REVIEW OF RELATED LITERATURE
Chapter – II

Review of Related Literature

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. Such a review brings about a deep and clear perspective of the overall field.

"The review of related literature is an instrument in the selection of the Topic, Formulation of Hypothesis and Deductive reasoning leading to the problem. It helps to get a clear idea and supports the findings with regard to the problem under study" (Tirumalaisamy, 1995).
The collection of relevant literature provides the basic understanding of the problem and its depth. It is a key to the thinking of the investigator.

“The literature in any field forms the foundation upon which all future work will be built” (J.C. Agarwal, 1975).

“The search for reference material is a time consuming but fruitful phase of the graduate programme. A familiarity with the literature in any problem area helps the student to discover what is already known, what others have attempted to find out, what methods have been promising or disappointing and what problems remain to be solved” (John. W. Best, 1978).

Now a days, the educational programme of any type is characterized by reforms and innovative ideas. It seems to be a necessary one to formulate such a review of various scholars’ work. We can bring out a deep in sight and clear perspective of the over all field in such reviews.

The present review is based upon the available literature in respect of the study under investigation and therefore confined to the studies to which the investigator has accessed. All the relevant literature thus obtained by the researcher has been abstracted in this chapter to furnish necessary background material to evaluate the significance of the study.

Wallin and Schendal (1969) investigated the difference between the tests taken before and after ten weeks of training. Twenty-one middle-aged males who participated in the jogging programme performed a six-minute sub maximal exercise on a bicycle ergo meter. Heart rate was obtained from
electro cardiograph and blood pressure was measured by a manual sphygmomanometer. 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.

**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 mental fatigue were taken as criteria measures for the purpose of the study. The tests were taken before and after the experimental period of six weeks. He concluded that anxiety level can be reduced either by training in selected Asanas or related physical exercise and the training in selected Asanas was superior to the training in physical exercise for both variables though the difference was not statistically significant.

**Thankamma Ommen (1981)** compared the isometrics, yogic physical culture and combination training on body composition and physical fitness status of high school boys. Results of this study have shown that all the three exercise groups showed a significant increase in toe-touching scores. The inter group differences show that yogic physical culture group is 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 of the secondary school level boys after exercise.
No 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.

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. Results indicate that tests, which included extensibility
exercises, allowed the subject to display greater flexibility.

Cindy and Hurley (1995) selected thirty-one men between the age of
54 and 74 years, were studied 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 more than the changes in the
control group. The strength and flexibility training alone was for improving
joint range of motion in shoulder abduction.
In a study conducted by Capen (1960) the time of 300-yard run was used as a measure of Cardio-respiratory endurance. Capen found that a group that trained with weights improved in 300 yard run by 6.2 percent. The control group, with emphasis placed upon endurance elements in the training programme improved by 6.3 percent. Capen concluded that weight training was effective in the development of Cardio-respiratory endurance. Such elements in the training programme improved to a greater extent. Capen concluded that weight training was effective in the development of Cardio-respiratory endurance as it was a programme of activity which especially emphasized endurance.

Campbell (1962) studied the effect on the supplemental weight training on the physical fitness of athletic squads. To determine how weight training affected the physical fitness of football, basketball and track and field squads in each sports the athletes were divided into two matched groups. One did weight training in the first half of the season only, and the other group during the second half only. In general, the resulting statistics show that weight training adds significantly to the physical fitness produced by normal training.

Fieldman (1966) 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 from the second to fifth tests they had various degrees
of warm-ups. Results indicate that tests, which included extensibility exercises, allowed the subject to display greater flexibility.

Franks (1969) reported that the middle aged men in a running and calisthenic programme of conditioning improve more than those in a programme of badminton or squash competition in resting and post-exercise systolic amplitude of the brachial pulse wave and left ventricular diastole, breath holding, trunk flexion and anxiety.

Rope skipping which is convenient and inexpensive form of exercise has been proposed as beneficial for improvement and maintenance of cardio-respiratory endurance.

Kobayashi (1969) studied the effects of 8-week rope skipping programme on the cardiovascular fitness of 13 male high school non-athletes. Each boy skipped rope five minutes daily for 35 training sessions. Oxygen consumption and heart rate were determined from a standard treadmill run. As shown by these tests, cardio-respiratory fitness was improved significantly.

