Chapter II

REVIEW OF RELATED LITERATURE

For any specific research project to occupy a place in the development of a discipline, the researcher must be thoroughly familiar with both previous theory and research. To assure this familiarity, every research project in the behavioural sciences has, as one of its early stage, a review of the theoretical and research literature.

The literature related to any problem helps the scholar to discover what is already known, which would enable the investigator to have a deep insight, clear perspective and a better understanding of the chosen problem and various factors connected with the study. So a number of books, journals, and websites were referred. In the following pages, an attempt has been made to present briefly a few of the important researches and studies conducted abroad and in India, as they have significant bearing on the present study.

The literature in any field forms the foundation upon which all future work will be built. If we fail to build upon the foundation of knowledge provided by the review of literature, the researcher might miss some work already done on the same topic.
Noonan (2007) examined the impact of hockey protective equipment on thermal and fluid homeostasis and power output, during a high-intensity, intermittent, exercise protocol. We hypothesized that protective equipment would increase core temperature and reduce sprint power after a simulated hockey game. Eight men (26.8 +/- 1.7 yr) performed a repeated sprint test before and at the completion of a prolonged intermittent exercise protocol (game simulation) on a cycle ergometer under typical hockey ambient conditions. Reduction in exercise performance was calculated by comparing the pre- and postgame repeated sprint power outputs. The protocol was performed twice; once while wearing cotton undergarments only (NOPADS), and once while wearing cotton undergarments and the typical protective equipment worn during a hockey game (PADS). Reduced power output at the completion of the simulated game in PADS was attributed to an elevated body temperature, dehydration, and a greater accumulation of blood lactate.

Bloomfield, et al., (2007) compared the effectiveness of 2 methodologies for speed and agility conditioning for random, intermittent, and dynamic activity sports (e.g., soccer, tennis, hockey, basketball, rugby, and netball) and the necessity for specialized coaching equipment. Two groups were
delivered either a programmed method (PC) or a random method (RC) of conditioning with a third group receiving no conditioning (NC). PC participants used the speed, agility, quickness (SAQ) conditioning method, and RC participants played supervised small-sided soccer games. PC was also subdivided into 2 groups where participants either used specialized SAQ equipment or no equipment. A total of 46 (25 males and 21 females) untrained participants received (mean +/- SD) 12.2 +/- 2.1 hours of physical conditioning over 6 weeks between a battery of speed and agility parameter field tests. Two-way analysis of variance results indicated that both conditioning groups showed a significant decrease in body mass and body mass index, although PC achieved significantly greater improvements on acceleration, deceleration, leg power, dynamic balance, and the overall summation of % increases when compared to RC and NC (p < 0.05). PC in the form of SAQ exercises appears to be a superior method for improving speed and agility parameters; however, this study found that specialized SAQ equipment was not a requirement to observe significant improvements.

Carey, et al., (2007) assessed the relationship between aerobic capacity, as measured by the Vo(2)max test, and recovery from high-intensity intermittent exercise. Eleven
female collegiate hockey players agreed to participate. Subjects skated 5 1-lap intervals around the hockey rink at maximal intensity with a 30-second recovery period between skates. The $\text{Vo}(2)_{\text{max}}$ test was performed on a motor-driven treadmill after a modified Bruce protocol. It was concluded that ability to recover from high-intensity intermittent exercise is not related to aerobic capacity. Coaches and trainers probably do not need to include aerobic training in their practices, because the high-intensity interval training commonly seen in hockey training also improves aerobic capacity, as reflected in the high $\text{Vo}(2)_{\text{max}}$ values of these subjects.

Elferink-Gemser, et al., (2007) identified the performance characteristics that could help predict future elite field hockey players, we measured the anthropometric, physiological, technical, tactical, and psychological characteristics of 30 elite and 35 sub-elite youth players at the end of three consecutive seasons. The mean age of the players at the end of the first season was 14.2 years ($s = 1.1$). Repeated-measures analyses of covariance, with standard of performance and measurement occasion as factors and age as a covariate, showed that the elite players fared better than the sub-elite players on technical and tactical variables. Female elite youth players also scored better on interval endurance capacity,
motivation, and confidence. Future elite players appear to have excellent tactical skills by the age of 14. They also have good specific technical skills and develop these together with interval endurance capacity better than sub-elite youth players in the subsequent 2 years. To verify our conclusions, we will be tracking these players into adulthood.

Chaya (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. 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.

