CHAPTER - II

REVIEW OF RELATED LITERATURE

The purpose of the study was to find out the effect of different conditioning methods on anthropometrical, physical and physiological variables on senior secondary school boys. In order to facilitate such a study, the knowledge and evaluation of similar works done becomes essential. Hence, the investigator went through textbooks, magazines, journals, and research quarterlies available in the libraries of Sports Authority of India, Bangalore, Sports Authority of India, Patiala, Government College of Physical Education, Patiala and Punjab University, Chandigarh, and INTERNET, in an effort to locate some literatures related to the present study. A discussion of the related works would help in justifying the findings of the study.

Stuart and Collings (1959) conducted comparative study of vital capacity of athletes and non-athletes. 20 athletes and 20 non-athletes were selected as subjects. Mean vital capacity of athletes was found to be significantly higher than that of the non-athletes. It was concluded that the higher vital capacity of athletes was due to regular training the athletes undergo.

Michael and Gallon (1960) studied effects of basketball conditioning on blood pressure. 17 basketball players were selected and were tested during and after 1957-58 seasons. It was found that during training the resting and post-exercise systolic blood pressure decreased significantly. The diastolic pressure measured immediately after exercise also decreased. Pulse-pressure decreased only slightly
during training and no consistent pattern of significance was seen in this change.

Sackett (1960) compared the effects of interval and developmental training on the physiological and performance function of 46 college freshmen. Resting pulse rate was one of the variables compared. The subjects were divided into two equal groups and given separate interval and developmental training programs for a period of 13 weeks. No significant differences were found between the results of two groups.

Harper, Billings and Mathew’s (1963) conducted a study on the effects of two physical conditioning programs on Cardio-respiratory fitness of 25 college men. The subjects were placed into three matched groups on the basis of maximum oxygen consumption. One group participated in the modified army conditioning program of calisthenics and marching, while the second group participated in a program of interval training involving running. The third group (control) participated in recreational activities. The group met five days per week for seven weeks and Cardio-respiratory efficiency was measured with the help of Harvard Step Test. The results showed that both intervals trained and army trained groups improved significantly in their Cardio-vascular efficiency. The control group did not significantly improve.

Jaimitra (1966) took fifty-four randomly selected male subjects to determine the effects of selected exercises on the physical fitness of sedentary adults. The subjects were divided into two groups. One experimental group and other control group. Experimental group was
subjected to a training program in selected exercises for six weeks. The study concluded that these significant gains in mean of the experimental group in abdominal strength and leg power and decreased the resting pulse rate.

Thirty-two male university students were protested with Astrand’s bicycle ergometer test of predicted maximum oxygen intake and selected strength tests. The subjects were randomly assigned to each of the eight treatment groups of 2 X 2 X 2 factorial design, to investigate the effect of speed, load and repetition of interval training bouts on endurance performance was the study of Tomik. He concluded that neither high levels nor low levels of experimental treatment favored the development of greater endurance capability as increased by the performance test. There was some evidence that the factor of repetition and load produced training effects, which were more beneficial in certain combination than in others.

Roskamm (1967) a German pioneer in this area, performed a carefully controlled experiment comparing the training effect of continuous and interval training. He found very small differences when testing the training response at maximal exercise. When heart rate at moderate exercise loads was used as the criterion for testing, continuous exercise produced far better results.

Milton (1967) studied the effects of three different long distance running programmes and an isometric exercise programme on Cardio-vascular efficiency. 463 college male students were taken as subjects for this study and were divided were four groups. Three groups were given running programmes of 10, 20 and 30 minute's
duration's respectively. While the fourth group followed isometric exercises programme and no running at all. Four days per week training was imparted to all the subjects and it was found that all the groups improved their Cardio-vascular efficiency. The improvement among the three running groups was more than the fourth group, which followed isometric exercises programme. But no significant difference was found among the three running groups improvement. It was concluded that running was superior to isometric exercise for developing Cardio-vascular efficiency, but the amount of running did not show any significant differences.

Jackson (1968) studied the effects of training at three different heart rate levels upon Cardio-vascular fitness. Seven male college subjects were randomly assigned to train at each of the following heart rate levels, 130, 245, and 160 beats per minute. The training programme consisted of 12 minutes walking on a triad mill, 4 days per week for six weeks. The resting heart rate, the heart rate response to two work tests (a treadmill test and bicycle ergo meter test), and the recovery heart rate from these two tests were utilized estimates of Cardio-vascular fitness. It was concluded that improvement in Cardio-vascular rate training intensity and that training at intensity of 145 beats per minute of higher is necessary to improve Cardio-vascular fitness.