Powell (1977) studied rope-skipping effects on five 10 year old boys. These boys skipped five days each week for 10 weeks. They practised the following three activities every day: (a) performed as many skips as possible without missing, (b) did as many turns as possible in five successive efforts, and (c) performed as many skips as possible in 60 seconds. Significant improvements were noted over the 10 week periods as follows: greater leg and knee strength, increased calf size, better jumping ability, faster running speed,
greater agility and flexibility, broader shoulders and deeper chests and improved heart response.

Lofgren (1977) reported that rope skipping did not significantly affect the recovery pulse rate of 100 ninth grade girls who skipped from one to four minutes two times a week in addition to participation in their regular physical education.

Donaghe (1977) studied the effects of rope skipping upon motor fitness elements and Badminton achievement of college women. Two beginning classes were utilized in the study. One class included 10 minutes of rope skipping and the other class who served as a control did not. The rope skipping routine started with rest periods interspersed with skipping. As time progressed the rest periods were gradually shortened until they were eliminated and the vigour and complexity of the skipping increased. Both groups improved significantly on all motor fitness and badminton tests. However, the differences between the groups were not significant.

Fitness results achieved from rope skipping not only depend on the length of time skipping is continued and the interspersing of rest period between skipping bouts, but also on the rapidity or speed of the rope turns.

Pollock, Cureton and Greninger (1969) compared the effects of frequency in jogging two days a week and four days a week. It was demonstrated that four days a week programme was superior to two days a
week programme, in obtaining significant improvements in working capacity, cardiovascular fitness and body composition.

In duration study by Tooshi (1977) the jogging was two days a week and four days a week. It was demonstrated that four days a week programme was superior to two days a week programme in obtaining significant improvements in working capacity, cardiovascular fitness and body composition.

In a duration study by Tooshi (1977) the jogging regimens were the same for three groups, but the lengths of participation, varied from 15 to 30 and 45 minutes. The 15-minute group improved only in running times. Groups with longer participation improved in the same runs as also on several cardiovascular measures. The 45-minute group was the only one to significantly reduce serum cholesterol and body fat.

De Vries (1971) studied the exercise intensity threshold level for improvement of the circulatory-respiratory function in men between 60 and 70 years of age. They participated in a week of jogging programme. The Astrand Bicycle Ergometre Test was utilized for the prediction of maximal oxygen consumption. The significant results included the following: (a) Improvement in the Astrand score varied directly with the intensity of work as indicated by percentage of maximal heart rate, (b) Improvement on the Astrand test varied inversely with the physical fitness level of the men at the start of the programme, (c) the exercise intensity threshold for older men appears to be
about 40% of maximum heart rate. (d) Men in the 60’s and 70’s of average physical fitness may improve their fitness by raising their heart rates above 90 and 95 respectively.

Kripet (1989) investigated the effectiveness of a six-week strength-training programme consisting of squat and plyometric exercises on vertical jump performance, static and dynamic muscular strength and muscular power production in college age adults. Fifteen male and two female college students in an advanced weight training class at the Oregon State University served as subjects for the study. Nine subjects were trained only with combined squat and plyometric exercise. All subjects were trained twice a week for six weeks. A pre-test and post-test randomized groups design was used in this study. The statistical analysis was conducted using a paired t-test, and a repeated measures analysis of variance (ANOVA). A 0.05 level of significance was selected for rejection of null hypothesis. The results indicated a significant mean increase from the pre-test to post-test for the vertical power jump within the combined squat and plyometric training. Static strength significantly decreased (P<0.05) from the pre-test level to the post-test level within the squat training groups. Hamstring strength and power significantly differed (P<0.05) within both training programmes when pre-test and post-test means were compared. However, the researcher found no significant difference, between the gains achieved by two training programmes.
Santo (1976) selected 76 college age men to study the effects of physical conditioning programmes on cardio respiratory endurance. The subjects were divided into four groups, three of which participated in different physical conditioning programmes and one remained as control group. Three conditioning programmes were (i) Cooper’s aerobic programme (ii) interval training and (iii) Regular physical education programme. Cardio respiratory endurance was measured by Harvard step test, 12-minute run/walk test, a three-minute shuttle run and one-minute lateral jump. It was concluded that interval training, aerobic conditioning and regular physical education programme groups improved significantly in cardio respiratory endurance in comparison to control group.

Uppal (1982) found that the efficiency of an individual in performing physical activities depends basically on cardio respiratory changes and training results in development of the circulo-respiratory efficiency. As a result of his study, he came to the conclusion that by endurance training, the efficiency of the circulatory and respiratory system is improved. Maximal O$_2$ uptake is increased. Stroke volume and cardiac output are increased. Ventilatory efficiency is improved, lung volumes become longer and diffusion capacities increased.

