CHAPTER II

REVIEW OF RELATED LITERATURE

The following materials collected from the views expressed by various personalities provide back ground information to the study and help us to understand the effect of various contributions of asanas, pranayama and combination of asanas and pranayama training on dexterity, body weight, body composition, basal metabolic rate, and bio-chemical variables of college men. The views of the experts and research workers in the field of physical education were given primary importance in the present study.

The literature in any field forms the foundation upon which all future work will be built. If one builds upon the foundation of knowledge provided by the review of literature, the investigator might not miss some similar work already done on the same topic. The reviews of the literature have been classified under the following headings:

1. Studies on asana training.
2. Studies on pranayama training.
4. Summary of the literature.

2.1. STUDIES ON ASANA TRAINING ON SELECTED VARIABLES

Dexterity

Manjunath and telles (1998) conducted the factors influencing changes in tweezer dexterity scores following yoga training and correlates age, gender, motivation to learn yoga with the performance in a dexterity task following yoga.
Tweezer dexterity was recorded in eighty subjects belonging to four groups. Two groups were given a month of yoga training. One group consisted of subjects who had volunteered to join for the training and the other group was deputed for the training as part of their job. The two remaining groups did not receive yoga training and were selected to match the respective groups receiving yoga, for age and sex, but not for their motivation to learn yoga. The test involved using a tweezer to place metal pins in evenly spaced holes in a metal plate within four minutes. Following yoga the scores of the volunteers who learnt yoga increased significantly, whereas there was no change in scores of deputed subjects and non-yoga groups. For reasons described in detail, factors such as age and gender did not appear to contribute to the difference in performance. Hence motivation to learn yoga appeared to influence the magnitude of increase.

Avinash et al., (2010) compared the fine motor performance of school students using three different integrated yoga modules. After stratifying for sex and age (Boys = 403, girls = 243; juniors 9-12 yrs, seniors 13-17 yrs), 604 school students were randomly allotted to three groups. All the 3 groups were trained in specific yoga modules designed for improving Physical Stamina (PS = 218), Creativity (CR = 216) and Analytical Intelligence (IQ, = 212), for 10 days in a residential set up in South India. Fine motor performance was assessed using Minnesota Manual Dexterity Test on day 1 and 9. There was significant improvement (Paired t test p=<0.001) in manual dexterity in all three groups (PS=13.5%, CR=14.4% and IQ=9.1%). Multiple comparisons (ANOVA and Tukey test) indicated significantly greater improvement in PS compared to IQ and no
significant difference between PS and CR. The junior group showed significantly greater improvement than the senior group.

Venkatesh (2010) assessed the effect of yoga on the personality development of students and the objectives were to study the effect of yoga practices on the muscle strength, dexterity, primary mental functions, emotional and behavioral aspects and the intellectual abilities of the students. A quasi-experimental non-equivalent control group design was used in this study. The participants for this study were drawn from two co-educational schools in Bangalore that were from different socioeconomic levels. Four hundred and three children participated in this study. Within each school, two classes were randomly assigned to the ‘Yoga’ group and two classes to the ‘control’ group. The ‘Yoga’ group in both schools was given yoga trainings by qualified yoga teachers whereas the ‘control’ group went on with routine schoolwork. The ‘Yoga’ groups received yogic training for approximately 45 minutes each day for 5 days a week for one academic year. All the groups were assessed at the beginning and at the end of the academic year by administering the Grip strength test and Dexterity test to assess the physical development, the personality Inventory, the school and Home Inventories, GASC, Anxiety test and EQ test to assess the emotional and behavioral development, the Letter Recognition and structure of Intellect abilities test to assess the primary mental functions and intellectual abilities development. Keeping in mind the design of the study, several approaches to data analysis were possible. In order to buffer against type I error, the analyses were performed in a multivariate model. The contrast of the posttest scores of the ‘Yoga’ vs ‘control’ using multivariate analysis of covariance (MANCOVA) with the present scores as covariates followed by Gain score analysis (posttest-
pretest, independent ‘t’ test) was deemed the most powerful and complete analytic framework to evaluate the outcome of this study. Paired t-tests were also conducted to look for within group differences in means. The results of the present indicate that regular practice of the various techniques had a beneficial effect on the personality development of students at the physical, mental, emotional and intellectual levels.

**Dash and Telles (1999)** studied the yoga training and motor speed based on a finger tapping task. A finger tapping task was used to assess motor speed (MS) of both hands in 53 adults and, 152 children before and after yoga training and in 38 adults of a non-yoga (control) group. All subjects were right hand dominant. The 30 second tapping speed (TS) test was considered as three time intervals, i.e. 0-10 second (TS1), 10-20 seconds (TS2) and 20- 30 seconds (TS3). There was a significant (Student's t-test) increase in all three TS values following 10 days of yoga in children and 30 days of yoga in adults. However for both groups at baseline and final assessments, TS2 and TS3 were significantly lower than TS1. Hence the TS was increased after yoga training during the first 10 seconds of the test but not during the next 20 seconds. These results suggest an increase in motor speed for repetitive finger movements following yoga training, but not in strength or endurance, as the increase was not sustained over 30 sec.

**Raghurai and Telles (1997)** compared critical flicker fusion frequency (CFF), degree of optical illusion ("di"), dexterity scores, and grip strength in three groups of subjects, viz community home girls who had learned yoga for 6 months (CHY), age-matched community home girls who had physical activity training for 6 months (CHP), and girls who were attending a regular school (SCH). There were
equal numbers in each group for each of the 4 assessment (range 11 to 30 subjects) and age range was 12 to 16 years of age. The CHP group had significantly lower CFF and "di" was significantly higher (one factor ANOVA, t test for unpaired data) in the CHP group, both compared to CHY and SCH groups. Right hand grip strength was also significantly less in the CHP group compared to SCH. The results were explained by previous reports of high levels of anxiety and aggression in community-home groups, which is known to influence the four parameters described here. The better performance of the CHY group compared to CHP, suggested that yoga practice has a beneficial effect in these subjects.

Kulkarni et al., (2010) studied the effect of omkar, chanting on concentration, memory and level of fatigue. Concentration is the measure of accuracy of work. Receiving power is the measure of understanding. Memory is a measure of ability to reproduce the knowledge that is known. The concentration, memory and the level of fatigue can be measured from the psychology based tests. Omkar recitation is an important yogic practice. The vibration due to Omkar meditaiton increases the efficiency of cells and the organs.

Telles et al., (2006) assessed the effect of yoga training program on performance in a mirror-tracing task. Two groups of volunteers (yoga and control) with 26 people in each group and age range between 18 and 45 years were participated. The star to be traced was six pointed and the outline was made up of 60 circles (4 mm in diameter). At the end of one month the yoga group showed a significant improvement in terms of an increase in the number of circles crossed (P<0.001, Wilcoxon paired signed ranks test) for both hands and a decrease in the
number of circles left out for the right hand (P<0.05). The control group showed a significant increase in number of circles crossed for the left hand alone (P<0.05) at the end of a month attributed to re-test. The study suggests that one month of yoga improved reversal ability, eye-hand co-ordination, speed and accuracy which are necessary for mirror star tracing.

Ray et al., (2001) observed the 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 submaximal exercise, body flexibility were recorded. Psychological parameters like personality, learning, arithmetic, 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.
Oken et al. (2006) determined the effect of yoga on cognitive function, fatigue, mood, and quality of life in seniors. Randomized, controlled trial comparing yoga, exercise, and wait-list control groups. One hundred thirty-five generally healthy men and women aged 65-85 years. Participants were randomized to 6 months of Hatha yoga class, walking exercise class, or wait-list control. Subjects assigned to classes also were asked to practice at home. Outcome assessments performed at baseline and after the 6-month period included a battery of cognitive measures focused on attention and alertness, the primary outcome measures being performance on the Stroop Test and a quantitative electroencephalogram (EEG) measure of alertness; SF-36 health-related quality of life; Profile of Mood States; Multi-Dimensional Fatigue Inventory; and physical measures related to the interventions. One hundred thirty-five subjects were recruited and randomized. Seventeen subjects did not finish the 6-month intervention. There were no effects from either of the active interventions on any of the cognitive and alertness outcome measures. The yoga intervention produced improvements in physical measures (eg, timed 1-legged standing, forward flexibility) as well as a number of quality-of-life measures related to sense of well-being and energy and fatigue compared to controls. There were no relative improvements of cognitive function among healthy seniors in the yoga or exercise group compared to the wait-list control group. Those in the yoga group showed significant improvement in quality-of-life and physical measures compared to exercise and wait-list control groups.