McDavid (1968) revealed that when total work was held constant, interval training offered no better results for endurance than uninterrupted running. He theorised that with intermittent work, presumably under anaerobic conditions, the runner does not
seem to obtain as great a lactic acid oxygen debt as common to prolonged aerobic work. The rest periods with interval training permit part of the oxygen debt to be repaid, thus the subject begins the next bout partially recovered.

Stamp (1968) conducted a study of the effects of 94 interval running program in circulorespiratory efficiency of college freshman women. 30 subjects were randomly selected from a group of freshman women enrolled in the basic instruction physical education program. The Experimental group participated in an interval running program over a 6-week period. The workload considered of running bouts on a graded treadmill with a specific interval rest period. It was concluded that interval running is an effective method of increasing circulo-respiration efficiency for women.

Terry (1968) selected eighteen members of the freshmen wrestling squad to study the effects of continuous running as compared to interval running on Cardio-respiratory efficiency. The subjects were equated into three groups using the results of Cardio-respiratory test. The groups were randomly designated as the interval group, continuous group and the control group. Oxygen consumption, pulse rate at rest and in recovery, calculated from a treadmill run was used as criteria to determined Cardio-respiratory efficiency of subjects at the beginning, mid point and the completion of the training program. It was concluded that a running program in addition to wrestling practice does not appear to increase the Cardio-respiratory efficiency of conditioned wrestlers.
Robert (1968) studied the effects of interval training programs on the maximal oxygen uptake of healthy college men aged 18 to 21 years. Three interval running training routines each of different intensity were performed to determine which produced greater improvement in maximal oxygen uptake. Training was carried out three times per week for six weeks. Analysis of training during work on bicycle ergometer revealed that training at 40% intensity stimulated largest maximal oxygen uptake gains and training at 60% intensity produce reductions in maximum oxygen uptake.

Bentley (1968) investigated those effects of three training programs on speed, strength, power, general endurance and speed of movement. Sixty male between 13-15 years of age served as subjects for this study. The experiment was conducted for a period of eight weeks, five days per week. Each group did the same amount of work each day, but their training methods were different. Group A, a continuous training group, ran 220-yards and jogging 220-yards for a total of 440-yards. Group B, one of the interval training groups, ran 110-yards and jogging 110-yards for a total of 440-yards. Group C, the other interval training group, ran 55-yards and jogging 55-yards for a total 440-yards. Group D, the control group, participated in a regular physical education class. Various measures and tests, such as the 50-yards dash, back and leg dynameters, leap meter, modified Harvard step test and extensors of the hip and flexor of the leg were respectively used to gauge the variables. A statistical analysis of the data showed significant mean gains in all the
variables, except in one case, i.e. speed of movement. Also it was revealed that the continuous and interval training methods used in this study produced the same results.

Webb (1968) conducted a study to determine the effects of three interval-training programmes (ITPS), i.e. (1) a programme of repetitive short distance running (55) yards, 110 yards or 220 yards. (2) A programme of long distance but less repetitive running (660 yards, 880 yards or 1320 yards), and (3) a combination of programmes (1) and (2) on the Cardio-respiratory fitness of unconditioned 23 young men. All the subjects placed in three matched groups; technically termed as short, long and mixed distance groups, respectively, on the basis of maximal O2 consumption (M=45.8ml/kg body wt./ min.) determined on a series of bicycle ergo meter rides. The rides were at sub-maximal and maximal loads (watts). Each subject rode for five minutes and rested for 10 minutes, until his maximum capacity was attended. The pedal speed for all rides was 60 r.p.m. Air samples collected during each ride were analyzed on the Beckman Apparatus. They were trained five days a week for eight weeks. It was found that the short and mixed distance groups made significant mean improvement in maximum O2 consumption. There were no significant mean changes by any group with regard to O2 debt. All three programmes of training led to improve ability among the subjects to perform the Harvard step test. The army physical fitness test and the 880 yards time trail run. Only the short distance training programme significantly decreased running time over 220 yards. With in the limitations of this study, it
was concluded that mixed-distance training is most effective, but it should be predominantly short-distance running.