Michael (1960) conducted study to find out the pulse were and blood pressure changes occurring during a physical training programme, it was concluded that the resting and post exercise systolic blood pressure
measurement decreased significantly during training. The changes were significant after 16 weeks while the pulse rate changes indicated conditioning and changed in six weeks. During training these measurements were reversed and made significant change in ten weeks.

James (1978) investigated the effects of isotonic and isometric exercise on heart rate and blood pressure and determined the relationship of these effects to physiological work capacity. He reached the conclusion that both isotonic and isometric exercises resulted in significant changes in the heart rate, systolic and diastolic blood pressure and pulse rate.

Donald, Charles and Mathews (1969) investigated college men selected and placed in three matched groups on the basis of maximum oxygen consumption. One group participated in a modified army conditioning programme of calisthenics and marching (N = 8), while the second group participated in a programme of interval training involving running (N = 9). The third group (control) participated in recreational activities (N = 8). The groups met five days per week to seven weeks. Pre and post conditioning maximum oxygen consumption and Harvard step test indexes were recorded to evaluate differences. The results showed that the interval trained group improved significantly on the two fitness tests. The army-trained group showed no significant improvement in maximum oxygen consumption but did have significant improvement for the Harvard step test. The control group did not significantly improve.
Baker (1968) conducted a study to determine the effects of cardiovascular efficiency that results from a programme of rope skipping and jogging. The Harvard step test was administered to ninety-two male students in order to determine their level of cardiovascular efficiency. The subjects were than randomly divided into two groups; group 1 skipped rope 10 min. daily for six weeks and group II jogged thirty minutes daily for six weeks. Upon completion of the conditioning programmes the subjects again were administered the Harvard step test and comparisons were made from the pre exercise and post exercise data. The conclusions of this study were that a daily ten minute programme of rope skill will significantly improve cardiovascular efficiency as measured by the Harvard step test. A daily thirty minute programme of jogging will significantly improve cardiovascular efficiency as measured by the Harvard step test and a ten minute daily programme of rope skipping is as efficient as a particular thirty minute daily programme of jogging for improving cardiovascular efficiency as measured by the Harvard step test.

Burnham (1967) investigated the comparative effect of isotonic and isometric exercise in the development of muscular strength for individuals with different levels of strength. College men participated three day a week in one of the following programmes. Isotonic exercises for ten weeks and isotonic exercises for five weeks were followed by five week of isometric exercises, isometric exercises for ten weeks, or isotonic exercises for five weeks followed by five weeks of isotonic exercises. The multiple linear regression analysis
revealed no significant differences between isometric and isotonic programs in
developing muscular strength of the arm or legs or either group as a whole or
for the different initial strength levels.

Harvey and Wehr (1965) observed the callisthenic exercise programme
advocated for adults by the Presidents Council on physical fitness. It was
tested for its effect on selected components of physical fitness. Nineteen
subjects participated in the exercise programme for ten weeks. The training
was preceded and followed by measurements relative to the council's
objectives for the programme strength, flexibility, improved general
appearance, endurance, coordination and efficiency. Flexibility in males and a
segment of the endurance complex in females appeared significant at the 0.05
level of confidence when the differences observed from training to post
training were exposed to non parametric tests; but this significance did not
appear in any of the other components of physical fitness in isolated instances
within a given component.

Fabricius (1964) studied the physical fitness development of fourth
grade boys and girls who participated in a regular elementary school physical
education curriculum with those who participated in a regular elementary
physical education curriculum with the addition of selected calisthenics.
Physical fitness was measured by the Oregon motor fitness test. In each class a
period of three minutes nine seconds was spent on added calisthenics. The
classes met four times per week. The result showed that both groups improved
significantly in physical fitness in the six month period from September 1962 to March 1963. The experimental group having the added calisthenics improved significantly more than the control group.

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 the 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 in which 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., contributed to the emotional training by influencing autonomic nervous system and endocrinal system.

Prasad (1966) evaluated the Yoga System of physical education. The evaluation was made through the 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 but it gave only a little contribution to the development of strength.

Bhole (1970) found the Yogic exercises significantly improving the vital capacity.
Ganguly and Gharote (1974) experimented that cardio-vascular efficiency was found to increase significantly at the end of eight month training in Yogic physical culture as studied on Harvard step test. A moderate negative correlation of 0.629 was found between Endurance and body fat percentage.

