0.01\&0.05$) than during the other two tests studied and pyruvate was significantly higher ($p<0.01$) than during treadmill-walking. The results indicate low exertion on the subjects, based on Borg scale during nadi sodhana than in

other forms of physical exercises. This low exertion may be attributed to efficient metabolic adaptations during nadi sodhana. In view of the above findings nadi sodhana can be included in the battery of fitness programs for both healthy and diseased individuals.

Seshien, (1998), conducted a study on the effect of pranayma and transcendental meditation on the pulse rate and blood pressure of the male students of the Sourastra College, Madurai. For first group performed pranayama, the second group performed transcendental meditation and the third group performed pranayama and transcendental meditation. Subjects in each group were trained with respective programmers for a period of six weeks, five days a week from Monday to Friday and two sessions of 20 minutes duration both in the morning and in evening. Prior to and at the end of the training period all the subjects were tested for pulse rate and blood pressure. The result showed that the pranayama reduced the blood pressure only combined pranayama and transcendental meditation showed very good effect on all the physiological parameters.

Raja, (1997) studied the short term effects of 4 weeks of intensive yoga practice on physiological responses in six healthy adult female volunteers who were measured by using the maximal exercise treadmill test. Yoga practice involved daily morning and evening sessions of 90 minutes each. Pre and post yoga exercise performance was compared maximal work output 9WMAX0 for the group increased by 21% with a significantly reduced level of oxygen consumption per unit work but without a concomitant significant change in heart rate. After intensive yoga training, at 154 Wmin (-1) (corresponding to Wmax of the pre yoga maximal exercise test) participants could exercise more comfortably with a significantly lower hart rate ($P <$

0.05), and a significantly lower respiratory quotient ($P < 0.05$). The implications for the effect of intensive yoga on cardio respiratory efficiency are discussed, with the suggestion that yoga has some transparently difference quantifiable physiological effects to other exercises.

Schell, (1994), examined the physiological and psychological effects of hatha yoga exercise in healthy women. Hatha yoga has become increasingly popular in western countries as a method for coping stress. However little is known about the physiological and psychological effects of yoga practice. We measured hart 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 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, emotionally 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 significant higher scores in high spirits and extrovertedness.

Durgalakshmi, (1989), conducted a study on effect of yogic exercises on selected physiological variables of High School boys. The group consisted of 60 students. The result of the study showed that systolic pressure was increased and

diastolic pressure remains unchanged after a six week training of yoga. The scores in breath holding time and vital capacity had also improved. It was statistically significant. She also recommended that the athletes could adopt these exercises and thereby increase in the cardio respiratory function and further she adds, yoga could be included in the regular programme of Physical Education in schools and colleges.

Mandanmohan et. al, (1993) designed to examined the effect of yoga training on Reaction time, respiratory Endurance and muscle Strength. The study contain the following, there is evidence that the practice of yoga improver physical and mental performance. The present investigation was under taken to study the effect of yoga training on visual and auditory reaction times (RTS) maximum expiratory pressure (MEP), maximum inspiratory pressure (MIP), 40 mm Hg test, breath holding time after expiration (BHT) breath holding time after inspiration (BHT insp), and hand grip strength (HGS), Twenty – seven students volunteers were given yoga training for 12 weeks. There was a significant ($P < 0.001$) decrease ub visual RT (from 270.0 +/- 6.20 (SE) ti 224.81 +/- 5.76 ms) as well as auditory RT from 194.18 +/- 6.0 to 157.33 +/- 4.85 ms) MEP increased from 92.61 +/- 9.04 to 126.46 +/- 1.75 mm Hg, while MP increased from 72.23 +/- 6.45 to 90.92 +/- 6.03 mm Hg, 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 33.36 +/- 3.958 and 13.78 +/- 0.58 to 16.67 +/- 0.49 Kg respectively. BHT EXP increased from 32.15 +/- 1.41 to 44.53 +/- 3.78s ($p < 0.05$). Our result show that yoga practice for 12 weeks results in significant reduction in visual and auditory RTs and significant increase in respiratory pressures, breath holding times and HGS.