Baker (1968) studied the comparative effects of rope skipping and jogging on Cardio-vascular endurance of 92 college students. The subjects were randomly placed into two groups, i.e., rope skipping group and jogging group. Subjects in group I skipping rope 10 minutes per day, five days a week, for six weeks. As the investigation progressed, the subjects gradually increased the speed of skipping. Subjects in group II jogged 30 minutes per day, five days per week, for six weeks. As the individual condition and ability developed, the subjects were allowed to increase the speed of running. Harvard step test was administered to all the subjects prior to and immediately after the six weeks programme of conditioning in order to determine the level of Cardio-vascular efficiency. It was concluded that Cardio-vascular efficiency can be improved significantly by administered rope skipping and jogging programmes.

Charles (1968) studied effects of jogging programme on selected physiology variables. 21 middle-aged men were given ten weeks jogging programme. Their blood pressures were recorded before and after the 10-week jogging programme during a 3-minute pre-exercise period, a six minutes sub maximal bicycle ergometer ride, and a five minutes post exercise period. No significant differences between initial and final tests were seen.
Faria (1969) selected 40 untrained male students to study the Cardio-vascular response to exercise as influenced by training of various intensities. The heart rate intensities selected were 120 to 130, 140 to 150 and 160 to 170 beats per minute. The subjects were administered a pre and post treatment physical work capacity test on a bicycle ergo meter. The experimental group trained 5 consecutive days per week for four weeks whereas the control group played volleyball. An analysis of data revealed significant differences between the control and experimental groups trained with various intensities.

Tooshi (1970) conducted a study on the effects of three different duration’s of endurance training on serum cholesterol, body composition and other fitness measures. In fitness measures a two-mile run was also one of the measures. Twenty-four adult men between the ages of 27-54 years were selected randomly from men who had requested to be included in the adult fitness programme. These men were divided on the basis of their serum cholesterol values into three experimental groups. Group A exercised 15 minutes a day, group B exercised 30 minutes a day and group C exercised 45 minutes a day for five day a week for total period of 20 weeks. A control group of eight sedentary men was used for the purpose of the study. The men were tested for two-mile runs at the beginning and at the conclusion of the training programmed. The training programmed consisted of walking, jogging and running. Changes as a result of endurance training were in proportion to the duration of training.
It was concluded that endurance training improves the running performance proportionately.

Gregory (1970) conducted study on the development of Cardio-respiratory endurance, a comparison of continuous and interval training. Twenty-eight volunteers who were untrained collage mates were randomly assigned to one of two experimental groups and a control group. The subjects numbered 5, 7 and 9 for control, interval and continuous groups respectively had significant improvement in the maximal oxygen consumption (ml/kg/min.). Their were no significant differences between the continuous and interval training groups. Continuous and interval training methods were equally effective in developing Cardio-respiratory endurance.

Wilmore and Associates (1970) in their study showed changes in physique for men aged 17 to 59 years who jogged 3 days a week for 10 weeks. The average distance run by the end of 10 weeks was 84.4 km or about 2.8 km a day. Body composition changes did occur but they were relatively small. Because lean body weight did not change, the decrease in body weight was due to a reduction in percentage body fat from pretest (18.9%) to post-test (17.8%) values, which represented a fat loss of 1.07 kg. The reduction in individual skin-fold values paralleled the decrease in body fat.

Viru and his associates (1970) trained students in nine groups employing different methods ranging from long uniform runs to fast interval training. They noted a significant reduction in 800m running
times as a result of both and further concluded that interval training was better in reducing running times.

The purpose of Chaloupka’s study was to initiate a conditioning regime, which would maintain the physiological benefits resulting from an 8 weeks interval-training program. After 8 weeks of training followed by physiological variables (Blood lactic acid concentration; resting; exercise; and recovery heart rates; maximum oxygen consumption; sub maximal oxygen consumption; physical working capacity; maximum ventilation; maximum muscular power and lean body mass) were retest. Based on collected data and analysis made by using ANOVA, the study concluded that all the selected variables improved in their functioning except the maximum muscular power. Panny (1971) investigated the effects of resistance running on speed, strength, power, muscular endurance and agility. The training programme consisted of fifty-minute sessions per week of six weeks. Results indicated that:

1. A training programme of resistance ruinsing alone of supplemented by weight training, iso-metric contractions, and repetitive sprinting would significantly increase speed, leg strength, leg power, muscular endurance and agility.