Oretzky (2007) examined the effects of a 5-week Vinyasa yoga intervention on depressive and somatic symptoms in young adults with elevated depressive symptoms. Fifty-nine participants between the ages of 18-29, who met criteria for at
least mild depressive symptoms at baseline, were included. Participants were randomly assigned to a twice weekly, 5-week Vinyasa yoga group or a wait-list control group. Analyses of manipulation checks, program adherence, and attrition data confirmed that the study accomplished what was proposed. Attrition in this study was low (2 yoga, 3 control), with a total 53 of 58 participants completing the study. Final data were analyzed for 53 participants (29 yoga, 24 control). Assessments conducted at baseline and after the 5-week intervention revealed significant decreases in both self-reported and observer-rated depressive symptoms, somatic symptoms, sleep quality and anxious symptoms, for the yoga group, as compared to controls. Short-term measures of positive and negative affect assessed before and after session 1, 5, and 10, demonstrated consistently, significant decreases in yoga participant's ratings of negative affect within each session, however not across time. Yoga participants did not demonstrate significant within-session increases in positive effect, however they did demonstrate a trend in the predicted direction over time. Finally, 83% of yoga participants were below criteria for mild depressive symptoms at posttest, as compared to 38% of controls. Results provide preliminary evidence for the efficacy of Vinyasa yoga in the treatment and management of depressive symptoms in young adults.

Body Composition

Kristal et al., (2005) examined the yoga practice is associated with attenuated weight gain in healthy, middle-aged men and women whether yoga practice is associated with lower mean 10-year weight gain after age 45. Participants included 15,550 adults, aged 53 to 57 years, recruited to the Vitamin and Lifestyle
(VITAL) cohort study between 2000 and 2002. Physical activity (including yoga) during the past 10 years, diet, height, and weight at recruitment and at ages 30 and 45. All measures were based on self-reporting, and past weight was retrospectively ascertained. Multiple regression analyses were used to examined covariate-adjusted associations between yoga practice and weight change from age 45 to recruitment, and poly chotomous logistic regression was used to examine associations of yoga practice with the relative odds of weight maintenance (within 5%) and weight loss (> 5%) compared to weight gain. Yoga practice for four or more years was associated with a 3.1-lb lower weight gain among normal weight (BMI < 25) participants [9.5 lbs versus 12.6 lbs] and an 18.5-lb lower weight gain among overweight participants [-5.0 lbs versus 13.5 lbs] (both P for trend <.001). Among overweight individuals, 4+ years of yoga practice was associated with a relative odds of 1.85 (95% confidence interval [CI] 0.63-5.42) for weight maintenance (within 5%) and 3.88 (95% CI 1.30-9.88) for weight loss (> 5%) compared to weight gain (P for trend .026 and .003, respectively). Regular yoga practice was associated with attenuated weight gain, most strongly among individuals who were overweight. Although causal inference from this observational study is not possible, results are consistent with the hypothesis that regular yoga practice can benefit individuals who wish to maintain or lose weight.

Jimenez (2010) evaluated the effect of an intensive HY intervention (IHY) on cardiovascular risk factors in middle-aged and older women from Northern Mexico. In this prospective quasi experimental design, four middle-aged and nine older CHY practicing females (yoginis) were enrolled into an 11-week 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 ∑ skin folds], cardiovascular fitness [maximal expired air volume (VE max), maximal O₂ consumption (VO₂ max), maximal heart rate (HR max), systolic (BPs) and diastolic blood pressure (BPd)], biochemical [glucose, triglycerides (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. Daily caloric intake (~1,916 kcal/day), program adherence (~85%), and exercising skills (asana performance) were similar in both middle-aged and older women. The IHY program did not modify any anthropometric measurements. However, it increased VO₂ max and VE max and HDL-C while TAG and LDL-C remained stable in both middle-aged and older groups (*P* < 0.01). The proposed IHY program improves different cardiovascular risk factors (namely VO₂ max and HDL-C) in middle-aged and older women.

*James and Raub (2002)* examined the effects of hatha yoga on musculoskeletal and cardiopulmonary function. 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 cardiopulmonary disease.

Sinha et al., (2004) observed the energy cost and cardio respiratory changes during the practice of suryanamaskar and analysised critically the energy cost and different cardio respiratory changes during the practice of suryanamaskar (SN). Twenty one male volunteers from the Indian Army practiced selected Yogic exercises for six days in a week for three months duration. The Yogic practice schedule consisted of Hatha Yogic Asanas (28 min), Pranayama (10.5 min) and Meditation (5 min). In the Yogic practice schedule 1st they practiced KapalaBhathi (breathing maneuvers) for 2 min then Yogamudra (yogic postural exercise) for 2 min, after that they took rest until oxygen consumption and heart rate (HR) came to resting value. Subsequently subjects performed SN for 3 min 40 seconds on an average. After three months of training at the beginning of the fourth month subjects performed entire Yogic practice schedule in the laboratory as they practiced during their training session and experiments were carried out. Their pulmonary ventilation, carbon dioxide output, Oxygen consumption, HR and other cardio respiratory parameters were measured during the actual practice of SN. Oxygen consumption was highest in the eighth posture (1.22 ± 0.073 1 min–1) and lowest in the first posture (0.35 ± 0.02 1 min–1). Total energy cost throughout the practice of SN was 13.91 kcal and at an average of 3.79 kcal/min. During its practice highest HR was 101 ± 13.5 b.p.m. As an aerobic exercise SN seemed to be ideal as it involves both static stretching and slow dynamic component of exercise with optimal stress on the cardio respiratory system.
Johnstone et al., (2006) analyzed the factors influencing variation in basal metabolic rate include fat-free mass, fat mass, age, and circulating thyroxine but not sex, circulating leptin, or triiodothyronine, the variance in BMR into within- and between-subject effects and explored the roles of FFM, FM, bone mineral content, sex, age, and circulating concentrations of plasma leptin, T3, and T4. This was a cross-sectional study of 150 white adults from northeast Scotland, United Kingdom. Only 2% of the observed variability in BMR was attributable to within-subject effects, of which 0.5% was analytic error. Of the remaining variance, which reflected between-subject effects, 63% was explained by FFM, 6% by FM, and 2% by age. The effects of sex and bone mineral content were not significant (P > 0.05). Twenty-six percent of the variance remained unexplained. This variation was not associated with concentrations of circulating leptin or T3. T4 was not significant in women but explained 25% of the residual variance in men. Our data confirm that both FFM and FM are significant contributors to BMR. When the effect of FM on BMR is removed, any association with leptin concentrations disappears, which suggests that previous links between circulating leptin concentrations and BMR occurred only because of inadequate control for the effects of FM.

Bezerra et al., (2010) studied the effects of Yoga on bone biochemical markers (BBM) of formation (osteocalcin) and absorption (carboxy-terminal collagen crosslinks, CTX), and estradiol hormone in postmenopausal women. Forty eight post-menopausal women (63.9 ± 5.6 years old) were divided into two groups: Yoga Group (YG, n = 24) and Control Group (CG, n = 24). The YG performed yoga three times per week (one hour each session) for six months, while the CG was instructed to do not alter their habitual daily routine. Bone mineral density (BMD),
BBM and estradiol hormone were analyzed before and after Yoga program by standard procedures. A mixed factorial ANOVA was performed to verify intra and inter group differences. A significant decrease in spinal lumbar and total hip BMD for the CG was observed while only spinal lumbar BMD decreased in the YG. Osteocalcin values increased in YG and decreased in CG, while CTX values decreased in both groups. No significant differences were observed for the estradiol hormone. It was concluded that the yoga intervention failed to induce significant improvements in post-menopausal women BMD, however, it was capable of enhancing biochemical marker of bone formation as measured by serum osteocalcin, thus suggesting an increased bone turnover.

Blank (2006) evaluated the physiological responses to iyengar yoga performed by trained practitioners, the acute physiological responses to hatha yoga asanas (poses) practiced in the Iyengar tradition. Preliminary data were collected on the impact of postural alignment on physiological responses. Intermediate / advanced level yoga practitioners (n=15females) were monitored for heart rate (HR), oxygen uptake (VO2), and brachial arterial blood pressure (n = 9) during a 90 min practice. The subjects, aged 43.5 ± 6.9 yr (average ± SD), had current weekly practice of 6.2 ± 2.4 hr/week and practice history 9.2 ± 7.2 yr. Physical characteristics of the subjects included: height (167.3 ± 4.1 cm), body mass (59.3 ± 7.2 kg), and percent body fat (23.1 3back arch asanas maintained for 1-5 min. Physiological responses were significantly (p<0.05) greater in standing asanas, inversions, and push up to back arch versus supine and seated asanas. The average metabolic equivalent (MET) of each pose did not exceed 5 METs. The practice expended 149.4 ± 50.7 Kcal. The cumulative time spent within a HR zone of 55-
85% HRmax was 29.7 ± 15.9 min (range = 10.8 – 59.9 min). Asana practice was classified as mild to moderate intensity exercise without evidence of a sustained cardiopulmonary stimulus. Intermediate and advanced practitioners maintained poses for up to 5 min without stimulating an undesirable pressure response. However, postural alignment significantly influenced blood pressure responses indicating that adherence to precise alignment has relevant physiological consequences for the yoga practitioner.