Montgomery (2006) examined the size, strength, and aerobic fitness of players from a professional hockey team. Beginning in 1917, data on body size were obtained from historical records of the Montreal Canadiens. Body composition,
strength, and VO2 max were obtained through physiological testing of Canadiens players between 1981 and 2003. Compared with players in the 1920s and 1930s, current players were an average of 17 kg heavier and 10 cm taller, with BMI increased by 2.3 kg/m2. The gain in BMI was not attributed to added fat mass, since percent body fat remained unchanged over the past 22 years. From 1992 to 2003, upper body strength was assessed using a bench press test. Predicted 1 repetition maximum (1 RM) for the 17- to 19-year-old group was 107.0 kg with the highest values attained by the 25- to 29-year-old age group (128.1 kg). Gains in body mass were associated with an increase in upper body strength. VO(2 max) was measured annually on a treadmill between 1992 and 2003 with annual mean values ranging between 54.6 and 59.2 mL x (kg x min)(-1). Compared with values from players in the early 1980s, VO2 max has increased with the improvements independent of body mass; however, given the variability in the data, we are hesitant to infer that VO(2 max) has increased significantly during the 1990s.

Cochrane and Stannard (2005) studied the acute effect of whole body vibration (WBV) training on arm countermovement vertical jump (ACMVJ), grip strength, and flexibility performance. Eighteen female elite field hockey
players each completed three interventions of WBV, control, and cycling in a balanced random manner. WBV was performed on a Galileo machine (26 Hz) with six different exercises being performed. For the control, the same six exercises were performed at 0 Hz, whilst cycling was performed at 50 W. Each intervention was 5 min in duration with ACMVJ, grip strength, and flexibility measurements being conducted pre and post intervention. Acute WBV causes neural potentiation of the stretch reflex loop as shown by the improved ACMVJ and flexibility performance. Additionally, muscle groups less proportionally exposed to vibration do not exhibit physiological changes that potentiate muscular performance.

Bossone, et al., (2004) investigated the cardiovascular response to training and competition at rest and during recumbent bicycle echocardiography Doppler exercise in 26 elite ice hockey players, and to compare the results with those of 14 healthy, active, young male student volunteers. Two-dimensional echocardiography Doppler was applied to determine cardiac chamber size and wall thickness, and to estimate rest and exercise tricuspid regurgitation peak velocity (TRV), stroke volume (SV) and cardiac output. Myocardial adaptation for elite ice hockey players is characterized by increased chamber size and wall thickness typical of combined
endurance and sprint sports. The systemic blood pressure response to exercise is similar in athletes and nonathletes. The higher TRV at rest and at each level of exercise appears to be related to the higher SV, an expression of a physiological phenomenon.

Elferink-Gemser, et al., (2004) determined the relationship between multidimensional performance characteristics and level of performance in talented youth field hockey players, elite youth players (n = 38, mean age 13.2 years, s = 1.26) were compared with sub-elit youth players (n = 88, mean age 14.2 years, s = 1.26) on anthropometric, physiological, technical, tactical and psychological characteristics. Multivariate analyses with performance level and gender as factors, and age as the covariate, showed that the elite youth players scored better than the sub-elite youth players on technical (dribble performance in a peak and repeated shuttle run), tactical (general tactics; tactics for possession and non-possession of the ball) and psychological variables (motivation) (P < 0.05). The most discriminating variables were tactics for possession of the ball, motivation and performance in a slalom dribble. Age discrimination between the two groups indicated that the elite youth players were younger than the sub-elite players. In the guidance of young
talented players to the top as well as in the detection of talented players, more attention has to be paid to tactical qualities, motivation and specific technical skills.

**Lemmink et al., (2004)** determined the reliability of two field hockey specific tests: the shuttle sprint and dribble test (ShuttleSDT) and the slalom sprint and dribble test (SlalomSDT). METHODS: The shuttle sprint and dribble performances of 22 young male and 12 young female field hockey players were assessed on two occasions within 4 weeks. Twenty one young female field hockey players took part in the slalom sprint and dribble test twice in a 4 week period. The ShuttleSDT required the players to perform three 30 m shuttle sprints while carrying a hockey stick alternated with short periods of rest and, after a 5 minute rest, three 30 m shuttle sprints alternated with rest while dribbling a hockey ball. The SlalomSDT required the players to run a slalom course and, after a 5 minute rest, to dribble the same slalom with a hockey ball. There were no differences in mean time scores between the two test sessions. The mean differences were small when compared with the means of both test sessions. With the exception of the slalom sprint time, zero lay within the 95% confidence interval of the mean differences indicating that no bias existed between the two measurements. With the exception
of delta shuttle time (0.79), all intraclass correlation coefficient values for the ShuttleSDT, met the criterion for reliability of 0.80. Intraclass correlation coefficient values for SlalomSDT were 0.91 for slalom sprint time, 0.78 for slalom dribble time, and 0.80 for delta slalom time. ShuttleSDT and the SlalomSDT are reliable measures of sprint and dribble performances of young field hockey players.