2. Resistance training supplemented by iso-tonic leg exercises, isometric contractions, and repetitive sprinting will not improve standing broad jump ability as significant as speed, leg strength, muscular endurance an agility.

3. Orthogonal comparison revealed upward trends in improvement of all variables during the six weeks training programme.
Hudder (1971) administered an aerobic training programme of sixteen weeks to 34 male subjects to determine its effects on maximal oxygen uptake of the 34 subjects, 7 subjects formed control group taking only the pre and post tests. The analysis of data revealed that experimental subjects (N= 27) improved significantly in maximal oxygen uptake as compared to the control group.

Stanley (1971) compared the effectiveness of interval training programmers of running at frequencies of two times a week and four times a week as reflecting the ability of each programmed to produce changes on performance in the mile run, the 800-yard run, the 220-yard dash, the 50-yard dash and on the Knox penny cup Test. The Barrow Zig-Zag run and the Margaria-kalmon power Test. Thirty six high school male athletes were placed into two groups on the basis of their best times on three separate mile-run time trials. One group (blue) participated in training sessions four times per week, while the second group (gold) participated in training sessions two times per week. All the subjects were given pre and post-training tests. Stanley concluded that there were no significant differences on the improvement of means between the groups of any of the variables after training. Furthermore it is important to note that training two time per week was found to be just as effective as four times per week on the variable tested over a seven–week training period.

Johnson (1971) compared the effectiveness of slow-continuous running, interval-training and pace-training methods in improving running performance. As many as 120 college freshmen served as subjects for this study. They were tested initially for maximum performance on three tests: (1) a maximum time run on a motor-
driven running at a speed of 10 miles per hour at zero percent incline; (2) a maximum time run on a motor-driven treadmill at 8.5 miles per hour at zero percent incline; and (2) a mile run. All the subjects were divided into three equal groups and assigned to one of the three groups. Group I: the slow running group. This group began training by running for 20 minutes in each session and progressed to 30 per session. Group II: the interval-training group. This group undertook fast and slow interval training on alternative days. Fast interval training was confined to distances of either 60 or 220 yards, and slow interval training involved running a set number of 440 or 880-yard distances. Group III: the pace running group, trained at a predetermined steady pace for the mile run. The subjects trained thrice a week for eight weeks. All subjects were re-tested on identical three tests at the completion of the training period. On the basis of a statistical analysis of the data, it was revealed that the three training methods involved in this study were highly effective in improving the running performance of college freshmen. Slow continuous running was better than the interval-training and pace-training methods for improving performance on the slower paced run. Furthermore, pace training was a very effective method to specifically train a runner for a particular pace and was highly effective from the standpoint of time as well as a psychological point of view.

Holt (1972) studied effects of jogging on Cardio-vascular fitness, 71 volunteers were chosen as subjects and were randomly divided in three groups. First group was assigned slow jog regimen, second group followed fast jogging schedules and the third group continued their sedentary habit and was called a non-jogging group. Subjects continued these schedules for 12 weeks, training thrice a week. At
the end of 12 weeks period it was found that slow as well as fast jogging improved Cardio-vascular fitness significantly. There was no improvement in the third group.

Gentry (1973) selected 15 male college students, ranging in age from 18 to 22 years to study the effects of jogging programme on selected Cardio-vascular functions. Blood pressure was selected as one of the Cardio-vascular functions. The training programme consisted of jogging or walking a specified distance (one to two miles) five times per weeks for nine weeks. On training commenced, each subject progressed at his own rate dependent upon in level of fitness and rest of adaptation. Analysis of data revealed significant decrease in resting diastolic blood pressure.

Mc Kibben (1973) in his study of the comparison of three workloads of varying intensities and distance on Cardio-respiratory endurance divided the subjects into three groups. Group-I trained at a heart rate of 150 beats per minute. Group-II trained at a rate of ranging from 120 to 180 beats per minute for fifteen minutes. Group-III trained at a rate of 150 beats per minute over a distance run by Group-II. The subjects were trained five days a week. It was concluded that running for 15 minutes a day at a heart rate of 150 beats per minute for seven weeks significantly increased Cardio-respiratory endurance.