In summarizing the findings of his study on Muscular fitness, Yogic and physical exercises, Moorthy observes. (1982)

Both experimental group I and experimental group II for boys showed significant improvement after six weeks’ training when compared to the control group. Although the percentage of improvement was seen much greater in Yogic exercises group than in physical exercise group, the differences between these two systems of exercises was not found to be significant.

Gharote (1983) Physical fitness index of 44 school children increased after three weeks’ training in Yogic physical culture as studied by Fleischmann battery of basic fitness tests which mainly contributed for the improvement in leg lifts, shuttle run and balance. Extent flexibility, dynamic flexibility, softball throw, cable jumps, 600 yard run and pull-ups did not show any improvement. The gain in physical fitness index was lost during non training period of three weeks while extent flexibility, dynamic flexibility soft ball throw, 600 yards run and balance improved thereby indicating delayed effect. When compared to the results obtained for control group, students having more fat, lost it while those having less fat showed a gain even though the average values remained unchanged.
Miles and Rao (1964) studied several Respiratory variables before, during and after Ujjayi pranayama. In the data presented by miles, the mean respiratory rate for 5 twenty-minute trials was 1.26 respirations per minute. In the minutes prior to the Ujjayi practice the respiratory rate was 19 in the first minute and 20 or 21 in the next several minutes. In the subject studied by Rao, respiratory rate during 10 minutes of Ujjayi was 1.5 at a low altitude of 520 metres and 3.0 at a high altitude of 3800 metres. During normal breathing, the respiratory rate was higher at the low attitude.

Giri (1966) using a set of Yogic exercises 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.

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

Kocher (1972) made a study on Yoga practice 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 months’ 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 groups did 20 jumps and sit-ups. The yoga group’s mean heart rate increased to 100 and 7 less than that of the light exercises group. A group with at least 6 weeks of certain Hatha yoga practice followed strenuous exercises with 1 minute sitting and then 3 minutes of either sitting, mild exercises or Savasana Relaxation. Just after the exercises the heart rate averaged over 180 and after one minute of sitting it dropped to 130. After 3 more minutes of sitting, it dropped to 17 more beats per minute, a lesser drop than that following 3 minutes of Savasana relaxation. This suggests that Savasana relaxation facilities pulse declaration following exercises.

Hubert Dhanraj (1974) studied the effects of yoga on selected physiological parameters. The result indicated an increase in basal metabolic ratio total volume in basal state T-4 thyroxin, hemoglobin, expansion, breath holding time and flexibility after yoga training, because in heart rate in basal state and respiratory rate also were observed. When yogic training was discontinued for six weeks following six weeks’ treatment, a significant decline in the values of PWC 130, flexibility and breath holding time were noticed.
Bhole (1977) feels that yoga practices is desirable for sportsman and advocates the usefulness of yogic exercises in certain areas like basic personality traits, mental peace and tranquility. Prevention, treatment and rehabilitation after injuries etc., are 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 anxiety level and the mental fatigue were taken as criteria measure for the purpose of the study. The tests were taken before and after the experimental period of six weeks. He concluded that anxiety level can be reduced either by training in selected asana or in related physical exercises. Mental fatigue can be reduced either by training in selected asana or in related physical exercise and the training in selected asana was superior to the training in physical exercise for both variables though the difference was not statistically significant.

Thankamma Ommen (1981) compared the isometrics, yogic physical culture and combination training on body composition and physical fitness status of high school boys. Results of this study have shown that all the three exercise groups showed a significant increase in toe-touching scores. The inter group differences show that yogic physical culture is 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.

**Moorthy (1983)** conducted a survey on minimum muscular fitness of school children of age group six to eleven years and compared the influence of selected logic 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.

**Chakrabarthi (1984)** studied the effects of individual Asana by dividing the volunteers into three groups, each group practising one of the three important ‘Asanas’ namely Sarvangasana, Sirasasana and Halasana. Each was practised along with complementary postures in Matsyasana, Mayurasana and Pachimotanasana for optimal results. The effect of sarvangasana induced cardio respiratory response and less endocrine and metabolic response. Sirasasana induced less physiological changes and Halasana produced more physical changes and less physiological changes.

**Mall (1989)** 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 of 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) Fleischmann
basic fitness test (b) cure ton’s flexibility test (c) Skin-fold and Harvard step test. The improvement was most significant in flexibility.