**Bera and Rajapurkar (1993)** studied the body composition, cardiovascular endurance and anaerobic power of yogic practitioner, forty male high school students, age 12-15 yrs, participated for a study of yoga in relation to body composition, cardiovascular endurance and anaerobic power. The Ss were placed into two subsets viz., yoga group and control group. Body composition, cardiovascular endurance anaerobic powers were measured using standard method. The duration of experiment was one year. The result of ANCOVA revealed that a significant improvement in ideal body weight, body density, cardiovascular endurance and anaerobic power was observed as a result of yoga training. This study could not show significant change in body fat (midaxillary), skeletal diameters and most of the body circumferences. It was evident that some of the fat-folds (tricep, subscapular, suprailiac, umbilical, thigh and calf) and body circumferences (waist, umbilical and hip) were reduced significantly.

**Fillmore et al., (2010)** documented the effects of yoga interventions on balance, flexibility, and strength in adolescent girls 14 to 18 years. Quasi-experimental, nonrandomizedA convenience sample of 33 female adolescents
participated in yoga training 2 times per week and a walking program 3 times per week, for 7 weeks. The instructor-led group received instruction from a registered yoga therapist in person, while the video-led group watched a tape of the instructor-led session. Pre- and post-measurements of weight, hamstring flexibility, body fat, strength, and balance were collected. Means were computed for all variables. Levene's tests for equality of variances were run to determine baseline homogeneity. Histograms with a normal curve superimposed were drawn to check for normal distribution. Repeated-measures general linear model tests were run to test for both within- and between-subjects factors, as well as interactions between the two. Yoga may be a useful adjunct to therapy programs and provide a method to keep this age group interested in exercise.

Bio-Chemical Variables

Manchanda et al., (2000) evaluated the retardation of coronary atherosclerosis with yoga lifestyle intervention, the 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. Revascularisation procedures (coronary angioplasty or bypass surgery) were less frequently required in the yoga group (one versus eight patients; relative risk = 5.45; P = 0.01). Coronary angiography repeated at one year showed that significantly more lesions regressed (20% versus 2%) and less lesions progressed (5% versus 37%) in the yoga group (chi-square = 24.9; P < 0.0001). The compliance to the total program was excellent and no side effects were observed. 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.

**Sayyed et al., (2010)** examined the effect of Sudarshan Kriya Yoga on lipid profile, pulmonary function and hemoglobin concentration; conducted a workshop of 8 days consisting of 150 participants. Out of which 55 were included in the study group. Our results show that after practicing Sudarshan Kriya, there is decrease in Total cholesterol, LDL-C along with significant increase in HDL-C. There are significant changes in pulmonary function (forced vital capacity, expiratory volume in the first second, peak expiratory flow rate and maximum voluntary ventilation), but statistically non-significant changes in hematological parameters. The present study confirmed the positive effect of Sudarshan Kriya Yoga on lipid profile and pulmonary function over period of 8 days.

**Yang (2007)** analyzed the effect of yoga programs for four leading risk factors of chronic diseases, 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.

**Yurtkuran et al., (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, creatinine, calcium, alkaline phosphatase, 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 phosphatase -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.

Damodaran 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 range 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.

Gordon et al., (2008) investigated the effect of exercise therapy on lipid
profile and oxidative stress indicators in patients with type 2 diabetes, the impact of
Hatha yoga and conventional physical training (PT) exercise regimens on
biochemical, oxidative stress indicators and oxidant status in patients with type 2
diabetes. This prospective randomized study consisted of 77 type 2 diabetic patients
in the Hatha yoga exercise group that were matched with a similar number of type 2
diabetic patients in the conventional PT exercise and control groups. Biochemical
parameters such as fasting blood glucose (FBG), serum total cholesterol (TC), triglycerides, low-density lipoprotein (LDL), very low-density lipoproteins (VLDL) and high-density lipoprotein (HDL) were determined at baseline and at two consecutive three monthly intervals. The oxidative stress indicators (malondialdehyde - MDA, protein oxidation - POX, phospholipase A2 - PLA2 activity) and oxidative status [superoxide dismutase (SOD) and catalase activities] were measured. The concentrations of FBG in the Hatha yoga and conventional PT exercise groups after six months decreased by 29.48% and 27.43% respectively (P < 0.0001) and there was a significant reduction in serum TC in both groups (P < 0.0001). The concentrations of VLDL in the managed groups after six months differed significantly from baseline values (P = 0.036). Lipid peroxidation as indicated by MDA significantly decreased by 19.9% and 18.1% in the Hatha yoga and conventional PT exercise groups respectively (P < 0.0001); whilst the activity of SOD significantly increased by 24.08% and 20.18% respectively (P = 0.031). There was no significant difference in the baseline and 6 months activities of PLA2 and catalyses after six months although the latter increased by 13.68% and 13.19% in the Hatha yoga and conventional PT exercise groups respectively (P = 0.144). The study demonstrate the efficacy of Hatha yoga exercise on fasting blood glucose, lipid profile, oxidative stress markers and antioxidant status in patients with type 2 diabetes and suggest that Hatha yoga exercise and conventional PT exercise may have therapeutic preventative and protective effects on diabetes mellitus by decreasing oxidative stress and improving antioxidant status.
2.2. STUDIES ON PRANAYAMA TRAINING

Dexterity

Naveen et al., (1997) assessed the effects of uninostril breathing on the performance in verbal and spatial memory tests. School children (N = 108 whose ages ranged from 10 to 17 years) were randomly assigned to four groups. Each group practiced a specific yoga breathing technique: (i) right nostril breathing, (ii) left nostril breathing, (iii) alternate nostril breathing, or (iv) breath awareness without manipulation of nostrils. These techniques were practiced for 10 days. Verbal and spatial memory was assessed initially and after 10 days. An age-matched control group of 27 were similarly assessed. All 4 trained groups showed a significant increase in spatial test scores at retest, but the control group showed no change. Average increase in spatial memory scores for the trained groups was 84%. It appears yoga breathing increases spatial rather than verbal scores, without a lateralized effect.

Raghuraj and Telles (2008) studied the effect of right, left, and alternate nostril yoga breathing (i.e. RNYB, LNYB, and ANYB, respectively) were compared with breath awareness (BAW) and normal breathing (CTL). Autonomic and respiratory variables were studied in 21 male volunteers with ages between 18 and 45 years and experience in the yoga breathing practices between 3 and 48 months. Subjects were assessed in five experimental sessions on five separate days. The sessions were in fixed possible sequences and subjects were assigned to a sequence randomly. Each session was for 40 min; 30 min for the breathing practice, preceded and followed by 5 min of quiet sitting. Assessments included heart rate variability,
skin conductance, finger plethysmogram amplitude, breath rate, and blood pressure. Following RNYB there was a significant increase in systolic, diastolic and mean pressure. In contrast, the systolic and diastolic pressure decreased after ANYB and the systolic and mean pressure were lower after LNYB. Hence, unilateral nostril yoga breathing practices appear to influence the blood pressure in different ways. These effects suggest possible therapeutic applications.