In another similar experiment Davies (1973) studied the effects of different training programs on Cardio-respiratory fitness. 118 university students were given crest load training, continuous running and high intensity running as experimental procedures.
Training was given for 30 minute a day, 3 days per week and continued for six weeks. It was found that there was a significant improvement in Cardio-respiratory fitness among all the three training groups as compared to the control group. The results did not show any significant differences among the three training methods. The improvement was almost identical.

MOBB (1973) conducted a study on three-interval training programme and their effect on physiological variables, 180 yards run was selected as one of the variables. Short and mixed distances of interval training were employed as experimental treatment. All groups improved significantly in 180 yards run time.

Pollock (1973) and associates selected 19 volunteers’ men between 28- 39 years of age and randomly divided them into two groups. One group exercised twice a week while the other group went for exercises 4 times a week. Exercise sessions were of 30 minutes duration and were consisted of continuous walking, jogging or running with progressive increased intensity. Exercise sessions were continued for twenty weeks and at the end of this period it was found that both the groups had improved their maximal oxygen intake. It was furthering concluded that fitness programme aimed at circulatory-respiratory endurance improves the oxygen transport system.

Mc Kibben (1974) in his study of the comparison of three workloads of varying intensities and distance on cardiovascular endurance divided the subjects into three groups. Group I, trained at a heart rate of 150 beats per minute for fifteen minutes Group II,
trained at a rate of ranging from 120 to 180 beats per minute for fifteen minutes group III, trained at a rate of 150 beats per minute over a distance run by group II. The subjects were trained 5 days a week for seven weeks. It was concluded that running for fifteen minutes a day at a heart rate of 150 beats per minute for seven weeks significantly increased cardiovascular endurance.

Effects of various intensities of running upon resting pulse rate were studied by Sparks (1974). Physical education college male students were chosen as subjects and were given zero, three, six, ten minutes running training programmers in addition to their regular participation in physical education class activities. Training programme was carried out 2 to 3 times per week. At the end of the seven week period it was found that resting pulse rate reduced significantly using zero, 3, 6, or 10 minutes running program. 10,6 and 3 running. There were no differences among ten, six and three minutes running programs.

In another similar study 63 female college students were selected by Anderson (1974) and divided into three training groups. First group consisted of 20 girls was named as experimental jogging group, second group had 21 students and was called experimental walking group. Third was control group numbering 22 students. It was found that jogging group had significantly higher maximal oxygen uptake as compared to the other groups. Among the walking group and control group, the walking group had higher oxygen uptake.

Saltin (1975) who is one of the Scandinavian authorities in this area of investigation, reviewed the evidence and came to conclusion
that interval training does not appear to have an advantage over continuous training in enhancing endurance capacity. Stamp (1968) conducted a study of the effect of 94 interval-running programs on circulo-respiratory efficiency of college freshmen women. 30 subjects were randomly selected from a group of freshmen women enrolled in the basic instruction physical education program. Experimental group participated in an interval running program over a 6-week period. The workload consisted of running bouts on a graded treadmill with a specific interval rest period. It was concluded that interval running is an effective method of increasing circulo-respiratory efficiency for women.

Swedburg (1975) studied the effect of three different distance-training methods upon performance and body composition. The methods selected were continuous running, interval running and continuous pace running. Subjects for the study were 51 male college students, he concluded that continuous run made a statistically significant change in body composition on .05 levels, however and this change was different from other three groups. The interval group showed significant changes on cooper's 12 minutes run/walk test and also made significant change in two mile run time when compared with continuous method.

Swedburg (1975) studied the effects of three different pace training methods upon vital capacity of 88 male college students. The subjects were divided into four groups and were named as continuous running training group, interval running training group and control group. Training program was carried out for 8 weeks and at the end it was found that timed vital capacity did not show end it
was found that timed vital capacity did not show statistically significant change in any of the groups.

Alteri (1975) studied the effects of endurance and interval running on selected physiological parameters on 63 college females of 17 to 22 years of age. Results of the study showed that both the training programs lowered the resting pulse rate.

