CHAPTER - II

REVIEW OF RELATED LITERATURE
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Study of the related literature comprises locating, reading and evaluating reports of research as well as reports of casual observation and opinion that are related to the individuals planned research report. A study of relevant literature is an essential step to get a full picture of what has been done with regard to the problem under study. The investigator has made an attempt to bring a brief review of research related to the present study to form the background for the present study.

2.1 STUDIES ON YOGA

**Manjunath, Shirley Telles (2001)** took twenty girls between 10 and 13 years of age, studying at a residential school they were randomly assigned to 2 groups. One group practised yoga for one hour fifteen minutes per day, 7 days a week, while the other group was given physical training for the same time. Time for planning and for execution and the number of moves required to complete the Tower of London task were assessed for both groups at the beginning and end of a month. These three assessments were separately tested in increasingly complex tasks requiring 2 moves, 4 moves and 5 moves. The Pre Post data were compared using the Wilsoxon Paired Signed Ranks Test. The yoga group showed a significant reduction in planning time for both 2 moves and 4 moves tasks (53.9 and 59.1 percent respectively) execution time in both 4 moves and 5 moves tasks (63.7 and 60.3 percent respectively) and in the number of moves in the 4 moves tasks (20.9 percent). The physical training group showed no change. Hence yoga training for a month reduced the
planning and execution time in simple (2 moves) as well as complex tasks (4, 5 moves) and facilitated reaching the target with a smaller number of moves in complex tasks (4 moves).

Dhanaraj (1974) studied the effect of yoga and the 5BX fitness plan as selected physiological parameters. The results indicated increases in flexibility after yoga training. Decreases in heart and respiratory rates in basal state were also covered. When yogic training was discontinued for six weeks following the six-week treatment, a significant decline in the valve of PWC 130, flexibility and breath holding time was noticed.

Gharote (1970) reported significant increase in the strength and endurance of the abdominal muscles of the females as a result of schedule of yogic exercises. Bhole et.al (1970) found the yogic exercises significantly improving the vital capacity.

Palsave and Kocher (1973) reported in a study on school children significant improvement in the immediate memory score as a result of a short routine of yogic exercises.

Prasad (1966) evaluated the yoga system of physical education using Hetherington concepts of physical education as criteria. The evaluation was made through use of scientific analysis, seminar discussions, some experiments and judgement of experts. Ratings by the experts indicated that the yoga asanas selected made a very good contribution to flexibility, balance and endurance.
Moorthy (1982) compared the influence of yogic exercise and non-yogic exercise to find out the minimum muscular fitness on school children. He concluded that yogic exercises were more beneficial than the non-yogic exercises to improve minimum muscular fitness of the school children.

Kocher (1971) studied the effects of short term courses of yogic training for three weeks duration on the mental health and found the yogic practices bringing favourable results.

Kocher and Vijayendra (1972) obtained encouraging results of yogic training for three weeks duration on the two hand co-ordination.

2.2 STUDIES ON SPECIFIC TRAINING AND SKILL PERFORMANCES

Malhotra and Subramanian (1982) conducted a study on “Effects of pre-competitive and off-season trainings on general physical fitness and skill in basketball players”. The study was conducted on seven students who were members of the college basketball team. For four weeks a modified training for the general fitness, the specific game fitness and techniques and tactics were imparted simultaneously. After this training the subjects participated in university competitions lasting for about two weeks. This was followed by the six weeks of rest without any training to offset the effect of the earlier training. Thereafter for a period of 4 weeks off-season conditioning, training was imparted for the development of general physical fitness.
The training programme was conducted for six days in a week with one day rest in between for recovery. On each day the training session lasted for 2 hours in the morning and 2 hours in the evening. First in the morning session, the training in individual techniques, tactics and group and team tactics were imparted. In the session 1 ½ hour was used for tactics training as in the morning and ½ an hour for imparting training in the general physical fitness and for the development of individual skill in the game. In the skill tests there had been significant improvement in three tests and in other tests there was a trend of improvement. However, as a result of the off-season training, there was significant improvement in the speed, endurance, strength, flexibility and explosive power and there was significant improvement in two skill tests.

It was concluded that to prevent drop in general physical fitness during the pre-competitive training period, strength and flexibility exercises should be also included. As the improvement in the skill in the game was also dependent on the general physical fitness, it was imperative that the exercises required to build up general fitness should also form part of the training programme.