Nordström (2004) investigated the effect of training and detraining on bone mineral density of both weight-bearing and non-weight-bearing bone in a cohort of young males who participated in ice hockey training. Forty-three healthy adolescent ice hockey players training for a mean of 9.7+/-2.4 h/week and 25 control subjects training for 2.1+/-2.7 h/week, were included in this longitudinal study. Between the first and the second follow-up, 21 ice hockey players stopped their active sports career. No differences were seen in bone areas when comparing the different groups. In conclusion, training associated with ice hockey is related to continuous accumulation of BMD after puberty in males. Reduced activity is followed by BMD loss within 3 years of cessation of sports career at predominantly weight-bearing sites. The effects are confined to bone density and not bone size.
Shannahoff-Khalsa et al., (2004) investigated the hemodynamics of a yogic breathing technique claimed "to help eliminate and prevent heart attacks due to abnormal electrical events to the heart," and to generally "enhance performance of the central nervous system (CNS) and to help eliminate the effects of traumatic shock and stress to the CNS." Parameters for (4) subjects were recorded during a preexercise resting period, a 31-minute exercise period, and a postexercise resting period. Parameters for subjects were recorded in a laboratory at the University of California, San Diego. Parameters for 3 males (ages 44, 45, 67) and 1 female (age 41) were recorded. One (1) subject (male age 45) had extensive training in this technique. Interventions: This yogic technique is a 1 breath per minute (BPM) respiratory exercise with slow inspiration for 20 seconds, breath retention for 20 seconds, and slow expiration for 20 seconds, for 31 consecutive minutes. Fourteen beat-to-beat parameters were measured noninvasively and calculated for body surface area to yield: stroke index (SI), heart rate (HR), cardiac index, end diastolic index, peak flow, ejection fraction, thoracic fluid index, index of contractility, ejection ratio, systolic time ratio, acceleration index, and systolic, diastolic, and mean arterial pressures (MAPs). Left stroke work index (LSWI) and stroke systemic vascular resistance index (SSVRI) were
calculated. Preclinical studies are warranted to examine the possible long-term effects of this technique that appear to reset a cardiorespiratory brain-stem pacemaker. We postulate that this effect may be the basis for the purported yogic health claim.

Singh, et al., (2004) studied the effect of forty days of Yogic exercises on cardiac functions in Type 2 Diabetics. 2. To study the effect of forty days of Yogic exercises on blood glucose level, glycosylated hemoglobin. The present study done in twenty-four Type 2 DM cases provides metabolic and clinical evidence of improvement in glycaemic control and autonomic functions. These middle-aged subjects were type II diabetics on antihyperglycaemic and dietary regimen. Their baseline fasting and postprandial blood glucose and glycosylated Hb were monitored along with autonomic function studies. The expert gave these patients training in yoga asanas and they pursued those 30-40 min/day for 40 days under guidance. These asanas consisted of 13 well known postures, done in a sequence. After 40 days of yoga asanas regimen, the parameters were repeated. These findings suggest that better glycaemic control and stable autonomic functions can be obtained in Type 2 DM cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with somato-
neuro-endocrine mechanism affecting metabolic and autonomic functions remain to be worked out.

Sinha, et al., (2004) observed critically the energy cost and different cardiorespiratory changes during the practice of 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, first, they practiced Kapal Bhathi (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 and at the beginning of the fourth month the 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 cardiorespiratory parameters were measured during the actual practice of SN. 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 cardiorespiratory system.
Spencer, et al., (2004) investigated the effects of field-hockey specific training on repeated-sprint ability, plasma hypoxanthine (Hx) concentration and other blood parameters in 18 elite female field-hockey players. All subjects performed a repeated-sprint ability test on a cycle ergometer (5 x 6-sec maximal sprints every 30 secs) before and after seven weeks of training, designed to improve repeated-sprint ability. The significant decrease in plasma Hx concentration (post-test minus rest values) following seven weeks of field hockey-specific training provides evidence that Hx production and/or efflux from the muscle are reduced. Therefore, one adaptation of sport-specific repeated-sprint training may be to conserve the purine nucleotide pool.

Balabinis, et al., (2003) compared regimens of concurrent strength and endurance training, 26 male basketball players were matched for stature, body composition, and physical activity level. Subjects completed different training programs for 7 weeks, 4 days per week. Groups were as follows: (a) the strength group (S; n = 7) did strength training; (b) the endurance group (E; n = 7) did endurance training; (c) the strength and endurance group (S + E; n = 7) combined strength and endurance training; and (d) the control group (C; n = 5) had no training. The S + E group showed greater gains in Vo(2)max
than the E group did (12.9% vs. 6.8%), whereas the S group showed a decline (8.8%). Gains were noted in strength and vertical jump performance for the S + E and S groups. The S + E group had better posttraining anaerobic power than the S group did (6.2% vs. 2.9%). No strength, power, or anaerobic power gains were present for the E and C groups. We conclude that concurrent endurance and strength training is more effective in terms of improving athletic performance than are endurance and strength training apart.