Sixty-three college aged females between seventeen and twenty-two years of age were randomly assigned to one of four running regimes described as blow; (I) interval running group two times a week, (ii) interval running group three times a week and long slow-distance running, two times a week (iv) long distance endurance running three times a week by Alteri. After the training, with the help “F” ratio the study revealed that:

1. Elevated cholesterol, Group;
2. Increased serum lactate dehydro-glucose in all four groups;
3. Elevated triglycerides vales, Group 2;
4. Increased calfgirth for groups 1 and 3;
5. Decreased supra-iliac skinfold for groups 1, 2 and 3 while groups 2 and 3 also decreased in sub scapular skinfold;
6. Lowered resting heart rate for groups 1 and 2;
7. Increased post-exercise blood pressure for groups 2 and 3;
8. Reduced diastolic blood pressure for groups 3 and 4;
9. Improved duration of effort on the modified Blake Treadmill Test for group 1, 3 and 4.
10. Improved distance covered on the Cooper Twelve-minute run/walk test for women in all groups.
11. Improved sub-maximal aerobic power for groups 3 and 4.

The purpose of Thomas’s study was to determine the effects of an interval-training program on aerobic, anaerobic and anthropometric parameters of women. Thirty-one females between thirty and thirty-nine years of age served as the subjects for this research. The training program was sub-maximal in nature and continued for seven and one-third weeks, there was three sessions a week for the equipment of 60 minutes of activities for the most highly conditioned subjects. The activities included two flexibility exercises. Six weight training activities emphasizing muscle endurance, three calisthenics and runners.

Swedburg (1975) studied the effects of continuous running, interval running and continuous pace running on maximal oxygen consumption. Eighty-eight college students were taken as subjects and were divided into four treatment groups. The training was carried out for a period of eight weeks. Results showed that the continuous running, interval running and continuous pace training groups
gained significantly in maximal oxygen consumption in liters. Oxygen consumption in milliliters per kilogram was significant in case of interval and continuous pace group.

In Buccola and Stone's (1975) study thirty-six men were divided into two groups, jogging and cycling. The two groups were administered pre and post-test on Astrand bike test and 16 P. F. test. The result of the study indicates that there was improvement in Vo2 max. and decreased in blood pressure and weight in both the groups where as flexibility in case of joggers and percentage of body fat in case of cyclist showed significant difference.

Parks (1976) determined the effects of a ten weeks physical fitness programme of selected physiological and psychological variables of individuals sixty-five to eighty-five years of age. After a ten weeks of medical physical fitness programme the study concluded that improvement in fitness for the elderly could be attain through participation in the physical training programme of moderate intensity. It was also concluded that under proper supervision could be safe and effective for the women between the ages sixty and eighty-two.

Steward and Cutin (1976) studied the effects of physical training on Cardio-respiratory fitness in children. Change in sub-maximal heart rate and vo2 as a result of eight weeks of interval training were studied in boys aged an to twelve years. Thirteen boys trained while eleven acted as control. The findings suggested that the use of vo2 maximum as the only training criterion for Cardio-vascular fitness may be misleading since most work tests improved at a sub-
maximal rate and a training induced improvement in sub-maximal response was demonstrated without improvements at maximal efforts. Perhaps sub-maximal psychological and performance measures are more important than maximal once in the assessment of Cardio-respiratory fitness.

Frank (1976) studied the effects of physical condoning programs on Cardio-respiratory fitness of college students. 76 men were selected as subjects for the study and were divided into four groups. Cooper’s aerobic program, interval conditioning program and Regular Physical Education Program were the three different physical conditioning programs given to three test groups. Fourth group was a control group and no conditioning was given to this group. Harvard step test, 12 minutes Run/Walk, three minute Shuttle Run and One Minute Lateral Jump were used to measure the Cardio-respiratory fitness of the subjects. It was observed that the three groups, which were given interval conditioning, aerobic conditioning and regular physical education period, improved significantly on Cardio-respiratory fitness in comparison to the fitness of the control group that was not given any conditioning schedule.

Knehr, Dill and Neufeld (1977) undertook a study in which 14 college men participated in a training programme for middle distance runners. The programme was of six months duration. The training programme included one day over-distance running, one day pace running and one day speed work per week. As a result of this training it was found that the resting heart rate reduced significantly.
Hilton (1977) studied the effects of jogging program on 12 married women of 27 to 58 years of age. The subjects jogged thrice a week and continued for 12 weeks. The emphasis was on increasing the distance and time jogged rather than speed. At the end of the 12 weeks training schedule, it was found that the mean resting heart rate dropped from 80.5 to 73.7 beats per minute.

The study conducted by Gray (1978) was to see the effects of cycling, jogging and swimming on Cardio-vascular endurance and to see if any of these three modes is more significant than the others, in improving Cardio-vascular endurance. The age of subjects ranged from 17-29 years. The subjects were allowed to select the aerobic training mode they desired. The subjects were trained three days per week for seven weeks.