Scriber (1986) conducted a study to evaluate a college football conditioning programme by investigating selected components of physical fitness. This assessment was made by measuring changes in body composition, cardiovascular endurance and muscular strength in college football players during various periods of training and detraining. Analysis of data consisted of a 4 group x 5 time repeated measures and a factorial ANOVA design for each variables was used. A posthoc Turkey test for HSDF was used for all significant F scores P <05 to determine specifically where significant
differences occurred between groups and over time. Significant differences were found between groups for body composition and cardiovascular endurance.

**Brown, et. al.,(1986)** conducted a study to find out the effect of plyometric training on Vertical Jump performance among high school basket ball players. For this purpose, they used twenty six freshmen and 50 sophomore high school male basket ball players as subjects. Players at random were included in a control group. The training group performed 3 sets of 10 depth jumps (bench height 45 cm) 3 days a week for 12 weeks. The control group performed only the regular basket ball training. Prior to and after the training two forms of Vertical Jump test (with arm swing and without arm swing) were conducted. The researchers found out that 1. the plyometric group improved in vertical jump and with arm assistance significantly (p<0.5) more than control group. 2. the two groups were not significantly (p > 0.5) different in vertical jump without assistance. 3. In the plyometric group 57% of the vertical jump gain was due to jumping skill improvement and 43% was due to strength gain. They concluded that plyometric training appears to enhance the co-ordination of the arms with strength development of the leg and provides a convenient in-season training method.

**Lewis (1968)** conducted a study on male college students (N=90) who participated in a 12 week training and conditioning programme. The subjects were randomly placed in 3 groups and were identified as the traditional group, usually characterized by conventional exercise, the resistive-exercise group, utilizing a combined isometric-isotonic techniques of exercise. He used the
exer-genic exercises in one group, in the other group that is control group no formal conditioning took place. The post test findings showed significant difference on the scores made by the resistive exercise group as compared with other two groups on all four criterion variables indicating that the combined isometric-isotonic method of conditioning was effective.

Singh (1991) found out the comparative effectiveness of specific circuit training, weight training and combination of training on selected skills among basket ball players. Ninety six male students from 14 to 16 years in Kendriya Vidyalaya, Gwalior were selected as subjects and divided into 4 groups each comprising of 24 students. Group I undergone specific circuit training, Group II undergone weight training, Group III undergone combination of training and Group IV acted as control. The training period was 12 weeks. The three experimental groups were found to be significantly better than the control group in the enhancement of skill performance. The combination training method was superior to the other two training methods in improving the basketball performance.

Baley (1977) explains that, each sports skill requires strength, power, muscular endurance, cardiorespiratory endurance, agility and flexibility in different areas. Participants in all sports need all the qualities of physical fitness but in some sports, leg power is of greatest importance. In some others, upper body strength is of greatest importance. In some, flexibility is of great importance.
2.3 STUDIES ON YOGIC EXERCISES AND PHYSICAL EXERCISES

Impact of yogic exercises on sports participants has been analysed in detail. Some of these studies have brought out the varied dimensions of yoga on general physical fitness. A few others have specifically studied the impact of yogic exercises on selected physical & physiological variables.

Limited studies have been carried out regarding the effects of a selected routine of yogic practices on the improvement of physical fitness. It is accepted by the Authorities in Physical education that yogic procedures are best to contribute to improve the flexibility (Smithless and Cameron, 1962). Yoga and physical education both strive to attain health and fitness through their programmes. Yogic approach seems to be more sound and effective. Apart from the practices like yamas and niyamas, meant for training and conditioning of attitudes, the nature of so-called physical practices like Asanas, Pranayamas, etc., contribute to emotional training by influencing autonomic nervous system and endocrinal system.

Giri (1966) using a set of yogic exercise studied the effects of the programme for 6 weeks on the five tests of National Physical Efficiency. He found a significant improvement among the experimental group in all the five sets as a result of yogic training. However when the group discontinued the practice of yogic exercises for the same period of 6 weeks, the effect gained was significantly lost.
Various studies reported by Gharote (1962) Pratap (1968) Kocher and Pratap (1971 a and b), Kocher (1972 a and b) and Palsane and Kocher (1973) showed favourable results of short term yogic training on mental health. Psycho physiological conditioning due to effects of short term yogic training programme on the working of the autonomic nervous system, using a sophisticated and elaborate battery of Wenger’s autonomic balance, brought evidence about the utility of yogic exercises toward improvement of emotional stability (Gharote, 1971 c).