**Samraj (1991)** conducted a study on the effect of practice of Asana alone and combination of Asanas, Pranayama and meditation on anxiety and aggression. In this study ninety schoolboys were selected at random by lot. They 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.

**K. Devaraj (2000)** conducted a study on the effect of yogic practice on health related physical fitness of visually impaired boys of the age group of 13 to 15 years. He selected 40 persons among which 20 were in the control group. He treated yogic practice on the experimental group. He treated yogic practice on the experimental group for six weeks to find out cardio-vascular endurance, flexibility, biceps and sub-exposa enhancement and made note at pre and post tests. The post test scores proved that there was significant improvement and enhancement among the boys due to the yogic practice.

**Gopal (1975)** and his associates reported that subjects who were trained for 6 months in yoga demonstrated lower heart rate during the performance of the variety of Yoga practice without previous training.
Kocher and Pratap (1971) made a study on neurotic trend and yogic practice. The purpose of this study was, whether yoga could be helpful in reducing the neurotic trend on neurosis in student and in general population.

Chinnasamy (1992) conducted a study on effects of Asana and physical exercise on selected physiological and Bio-chemical 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 variables namely pulse rate, systolic blood pressure, diastolic 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 Asana group for the pre and post test mean gain were determined by F-ratio through analysis of variance. Asana had significantly improved the hemoglobin content, blood sugar opulscrate and blood pressure.

Krishnan (1991) conducted a study on the effect of exercises and yogic exercises on physiological variables among school boys. In this study 90 students were selected from Thirumayam. Three groups were randomly selected of which one served as control group and other two served as experimental groups with Bharalthiyam and Yogasana exercises respectively. They were measured for selected physiological variables like pulse rate, breath holding time, cardiovascular efficiency and vital capacity before training as well as immediately after six weeks of training. The significance of the difference among the means of control group, Bharathiyam group and
Yogasana group, pre test and post test were determined by ‘t’ - ratio. Through analysis of variance, Bharathiyam and yogic group significantly improved the pulse rate, Breath holding time, cardio vascular efficiency and vital capacity.

The practice of Pranayama and aerobic exercise improves physical and mental performance. The effect of Pranayama with aerobic exercise on muscular endurance, vital capacity and cardio respiratory endurance was studied on 30 normal male volunteers who had undergone a 12-week training course in Pranayama ($n_1 = 10$) with aerobic exercise ($n_2 = 10$) and Pranayama with aerobic exercise ($n_3 = 10$). The result showed that the Pranayama group marked a higher degree in capacity ($P<0.05$). The Aerobic group showed greater cardio-respiratory endurance and muscular endurance more than the other groups ($P<0.05$). But the combined Pranayama aerobic groups showed a greater improvement in all aspects more than the other two groups ($P<0.05$) Sakthignavel, (1998).

Yogic practices have been reported to improve the health and fitness of an individual. The study was undertaken on 14 male students of R.P.T.S. Khandala with a view to seeing the immediate effect of Kapalabhati on cardio-vascular endurance as measured through Harvard step Test. Significant improvement ($P<0.01$) was seen in their cardio-vascular endurance after performing one minute of Kapalabhati as compared to the hyperventilation. (S.K. Ganguly, 1989).
R.S. Sashein (1988) studied the effects of Pranayama and transcendental meditation on the pulse and blood pressure of the male students of the Sourashtra College, Madurai. For this purpose the college students were randomly assigned to two groups. Group I performed Pranayama, Group II performed transcendental meditation. Subjects in each group were trained with respective programmes for a period of 6 weeks fine days a week from Monday to Friday and two sessions of twenty minutes duration both in the morning and evening. Prior to and at the end of training period all the subjects were tested for pulse rate and blood pressure. The results showed that the Pranayama reduced blood pressure only. Combined Pranayana and transcendental mediation showed very good effect on all the three parameters.

M.S. Nayer (1975) investigated the effects of yogic exercise on human physical efficiency. The subjects were conducted on 53 cadets of National Defense Academy. The parameters of assessment included ventilation minute volume; rate of respiration, oxygen consumption, pulse rate, blood pressure, mechanical efficiency and maximum oxygen intake. Four additional assessments were made under resting conditions, viz., vital capacity (VC) minimum breathing capacity (M.B.C), forced expiratory volume (FFV 10 sec) and breath holding time. All 3 groups showed significant decrease in pulse rate during exercise. The yogic group in addition recorded highly significant increases in breath holding time (From 54 to 106 sec. And VC from 1.98 to 2.89 L/M² body surface area). The remaining two groups recorded only
significant increases in VC, ventilation minute volume, rate of respiratory, blood pressure, mechanical efficiency, maximum oxygen intake capacity, and MBC remained unaltered is all 3 groups.