Based on the findings and within the limitation of the study, the following conclusion were drawn:

1. An aerobic exercise programme of cycling or swimming produced a significant gain in Cardio-vascular endurance.

2. There was no significant difference in cycling, jogging or swimming to produce a significant increase in Cardio-vascular endurance.

3. There was no significant difference in the specific exercise heart rate training method and the non-specific heart rate training method to produce a significant increase in Cardio-vascular endurance in the aerobic training modes of cycling, jogging and swimming.

Dulin’s (1978) study attempted, through laboratory testing, to determine whether reconditioned adult males would, with regard to Cardio-respiratory fitness, benefit more from working at duration
running or from running in intervals. The study concluded that neither exercise programs, interval running or continuous running, was superior to the other in terms of promoting Cardio-respiratory fitness of the participants.

Mc Namara’s (1978) study was designed to compare the effect of three physical fitness training programmes on selected psychological and somatic (body composition, posture, flexibility, muscular strength, muscular endurance and Cardio-vascular endurance) variables on both male and females. Three treatments (Army readiness, Calisthenics and weight training) were administered for ten weeks. Statistical analysis of data indicated that physical fitness training enhances all the somatic variables irrespective of training programme.

Dolgener and Brooks (1978) determined the effects of an interval and continuous training program in the mile run performance and Vo2 max. 14 male volunteers were engaged in a six-week-training program consisting of either interval or continuous training, the total distance run by both groups being equal. Physiological physical parameters, including Vo2 max and the mile run were measured before and after the training program. The interval-training group demonstrated significant increase in Vo2 max, VE and total time on the bicycle and significant decreases in the percentage of body fat, the resting heart rate and the mile run time. The continuous group demonstrated significant increases in total time on the bicycle and significant decreases in the sub maximal heart rate and mile time. There were no significant differences between the groups on any of the post-test parameters. The evidence
suggests that there is no clear superiority of either interval or continuous training in improving Vo2 max or time in the mile run.

Pickle (1979) conducted a study to determine the effects of two interval-running programmes on college women for five and eight weeks. The effects were measured by running time on field tests of 50 yards, 400 yards and 1.5 miles. Forty-eight subjects were assigned to four groups to study four experimental conditions. The four experimental conditions were training programme R-1 for five weeks, training programme R-1 for eight weeks, training programme R-2 for five weeks, training programme R-2 for eight weeks. The R-1 training programme consisted of distances of 55, 110 and 220 yards. The programme was designed to emphasize development of anaerobic efficiency. The R-2 training programme involved distances 110, 220, 660, 880 and 1320 yards. This programme was designed to develop anaerobic and aerobic energy system. The running tests were selected as the methods of evaluating changes resulting from the training programme. The 50 yards dash was used to measure the improvement in efficiency of the ATP-PC anaerobic system.

Gregory (1979) conducted a study on 21 untrained males who were randomly assigned to control (N=5), interval (N=7) and continuous (N=9) groups. An analysis of covariance (ANCOVA) demonstrated significant differences among the groups. A post-hoc test of significance revealed significant differences between the experimental groups and the control group. Furthermore, it was concluded that the continuous and interval methods of training were equally effective in developing endurance when the total amount work performed was the same.
The purpose of Chakrabarti's (1979) study was to compare effects of endurance running and vigorous free hand exercises on selected physiological variables. The data was collected on 32 male students of first year bachelor of physical education class, before and after an experimental period of eight weeks. The training was administered by dividing the subjects into two groups. One group took endurance running and other group received vigorous free hand exercises. The result of the study indicated that:-

1. Both the training programme improved significantly Hg. Content, systolic blood pressure and pulse rate in terms of the efficiency whereas there was not improvement recorded in case of vital capacity and breath holding.

2. The result also indicated that neither of two training methods, i.e. endurance running and vigorous free hand exercises was superior to each other.

Lathen (1979) investigated the effects of three types of treadmill running programmes on body weight, resting heart rate, heart weight, gastrocnemious muscle weight and other ratios in Sprague-Dawley rats. After a ten weeks of training, the study concluded that exercised animals had significantly less total body weight and fat free body weight than non-exercised animals. The long continuous running group had significantly less total body fat and percentage of body fat than any of the other groups. The non-exercised animals had significantly greater heart weight than those of the long continuous and interval groups and they also had significantly greater gastrocnemious muscles weight than those of all the exercised animals. The data also indicated that long continuous
group had significantly greater changes in body composition. None of the running programmes produced a significant difference in resting heart rate as compared to the control group.