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

Wallin and Schendal (1969) investigated the difference between the tests taken before and after ten weeks of training. They reached the conclusion that ten weeks of jogging programme produced reduction in heart rate for middle aged men at rest and did not produce any significant change in either systolic or diastolic blood pressure.

A study conducted by Gharote (1971) concluded that yogic training tended to contribute to calmness of mind and stability of emotional behaviour.
He further stated that the effect of training was retained at least for another period of two months even when the practices were discontinued. It led to the assumption that a continued practice of yogic exercise might contribute to established pattern of emotional stability.

**Gharote and Ganguly (1971)** reported that a yogic training for 3 weeks showed an improvement of 36.8 percent in minimum muscular fitness in comparison to 20 percent improvement in the case of other training.

**Barrow and Mc Gee (1971)** recommend that a best fitness programme for a player’s physical development should include both strength exercise and flexibility exercises. One most important and distinguishing quality top players have is flexibility and strength. Strong muscles will not hamper flexibility if they are developed through exercises employing a wide range of motion.

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

**Gopal (1973)** found a mean heart rate of about 71 beats per minute for a group which had been trained in yoga for six months and for a group which regularly engaged in long walks and light games. Afterwards both group did 20 jumps and sit ups. The yoga group’s mean heart rate increased to 100, which was 7 less than that of the light exercises group. A group with at least 6 weeks
of certain Hatha Yoga practices followed strenuous exercises with 1 minute sitting and then 3 minutes of either sitting or mild exercises of Shavasana (Corpse Posture) relaxation. Just after the exercises, heart rate averaged over 180 and after 1 minute of sitting it had dropped to about 130. After 3 more minutes of sitting, it had dropped 17 more beats per minute, a lesser drop than that following 3 minutes of Savasana relaxation. This suggests that Savasana relaxation facilitates pulse declination following exercises.

Hubert (1974) studied the effects of yoga on selected physiological parameters. The results indicated an increase in basal metabolic rate, total volume in basal state, T-4 thyroxine, haemoglobin, expansion, breath holding time and flexibility after yoga training. Decrease in heart rate in basal state and respiratory rate also were observed. When yogic training was discontinued for six weeks following six week treatment, a significant decline in the values of PWC 130, flexibility and breath holding time were noticed.

Udupa et al, (1975) observed that average systolic blood pressure decreased after three months of Hatha yoga practice but returned to the pre-experiment value after 6 months. The average changes involved were small.

Gharote (1976) found that the physical fitness index of forty four school children studied by Fleshman battery of basic fitness test, increased after three weeks of training in yogic physical culture which was mainly contributed by improvement in leg lifts, agility and balance.
Bhole (1977) feels that yoga practices are desirable for sportsman and advocates the usefulness of yogic exercises in certain areas like basic personality traits, mental peace and tranquility. Prevention, treatment and recuperation after injuries, etc., as a complementary to sports training programme.

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

Thankamma Oommen (1981) compared the isometrics, yogic physical culture and combination training on body composition and physical fitness status of high school boys. Results of all the three exercise groups showed a significant increase in toe-touching scores. The inter group differences showed that yogic physical culture group was more helpful in developing flexibility than the isometric and combination groups. And in dynamic flexibility, comparatively yogic exercises were the best in developing dynamic flexibility.
Uppal (1982) in his study investigated endurance training employing slow continuous running method which significantly reduces resting systolic and diastolic blood pressure after exercise of the secondary school level boys. significant change was found out in resting and exercise blood pressure in the case of control group as it was obviously a reflection of inactivity.

Moorthy (1982, a) concluded that yogic exercises were effective in improving the percentage of subjects in passing the minimum muscular fitness test. It was also effective in improving the percentage of subjects in passing the individual items of minimum muscular fitness tests. The percentage of improvements in boys and girls in abdominal minuspsoas and lower back after the experimental period brought a total improvement in passing the minimum muscular fitness test.