2.3 Studies on Psychological variables

Khemka, et al., (2011), conducted a study on effect of integral yoga on psychological and health variables and their correlations. In this study was a pre-post intervention study. The variables were measured at the beginning and the end of a one-month yoga course. There was no control group. The study was carried out at Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) University, in its rural campus south of Bangalore. Based on health criteria, 108 subjects were selected out of 198 volunteers to form the experimental yoga group. Ages ranged from 17 to 63 years. The yogasanas (postures), pranayama (breathing exercises), relaxation techniques, meditation, chanting and lectures were the components of yoga intervention. The variables measured were sustained attention, emotional intelligence - EQ, general health - GHQ, guna personality - sattva, rajas and tamas. The result showed that significant pre-post changes were found in all variables. Significant correlations were found between the following pairs: The two sustained attention variables; emotional intelligence and general health; GHQ and tamas; sattva and tamas; and rajas and tamas. And they concluded that there were significant changes in all variables ($P< 0.001$) except in sattva. It also confirms that EQ and general health variables correlate significantly with each other and negatively with tamas. EQ and tamas form positive and negative predictors of health respectively. Sattva correlates positively with EQ suggesting that a sattvic personality indicates better self-control. This suggests that, by improving guna personality, long-term yoga practice may stabilize EQ.

Arvind, et al., (2011), conducted a study on "Effects of integrated yoga practice on immune responses in examination stress", The sample consisted of sixty first year M.B.B.S students randomly assisted to yoga group, control group (30 each)

the yoga group underwent integrated yoga practice of 35 minutes daily in the presence of trained yoga teacher for 12 weeks, control group did not undergo any kind of yoga practice or stress managements. Physiological parameters like heart rate, and blood pressure were measured. Global Assessment of Recent Stress Scale and Spielbergers State Anxiety score were assesses at baseline and during the examination. Serum cortisol levels,IL-4 and IFN-y levels were determined by enzyme-linked immunosorbent assay technique, the results revealed that the psychological stress highly significant difference in control group compared with significant difference in yoga group, During the examination, the increase in serum cortical and decrease in serum IFN-y in yoga group was less significant ($P>0.01$) then in the control group ($P<0.001$). Both the group demonstrated an increase in serum IL-4 levels, the chances being insignificant for the duration of the study.

Field, et al., (2011), examined the Tai chi/yoga effects on anxiety, heart rate, EEG and math computations. For that 38 adults participated in a 20-min Tai chi/yoga class. The session was comprised of standing Tai chi movements, balancing poses and a short Tai chi form and 10 min of standing, sitting and lying down yoga poses. Main outcome measures are the pre and post Tai chi/yoga effects were assessed using the State Anxiety Inventory (STAI), EKG, EEG and math computations. The result showed that Heart rate increased during the session, as would be expected for this moderate-intensity exercise. Changes from pre to post-session assessments suggested increased relaxation including decreased anxiety and a trend for increased EEG theta activity. And they concluded the increased relaxation may have contributed to the increased speed and accuracy noted on math computations following the Tai chi/yoga class.

Yoshihara, et al., (2011), examined the profile of mood states and stress-related biochemical indices in long-term yoga practitioners. The sample consists of 38 healthy females with more than 2 years of experience with yoga (long-term yoga group) and 37 age-matched healthy females who had not participated in yoga (control group). Their mental states were assessed using the Profile of Mood States (POMS) questionnaire. The level of cortisol, 8-hydroxydeoxyguanosine (8-OHdG) and biopyrrin in urine were used as stress-related biochemical indices. The results showed that the average self-rated mental disturbance, tension-anxiety, anger-hostility, and fatigue scores of the long-term yoga group were lower than those of the control group. There was a trend toward a higher vigor score in the long-term yoga group than that in the control group. There were no significant differences in the scores for depression and confusion in the POMS between the two groups. The urine 8-OHdG concentration showed a trend toward to being lower in the long-term yoga group in comparison to the control group. There were no significant differences in the levels of urine biopyrrin or cortisol, and they concluded, the present findings suggest that long-term yoga training can reduce the scores related to mental health indicators such as self-rated anxiety, anger, and fatigue.