Pal et al., (2004) studied the effect of short-term practice of breathing exercises on autonomic functions in normal human volunteers, practiced of breathing exercises like pranayama is known to improve autonomic function by changing sympathetic or parasympathetic activity. Therefore, in the present study the effect of breathing exercises on autonomic functions was performed in young volunteers in the age group of 17-19 yr. A total of 60 male undergraduate medical students were randomly divided into two groups: slow breathing group (that practiced slow breathing exercise) and the fast breathing group (that practiced fast breathing exercise). The breathing exercises were practiced for a period of three months. Autonomic function tests were performed before and after the practice of breathing exercises. The increased parasympathetic activity and decreased sympathetic activity were observed in slow breathing group, whereas no significant change in autonomic functions was observed in the fast breathing group. The findings of the present study show that regular practice of slow breathing exercise for three months improves autonomic functions, while practice of fast breathing exercise for the same duration does not affect the autonomic functions.
Body Composition

Ruhal et al., (2010) studied the effect of kapalbhati on selected body composition variables, 30 male students of BPE first year of LNIPE (Deemed University), Gwalior were randomly selected as subjects for this study. Subjects were divided into two groups that is, one experimental group and one control group. The quantitative measurements of each subject were taken with the help of standard equipment, before and after the treatment period of 12 weeks. The selected body composition variables were body fat (%), lean body mass (kg), body water content (%) and basal metabolic rate (KCl) were administered in the Yoga Laboratory of the Institute. Paired ‘t’ test was applied to determine the effect of kapalbhati on selected body composition variables. The paired ‘t’ test revealed that practice of kapalbhati pranayama had significant effect on body fat % (t = 5.47, against required value of 1.761), lean body mass (t = 9.65, against required value of 1.761), body water content (t = 17.24, against required value of 1.761) and basal metabolic rate (t = 9.410, against required value of 1.761) which showed significant effect of practice of kapalbhati pranayama. On the basis of results following conclusions were drawn: (1) significant effect was found on body fat % and no change was found in control group. (2) Significant effect was found on lean body mass and no change was found in control group. (3) Significant effect was found on body water content and no change was found in control group. (4) Significant effect was found on basal metabolic rate and no change was found in control group.

Acharya et al., (2010) studied the effect of pranayama (voluntary regulated breathing) and yogasana (yoga postures) on lipid profile in normal healthy junior
footballers. Twenty 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. They were of age 14.65±0.58 years and none of them had a history of lipid metabolism disorders. 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 footballers. This demonstrated that Pranayama and Yogasana were helpful in regulating sugar level also. Study demonstrates the efficacy of SRY (Swami Ramdev Yoga)- Pranayama and Yogasana sequences on blood lipid profiles in normal healthy footballers. Pranayama and Yogasana can be used as supportive therapy in patients with lipid disorders, heart diseases, hypoglycemia, and so on. There is a need for conducting the experiments on a larger number of participants, to explore the results and mode of action.

McTiernan et al., (2007) studied the effect of national exercise recommendations on adiposity is unknown and may differ by sex. We examined long-term effects of aerobic exercise on adiposity in women and men. This was a 12-month randomized, controlled clinical trial testing exercise effect on weight and body composition in men (N = 102) and women (N = 100). Sedentary/unfit persons, 40 to 75 years old, were recruited through physician practices and media. The intervention was facility- and home-based moderate-to-vigorous intensity aerobic activity, 60 min/d, 6 days/wk vs. controls (no intervention). Exercisers exercised a
mean 370 min/wk (men) and 295 min/wk (women), and seven dropped the intervention. Exercisers lost weight (women, -1.4 vs. +0.7 kg in controls, p = 0.008; men, -1.8 vs. -0.1 kg in controls, p = 0.03), BMI (women, -0.6 vs. +0.3 kg/m(2) in controls, p = 0.006; men, -0.5 kg/m(2) vs. no change in controls, p = 0.03), waist circumference (women, -1.4 vs. +2.2 cm in controls, p < 0.001; men, -3.3 vs. -0.4 cm in controls, p = 0.003), and total fat mass (women, -1.9 vs. +0.2 kg in controls, p = 0.001; men, -3.0 vs. +0.2 kg in controls, p < 0.001). Exercisers with greater increases in pedometer-measured steps per day had greater decreases in weight, BMI, body fat, and intra-abdominal fat (all p trend < 0.05 in both men and women). Similar trends were observed for increased minutes per day of exercise and for increases in maximal oxygen consumption.

**Telles et al., (1994)** assessed the breathing through a particular nostril can alter metabolism and autonomic activities at checking whether such changes actually do occur, and whether breathing is consciously regulated. 48 male subjects, with ages ranging from 25 to 48 years were randomly assigned to different groups. Each group was asked to practice one out of three pranayama (viz. right nostril breathing, left nostril breathing or alternate nostril breathing). These practices were carried out as 27 respiratory cycles, repeated 4 times a day for one month. Parameters were assessed at the beginning and end of the month, but not during the practice. The 'right nostril pranayama' group showed a significant increase, of 37% in baseline oxygen consumption. The 'alternate nostril' pranayama group showed an 18% increase, and the left nostril pranayama group also showed an increase, of 24%. This increase in metabolism could be due to increased sympathetic discharge to the adrenal medulla. The 'left nostril Pranayama' group showed an increase in volar
galvanic skin resistance, interpreted as a reduction in sympathetic nervous system activity supplying the sweat glands. These results suggest that breathing selectively through either nostril could have a marked activating effect or a relaxing effect on the sympathetic nervous system. The therapeutic implications of being able to alter metabolism by changing the breathing pattern have been mentioned.

Bio-Chemical Variables

Danucalov et al., (2008) investigated the effects of respiratory exercises and meditation practices 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, MedGraphics-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 was 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.

Subbalakshmi et al., (2005) studied the immediate effect of ‘nadi –shodhana pranayama’on some selected parameters of cardiovascular,pulmonary, and higher
functions of brain. Practice of pranayama has been known to modulate cardiac autonomic status with an improvement in cardio-respiratory functions. Keeping this in view, the present study is designed to determine whether Nadi-shodana pranayama practice for 20 minutes has any immediate effect on heart rate, systolic and diastolic blood pressure, peak expiratory flow rate, and simple problem solving ability. Ten normal healthy subjects of first year physiotherapy course volunteered for this study. They were aged between 17-20 years. Among them, five were females and five were males. They did not have any previous training in Pranayama. They were highly motivated to participate in this study program. Study procedures were done separately for each subject at the same time of the day between 4-5 pm. All the selected physiological parameters were measured before and after performing ‘Nadi-shodhana Pranayama’. Two sets of controls were done in the matched subjects by allowing them to relax in a couch (A) or close their eyes with quiet breathing for 20 minutes. Following nadi-shodhana pranayama of 20 minutes, a significant decline in basal heart rate (P<0.0001) and systolic blood pressure (P<0.001) was observed. Peak expiratory flow rate was significantly improved (P<0.01) and the time taken for simple problem solving was significantly less following pranayama practice (P<0.0001). In contrast, both control subjects did not show any significant change in respiratory and cardiovascular parameters with 20 minutes. The present study suggests that the ‘Nadi-shodhana Pranayama’ rapidly alters cardiopulmonary responses and improves simple problem solving. Further studies on a larger sample size need to illustrate the underlying mechanisms involved in this alteration.
Pramanik et al., (2009) evaluated the immediate effect of slow pace bhastrika pranayama (respiratory rate 6/min) for 5 minutes on heart rate and blood pressure and the effect of the same breathing exercise for the same duration of time (5 minutes) following oral intake of hyoscine-N-butylbromide, a parasympathetic blocker drug. 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°C). After 5 minutes of this breathing practice, the blood pressure and heart rate again were recorded in the aforesaid manner using the same instrument. The other group (n = 10) took part in another study where their blood pressure and heart rate were recorded following half an hour of oral intake of hyoscine-N-butylbromide 20 mg. Then they practiced the breathing exercise as stated above, and the abovementioned parameters were recorded again to study the effect of parasympathetic blockade on the same pranayama. It was 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
same breathing exercise for the same duration following oral intake of hyoscine-N-butylbromide. Pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during above tidal volume inhalation as in Hering Bruer reflex, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance and thus decreasing the diastolic blood pressure. After hyoscine-N-butylbromide, the parasympathetic blocker, it was observed that blood pressure had not decreased significantly as a result of pranayama, as it was observed when no drug was administered. Vagal cardiac and pulmonary mechanisms are linked, and improvement in one vagal limb might spill over into the other. Baroreceptor sensitivity can be enhanced significantly by slow breathing (supported by a small reduction in the heart rate observed during slow breathing and by reduction in both systolic and diastolic pressure). Slow pace bhashrika pranayama (respiratory rate 6/min) exercise thus shows a strong tendency to improving the autonomic nervous system through enhanced activation of the parasympathetic system.

Bal (2010) examined the effects of Anulom Vilom and Bhashrika Pranayama on Vital Capacity and Maximal Ventilatory Volume, thirty (N = 30) randomly selected male students aged 18 - 26 years volunteered to participate in the study from D.A.V. Institute of Engineering and Technology, Jalandhar (Punjab), India. They were randomly assigned into two groups: A (experimental) and B (control). The subjects were subjected to the eight week pranayama training programme that includes ‘Anulom Vilom Pranayam’ and ‘Bhashrika Pranayam’. The between-group differences were assessed using the Student’s t-test for dependent data. The level of p < 0.05 was considered significant. The vital capacity and maximal ventilatory
volume significantly improved in group A compared with group B. Pranayama training programme may be recommended to improve vital capacity and maximal ventilatory volume.