Moorthy (1982, b) in his study, stated that yogic asanas as well as physical exercises improved flexibility of 90 boys and 90 girls after six weeks of training as judged by Cureton's flexibility test. Forward flexibility in standing was found to be more in doing asanas oriented than in feeling oriented one (Hasta-Padasana) in the same subjects.

Moorthy (1982, c) tried to find the training effect of selected yogic exercise on fitness. A group of 60 boys and 60 girls were selected from the failures of the fitness test and were randomly allotted to each group in control and experimental groups. The subjects were tested twice before and after 6 weeks of yogic training on fitness tests. On all other days, except Sundays, eight Yogic exercises (slides) were imparted to experimental group for a period
of 30 minutes in the afternoon everyday. The control group did not participate in Yogic exercises. He found that the experimental group made statistically significant gains in muscular fitness after six weeks of yogic training. Even though the control group boys made a numerical gain of 3.33, this was not statistically significant.

Moorthy (1982, d) conducted a survey on minimum muscular fitness of school children of age group of six to eleven years and compared the influences of selected Yogic Exercises and Physical Exercises on them. He concluded that both the experimental groups showed significant improvement after six weeks training when compared to the control group. The percentage of improvement was seen much greater in yogic group than in the physical exercise group.

Moorthy (1983) randomly selected 180 students (90 boys and 90 girls) in each group ranging from 6 to 11 years. He concluded that after discontinuing the training in both non yogic exercises as well as yogic exercises the improvement percentages have been decreased. But the decrease in non-yogic exercise group was more significant as compared to the decrease in yogic group. Thus yogic exercises helped to retain their effects longer than non-yogic exercises and hence more advantageous than non-yogic exercises for boys and girls.

Chakrabarthis et. al (1984) studied the effects of individual asanas by dividing the volunteers into three groups, each group practising one of the three important ‘asanas’ namely Sarvangasana (standing on shoulder) Sirasana
(standing on head) and Halasana (plough pose). Each was practised along with its complementary postures i.e., Matsyasana, Mayurasana and Pachimattanasana for optimal results. The effect of Sarvasagana induced more cardiorespiratory response and less endocrine and metabolic responses. Sirasasana induced less physiological changes and Halasana produced more physical changes and less physiological changes.

Cummings (1984) investigated a study to evaluate the effectiveness of six weeks endurance training progressive relaxation- meditation and their combinations for changing stress levels as reflected by change in heart rate, state anxiety levels, urinary catecholamines at rest and after twenty minutes of examination stress. The effect of the treatment on PWC 170, trait anxiety levels and resting systolic and diastolic blood pressure were also determined. Thirty seven healthy female subjects were randomly assigned to one of four treatment groups  1) Control and specific training 2) exercise 20 min/day, 3 days/week at 75% of age related max heart rate 3) meditation 20 min/day, 3 days/week 4) combination exercise and meditation. The result showed that post treatment adjusted mean trait anxiety, resting systolic pressure and stress heart rate were significantly reduced in the exercise, meditation and combination groups. The exercise and combination treatment also showed a significant increase in post treatment adjusted mean PWC 170. The groups trained in progressive relaxation meditation showed a greater effect on heart rate and blood pressure than the exercise group. The exercise group on the other hand had its greater, effect on trait anxiety scores and urinary catecholamine concentrations.
Kanil (1984) in his study investigated the effects of a conditioning programme on selected physiological variables of college women gymnasts. Ten women gymnasts at Oklahoma State University were tested prior to and following a three month conditioning programme. The conditioning programme consisted of running, warm up including stretching and flexibility exercises, formal gymnastic training and strength training. A modified Balke treadmill protocol was used to determine the anaerobic threshold and maximal oxygen uptake. Also measured were resting blood pressure, resting heart rate, percentage of body fat by skinfold and underwater weighing and strength. The data from pre and post tests were statistically tested and significant differences existed in regard to the physical and physiological variables. The results of this study revealed significant improvement in anaerobic threshold heart rate, blood pressure in the standing position, percentage of body fat from both skinfold and underwater weighing and all strength measures except for right leg strength. No significant differences were found in the means of VO2 max, supine resting blood pressure, resting heart rate and right leg strength.