Coelho, et al., (2003) compared physiological responses to 2 high-speed resistance training (RT) protocols in untrained adults. Both RT protocols included 12 repetitions for the same 6 exercises, only differing in continuous (1 x 12) or discontinuous (2 x 6) mode. For discontinuous mode, there was a 15-second rest interval between sets. We hypothesized that the 2 x 6 protocol was less physiologically demanding than the 1 x 12 protocol. Fifteen untrained adults randomly performed the protocols on 2 different days while heart rate (HR), blood lactate (BL), rate of perceived exertion (RPE), and concentric phase mean power (CPMP) were measured. The discontinuous protocol was significantly less physiologically demanding, although similar or higher CPMP values were obtained. These findings may help foster long-term adherence to RT in
untrained individuals. However, future studies are needed to compare physiological adaptations induced by these 2 RT protocols.

Jaeger, et al., (2003) investigated differences in stretching behaviour of hamstring muscles in elite field hockey players and normal subjects. They are 16 normal healthy subjects (group A) and 16 elite field hockey players (group B). Stretching of the hamstrings was performed with a knee extension device. Two successive single stretches (1 and 2) until the maximum stretch tolerance was achieved were applied to each subject twice. Simultaneously range of movement (ROM), passive resistance to stretch (PRS) at 36 degrees ROM, and electromyographic (EMG) activity of the biceps femoris and semitendinosus muscles were recorded. Significant differences exist in the stretching behaviour of elite field hockey players and non-athletes. ROM, PRS and EMG activity are higher in athletes. Implications for treatment should be considered, but recommendations cannot be made on the basis of this study yet.

Keogh, et al., (2003) developed an effective testing battery for female field hockey by using anthropometric, physiological, and skill-related tests to distinguish between
regional representative (Rep, n = 35) and local club level (Club, n = 39) female field hockey players. Rep players were significantly leaner and recorded faster times for the 10-m and 40-m sprints as well as the Illinois Agility Run (with and without dribbling a hockey ball). Rep players also had greater aerobic and lower body muscular power and were more accurate in the shooting accuracy test, p < 0.05. No significant differences between groups were evident for height, body mass, speed decrement in 6 x 40-m repeated sprints, handgrip strength, or pushing speed. These results indicate that %BF, sprinting speed, agility, dribbling control, aerobic and muscular power, and shooting accuracy can distinguish between female field hockey players of varying standards. Therefore talent identification programs for female field hockey should include assessments of these physical parameters.

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

Hofman, et al., (2002) investigated the effect of 8 weeks of supplementation with bovine colostrum (Intact) on body composition and exercise performance (5 x 10-m sprint, vertical jump, shuttle-run test, and suicide test). Seventeen female and 18 male elite field hockey players, including players from the Dutch national team, received either 60 g of colostrum or whey protein daily. There were also no significant differences in changes in body composition and endurance tests between the 2 groups. It is concluded that in elite field hockey players, colostrum supplementation improves sprint performance better
than whey. However, there were no differences with regard to body composition or endurance performance.

Wassmer and Mookerjee (2002) developed a descriptive profile and examine the relationships between grip strength, power and sport specific test performance in 37 elite, female collegiate field hockey players (N=8 backs, N=13 forwards, N=4 goalkeepers, N=8 midfield players, N=4 wings). The tests included circumference and limb lengths, %body fat, Margaria-Kalaman stair test, 50-yard dash test, Queen's College step test, grip strength, Illinois agility test, field hockey specific skills tests, and a coordination test. In profiling a sample of elite collegiate field hockey players in the United States, the results of this study indicate that there are similarities amongst the defensive and offensive players with international level field hockey players, and that measures of power and sport specific tests are significantly correlated.

Ray (2001) observed the effect of training in Hatha yogic exercises on aerobic capacity and PE after maximal exercise. Forty men from the Indian army (aged 19-23 yr) were administered maximal exercise on a bicycle ergometer in a graded work load protocol. The oxygen consumption, carbon dioxide output, pulmonary ventilation, respiratory rate, heart
rate (HR) etc., at maximal exercise and PE score immediately thereafter were recorded. The subjects were divided into two equal groups. Twelve subjects dropped out during the course of study. One group (yoga, n = 17) practiced Hatha yogic exercises for 1 h every morning (6 days in a week) for six months. The other group (PT, n = 11) underwent conventional physical exercise training during the same period. Both groups participated daily in different games for 1 h in the afternoon. In the 7th month, tests for maximal oxygen consumption (VO2Max) and PE were repeated on both groups of subjects. The practice of Hatha yogic exercises along with games helps to improve aerobic capacity like the practice of conventional exercises (PT) along with games. The yoga group performed better than the PT group in terms of lower PE after exhaustive exercise.

Ray, et al., (2001) observed any beneficial effect of yogic practices during training period on the young trainees. Fifty four 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 and psychomotor ability, mental well being were also recorded. Various parameters were taken before and during the 5th and 10th month of training period. Initially there was relatively higher sympathetic activity in both the groups due to the new work/training environment but gradually it subsided. Later on at the 5th and 10th month, yoga group had relatively lower sympathetic activity than the control group. There was improvement in performance at submaximal 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.