**Bhargavar et al., (1988)** investigated the autonomic responses to breath holding and its variations following pranayama. Autonomic responses to breath holding were studied in twenty healthy young men. Breath was held at different phases of respiration and parameters recorded were Breath holding time, heart rate, systolic and diastolic blood pressure and galvanic skin resistance (GSR). After taking initial recordings all the subjects practised Nadi- Shodhana Pranayama for a period of 4 weeks. At the end of 4 weeks same parameters were again recorded and the results compared. Baseline heart rate and blood pressure (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.

**Mourya et al., (2009)** analysed the effect of slow- and fast-breathing exercises on autonomic functions in patients with essential hypertension. Breathing exercises practiced in various forms of meditations such as yoga may influence autonomic functions. This may be the basis of therapeutic benefit to hypertensive patients. The study design was a randomized, prospective, controlled clinical study using three groups. The subjects comprised 60 male and female patients aged 20–60 years with stage 1 essential hypertension. Patients were randomly and equally divided into the control and other two intervention groups, who were advised to do 3
months of slow-breathing and fast-breathing exercises, respectively. Baseline and postintervention recording of blood pressure (BP), autonomic function tests such as standing-to-lying ratio (S/L ratio), immediate heart rate response to standing (30:15 ratio), Valsalva ratio, heart rate variation with respiration (E/I ratio), hand-grip test, and cold presser response were done in all subjects. Slow breathing had a stronger effect than fast breathing. BP decreased longitudinally over a 3-month period with both interventions. S/L ratio, 30:15 ratio, E/I ratio, and BP response in the hand grip and cold pressor test showed significant change only in patients practicing the slow-breathing exercise. Both types of breathing exercises benefit patients with hypertension. However, improvement in both the sympathetic and parasympathetic reactivity may be the mechanism that is associated in those practicing in the slow-breathing exercise.

Bernardi et al., (2007) compared ventilatory, cardiovascular and hematological parameters in: 12 Caucasian yoga trainees and 12 control sea-level residents, at baseline and after 2-week exposure to high altitude (Pyramid Laboratory, Nepal, 5,050 m), 38 active lifestyle high-altitude natives (Sherpas) and 13 contemplative lifestyle high-altitude natives with practice of yoga-like respiratory exercises (Buddhist monks) studied at 5,050 m. At baseline, hypoxic ventilatory response (HVR), red blood cell count and hematocrit were lower in Caucasian yoga trainees than in controls. After 14 days at altitude, yoga trainees showed similar oxygen saturation, blood pressure, RR interval compared to controls, but lower HVR (−0.44 ± 0.08 vs. −0.98 ± 0.21 l/min/m/%SaO₂, P < 0.05), minute ventilation (8.3 ± 0.9 vs. 10.8 ± 1.6 l/min, P < 0.05), breathing rate (indicating higher ventilatory efficiency), and lower red blood cell count, hemoglobin,
hematocrit, albumin, erythropoietin and soluble transferrin receptors. Hypoxic ventilatory response in monks was lower than in Sherpas \((-0.23 \pm 0.05 \text{ vs. } -0.63 \pm 0.09 \text{ l/min/m/%SaO}_2, P < 0.05\); values were similar to baseline data of yoga trainees and Caucasian controls, respectively. Red blood cell count and hematocrit were lower in monks as compared to Sherpas. In conclusion, Caucasian subjects practicing yoga maintain a satisfactory oxygen transport at high altitude, with minimal increase in ventilation and with reduced hematological changes, resembling Himalayan natives. Respiratory adaptations induced by the practice of yoga may represent an efficient strategy to cope with altitude-induced hypoxia.

2.3. STUDIES ON COMBINATION OF ASANAS AND PRANAYAMA TRAINING.

Dexterity

Peters and Campagnaro (1996) analysed one of the axiomatic claims of both academic and folk psychology that women have greater manual dexterity than men. On the basis of the performance of right-handed men \((N = 47)\) and women \((N = 57)\) on 6 different motor tasks, this general claim is shown not to be valid. On a peg-moving task with thick pegs that can easily be picked up by large hands and that required a large movement trajectory, men performed better than women, whereas on a peg-moving task with very thin pegs, women performed better than men. When the same thin pegs were picked up and placed with tweezers, eliminating finger size as a factor, sex differences disappeared. A tapping and a sequencing task favored men. The results show that a variety of factors other than dexterity determine magnitude and direction of sex differences on fine motor tasks.
Tellies et al., (1993) examined the improvement in static motor performance following yogic training of school children. To achieve this purpose, two groups of 45 children each, whose ages ranged from 9 to 13 years, 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 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 (the 'Yoga' group) received training in special physical postures (asanas), voluntary regulation of breathing (Pranayama), maintenance of silence, as well as visual focussing 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 (Wilcoxon's paired signed-ranks test) decrease in errors, whereas the 'Control' group showed no change.

Tellies et al., (1994) studied the immediate effect of three yoga breathing techniques on performance on a letter-cancellation task, static motor performance was tested in two groups with 20 subjects in each (age range 17 to 22 years, and 5 females in each group). Tests were carried out at the beginning and end of a 10 day period. The test required being able to insert and hold a metal stylus within holes of varying sizes for 15 sec. Accidental contacts between the stylus and the sides of the holes, were registered on a counter as errors. During the 10 days one group (the yoga group) practised asanas (physical postures), pranayama (voluntary regulation of breathing), meditation, devotional sessions, and tratakas (visual focussing exercises). The control group followed their usual routine. At the end of 10 days the
yoga group showed a significant reduction in number of errors (Wilcoxon paired
d signed ranks test), while the control group did not change. Our earlier study showed
a similar improvement in children (9-13 years). It was interesting to note the same
degree of plasticity in motor control systems in young adults. The implications for
rehabilitation programmes have been discussed.

Kiellgren et al., (2007) investigated whether Sudarshan Kriya and related
practices (SK&P) can lead to increased feeling of wellness in healthy volunteers.
Participants were recruited in a small university city in Sweden and were instructed
in a 6-day intensive program of SK&P which they practiced daily for six weeks. The
control group was instructed to relax in an armchair each day during the same
period. Subjects included a total of 103 adults, 55 in the intervention (SK&P) group
and 48 in the control group. Various instruments were administered before and after
the intervention. Hospital Anxiety Depression Scale measured the degree of anxiety
and depression, Life Orientation Test measured dispositional optimism, Stress and
Energy Test measured individual's energy and stress experiences. Experienced
Deviation from Normal State measured the experience of altered state of
consciousness. There were no safety issues. Compliance was high (only 1 dropout in
the SK&P group, and 5 in the control group). Outcome measures appeared to be
appropriate for assessing the differences between the groups. Subjective reports
generally correlated with the findings from the instruments. The data suggest that
participants in the SK&P group, but not the control group, lowered their degree of
anxiety, depression and stress, and also increased their degree of optimism
(ANOVA; p < 0.001). The participants in the yoga group experienced the practices
as a positive event that induced beneficial effects. These data indicate that the
experimental protocol that is developed here is safe, compliance level is good, and a full scale trial is feasible. The data obtained suggest that adult participants may improve their wellness by learning and applying a program based on yoga and yogic breathing exercises; this can be conclusively assessed in a large-scale trial.

Altman and Elaine (2001) to measure whether the Complementary and Alternative Medicine (CAM) techniques of breathing exercises, mindful meditation, and yoga stretching affect the stress indicators of heart rate, blood pressure, and respiration rate during a 4-week stress reduction program. The brief therapy model is tested both from quantitative and qualitative perspectives to determine its effectiveness in reducing stress. The theoretical basis of this research is the seminal work of the Benson and Kabat-Zinn 8-week programs founded at Harvard Medical School and the University of Massachusetts Medical Center, respectively. The data for this research were collected from outpatients at the Foshay Cancer Center of the Jupiter Medical Center in Florida and the program benefits were accessed from physical, mental, emotional, and spiritual perspectives. From the beginning of the first program session to the end of the fourth program session, significant reductions in the average heart rates, systolic blood pressures, and respiration rates of the research participants were recorded. The findings suggest that the brief therapy model can be effective in reducing stress using breathing exercises, mindful meditation, and a major component of yoga stretching.

**Body Composition and BMR**

Sukhee et al., (2006) identified the effects of aerobic exercise and yoga on body composition and lipid metabolism in abdominal obese women. Using one-
group pretest-posttest design, a convenience sample of 23 women who had abdominal obesity (greater than 32 inches of waist circumference) was recruited in a local area of P city and participated in 1 hour of aerobic exercise and yoga program twice a week for 12 weeks. Body composition was measured by body mass index, body fat ratio, waist and hip circumference, and waist-hip ratio; and lipid metabolism was measured with blood pressure, total cholesterol and triglycerides. At pretest, mean age of the subjects was 48.7(SD=9.5) and body fat ratio was 33%, and waist-hip ratio was .85. By paired t-tests, waist circumference and waist-hip ratio were significantly decreased before and after the program but body mass index, blood pressure, and the level of lipid metabolism did not change.