Allen and Basker (1986) investigated to determine the relationship of the Sit and Reach Test on 825 young females who were administered with two trails of three tests. The purpose of the study was to measure back and hamstring flexibility of young female (N=100) with a mean age of 14.08 years. The measurements included the Sit and Reach Test, passive hamstring flexibility and back flexibility, but it did not seem to provide a valid assessment of back, in particular, low back flexibility.
Oberg et al (1986) observed that good muscular strength reduces the number and severity of injuries and delays muscular fatigue. It increases confidence in athletic ability, because it enhances better technique, power and speed of movement. Football players must work with strength training programme as it brings about beneficial changes on the adaptation process. A high level of flexibility fosters a saving in energy during vigorous movements because of this better mechanical advantage. Because of this better physiological and mechanical adjustment of the joint and muscles, the individual may be less vulnerable to injury. Flexibility plays its part in maintaining good posture and it is related to such components as endurance, speed and agility.

Harold (1986) has taken 33 college men doing the toe touch test as subjects to ascertain the relative contribution of selected extensibility exercises, arranged with progressive increase, to the flexibility of the hip joint. The subjects performed six tests over a five-week period. The first and sixth tests had no warm ups, while the second to fifth tests had various degree of warm ups. Results indicate that tests which included extensibility exercises allowed the subjects to display greater flexibility.

Selvarajan (1987) made a study on the effect of practice of asanas on stretching movements. The asanas not only supply the organs with an external massage, but also give them unique internal exercises which cannot be equaled by any other system of sports in the world. It is a recognized fact of therapeutics that the muscle can only retain their strength and elasticity only if they are obliged to perform contracting and stretching movements. Among the
asanas, Bhujangasana, Shalabasana and Dhanurasana are the most magnificent exercises for stretching the abdominal muscles and contracting the back muscles.

**DeWith (1987)** conducted a study of the sit up test as a means of measuring strength and endurance of the abdominal muscles. The findings of this study indicated that:

1. There was a definite question as to the justification for conducting sit up test of strength and endurance of the abdominal muscles.

2. Size appears to have little relationship to strength and endurance of the abdominal muscles as measure in this study.

3. Strength and endurance do not seem to be significantly related so far as the abdominal muscles are concerned and

4. Heavier and taller men seem to be handicapped in performing test of the sit-up type.

**Johnson and Nelson (1988)** observed that the heart rate is an index of the physiological strain incurred by the players during play. It has been observed that resting heart rate is indicative of physical fitness from the standpoint that resting heart is lowered as a result of conditioning. The resting pulse rate of a trained individual decreases reflecting a stronger contraction of the heart and a more forceful expulsion of blood with each contraction. Heart rates of top level players at rest tend to be much lower than the average of 72 beat/min found in general population.
Mall (1980) found Savasana, a yoga relaxation method to be of great utility in reducing the heart rate, systolic and diastolic pressure of all the four recovery techniques. Nine weeks training in yogic physical culture was helpful to improve general physical fitness level for forty-nine cadet police who were already conditioned to physical activities as against the control group of forty-nine engaged only in school schedule as judged through (a) Fleishman-Basic fitness test (b) Cureton’s flexibility test (c) Skin-fold and Harvard-step test. The improvement was most significant in flexibility.

Sharma and Mann (1990) conducted a study on the comparative effect of yoga and Proprioceptive Neuromuscular Facilitation (PNF) technique in improving the hip joint flexibility. They were measured in right and left hip joint flexion before and after the experiment. The results of Analysis of variance was related that subjects were randomly divided into three groups in the age group of 14-16 years each group consisting 12 each and the observed mean difference was found to be statistically significant.

Samraj (1991) conducted a study on the effect of practice of asanas alone and a combination of Asanas, Pranayama and Meditation on anxiety and aggression. In this study, ninety school boys were selected at random by lot. Subjects were tested on anxiety and aggression before and after ten weeks of yogic training. In using analysis of covariance, he observed that anxiety level was significantly reduced but there was no significant decrease in aggression after practising yoga.
Cindy and Hurley (1995) selected thirty one men between the age of 54 and 74 years they were studied in order to compare the effects of strength and flexibility training (SF), flexibility only training (FO) and no training (inactive control group) on shoulder and hip range of motion. The results indicated that the FO group increased its range of motion in shoulder abduction to a significantly greater extent than the SF group, and none of the changes in range of motion for the SF group was significantly different than the changes in the control group. Thus strength and flexibility training is not as effective as flexibility training alone for improving joint range of motion in shoulder abduction.