Yadav and Das (2001) assessed the effects of yogic practice on some pulmonary functions. Sixty healthy young female subjects (age group 17-28 yrs.) were selected. They had to do the yogic practices daily for about one hour. The observations were recorded by MEDSPIROR, in the form of FVC,
FEV-1 and PEFR on day-1, after 6 weeks and 12 weeks of their yogic practice. There was significant increase in FVC, FEV-1 and PEFR at the end of 12 weeks.

Young, et al., (2001) determined if straight sprint training is transferred to agility performance tests that involved various change-of-direction complexities. Thirty-six males were tested on a 30-m straight sprint and 6 agility tests with 2-5 changes of direction at various angles. The subjects participated in 2 training sessions per week for 6 weeks using 20-40-m straight sprints (speed) or 20-40-m change-of-direction sprints (3-5 changes of 100 degrees) (agility). After the training period, the subjects were retested, and the speed training resulted in significant improvements (p < 0.05) in straight sprinting speed but limited gains in the agility tests. Generally, the more complex the agility task, the less the transfer from the speed training to the agility task. Conversely, the agility training resulted in significant improvements in the change-of-direction tests (p < 0.05) but there is no significant improvement (p > 0.05) in straight sprint performance. We concluded that straight speed and agility training methods are specific and produce limited transfer to the other. These findings have implications for the design of speed and agility training and testing protocols.
Malathi, et al., (2000) assessed with forty eight healthy volunteers who participated in the practice of yoga over a period of 4 months on Subjective Well Being Inventory (SUBI) before and after the course in order to evaluate the effect of practice of yoga on subjective feelings of well-being and quality of life. A significant improvement in 9 of the 11 factors of SUBI was observed at the end of 4 months, in these participants. The paper thus, reiterates the beneficial effects of regular practice of yoga on subjective well being.

Machanda, et al., (2000) evaluated 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 programme 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. After 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.

**Murugesan, Govindarajan and Bera (2000)** conducted a study on the basis of medical officers diagnosis, thirty three (N = 33) hypertensives, aged between 35 and 65 years, from the Govt. General Hospital, Pondicherry, were examined with four variables viz. systolic and diastolic blood pressure, pulse rate and body weight. The subjects were randomly assigned into three groups. The exp. group-I underwent selected yoga practices, Exp. group-II received medical treatment by the physician of the said hospital and the control group did not participate in any of the treatment stimuli. Yoga training was imparted in the morning and in the evening with 1 hr/session/day for a total period of 11 weeks. Medical treatment comprised drug intake every day for the whole experimental period. The result of pre-post test with ANACOVA revealed that both the treatment stimuli (i.e., yoga and drug) were effective in controlling the variables of hypertension.

**Telles, Reddy and Nagendra (2000)** evaluated a statement in ancient yoga texts that suggests that a combination of both “calming” and “stimulating” measures may
be especially helpful in reaching a state of mental equilibrium. Two yoga practices, one combining “calming and stimulating” measures (cyclic meditation) and the other, a “calming” technique (Shavasan), were compared. The oxygen consumption, breath rate, and breath volume of 40 male volunteers were assessed before and after sessions of cyclic meditation (CM) and before and after sessions of shavasan (SH). The 2 sessions (CM, SH) were 1 day apart. Cyclic meditation includes the practice of yoga postures interspersed with periods of supine relaxation. During SH the subject lay in a supine position throughout the practice. There was a significant decrease in the amount of oxygen consumed and in the breath rate and an increase in breath volume after both types of sessions (2 factor ANOVA, paired t test). However, the magnitude of change in all the three measures was greater after CM: (1) Oxygen consumption decreased to 32.1% after CM compared with 10.1% after SH; (2) breath rate decreased to 18.0% after CM and 15.2% after SII; and (3) breath volume increased 28.8% after CM and 15.9% after SII. These results support the idea that a combination of yoga postures interspersed with relaxation reduces arousal more than what relaxation alone does.
Mahajan, et al., (1999) studied the effect of yogic lifestyle on the lipid status in angina patients and normal subjects with risk factors of coronary artery disease. The parameters included the body weight, estimation of serum cholesterol, triglycerides, HDL, LDL and the cholesterol - HDL ratio. A baseline evaluation was done and then the angina patients and risk factors subjects were randomly assigned as control (n = 41) and intervention (yoga) group (n = 52). Lifestyle advice was given to both the groups. An integrated course of yoga training was given for four days followed by practice at home. Serial evaluation of both the groups was done at four, 10 and 14 weeks. Dyslipidemia was a constant feature in all cases. An inconsistent pattern of change was observed in the control group of angina (n = 18) and risk factor subjects (n = 23). The subjects practising yoga showed a regular decrease in all lipid parameters except HDL. The effect started from four weeks and lasted for 14 weeks. Thus, the effect of yogic lifestyle on some of the modifiable risk factors could probably explain the preventive and therapeutic beneficial effect observed in coronary artery disease.