Gopal (1973) studied the effect of Yogasana and Pranayamas on blood pressure, pulse rate and some respiratory functions. Two groups of male volunteers, 20-23 years of age and having the same average height and weight were studied. The experimental group consisted of 14 subjects in Yogasanas and Pranayamas for a period of 6 weeks. The control group consisted of 14 normal untrained subjects, who carried out non-yogic exercises i.e. long walk and playing light games. Pre and post tests were conducted on both the groups. The results were compared. The trained persons had greater vital capacity, more tidal volume and less respiratory rate than the untrained. The prescribed standard exercise increased the respiratory rate in both the groups but the increase was less in trained group who instead exhibited a corresponding increase in total volume.

S. Telles et al., (1993) “Physiological Changes in Sports Teachers following 3 Months of Training in Yoga” This report shows that in a group of 40 physical education teachers who already had an average of 8.9 years of physical training, 3 months of Yogic training produced significant improvement in general health (in terms of body weight and BP reduction and improved lung functions). 2. There was also evidence of decreased autonomic arousal and more of psycho physiological relaxation (heart rate and respiratory
rate reduction), and improved somatic steadiness (decreased errors in the steadiness test). 3. The changes at the end of 3 months in velar GSR in different directions (increase/decrease/no change), depending on the initial values, suggest that practising, yoga may help to bring about a balance in different autonomic functions, so that functioning is optimized.

**Shirley Telles et al., (1993) “Recording of Auditory Middle Latency Evoked Potentials During the Practice of Meditation with the Syllable” “OM”**

Middle latency auditory evoked potentials were examined in 7 proficient subjects during the practice of meditation on the syllable ‘OM’, to determine whether these potentials would differ significantly from those recorded during the baseline state without practising meditation. Similar records were also obtained in 7 ‘naive’ subjects, matched for age, before and during a control period which involved sitting with eyes closed, and with no special instructions for focusing their thoughts. There was considerable inter-subject variability in the different components. However, during meditation there was a Small but significant reduction in the peak latency of the Nb wave (the maximum negativity occurring between 35 and 65 m sec). This reduction was observed consistently during the 3 repeat sessions of each subject, while the ‘naive’ subjects did not show this change. These auditory evoked potentials preclude using them as the method of choice for assessing the effects of meditation. The small but consistent decrease in the Nb wave peak latency indicates that the
middle latency auditory evoked potentials do change with meditation. However, the variability of the potentials may mask subtle changes.

**Shirley Telles et al., (1993)** “Improvement in Static Motor Performance Following Yogic Training of School Children”.

Two groups of 45 children each, whose ages ranged from 9 to 13 years, were assessed on a staidness 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 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 exercise (Tratakas) and games to improve the attention span and memory. The other group showed a significant (Wilcoxon’s paired signed-ranks test) decrease in errors, whereas the ‘control’ group showed no change.

**Shirley Telles et al., (1995)** “Autonomic Changes During “OM” Meditation” the autonomic and respiratory variables were studied in seven experienced Mediators (with experience ranging from 5 to 20 years). Each subject was studied in two types of sessions-meditation (with a period of mental chanting of “OM”) and control (with a period of non-targeted thinking). The mediators showed a statistically significant reduction in heart rate during
meditation compared to the control period (Paired ‘t’ test). During both types of sessions there was a comparable increase in the coetaneous peripheral vascular resistance. Keeping in mind similar results of other authors, this was interpreted as a sign of increased mental alertness, even while being physiologically relaxed (as shown by the reduced heart rate).