Yogic exercises bring a variety of benefits both physiological and mental. Some yoga postures are intended to stretch and strengthen muscles. A few others try to improve posture and work on the skeletal system, while a few more aim to compress and release the organs and nerves. According to American Yoga Association (1999) Yoga produces measurable physiological changes in the body such as a decrease in the respiratory rate and blood pressure. In addition, yoga helps an alteration in brain-wave activity and improves physical fitness and circulation.

Ganguly (1981) insisted that everyday one hour training in yogic physical culture for 3 weeks as per the national fitness corps program was found to improve cardiovascular endurance significantly as measured by 20 inch Harward Step test.
The study of **Bhole, Karambelkar and Gharote (1970)** found that vital capacity was significantly increased from 3399 ml. to 3443 ml. in a group of 24 adult males undergoing training in yogic physical culture for three weeks in comparison to the increase from 3095 ml. to 3132 ml. in the control group.

The beneficial effects of yoga is not limited to fine motor skills but also extended to gross motor performances. **Raghuraj (1997)** has reported the effects of pranayama on hand grip strength. 130 right hand dominant school children were assessed for grip strength of both hands. Following 10 days of yoga there was a significant increase in handgrip strength, though no lateralized effect was seen in the groups who practised different uninostril breathing techniques.

**Gore (1987)** investigated effect of yogic training on neuromuscular efficiency in normal and stressful conditions. He concluded that short term yogic training comprising of Asanas and Pranayamas having primary objective of physical culture, improve neuro-muscular efficiency in normal as well as stressful conditions. Thus the ability to continue the work to some extent even in challenging situations, is improved after such yogic training. The study of the associated psychological factors would further confirm the results.

**Balasubramanian B, PansareMs (1991)** in their study “Effect of yoga on aerobic and anaerobic power of muscles” inferred that aerobic power (VO$_2$ max) and anaerobic power were estimated in medical students before and after 6 weeks of yoga training. A significant increase in aerobic power and a significant decrease in anaerobic power were observed. This may be due to
conversion of some of the Fast Twitch (FT) muscle fibres into slow Twitch fibres (ST) during yoga training.

Handerson and Haggard (1955) observed that the economical energy expenditure is indicative of improvement in physical fitness, which directly helps an individual to spend less energy with greater work output. So, it has been inferred that the decreased energy expenditure after Asana training should also contribute to the improvement in physical fitness.

Santhanam (1976) concluded that the short term asana training programme had positively decreased the energy expenditure among the secondary male subjects. It is also clear from the results that Asana practice seems to develop the ability to economise the energy expenditure.

Kalidasan (1998) in his study on Influence of training with and without selected yogic practices on the test match skill level among cricketers concludes that the performance of the boys who had training with yogic practices was better in technical skills and performances, than those of other groups.

Israel (1987) conducted a study on the effect of aerobic, anaerobic and pulse workout exercise on selected physical fitness and physiological parameters. Sixty five volunteers all male under-graduate students were used as subjects. The four treatments consisted of aerobic, anaerobic and pulse workout conditioning programme as well as a control group. The aerobic treatment consisted of a 30 minute continuous jogging session, while the
anaerobic treatment consisted of 15 maximal sprints 40 yards in length. The pulse workout exercise programme was designated to work the subject at his optional work capacity (180 6 pm). All exercise groups worked out four days per week for five week while the control group remained sedentary. Pre and post test measurements were taken on Cooper’s 12 minute run distance, Balke treadmill test measures endurance time and other physiological variables. The data from each variable were analysed by using a one way analysis of variance. It was concluded that the aerobic and pulse workout exercise programme increase the cardiorepiratory endurance most efficiently.

Gray (1988) studied the effect of three modes of aerobic training on cardio-vascular endurance, which were cycling, jogging and swimming. The subjects for this study were 102 college men and women of 17 to 29 years of age. The subjects were allowed to select the mode of training on their own (Cycling, Jogging and Swimming). These three groups were further divided into two sub groups each of which were designated experimental and control sub groups. Experimental group exercised for forty minutes thrice a week for seven consecutive weeks. Based on the findings of this study, it was concluded that anaerobic exercise programme on cycling, jogging and on swimming produced a significant gain in cardio-vascular endurance and it was further concluded that there was no significant difference in specific exercise, heart rate training method to produce a significant increase in cardio-vascular endurance in the aerobic training modes of cycling, jogging and swimming.