Raju et al., (1997) studied six female physical education teachers, mean age 25.6, who yoga trained intensely for four weeks. Each participant’s body fat was predicted from skin fold measurements made upon arrival at the yoga camp and again after the four weeks of yoga training. Yoga training consisted of practicing twice a day for 90 minutes each time. Although these women were physically fit upon entering the yoga camp, they still had significant improvement in body composition after yoga training; percent body fat was significantly lower post yoga training. However, women who train less intensely may not experience improvements in body composition. A study of nine female college students who trained for 85 minutes at least twice a week for eight weeks found that yoga training did not significantly improve body composition. Only these combinations of yoga training durations and frequencies have been used to assess the effects of yoga training on the body composition of females. It is obvious that more research is
needed to assess the effectiveness of yoga training to change the body composition of females.

Sinha et al., (2001) studied 20 Indian Army men between the ages of 19-23 who yoga trained for six months, 60 minutes a day, six days a week. Skin fold measurements for these men were made at the subscapula and thigh and used in the Sloan method to predict body fat percentages. The changes in body composition of these men were compared to those of 20 men of similar ages in a control group. Men in the control group did not yoga train but were physically active for the same durations and frequencies as the men in the experimental group. In comparing pre and post results, the experimental group had a significant reduction in percentage of body fat and an increase in lean body mass. There were no significant changes in body composition for the control group.

Milind et al., (2011) studied that how effective is sun salutation in improving muscle strength, general body endurance and body composition? The purpose of the present study was to evaluate effects of regular practice of sun salutation on muscle strength, general body endurance and body composition. Subjects (49 male and 30 female) performed 24 cycles of sun salutation, 6 days a week for 24 weeks. Upper body muscle strength was determined by 1 repetition maximum (1RM) for bench press and shoulder press technique. Back and leg dynamometry was used to assess strength of back and leg muscles. General body endurance was evaluated by push-up and sit-up tests. Body composition was assessed by noting % body fat by using bioelectric impedance analysis. Perceived intensity of exercise by subjects was noted by Borg scale. Muscle strength by bench press showed significant increase in male (29.49±9.70 to 36.12±9.09 Kg, \( P<0.001 \)) and female (10.5±4.42 to 13.16±4.44 Kg, \( P<0.001 \)) subjects. Strength by shoulder
press also increased (males; 22.96±9.57 Kg to 26.53±11.05 Kg, \(P<0.001\), females; 6.83±2.78 to 8.83±3.87, \(P<0.001\)). Endurance by push-ups & sit-ups showed similar findings in male (19.0±9.58 to 21.98±8.98, \(P<0.001\) and 24.92±10.41 to 29.84±12.64, \(P<0.001\) respectively) and female (14.66±6.80 to 18.56±6.97 and 13.16±7.75 to 19.23±8.25, \(P<0.001\) respectively) subjects. A significant decrease in body fat percent was observed only in female (27.68±5.46 to 25.76±4.72, \(P<0.001\)) but not in male subjects. BMI significantly decreased in both the groups (\(z=4.37, P<0.001\) and \(t=5.41, P<0.001\) respectively). From our observations we conclude that sun salutation can be an ideal exercise to keep oneself in optimum level of fitness.

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

**Farias et al., (2009)** studied the influence of programmed physical activity on body composition among adolescent students during 1 school year. The sample
included 383 students (age range: 10 to 15 years) separated into two groups: 186 cases (96 male and 90 female) and 197 controls (108 male and 89 female). This was an intervention study with pre- and post-test assessments in which interventions consisted of programmed physical activity; the control group had conventional school physical education. Body composition was assessed by anthropometric measurements, body mass index (BMI), body fat percentage and fat and lean body mass. In the case group, subscapular skinfold thickness, BMI, body fat percentage and fat body mass remained stable; there were significant reductions in tricipital skinfold thickness and in abdominal perimeter among girls and significant increases in arm, waist and calf perimeters and in lean body mass. In the control group, there were significant increases in BMI, tricipital skinfold thickness, abdominal perimeter and fat body mass among girls. At post-test, overweight and obesity significantly decreased among case group subjects, but not among controls. Programmed physical activity resulted in improvement or maintenance of body composition parameters and in reduction of overweight and obesity in the intervention group.

Scheffler et al., (2007) analysed the body composition, motor development and cardiovascular parameters of preschool-children. In 2001/2002 a longitudinal study started in 17 nursery schools in Berlin. A total of 160 children out of the 264 children participated in a regular exercise programme. After 24 months of training significant differences of body composition, motor skills and cardiovascular parameters between 5 complete year old children of the intervention and the control group were observed. The results show that such an exercise programme is successful as a preventive measure to decrease the risk of obesity.
Chaya et al., (2006) investigated the net change in the basal metabolic rate (BMR) of individuals actively engaging in a combination of yoga practices (asana or yogic postures, meditation and pranayama or breathing exercises) for a minimum period of six months, at a residential yoga education and research center at Bangalore. The measured BMR of individuals practicing yoga through a combination of practices was compared with that of control subjects who did not practice yoga but led similar lifestyles. The BMR of the yoga practitioners was significantly lower than that of the non-yoga group, and was lower by about 13% when adjusted for body weight (P < 0.001). This difference persisted when the groups were stratified by gender; however, the difference in BMR adjusted for body weight was greater in women than men (about 8 and 18% respectively). In addition, the mean BMR of the yoga group was significantly lower than their predicted values, while the mean BMR of non-yoga group was comparable with their predicted values derived from 1985 WHO/FAO/UNU predictive equations. This study shows that there is a significantly reduced BMR, probably linked to reduced arousal, with the long term practice of yoga using a combination of stimulatory and inhibitory yogic practices.

Telles et.al., (2010) studied the short term health impact of a yoga and diet change Program on obesity for that :a single group of 47 persons were assessed on the first and last day of a yoga and diet change program, with 6 days of the intervention between assessments. The assessments were: body mass index(BMI), waist and hip circumferences, mid-arm circumference, body composition, hand grip strength, postural stability, serum lipid profile and fasting serum leptin levels. Participants practiced yoga for 5 hours every day and had a low fat, high fiber,
vegetarian diet. Last and first day data were compared using a t-test for paired data. Results: Following the 6-day residential program, participants showed a decrease in BMI (1.6 percent), waist and hip circumferences, fat-free mass, total cholesterol (7.7 percent decrease), high density lipoprotein (HDL) cholesterol (8.7 percent decrease), fasting serum leptin levels (44.2 percent decrease) and an increase in postural stability and hand grip strength (p<0.05, all comparisons) Conclusions: A 6-day yoga and diet change program decreased the BMI and the fat-free mass. Total cholesterol also decreased due to reduced HDL levels. This suggests that a brief, intensive yoga program with a change in diet can pose certain risks. Benefits seen were better postural stability, grip strength (though a ‘practice effect’ was not ruled out), reduced waist and hip circumferences and a decrease in serum leptin levels.

**Bio-Chemical Variables**

**Prasad et al., (2006)** conducted the impact of pranayama and yoga on lipid profile in normal healthy volunteers, 41 men and 23 women, to evaluate the impact of Pranayama and Yoga asanas 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 alone 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 Pranayamam, while triglycerides and LDL- cholesterol decreased in women after yoga asanas. The
results of the present study indicate that Pranayama and yoga asanas can be helpful in patients with lipid metabolism disorders such as coronary artery disease, diabetes mellitus and dyslipidemia etc.

**Malhotra et al., (2004)** examined the effects of yoga and pranayama in non-insulin dependent diabetes mellitus. To achieve this purpose twenty Type 2 diabetic subjects between the age group of 30-60 years were studied to see the effect of 40 days of Yoga asanas on biochemical profile. The duration of diabetes ranged from 0 to 10 years. Subjects suffering from cardiac, renal and proliferative retinal complications were excluded from the study. Surya Namaskar, Tadasam, Konasam, Padmasan, Pranayama, Pasimottanasan, Ardhmatsyendrasam, Shavasan, Pavanmuktasan, Sarpasan and Shavasan were given to the subjects. Subjects were called to the cardio-respiratory laboratory in the morning time and were given training by the Yoga expert. The Yogic exercises were performed for 30-40 minutes every day for 40 days in the above sequence. The subjects were prescribed medicines and diet. The basal blood glucose, lipid profile and glycosylated haemoglobin was measured and repeated after 40 days of yoga asanas. The findings of the study suggest that yoga asanas have a beneficial effect on glycaemic control and lipid profile (serum cholesterol, LDL, VLDL and triglycerides) in mild to moderate Type 2 diabetes.