Bhole (1998) Yogic techniques could be advantageously added to and integrated with the present day physical education programme if the term physical education is
understood as the education of the individual through his physical i.e. body which is governed by the CNS as well as ANS. Yoga techniques can be looked upon as physical practices having their own psycho-physiological, bio-chemical and neurohumoral consideration. In certain respects these techniques could be complimentary and/or supplementary to the existing techniques of physical education. There is a wide scope to undertake broad based well planned research projects in the field of yoga and physical education to come to definite conclusions.

Mehrotra, et al., (1998) assessed the relation between the quality of exercise performed and the quantitative effect of these exercises on the lungs. Pulmonary function tests of sportsmen engaged in various sports were compared with each other and with that of the controls. Players playing football (n=18), hockey (n=19), volleyball (n=20), swimming (n=20) and basketball (n=18) were chosen for this study. Medical students (n=20) were chosen as controls. The parameters taken into account in this study were forced vital capacity (FVC), forced expiratory volume (FEV-1), and peak expiratory flow rate (PEFR). The results indicate that all the sportspersons had a higher values of lung functions compared to the controls. Among the various groups of players chosen for this study, the
Swimmers showed the maximum increase in their lung functions.

Raghuraj, et al., (1998) conducted the study on HRV in two yoga practices which have been previously reported to have opposite effects, viz, sympathetic stimulation (kapalabhati, breathing at high frequency, i.e., 2.0 Hz) and reduced sympathetic activity (nadisuddhi, alternate nostril breathing). Twelve male volunteers (age range, 21 to 33 years) were assessed before and after each practice on separate days. The electrocardiogram (lead I) was digitized on-line and off-line analysis was done. The results showed a significant increase in low frequency (LF) power and LF/HF ratio while high frequency (HF) power was significantly lower following kapalabhati. There were no significant changes following nadisuddhi. The results suggest that kapalabhati modifies the autonomic status by increasing sympathetic activity with reduced vagal activity. The study also suggests that HRV is a more useful psychophysiological measure than heart rate alone.

Raja et al., (1997) examined the short-term effects of 4 weeks of intensive yoga practice on physiological responses in six healthy adult female volunteers who were measured by using the maximal exercise treadmill test. Yoga practice
involved daily morning and evening sessions of 90 minutes each. Pre and post-yoga exercise performance was compared. Maximal work output (Wmax) for the group increased by 21% with a significantly reduced level of oxygen consumption per unit work but without a concomitant significant change in heart rate. After intensive yoga training, at 154 Wmin (-1) (corresponding to Wmax of the pre-yoga maximal exercise test) participants could exercise more comfortably, with a significantly lower heart rate (P < 0.05), reduced minute ventilation (P<0.05), reduced oxygen consumption per unit work (P < 0.05), and a significantly lower respiratory quotient (P < 0.05). The implications for the effect of intensive yoga on cardiorespiratory efficiency are discussed, with the suggestion that yoga has some transparently different quantifiable physiological effects to other exercises.

Schmidt (1997) evaluated participants of a comprehensive residential three month yoga and mediation training programme living on a low fat lacto-vegetarian diet changes in cardiovascular risk factors and hormones were studied. Substantial risk factor reduction was found. Body mass index, total serum and LDL cholesterol, fibrinogen, and blood pressure were significantly reduced especially in those with elevated levels. Urinary excretion of adrenaline, noradrenaline,
dopamine, aldosterone, as well as serum testosterone and 
luteinizing hormone levels were reduced, while cortisol excretion 
increased significantly. Pansarc Kulkarni and Pendsc (1989) 
determined the effect of yogic training on serum LDL levels. 
LDH is a glycolytic enzyme utilized during exercise to provide 
energy to contracting muscles. Chronic submaximal exercise for 
a longer duration shows about two-fold increase in LDH levels. 
Yogic practices might be bringing similar effects. The present 
work was designed to study effect of yogic training on LDH levels. 
Fourteen female and six male students of average age or 
18 years were subjected to yogic training for six weeks. Serum 
LDH levels were found before and after the training course by 
spectrophotometric method of Henry et al. The serum LDH 
levels were within normal limits and showed significant increase 
both in females and males after yogic training. It indicates that 
Yoga has similar effect on LDL levels like endurance training.

Telles et al., (1997) studied the heart rate, breathing 
rate, and skin resistance for 20 community home girls (Home 
group) and for 20 age-matched girls from a regular school 
(School group). The former group had a significantly higher rate 
of breathing and a more irregular breath pattern known to 
correlate with high fear and anxiety, than the school group. 
Skin resistance was significantly lower in the school group,
which may suggest greater arousal, 28 girls of the Home group formed 14 pairs, matched for age and duration of stay in the home. Subjects of a pair were randomly assigned to either yoga or games groups. For the former emphasis was on relaxation and awareness, whereas for the latter increasing physical activity was emphasized. At the end of an hour daily for six months both groups showed a significant decrease in the resting heart rate relative to initial values (Wilcoxon paired sample rest) and the yoga group showed a significant decrease in breath rate, which appeared more regular but no significant increase in the skin resistance. These results suggest that a yoga program, which includes relaxation, awareness, and graded physical activity, is a useful addition to the routine of community home children.