P.R. Vani et al., (1994) “Alterations in Auditory Middle Latency Evoked Potentials During Meditation on a Meaningful Symbol” “OM” Middle latency auditory evoked potentials were recorded in 18 male volunteers with age between 25 and 45 years, 9 of whom had more than 10 years of experience in “OM” meditation (senior subjects), whereas the other 9 had no meditation experience (naive subjects). Both groups were studied in two types of sessions. (1) Before, during and after 20 minutes of mentally repeating “OM” (control session), and (2) a similar session, though with 20 minutes of mentally chanting “OM” (meditation session). The senior subjects’ amplitude of Na wave was (the maximum negative peak between 14 and 18 ms) during meditation. While the same subjects showed a statistically significant reduction in the Na wave peak amplitude during control session. In contrast, the naive subjects had a significant decrease in the Na wave peak amplitude during meditation sessions and a non-significant trend of reduction during control sessions, as well. This difference between senior and naive subjects was significant (two-way ANOVA). There were no significant changes in short latency wave V or Pa wave (the positive peak between the Na wave on a meaningful symbol, and
mental repetition of a neutral word causes neural changes at the same levels (possibly die cephalic). However, the change could be in opposite directions, and this difference could be correlated with differences in the duration of experience in meditation between senior and naive subjects.

Shirley Telles et al., (1994) "Breathing Through a Particular Nostril can alter Metabolism and Autonomic Activities". There is increasing interest in the fact that breathing exclusively through one nostril may alter the autonomic functions. The present study aimed at checking whether such changes actually do occur, and whether breathing is consciously regulated. 48 participants were randomly assigned to different groups. Each group was asked to practise one out of three Pranayamas (viz. right nostril breathing, left nostril breathing, left nostril breathing or alternate nostril breathing). These practices were carried out as 27 respiratory cycles, repeated 4 times a day for one month. Parameters were assessed at the beginning and end of the month, but not during practice. The 'right nostril Pranayama' group showed a significant increase, of 37% in baseline oxygen consumption. The 'alternate nostril' Pranayama group showed an 18% increase, and the 'left nostril' Pranayama group also showed an increase, of 24%. This increase in metabolism could be due to increased sympathetic discharge to the adrenal medulla. The 'left nostril' Pranayama group showed an increase in velar galvanic skin resistance, interpreted as a reduction in sympathetic nervous system activity supplying the sweat glands. These results suggest that breathing selectively through either nostril could
have a marked activating effect or a relaxing effect on the sympathetic nervous system. The therapeutic implications of being able to alter metabolism by changing the breathing pattern have been mentioned.

**Shirley Teller et al., (1996) “Physiological Measures of Right Nostril Breathing”** This study was conducted to assess the physiological effects of a Yoga breathing practice that involves breathing exclusively through the right nostril. This practice is called Surya Anuloma Viloma Pranayama (SAV). Twelve volunteers (average age 27.2 ± 3.3 years, took part on two consecutive days. The test sessions were conducted on two consecutive days. One day the test session involved practising SAV Pranayama for 45 minutes (SAV session). During the test period on the other day subjects were asked to breathe normally for 45 minutes (NB session). For half the patients (randomly chosen) the SAV session was on the first day and NB session on the next day. For the remaining six patients the order of the two sessions was reversed. After the SAV session (but not after NB) there was a significant (P < .05, paired t – test two tailed) increase in oxygen consumption (17%) and in systolic blood pressure (mean increase 9.4 mm Hg). The latter two changes are interpreted to be the result of increased cutaneous vasoconstriction. These findings show that SAV has a sympathetic stimulating effect. This technique and other variations of unilateral forced nostril breathing deserve further study regarding therapeutic merits in a wide range of disorders.
Benny K.M. (2002) Effect of Pranayamas and Kapalabhati on oxygen consumption and different lungs capacities in players of contract and non-contact sports. The investigator selected 120 intercollegiate contact sports players (60 control group and 60 experimental group) and 120 non-contact sports players (60 control groups and 60 experimental groups).

In this study the initial oxygen consumption and different lung capacities in players of contact and non-contact sports subjects were recorded separately. They were divided into two equivalent groups, both contact and non-contact sports according to oxygen consumption and different lung capacities. Thus the experimental design was a parallel or equivalent group design.

The two groups were randomly assigned as one control group and one experimental group. During the period of experiment the experimental group was given five Pranayamas and Kapalabhati. After eight weeks’ duration, the final improvement of oxygen consumption and different lung capacities of both contact and non-contact sports groups were analyzed separately.

The investigator determined the age and weight and tested the subjects’ heart rate of 5th and 6th minutes, the workload of 150 waltz, with bicycle ergometer before the practice (Pranayamas and Kapalabhati) and after the practice. Vital capacity, tidal volume, inspiratory reserve volume, expiratory reserve volumes with wet Spiro meter before the practice (Pranayamas and Kapalabhati) and after the practice were also measured.
The collected data were analyzed by using t-test. The result of this study indicated that there was significant difference between the control and experimental groups and the contact and non-contact groups game players when oxygen consumption (VO₂ max), vital capacity, inspiratory reserve volume, expiratory reserve volume and tidal volume were also taken into consideration.