**Singh et al., (2008)** aimed to see if yoga-asana and pranayama have any influence in modifying certain biochemical parameters. Sixty patients of uncomplicated type 2 diabetes (age 35-60 yrs of 1-10 yrs duration) were divided into two groups: Group 1 (n=30): performed yoga along with the conventional
hypoglycemic medicines and group 2 (n=30): patients who only received conventional medicines. Duration of the study was 45 days. Basel recordings of blood glucose (fasting and post-prandial), lipid profile and serum insulin were taken at the time of recruitment and the second reading after forty five days. Results showed a significant improvement in all the biochemical parameters in group 1 while group 2 showed significant improvement in only few parameters, thus suggesting a beneficial effect of yoga regimen on these parameters in diabetic patients.

Kanagasabai and Saravanan (2010) examined the effects of Yogasana and pranayama on the selected biochemical and physiological variables. Sixty male students studying B.P.Ed, in the Department of Physical Education and Sports Sciences, Annamalai University were selected randomly as subjects and their age ranged between 25-28 years. They were divided into four groups of fifteen each. Group I served as a control; Group II as Asana; Group III Pranayama and Group IV Yogasana (Asana and Pranayama). Yogasana practices were given to all the selected subjects except the control for three months (4 days/week). Biochemical and physiological variables were analyzed before and after the treatment of yoga. Data were collected and statistically analyzed using ANOVA and DMRT. Results showed that Asana and Pranayama treatment moderates the lipid levels and blood pressure than other groups. The study also reveals that combined work of Asana and Pranayama significantly improves HDL concentration and decreases blood pressure, cholesterol, triglycerides and LDL level.

Yadav et al., (2005) measured the concentration of thiobarbituric acid reactive substances (TBARS) in blood as an indicator of oxidative stress at the
beginning and at the end of a comprehensive yoga-based lifestyle modification program (YLMP). The data was collected from 104 subjects (59 male, 45 female), 19-71 years of age (mean +/- SD, 41.2 +/- 14.6 years). The YLMP consisted of a nine-day educational out-patient course on the theory and practice of yoga and included, besides a daily one-hour practice of physical postures (asanas) and breathing exercises (pranayama), lecture and films on yoga, stress management and nutrition, practice of meditation and shavasana (a relaxation technique), and individual counseling. Venous blood samples were collected on the first and last day of the course. The serum concentration of TBARS decreased significantly from 1.72 +/- 0.72 nmoles/ml on day 1 to 1.57 +/- 0.72 nmoles/ml on day 10 (P<0.05). The study suggests that a brief low cost lifestyle intervention based on yoga reduces oxidative stress.

Tundwala et al., (2012) examined the effect of pranayama and certain yogic asanas on parameters of obesity viz. weight reduction (BMI and waist hip ratio), Blood pressure and lipid profile were studied. Our study Included 150 patients after screening inclusion and exclusion criteria for obesity, hypertension and dyslipidemia. The duration of the study was 3 months. Various parameters on demographic and clinical data for these diseases were recorded at the start of the study.75 study group Patients were to attend Yoga camp daily for 3 months. The clinical data was again recorded at the end of the study period of 3 months for comparison. There were significant decrease in the parameters of obesity viz. BMI and WHR, significant improvement in hypertension both systolic and diastolic blood pressure and significant improvement in various lipid profile parameters viz.
decrease in total cholesterol, LDL, triglycerides, VLDL and increase in HDL in
study group as compared to control group.

Singh et al., (2011) analyzed the effects of 6-weeks yogasanas training on
agility and muscular strength in sportsmen. A group thirty randomly selected male
players of department of physical education, Guru Nanak Dev University, Amritsar
(Punjab, India)aged 18 – 24 years, volunteered to participate in the study. They were
randomly assigned into two groups: Y (experimental N=15) and C (control
N=15). The subjects from Group Y were subjected to a 6-weeks yogasanas training
programme. Student’s t test for independent data was used to assess the between-
group differences for dependent data to assess the Post-Pre differences. The level of
p≤0.01 was considered significant. The agility and muscular strength significantly
improved in Group Y compared with the control one. The yoga asana training may
be recommended to improve agility and muscular strength. and contribute to
enhance sports performance.

Jatiya et.al.,(2003) assessed the effect of yoga training on hand grip,
respiratory pressures and pulmonary function, Although there are a number of
reports on the effect of yoga training on pulmonary functions, very few studies have
been under taken on the effect of yoga training on respiratory pressures and hand
grip endurance. Hence the present work was planned to study the effect of yoga
training on hand grip strength (HGS), hand grip endurance (HGE), maximum
expiratory pressure (MEP), maximum inspiratory pressure (MIP), forced expiratory
volume (FEV), forced expiratory volume in first second (FEV1) and peak expiratory
flow rate (PEFR). 20 school children in the age group of 12 to 5 years were given
yoga training (asans and pranayams) for 6 months. 20 age and gender-matched
students formed the control group. Yoga training produced statistically significant
(P<0.05) increase in HGS and HGE. MEP, MIP, FEV, FEV1 and PEFR also
increased significantly (P<0.001) after the yoga training. In contrast, the increase in
these parameters in the control group were statistically insignificant. Our study
shows that yoga training for 6 months improves lung function, strength of
inspiratory and expiratory muscles as well as skeletal muscle strength and
endurance. It is suggested that yoga be introduced at school level in order to
improve physiological functions, overall health and performance of students.

Ahmadi et al., (2010) studied the iron deficiency anemia is the most
prevalent micronutrient deficiency in the world, affecting 20-50% of the world’s
population. It is estimated that 10 and 20% of male and female athletes are iron
deficient, respectively. Iron deficiency has deleterious effects on the physical
performance of athletes. It decreases aerobic capacity, increases heart rate and
elongates the recovery time after exercise. In this cross-sectional study, 42 semi-
professional female athletes who had been playing in basketball, volleyball and
handball super league teams served as subjects. Data on socioeconomic and fertility
status as well as the type of sport were obtained through a questionnaire. Nutritional
data were gathered with a 3 day dietary recall. Total intake of calorie, iron, zinc,
folate, vitamin C and B12 were also analyzed. In addition, ferritin and TIBC were
measured and a CBC test was done for each subject. The results showed that the
mean total calorie intake of women was 2049.79±735.12 kcal, where their iron
intake was 22.33±9.24 mg day-1. There was a significant difference between the
iron intake of basketball and volleyball players (p = 0.036). Of our subjects, 33.33%
had low ferritin levels (<30 ng mL-1) and it was lowest in handball players. Higher
than normal ferritin levels were seen in 12.5% of the subjects. We saw a significant difference in ferritin levels of basketball and handball players (p = 0.047). We conclude that the intake of calorie and iron is low in female athletes and therefore, their hematological indices such as ferritin level are below standard values.

Pouramir et al., (2004) evaluated the effect of gymnastic exercise on body iron status and hematologic profile. The present investigation involved 35 male gymnasts aged from 6 to 14 yrs. Serum ferritin level, total iron binding capacity (TIBC), iron and transferrin saturation, along with hematological indices (RBC, Hb, Hct, MCV, MCH, MCHC) were analyzed in venous blood samples before starting the exercise course and 10 weeks later. The second readings of serum ferritin level, RBC, Hct, and Hb were decreased significantly (p<0.05) as compared to the baseline values, whereas TIBC increased significantly (p<0.02). We concluded that gymnastic training is associated with a reduction in the body iron stores, leading to early stages of iron depletion which might compromise the health and performance of athletes.

Rahmani-Nia et al., (2007) evaluated the effect of two different types of physical activity on soluble transferrin receptor concentration and other indicators of iron status in female taekwondoist. Thirteen members of the National Taekwondo team aged 18-25 yrs with about 4.5 yrs training experience participated in this study. Body mass and height of subjects were accordingly 57.5 ± 13.7 kg and 168.3 ± 7.1 cm. They performed two different laboratory tests: A, incremental treadmill running test and B, 30 – min running test at constant speed at 50% of the HR max. The interval between the tests was 5 – days and the subjects were instructed to refrain
from strenuous physical exercise for 2 – days before test – A and throughout interval test A and B. Blood sample was withdrawn 20 – min before and immediately after two types of tests and were analyzed iron, ferritin, transferrin, sTfR, hemoglobin and hematocrit. Data were analyzed by student t –test. Our results showed that hematocrit increased significantly (P < 0.05) after test A, but not in test B. Soluble transferrin receptor increased after tests A and B, but increases were significant (P < 0.05) after test A only. Also, iron decreased significantly (P < 0.05) after test A and B. However, there were not significant differences (P > 0.05) in ferritin, transferrin receptor and hemoglobin after exercise. It can be concluded that variable of the iron status responded to physical stress and erythropoietic activity and if iron deficiency do not compensate, athletes may experience anemia.