Megan and Thygeson, (2010), conducted a study on Peaceful Play Yoga: Serenity and Balance for Children with Cancer and Their Parents. In this Children with a cancer diagnosis experience symptom distress, including anxiety, because of the disease and its treatment. Parents experience stress and anxiety because of the uncertainty of the disease as well as the suffering of their children. Yoga is a complementary intervention that has physiological and psychological benefits in healthy children and healthy and chronically ill adults. On an inpatient hematology/oncology unit, 11 children aged 6 to 12 years, 5 adolescents aged 13 to 18

years, and 33 parents participated in a single yoga session tailored to the needs and abilities of the patients and parents. Sense of well-being pre- and post class was measured with the Spielberger State Anxiety Scale. Children had normal anxiety scores pre-class that did not change. Adolescents and parents experienced significant decreases in anxiety scores, and all cohorts gave positive feedback about the experience and they conclude that yoga is a feasible intervention for this population and is beneficial to adolescents and parents.

Gupta, et al., (2006), conducted a study on short-term impact of a comprehensive but brief lifestyle intervention, based on yoga, on anxiety levels in normal and diseased subjects. The study was the result of operational research carried out in the Integral Health Clinic (IHC) at the Department of Physiology of All India Institute of Medical Sciences. The subjects had history of hypertension, coronary artery disease, diabetes mellitus, obesity, psychiatric disorders (depression, anxiety, and 'stress'), gastrointestinal problems (non ulcer dyspepsia, duodenal ulcers, irritable bowel disease, Crohn's disease, chronic constipation) and thyroid disorders (hyperthyroidism and hypothyroidism). The intervention consisted of asanas, pranayama, relaxation techniques, group support, individualized advice, and lectures and films on philosophy of yoga, the place of yoga in daily life, meditation, stress management, nutrition, and knowledge about the illness. The outcome measures were anxiety scores, taken on the first and last day of the course. Anxiety scores, both state and trait anxiety were significantly reduced. Among the diseased subjects significant improvement was seen in the anxiety levels of patients of hypertension, coronary artery disease, obesity, cervical spondylitis and those with psychiatric disorders. The results showed that the observations suggest a short educational programme for

lifestyle modification and stress management leads to remarkable reduction in the anxiety scores within a period of 10 days.

Michalsen, et al., (2005), examined the rapid stress reduction and anxiolysis among distressed women as a consequence of a three-month intensive yoga program". In this non-randomized study was conducted in 24 self-referred female subjects (mean age 37.9+/-7.3 years) who perceived themselves as emotionally distressed. Subjects were offered participation in one of two sub sequential 3-months yoga programs. Group 1 (n=16) participated in the first class, group 2 (n=8) served as a waiting list control. During the yoga course, subjects attended two-weekly 90-min Iyengar yoga classes. Outcome was assessed on entry and after 3 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 cortisol levels were measured before and after an evening yoga class in a second sample. Women suffering from mental distress participating in a 3-month Iyengar yoga class show significant improvements on measures of stress and psychological outcomes.

Stueck and Gloeckner (2005) aimed the Training of Relaxation with Elements of Yoga for Children. The technique introduced and evaluated is the communication of self-control and relaxation based on experience using breathing exercises, imagination journeys and specifically selected yoga techniques for children. This stress-handling program me has been investigated by means of a test/control/group design with 48 pupils of the fifth grade. The result indicated that yoga is suited for children as an independent control method.

Lavey, et al., (2005), evaluated the effects of yoga on mood in psychiatric inpatients. In this they selected in 13 psychiatric inpatients at New Hampshire Hospital. Participants completed the Profile of Mood States (POMS) prior to and following participation in a yoga class. Analyses indicated that participants reported significant improvements on all five of the negative emotion factors on the POMS, including tension-anxiety, depression-dejection, anger-hostility, fatigue-inertia, and confusion-bewilderment. There was no significant change on the sixth POMS factor, vigor-activity. Improvements in mood were not related to gender or diagnosis. The results suggest that yoga was associated with improved mood, and may be a useful way of reducing stress during inpatient psychiatric treatment.