Raju (1994) studied the effect of pranayama a controlled breathing practice, on exercise tests was studied in athletes in two phases, sub-maximal and maximal exercise tests. At the end of phase 1 (one year) both the groups (control and experimental) achieved significantly higher work rate and reduction in oxygen consumption per unit work. There was a significant reduction in blood lactate and an increase P/L ratio in the experimental group, at rest. At the end of phase II (two years), the oxygen consumption per unit work was found to be
significantly reduced and the work rate significantly increased in the experimental group. Blood lactate decreased significantly at rest in the experimental group only. Pyruvate and pyruvate–lactate ratio increased significantly in both the groups after exercise and at rest in the experimental group. The results in both phases showed that the subjects who practised pranayama could achieve higher work rates with reduced oxygen consumption per unit work and without increase in blood lactate levels. The blood lactate levels were significantly low at rest.

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

**Telles, et al., (1993)** assessed two groups of 45 children each, whose ages ranged from 9 to 13 years on a steadiness test, at the beginning and again at the end of a 10-day period during which one group received training in yoga, while the other group did not. The steadiness test required insertion of and holding for 15 sec. a metal stylus without touching the sides of holes of decreasing sizes in a metal plate. The contacts were counted as 'errors'. During the 10-day period, one group (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.

**Chinnasamy (1992)** conducted a study on effects of asanas and physical exercise on selected physiological and biochemical variables among school boys. In this study ninety male students were randomly selected from Government Higher Secondary School. The initial scores were measured for the selected physiological and biochemical variables namely pulse rate, systolic blood pressure, diastolic blood pressure, haemoglobin content and blood sugar level. The treatment was given for a period of 6 weeks for the experimental group. The significance of the difference among two kinds of exercise group and asanas group for the pre and post test mean gain were determined by ‘F’ ratio through analysis of covariance. Asanas had significantly improved the haemoglobin content and reduced the blood sugar pulse rate and blood pressure.

**Greer et al., (1992)** examined the effects of a 7-week hockey-specific training program on the on- and off-ice test performance scores of 14- and 15-year-old (Bantam) hockey players. Pre- and post-training tests of percent fat (ultrasound), centre of gravity location, 40-yard dash, vertical jump, and on-ice tests of top speed, acceleration, and concerning ability were
completed on 28 male subjects (16 in a training group, 12 in a control group of summer league participants). The training group showed significant improvements (p less than .01) in percent fat, top speed, acceleration, and cornering test performance whereas only percent fat was significantly improved for the control group. The results suggest that performance on tests related to ice hockey can be improved by training specifically for hockey but that performance is not affected by summer league play alone.

Moorthy (1992) conducted a study on minimum muscular fitness of school children of the age group of six to eleven years and compared the influence of selected yogic exercises and physical exercises on them. In that study, 1000 children (517 boys and 429 girls) from second and eleventh standard attended at three schools in Pune. 90 boys and 90 girls from the failure group were randomly allotted to control group. Experimental group I (physical exercises) and Experimental group II (Yogic group) underwent the treatment for a period of six weeks. He concluded that both experimental groups showed significant improvement also the improvement in the yogic group was greater than in physical exercise group.
Satyanarayana, et al., (1992) determined the effect of Santhi Kriya on certain psycho physiological parameters. Eight healthy male volunteers of the age group 25.9 +/- 3 (SD) years were subjected to Santhi Kriya practice daily for 50 minutes for 30 days. The volunteers’ body weight, blood pressure, oral temperature, pulse rate, respiration, ECG and EEG were recorded before and after the practice on the 1st day and subsequently on 10th, 20th and 30th day of their practice. They were also given a perceptual acuity test to know their cognitive level on the 1st day and also at the end of the study i.e., on the 30th day. This study also revealed that Santhi Kriya practice increases oral temperature by 3 degrees F and decreases respiratory rate significantly (P less than 0.05) on all practice days. Other parameters were not found to be altered significantly. It is concluded that the Santhi Kriya practice for 30 days reduces body weight and increases calmness.