Chatard et al., (1999) studied the trained athletes frequently experience low levels of blood haemoglobin (13 to 14 g/100ml in men and 12 g/100ml in women) plus low hematocrit and low ferritin levels. These parameters define the concept of 'sports anaemia'. Low iron levels may be due to mechanical haemolysis, intestinal bleeding, haematuria, sweating, low iron intake or poor intestinal absorption. The resulting decrease in blood gas transport and muscle enzyme activity impairs performance. The concept of sports anaemia can be criticised. Simply measuring the blood levels does not take into account the haemodilution that occurs in athletes because of training. The lack of these measurements makes it difficult to diagnose anaemia or evaluate any treatment. Anaemia is treated by preventing decreased iron stores through a balanced food intake or iron supplements. Self-medications must be discouraged because of intolerance, risk of overdose and many other drug interactions.
O’Toole et al., (1999) provided a basis for establishing safety cutoffs for hematocrit levels in triathletes and background data for possible future medical control regulations. Competitors from three different distance triathlons participated: Olympic (N = 118), half-Ironman (N = 87), and Ironman (N = 207). Blood samples were drawn within 24-36 h prerace (N = 412) and within minutes of race finish (N = 296). Prerace hematocrits approximated a normal distribution for men (X = 43.2 ± 2.9) and women (X = 40.2 ± 2.6). Prerace hematocrits decreased as competitive distance increased for men (X = 45.0, 43.4, 42.5; respectively; P < 0.01) but not for women (P > 0.05). Mean race day changes were small but statistically significant for Olympic and Ironman men and for half-Ironman women. Individual responses were more variable with hemoconcentration occurring in 57%, hemodilution in 43%, and no change in 2% of participants. The magnitude of individual responses was also variable with hematocrit changes ranging from -7.1 to +10%. No athlete in this sample had a hematocrit that would place him/her in the "danger zone" (Hct > 55%). Cutoff values (3 SD above the means) of 52% for men and 48% for women are suggested by these data. However, the relationship of these cutoffs to either athlete safety or the ability to detect rules violations remains unknown.

Green et al., (1991) clarified the role of progressive heavy training on vascular volumes and hematologic status, seven untrained males [maximal O2 uptake (VO2max) = 45.1 +/- 1.1 (SE) ml.kg-1.min-1] cycled 2 h/day at an estimated 62% of VO2max. Training was conducted five to six times per week for approximately 8 wk. During this time, VO2max increased (P less than 0.05) by 17.2%. Plasma volume (PV) measured by 125I increased (P less than 0.05) from
3,068 +/- 104 ml at 0 wk to 3,490 +/- 126 ml at 4 wk and then plateaued during the remaining four wk (3,362 +/- 113 ml). Red cell (RBC) mass (RCM) measured by 51Cr-labeled RBC did not change during the initial 4 wk of training (2,247 +/- 66 vs. 2,309 +/- 128 ml). As well, no apparent change occurred in RCM during the final 4 wk of training when RCM was estimated using PV and hematocrit (Hct). Collectively, PV plus RCM, expressed as total blood volume (TBV), increased (P less than 0.05) by 10% at 4 wk and then stabilized for the final 4 wk. During the initial phase of training, reductions (P less than 0.05) were also noted in Hct (4.6%), hemoglobin (Hb, 4.0%), and RBC count (6.3%). In contrast, an increase in mean cell volume (MCV, 1.7%) and mean cell Hb (2.3%) was observed (P less than 0.05). From 4 to 8 wk, no further changes (P greater than 0.05) in Hb, RBC, and MCV were found, whereas both mean cell Hb and Hct returned to pretraining levels.

**Pasricha et al., (2010)** determined biological, nutritional, and socioeconomic risk factors for anemia in this vulnerable age group. Conducted a cross-sectional study of children aged 12 to 23 months in 2 rural districts of Karnataka, India. Children were excluded if they were unwell or had received a blood transfusion. Hemoglobin, ferritin, folate, vitamin B₁₂, retinol-binding protein, and C-reactive protein (CRP) levels were determined. Children were also tested for hemoglobinopathy, malaria infection, and hookworm infestation. Anthropometric measurements, nutritional intake, family wealth, and food security were recorded. In addition, maternal hemoglobin level was measured. Anemia (hemoglobin level < 11.0 g/dL) was detected in 75.3% of the 401 children sampled. Anemia was associated with iron deficiency (low ferritin level), maternal anemia, and food insecurity. Children's ferritin levels were directly associated with their iron intake and CRP levels and with maternal hemoglobin level and inversely associated with
continued breastfeeding and the child's energy intake. A multivariate model for the child's hemoglobin level revealed associations with \( \log(\text{ferritin level}) \) (coefficient: 1.20; \( P < .001 \)), folate level (0.05; \( P < .01 \)), maternal hemoglobin level (0.16; \( P < .001 \)), family wealth index (0.02; \( P < .05 \)), child's age (0.05 per month; \( P < .005 \)), hemoglobinopathy (–1.51; \( P < .001 \)), CRP level (–0.18; \( P < .001 \)), and male gender (–0.38; \( P < .05 \)). Wealth index and food insecurity could be interchanged in this model. Hemoglobin level was primarily associated with iron status in these Indian toddlers; however, maternal hemoglobin level, family wealth, and food insecurity were also important factors. Strategies for minimizing childhood anemia must include optimized iron intake but should simultaneously address maternal anemia, poverty, and food insecurity.

Schneider et al., (2005) determined the prevalence of anemia, low iron stores, ID, and IDA in children participating in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) population, and to assess the value of using hemoglobin to predict ID. This was a cross-sectional study of a convenience sample of 12–36-mo-old children from WIC clinics in 2 California countries. The prevalence of anemia was 11.1% (hemoglobin <110 g/L at 12–24 mo or <111 g/L at 24–36 mo). Study- and literature-determined abnormal values for iron measures were as follows: serum ferritin 8.7 or <10.0 µg/L, serum transferrin receptor 8.4 or >10.0 µg/mL, and transferrin saturation 13.2% or <10.0%, respectively. The prevalences of low iron stores (low ferritin) were 24.8% and 29.0%, of ID (2 abnormal iron measures) were 16.2% and 8.8%, and of IDA (ID with low hemoglobin) were 3.4% and 3.2% on the basis of study- and literature-determined cutoffs, respectively. Hemoglobin concentration was used to predict study- and
literature-determined ID on the basis of receiver operating characteristic curves. The sensitivity of low hemoglobin in predicting study- and literature-determined ID was low (23.2% and 40.0%, respectively).

2.5. SUMMARY OF REVIEW OF LITERATURE

The reviews are presented under the two sections namely studies on asana (n=25), pranayama (n=14), combination of asanas and Pranayama (n=30). All the research studies that are presented in this section prove that asana, pranayama and combined training methods contribute significantly for better improvement in dexterity level, body composition, bodyweight lipoprotein, and hematocrit.

Research studies using asana training revealed compatible results (Venkatesh, 2010, Avinash, Sanjay and Nagarathna, 2010, Manjunath and Telles, 1998, Damordaran, et al., 2002, Yang, 2007, Sayyed et al., 2010 and Gordon, et al., 2008). There was clear evidence that the use of asana training was one of the effective training methods to improve the selected criterion variables.

Research studies using pranayama training revealed compatible results (Kiellgren, et al., 2007, Tellies, et al., 1993, Prasad, et al., 2006, Danucalov, Simoes, Kozasa and Leite, 2008, Ruhal et.al 2010 and Bernardi, et al., 2007). The current study created pranayama training programme to determine its effectiveness as a tool for selected variables among men students. Pranayama training protocols are presently being used for the improvement of selected criterion abilities and research.

The independent and dependent variable for the current study are combined training and the change of level of selected variables. Combined training has been
found to elicit greater change in selected variables than the asana training and pranayama training on selected variables. (Altman and Elaine, 2001, Chaya et al., 2006, Raju et al., 1997, Milind V et al., 2011, Prasad, et al., 2006, Yadav, Ray, Vempati and Bijlani, 2005, Singh et al., 2001 and Kanagasabai and Saravanan, 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 dexterity level, bodyweight, body composition, basal metabolic rate, lipoprotein level and hematocrit.