Dulin (1988) conducted a study on comparison of the effects of interval and continuous training on the cardio-respiratory fitness on reconditioned
mature males. With Cooper’s aerobic starter programme as a framework for both the interval and the continuous running programmes, workouts were designed to double the time and distance parameters prescribed. The continuous running group afforded a norm group. The interval training group went through the same programme, but prolonged in intervals rather than the continuous running. By running faster, then slower than the continuous runners, the interval runners ran the same times and the same distance. After the two groups had completed their respective programmes a comparison of cardio-respiratory fitness scores was made. The results of this investigation indicated that neither exercise programme, interval running nor continuous running was superior to the other in terms of promoting cardio-respiratory fitness of the participants.

**Renfrow (1989)** conducted a study to determine the effects of an aerobic training regimen of second and fourth grade pupils in Fayetteville School system. Two hundred and twenty two students were the subjects for this study. The students were measured on the following variables; height, weight, skinfold measurements, fifty yards dash, vertical jump, shuttle run, flexibility and nine minute run before and after the experimental period. The treatment group participated in a 21 week aerobic programme consisting of twelve minutes of aerobic activity per day. Comparisons were made between the treatment and control groups for second graders, fourth graders and total groups. The result of this study showed that anaerobic training programme had little or no effect on cardiovascular endurance in elementary school children.
However, the aerobic programme did have a significant effect on percentage of body fat.

2.4 STUDIES ON SPECIFIC TRAINING AND PHYSICAL FITNESS VARIABLES

Barik and Banerjee (1990) investigated the effects of specific conditioning programme on selected performance variables among tribal students. By random sampling 17 tribal schoolboys of 14-16 years of age were selected from a residential school of West Bengal. All the subjects underwent a 6 weeks conditioning programme specially designed for developing speed, endurance, strength and other fitness components. Standard tests were conducted before the 6 weeks training programme and after its completion. From the findings the following conclusions were drawn. Speed, endurance, strength and agility increased significantly after training.

Jim Hilyer (1989) in his study gave plyometric training to the University level basketball players. The basic training mode was rapid, repetitive bench jumping. Other plyometric activities that were incorporated into the programme were bounding on grass and box jumping. The results showed that the University of Alabama at Birmingham men’s basketball players significantly improved, in endurance, power, strength and flexibility.

Cornelius (1989) in his study proved that the contemporary modified proprioceptive neuromuscular facilitation (PNF) stretching techniques can
provide greater increases in joint range of motion (ROM) than conventional
techniques such as passive, static, and ballistic stretching.

**Behm (1990)** in his research article mentioned that the training
programmes should indicate different exercises over alternate weeks. This
serves two important functions; psychological and physiological.
Psychologically, a continually changing programme forces the athlete to
concentrate on the specifics of the programme. In addition, it helps to alleviate
the boredom of a static programme. Minor changes in the exercises that alter
the orientation of the grip, range of motion or angle of pull activates, to varying
degrees, different muscles, sections of muscles or motor units. Weekly changes
in the training programme ensure that the entire musculature is overloaded and
forced to over compensate.

**Nelson (1984)** designed a study to determine whether or not significant
changes occurred in flexibility, heart rate, body weight, selected anthropometric
measurements, body fat and general physical conditioning as a result of
participation in aerobic dancing and aerobic exercise. 1. Participation in both
the dance programmes resulted in an increase in the general level of physical
fitness. 2. Participation in the aerobic dancing programme significantly
reduced body fat. 3. Participation in the aerobic programme significantly
increased flexibility. 4. Neither participation in the aerobic exercise nor aerobic
dancing produced significant change in body weight. 5. Participation in aerobic
dancing resulted in significant changes in various anthropometric measures
along with a significant decrease in body fat. These results considered in
conjunction with the fact that there was no corresponding significant weight
loss and indicated that participation in aerobic dancing caused an increase in lean muscle mass and or a decrease in body fat mass.