Balasubramanian and Pansare (1991) estimated aerobic power (VO2 max) and anaerobic power in medical students before and after six weeks of yogic training. A significant increase in aerobic power and a significant decrease in anaerobic power was observed. This may be due to conversion of some of the Fast Twitch (F.T) muscle fibres into Slow Twitch fibres (S.T) during yogic training.
Ghosh et al., (1991) studied the heart rate and blood lactate in field hockey players (25 juniors and 29 seniors) as well as the blood lactate response in training to assess the anaerobic demand of the game and the adaptability of the players to anaerobic metabolism, respectively. The mean VO2 max of the junior and senior players were 3.32 l/min (54.4 ml/kg/min) and 3.28 l/min (53.8 ml/kg/min), respectively. Blood lactate levels after warm up, training and the game were 2.1, 7.4 and 4.2 mM/l, respectively for the juniors and 2.6, 7.7 and 5.6 mM/l, for the seniors. The aerobic capacity (VO2 max) of the juniors did not differ from their senior counterparts, indicating a similar adaptability to aerobic metabolism. However, the Indian players revealed a lower VO2 max than their International counterparts. Similar lactate levels in juniors and seniors after training indicated a similar adaptability to the anaerobic metabolism also. The higher blood lactate level in seniors after the game reflected that they played with greater intensity than the juniors, due to more experience, better motivation and skill.

Mokha et al., (1990) conducted on 18 female players of the Punjabi University hockey team during their camp held at Punjabi University from 4.10.1988 to 24.10.1988; before participating in the Inter-varsity competition held at Ranchi.
Weight, heart rate and blood pressure of each subject was taken before doing the exercise on the treadmill. The players were asked to run on the treadmill for four minutes at the speed of 10 km/hr. Recovery heart rate and blood pressure were also taken. All these tests were taken twice on each player, i.e. initially at the commencement of the training and finally at the completion of the training camp. It has been observed that there is a reduction of body weight in all the categories of players, the maximum being in halves (2.5 kg). There is an improvement in the percentage recovery in the heart rates of all the categories of players except the halves where the recovery is much less at the end of the training camp as compared to the values in the beginning of the camp.

**Durgalakshmi (1989)** conducted a study on “Effect of yogic exercises on selected physiological variables of high school boys”. The group was consisted of 60 students. The result of the study showed that systolic pressure was increased and diastolic pressure remain unchanged after a six week training of yoga. The scores in breath holding time and vital capacity had also improved. It was statistically significant. She also recommended that the athletes could adopt these exercises and thereby increase in the cardio-respiratory function and further she
adds, yoga could be included in the regular programme of physical education in schools and colleges.

**Ganguly and Gharote (1989)** studied the effect of yogic training on endurance and flexibility. The study was conducted on 70 students of Regional Police Training School (RPTSP), Khandala, from which 35 subjects were assigned to each of the experimental and control groups. Significant lowering of the sitting pulse rate was observed in the experimental group as compared to the control group. The cardiovascular endurance as judged by the Harvard step improved significantly in the experimental group. Although mean increase in the toe touch flexibility was observed in the experimental group, it did not reach the expected statistical significance.

**Bhargava, Gogate and Mascarenhas (1988)** examined the effect of 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 practiced Nadi-Shodhana Pranayama
for a period of 4 weeks. At the end of 4 weeks the 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 appeared to alter autonomic responses to breath holding probably by increasing muscle tone and decreasing sympathetic discharges.

**Moorthy (1988)** conducted a study to find out the effect of selected yogic practices on cardiovascular fitness level of college men and women. Investigations were carried out on 10 male and 5 female students of YMCA College Physical Education, Chennai. The cardiovascular level was assessed by Harvard step test. Results of the study indicated that significant improvement existed in Cardiovascular fitness after 6 weeks of Yogic training programme.

**Gharote (1987)** compared the effect of every day and alternate day yogic training on physical fitness. School boys with mean age of 17 years were tested with the Fleighman Battery of Basic Physical Fitness Test. Results indicated that
significant improvement existed in both the experimental
groups: 6 days and 3 days a week for six weeks in comparison to
the control group in physical fitness.

**Sundar, et al., (1984)** in their study assessed twentyive patients of essential hypertension. Of these, 20 patients
were not given any antihypertensive drug treatment (Group A);
other 5 had to be put on antihypertensive drugs before
including them in the study (Group B). These patients were
demonstrated “Shavasana” and trained to perform it correctly.
Shavasana therapy was continued for six months. There was a
statistically significant fall in both mean systolic and diastolic
pressure of both groups. Further, there was a significant
reduction in doses of antihypertensive drugs, being given to
patients of group B. In 65% patients of group A, blood pressure
could be controlled with Shavasana only and no drug was
needed in them at all. Blood pressure rose significantly to pre-
Shavasana levels in patients who left from practicing yoga.
Thus, with the use of yoga (Shavasana) in therapy of
hypertension, requirement of antihypertensive drugs may be
significantly decreased and in some cases it may be totally
dispensed with and it may be an useful adjunct in treatment of
hypertension.
**Bhole (1982)** conducted study on Breath Holding time after complete expiration and different conditions of the Abdominal Muscles. Relaxed, bulged out and contracted condition of the abdominal wall did not influence breath holding time of 22, 28 sec after deep expiration. Kapalbhati for 30 to 45 sec was found to increase breath holding time by 12 and 9 seconds from the average value of 57 sec for males and 41 sec for females, respectively.