Dobalion, et al., (2003), investigated to determine whether differences in likelihood of diagnosis exist between the urban and rural nursing home residents for eight common medical conditions: four mental health conditions (depression, anxiety, Alzheimer's, and non-Alzheimer's dementia) and four physical health conditions (cancer, emphysema/chronic obstructive pulmonary disease, heart disease, and stroke/transient ischemic attack). They used multivariate logistic regression to examine data derived from the 1996 Nursing Home Component of the Medical Expenditure Panel Survey, a multistage stratified probability sample of 815 nursing homes and 5899 residents, representing 3.1 million individuals in the United States who spent one or more nights in nursing homes during 1996. Residents in rural homes were less likely to be diagnosed with depression compared to those in homes in large metropolitan areas, and residents in homes in small metropolitan areas were less likely to have cancer than those in large metropolitan areas.

Malathi et al., (2000) assessed on Subjective Well Being Inventory (SWBI) before and after the course in order to evaluate the effect of practice of yoga on subjective feelings of well-being and quality of life. Forty eight healthy volunteers participated in the practice of yoga over a period of four months. It was concluded that, a significant improvement in 9 of the 11 factors of SWBI was observed at the end of four moths, in these participants. The paper thus, reiterates the beneficial effects of regular practice of yoga on subjective well being.

2.4 Studies on Bio-chemical variables

Yang, (2007 studied yoga, a form of physical activity, is rapidly gaining in popularity and has many health benefits. Yet healthcare providers have been slow to recognize yoga for its ability to improve health conditions, and few interventions have been developed that take full advantage of its benefits. The purpose of this article is to review published studies using yoga programs and to determine the effect of yoga interventions on common risk factors of chronic diseases (overweight, hypertension, high glucose level and high cholesterol). A systematic search yielded 32 articles published between 1980 and April 2007. The studies found that yoga interventions are generally effective in reducing body weight, blood pressure, glucose level and high cholesterol, but only a few studies examined long-term adherence. Additionally, not enough studies included diverse populations at high risk for diabetes and its related common health problems.

Chinnaswamy, (1992), conducted a study on the effect of asanas and physical exercise on selected physiological and biochemical variables among school boys. In this study ninety male students were randomly selected from government higher secondary school, Thampatti. The initial scores were measured for the selected

physiological and biochemical variables, namely pulse rate, systolic blood pressure, diastolic blood pressure, hemoglobin blood content and blood sugar land. The treatment was given for a period of six weeks for the experimental groups. The significance of the difference among the two means of exercise group and asana group for the pre test and mean gains were determined by F ratio through analysis of variance. Asana and physical exercise had significantly improved hemoglobin contains – blood sugar, pulse rate and diastolic pressure. There was no difference is systolic pressure in which either physical exercise group or asana group made any effect.

Acharya, et al., (2010), conducted a study on Effects of Pranayama (voluntary regulated breathing) and yogasana (Yoga postures) on lipid profile in normal healthy junior footballers. In this study 20 male junior footballers younger than 15 years of age, belonging to the Mohun Bagan Athletic club, Kolkata, were selected for the study at Haridwar. They had to play in a football cup organized in UK and they were here to practice Yoga sequences taught by Swami Ramdevji, (1-3) they were of age 14.65+ or – 0.58 years and none of them had a history of lipid metabolism disorders. All the footballers were healthy with no history of smoking or alcohol consumption. The Scope and objectives of the present study were explained to the subjects and their written consent was obtained for participation in the study. The institutional ethical committee had approved the study protocol and design. The subject were asked to follow their routine diet and exercise pattern during the period of the study none of the subjects were exposed to Yogic practices before this yoga training session. There was a significant reduction in the levels of serum cholesterol, Low density lipoprotein (LDL) cholesterol, serum triglycerides, and very low density

lipoprotein (VLDL) cholesterol at the end of the yoga session the results indicated that the fasting blood sugar (FBS) level was positively elevated in junior footballer.