Based on the result and discussion the following conclusions were derived at:

1. After Pranayamas and Kapalabhati practice there was significant difference between the control group and the experimental group of both contact and non-contact sports players. It was seen that there was a significant effect of oxygen consumption (VO₂max) and different lung capacities in the players of contact and non-contact sports groups.

2. There was significant difference between contact and non contact sports players in oxygen consumption (VO₂ max) vital capacity, inspiratory reserve volume, expiratory reserve volume and tidal volume.

3. There was significant correlation between inspiratory reserve volume and vital capacity in the case of non-contact sports players and contact players on control group and experimental group.

Venkatareddy et al., (2003) “Effect of Yoga on Weight and Fat Fold Thickness in Obese Women” 30 obese women of age range 19-53, categorized into two groups, as per Body Mass Index (BMI), were exposed to one-hour
practice of asanas and pranayamas in the morning for a period of 90 days. A significant reduction (P<0.05) in BMI was seen in both the groups. In-group II (BMI greater than 35) the reduction was greater as compared to group II (BMI 25-35). Lean Body Mass (LBM), however, did not show significant change in both the groups.

Gore et al., (2003) “Effects of Yoga and Aerobics Training on Cardio respiratory Functions in Obese People” As an outcome of one month programme of weight reduction using Yoga practice and Aerobics, Female Residential Yoga Group (FRYG) of 25-40 age range, showed a significant and consistent reduction in systolic Blood Pressure (SBP) in all the testing sessions. Their Peak Expiratory Flow Rate (PEFR) also improved in two of the follow up (FU) testing sessions. FRYG of 41-70-age range reduced their SBP significantly in two of the FU sessions as well as a significant increase in PEFR was recorded. Pulse Rate (PR) did not show significant changes. FNRYG (Female Non-Residential Yoga Group) of 25-40 age range with a normal BP and PR initially, showed a significant reduction in DBP in two of the FU testing sessions, while the increase in their PEFR was not significant. FNRYG of age 41-70 showed a significant improvement in PEFR in post-test and first FU; yet, reduction in BP was non-significant statistically. Female Aerobic Group (FAG) of age range 25-40 showed non-significant reduction in BP and PEFR. However FAG of age range 41-70 age range did not show significant change in BP, and PEFR, however, MAG (Male Aerobic Group) of the same
age range showed significant reduction in SBP only, in one of the FU testing sessions. Their PEFR showed non-significant reduction, MAG of age range 25-40 showed non-significant reduction in BP & PEFR.

*Mishra et al., (2003)* "Cardiac Efficiency of Long Distance Runners and Yoga Practitioners" Cardiac efficiency of 120 male students, in the age range 16 to 17 years, from the Aggarsain Public School, Kurukshetra, Haryana, was tested through Harvard Step Test. The students were divided into three equally matched groups viz., Long Distance Running Group (Group-A), Yoga group (Group-B) and Control Group (Group-C). Duration of the experimental period was 6-month which was divided into two sessions of 3 months each. Result of 2 × 3 Factorial ANOVA revealed that Yoga practitioners had higher cardiac efficiency than long distance runners.

*Govindarajulu et al., (2003)* "Effect of Yoga Practices on Flexibility and Cardio respiratory Endurance on High School Girls" Sixty (n = 60) high school girls (average age 12 years) volunteered for a pre-experimental group design, where the practice of selected yoga practice was given as an intervention to the experimental group ‘A’ (n₁ = 30) for a period of eight weeks. The control group ‘B’ (n₁ = 30) was not allowed to participate in the experimental treatment. The pre-and post-tests were conducted on flexibility and cardio-respiratory endurance. The results of ANOVA revealed that there was an improvement in the flexibility and no significant change was evident in the cardio-respiratory endurance. Thus, short-term yoga is useful in improving
flexibility, but not the cardio respiratory endurance vent at the stage of puberty in girls.

From the review of literature given above, the following facts are observed.

i) Only limited studies have been done using ‘Yogic practices and physical exercises on physical and physiological variables.

ii) Favourable effects of yogic practice have been reported in the literature more than the physical exercises, However, their application for the improvement of specific variables selected for the study like peak flow rate, maximum inspiratory volume have been explored on a limited scale.

Under these circumstances, the present study was undertaken to bridge the gap and improve upon our understanding on the unexplored area mentioned above.