Monk (1987) conducted a study to measure the effects of a “Super circuit” exercise programme on university of Albama police officers. 19 male and 3 female officers participated in the 11-week programme multivariate analysis revealed significant gains in cardiovascular fitness as evidenced by a 15% increase in treadmill test performance. Benefits to cardiovascular fitness were also realised in a reduction of resting and exercise recovery heart rate (7% and 13% respectively). There were also significant increases in lower leg strength (7%), upper leg strength (15%), vertical jump (12.5%), and sit ups (37%). It was concluded that the ‘super circuit’ exercise programme does appear to be a time efficient programme for eliciting and maintaining physical fitness among University of Albama police officers. The programme was sufficient to bring about changes in the majority of fitness variables tested; cardiovascular endurance, muscular strength and endurance and power.

Brown (1986) conducted a study to determine the effects of a strength training programme on strength, body composition and self concept in young and matured women. Forty three subjects completed 12 weeks of weight training while 42 acted as controls. The mature experimental (ME) and young experimental (YE) groups showed significant (P< 0.05) increase in strength as compared to the control group. The ME group gained strength at the same rate as the YE group. No changes in body composition were observed. The experimental groups showed significant (p<0.05) improvements
on the self concept scales compared to control group. Those results support the inclusion of strength training in fitness programme for healthy mature women.

Meyer (1987) conducted a study to investigate the effects of ten weeks of strength and flexibility training on the strength, flexibility, body circumference and self perception. Thirty one untrained women were selected and trained three times a week for ten weeks for strength and flexibility using Nautilus machines and static stretching. Strength increased significantly in both groups from pre-test to post-test in all strength tests except for right elbow extension which did increase but was not statistically significant for the control group indicated that maturation and normal activities affected the strength of preadolescent boys.

Uppal and Tunidan (1984) studied the comparative effect of different frequencies of endurance training on cardio-respiratory endurance. According to their findings the cardio-respiratory endurance of secondary school students could be effectively improved by administering a progressive programme of interval training. To bring about significant improvement in cardio-respiratory endurance, varied frequencies of training namely twice, thrice and five days a week were employed. Endurance training workout using interval training method administered three and five days a week was more effective in developing cardio-respiratory endurance as compared to workouts twice a weeks.

Frank Tyson (1990) explains the importance of physical fitness in cricket as follows: In the past, physical training programmes for cricket aimed
at producing a general level of fitness without any regard for the specialised batsman, bowlers, wicket keeper, and field-man whose physical requirements must differ widely. To plan an exercise programme it necessary to identify the functions and skills which need developing. So the specific fitness programme should include programme designed to increase strength, power, muscular endurance cardio-respiratory endurance, a circuit training programme, running training, flexibility training etc.

Mankad (1980) explains the physical fitness that one should posses to become a bowler as follows: the art of bowling is more difficult to acquire than the art of batting. The essential qualities to be a successful bowler are patience, perseverance, a cool mind, zeal, endurance, agility, intelligence, observations, sound physical fitness, will power, judgement and last but not the least strong nerves. To achieve mastery in bowling one should exercise with certain light equipments to strengthen fingers, wrists, shoulders and other muscles.

Hilsendager et. al (1969) in their study, divided 83 male University subjects into five groups with one group each participating in exercises designed to improve agility, speed, strength, speed and strength, and the remaining groups participating in lectures. Thirty one tests were administered before and after participation in the 6 week programmes, and the data were analysed by the analysis of covariance technique. The group participating in agility exercises demonstrated statistically significant superiority over one or more of the other groups on four of the seven agility tests. The only other groups which demonstrated superiority on any of the agility tests were the speed group on the 10 - second squat thrust test and the control group on the
right boomerang run test, thereby leading to the conclusion that agility can best be developed in programmes designed specifically for that purpose and consequently that a unique factor of agility does exist.

**Dintiman (1969)** conducted a study to determine whether a flexibility training programme, a weight training programme and the combination of both would affect running speed when used as supplementary training programmes to the conventional method of training sprinters. One hundred and forty five subjects randomly assigned to one of five training groups were tested for flexibility, leg strength and running speed before and after eight week training period. Results showed that both weight training and flexibility training, as supplements to sprint training, increased running speed significantly more than an unsupplemented sprint training programme.