Damordaran, et al., (2002), studied the therapeutic potential of yoga practices in modifying cardiovascular risk profile in middle age man and women. 20 subjects (16 males, 4 females' age ranged 35 to 55 years) with mild to moderate hypertension. Subjects underwent daily yoga practice for 3 months. Biomechanical, physiological and psychological parameters were studied prior to and after 3 months of yoga practice. After intervention, subjects demonstrated a decrease in heart rate, respiration, blood pressure, blood glucose and cholesterol. Subjects also demonstrated improvements in concentration and memory indicates that yoga may play an important role in risk modification.

Romos, et al., (2009), conducted study on Cardiovascular and metabolic effects of intensive Hatha Yoga training in middle-aged and older women from northern Mexico. In this prospective quasi experimental design, four middle-aged and nine older conventional Hatha Yoga (CHY) practicing females (yoginis) were enrolled into an 11-week intervention Hatha Yoga (IHY) program consisting of 5 sessions/week for 90 min (55 sessions). The program adherence, asana performance, and work intensity were assessed along the intervention. Anthropometric [body mass index (BMI), % body fat and Σ skin folds], cardiovascular fitness [maximal expired air volume (VE(max)), maximal O(2) consumption (VO(2max)), maximal heart rate (HR(max)), systolic (BPs) and diastolic blood pressure (BPd)], biochemical [glucose, triglyceride (TAG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C)], and dietary parameters were evaluated before and after IHY. The results showed that Daily caloric intake (~1,916

kcal/day), program adherence (~85%), and exercising skills (asana performance) were similar in both middle-aged and older women. The IHY program did not modify any anthropometric measurements. However, it increased VO (2max) and VE(max) and HDL-C while TAG and LDL-C remained stable in both middle-aged and older groups ($P < 0.01$) and they concluded, The proposed IHY program improves different cardiovascular risk factors (namely VO(2max) and HDL-C) in middle-aged and older women.

Yurtkuran, Alp, Yurtkuran, and Dilek, (2007), evaluated the effects of a yoga-based exercise program on pain, fatigue, sleep disturbance, and biochemical markers in hemodialysis patients. In 2004 a randomized controlled trial was carried out in the outpatient hemodialysis unit of the Nephrology Department, Uludag University Faculty of Medicine. Clinically stable hemodialysis patients (n=37) were included and followed in two groups: the modified yoga-based exercise group (n=19) and the control group (n=18). Yoga-based exercises were done in groups for 30 min/day twice a week for 3 months. All of the patients in the yoga and control groups were given an active range of motion exercises to do for 10 min at home. The main outcome measures were pain intensity (measured by the visual analogue scale, VAS), fatigue (VAS), sleep disturbance (VAS), and grip strength (mmHg); biochemical variables urea, creatinne, calcium, alkaline phosphates, phosphorus, cholesterol, HDL-cholesterol, triglyceride, erythrocyte, hematocrit--were evaluated After a 12-week intervention, significant improvements were seen in the variables: pain -37%, fatigue -55%, sleep disturbance - 25%, grip strength +15%, urea -29%, creatinine -14%, alkaline phosphates -15%, cholesterol -15%, erythrocyte +11%, and hematocrit count +13%; no side-effects were seen. Improvement of the variables in the yoga-based exercise program was found to be superior to that in the control group for all

the variables except calcium, phosphorus, HDL-cholesterol and triglyceride levels. A simplified yoga-based rehabilitation program is a complementary, safe and effective clinical treatment modality in patients with end-stage renal disease.

Prasad, et al.,(2006), presented a study on normal healthy volunteers, 41 men and 23 women, to evaluated the impact of Pranayama and yoga asana on blood lipid profiles and free fatty acids, in two stages. In stage-I Pranayama was taught for 30 days and in stage-II, yogic practices were added to Pranayama for another 60 days. A Significant reduction was observed in triglycerides, free fatty acids and VLDL-cholesterol in men and free fatty acids along were reduced in women at the end of stage-I. A significant elevation of HDL-cholesterol was seen only in the men at the end of stage-I. At the end of stage-II, free fatty acids increased in both men and women and women demonstrated a significant fall in serum cholesterol, triglycerides, LDL-and VLDL-cholesterol. The results indicated that HDL-cholesterol was elevated in men with Pranayama, while triglycerides and LDL-cholesterol decreased in women after yoga asanas. The results of the study indicate that Pranayama and yogaasana can be helpful in patients with lipid metabolism disorders such as coronary artery disease, diabetes mellitus and dyslipidemia etc.

Manchanda, et al., (2000), evaluated possible role of lifestyle modification incorporating yoga, on retardation of coronary atherosclerotic disease. In this prospective, randomized, controlled trial, 42 men with angiographically proven coronary artery disease (CAD) were randomized to control (n = 21) and yoga intervention group (n = 21) and were followed for one year. The active group was treated with a user-friendly program consisting of yoga, control of risk factors, diet control and moderate aerobic exercise. The control group was managed by

conventional methods i.e. risk factor control and American Heart Association step I diet. 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. Revascularization procedures (coronary angioplasty or bypass surgery) were less frequently required in the yoga group (one versus eight patients; relative risk = 5.45; P = 0.01). Coronary angiography repeated at one year showed that significantly more lesions regressed (20% versus 2%) and less lesions progressed (5% versus 37%) in the yoga group (chi-square = 24.9; P < 0.0001). The compliance to the total program was excellent and no side effects were observed. 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.

Sahay, et al., (1982), attempted to find out the changes occurring invariance biochemical parameter in normal healthy volunteers before and after the yogic practices subjected to training in yogic practices like Pranayama, Vajrasana, Bhujangasana, Shalabasana, Dhanursana, Makarasana Halasana, Naukasana, Ardhmatsyendrasana, Sirshasana and Savasana for a period of 3 months. The parameters studied included fasting blood sugar serum cholesterol, serum triglycerides – phosphokinase, serum cholinesterase, blood lactate, blood pymvalte and urinary creatinine. The subjects were 53 male body weights being 54.5 Kg. There was significant increase in the levels of creatinine, phospokinase and pyrauvate to locate P or V ratio in the males as well as females at the end of the period of study. The values of serum triglyceride were increased in females and those of serum

Hunesterase in males. The results indicated an increased muscular activity in an anaerobic metabolism, which was evidenced by increased ratio as a result of training.

2.5 Summary of Literature

The reviews are presented under the four sections namely studies on motor fitness (n=7), studies on physiological variables (n=18), studies on psychological variables (n=11) and studies on bio-chemical variables (n=9). All the research studies that are presented in this section prove that yogasanas training methods contribute significantly for better improvement in all the criterion variables.

Research studies using yoga asana practice revealed compatible results *(**Chan, et al.,(2009), Rananjay, (2006),*** **Bal, et. al., (2009),** ***Mark and Tran, (2001)*** *and* ***Ray, et al., (2001))***. There was clear evidence that the use of yogaasana training was one of the effective training methods to improve the selected motor fitness variables.

Research studies using yoga asana practice revealed compatible results (***Telles, et al., (2011), Field, et al., (2011), Scholl, (1994), Pramanik, et al., (2009), Pramanik, et al., (2010)*** *and* ***Harinath, et al., (2004))***. The current study created yoga asana programme to determine its effectiveness as a tool for selected physiological variables among men students. Yoga asana training protocols are presently being used for the improvement of selected physiological qualities and research.

The independent and dependent variable for the current study are combined training and the change of level of selected psychological and bio-chemical variables. ***(Yoshihara, et al., (2011), Megan and Thygeson,*** *(2010),* ***Arvind, et al., (2011), Field, et al., (2011), Chinnaswamy, (1992), Romos, et al., (2009)*** *and* ***Acharya, et al., (2010))***

The review of literature helped the researcher from the methodological point of view too. It was learnt that most of the research studies cited in this chapter on analysis and experimental design as the appropriate methods for finding out the training. The present study may serve as a foundation and main ingredient for future research and investigation in training methods for changing the motor fitness, physiological, psychological and bio-chemical variables.