Popli (1980) compared the effects of physical conditioning programme of the physiological variables of vegetarians and non-vegetarians. The subjects were 32 boys of the age group of 13-14 years. Before and after the eight weeks of conditioning programme was administered the selected physiological variables (hemoglobin content, resting blood pressure and resting pulse rate) of the subjects were measured. After the collected data was analyzed using t-test. The study concluded that all the selected physiological variables of both the groups improved significantly through a programme of physical conditioning but no group was found superior to each other as far as the physiological variables are concerned.

Reddy (1980) examined the effects of massed and distributed endurance running on selected physiological variables. 60 male students of the age group 14 to 15 years. Were divided into three groups. Group A practiced massed endurance running and Group B practiced distributed endurance running where as Group C served as control group, the data on resting pulse rate, vital capacity and 12 minute run/walk test before and after the experimental period of ten weeks were recorded. With the help of ANOVA, the study concluded that massed and distributed running methods are effective in reducing resting pulse rate and increasing vital capacity and performance of 12 minutes run/walk test. It was also indicated that massed endurance reduced
running pulse rate, whereas in the case of vital capacity and 12 minute run/walk test no difference was found.

Uppal (1980) conducted a study to determine the effects of interval training and two continuous methods in cardio-respiratory and selected physiological parameters. 80 unmarried subjects were divided into three experimental groups and the control group. One group was given interval training, the second group fartlek and the third group slow continuous running for a period of ten weeks. The load was progressively increased, after every two weeks. It was found that all the three groups had equal training effects on maximal oxygen uptake, vital capacity, leg strength, positive breath holding time, negative breath holding time. Slow continuous and fartlek method resulted in significantly higher improvement in cardio-respiratory endurance when compared to interval training. Slow continuous and interval training were superior to fartlek in reducing resting pulse rate. However, all the three training method did not show any significant differences in diastolic blood pressure after exercise blood hemoglobin content and red and white blood corpuscles.

Smith and Wenger (1981) undertook a study to investigate the changes in aerobic power in response to 10 days of interval versus continuous training at relatively high and low intensities. 24 male subjects of relatively high aerobic power, 46 ml/kg/min, were randomly assigned to one of four training groups: continuous training at a heart rate of 140 beats/minute or 172 beats/minute and interval training at a heart rate of 140 beats/minute or 172 beats/minute. The total work output for
each session was equated between the groups. Following 10 days of training, the pooled continuous groups showed an increase in Vo2 max when compared to both pre-training and interval group scores. When the intensities were pooled, the group, which trained at a heart of 172 beats / minute demonstrated an elevated Vo2 max over the pooled group which trained at 142 beats/minute. However, a comparison between the means of the four different groups revealed that the group trained at 172 beats/minute was the only one, which improved significantly over pre-training values. This study suggests that for optimal improvement in aerobic power over 10 training days, high intensity, continuous work is the most effective.

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Shaver (1982) studied high percentage of body fat decreases the ability of the Cardio-respiratory system to supply oxygen to various parts of body, thereby lowering one's Cardio-respiratory endurance capacity. Fat causes poor performance interval, the area of Cardio-respiratory endurance because it not only places an overload on the circulatory system as a result of which heart has to pump more blood to a larger vascular system, but also fat acts as dead weight in the body (thus offering extra resistance to movement) while contributing nothing to muscle contraction.

Marcal (1983) obtained data from 41 males and 31 females enrolled interval he class exercise and health at university to Toledo, Ohio. The subjects were divided into 2 groups, 12 minutes continuos run group and the Cooper Groups, 12 minutes continuos run group and the Cooper Group on the basis of VO2 scores to produce groups that were approximately equipment in fitness levels. After a pre-test and post-test ten weeks later, the data were evaluated by the a repeated measures ANOVA, using .05 level of significance.

Salih (1984) identified the effects of a conditioning program 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. After the conditioning program the study concluded significant improvements were found in anaerobic threshold heart rate, resting blood pressure
interval in the standing position, percent body fat from both skinfold and under water weighing and all strengths. No significant differences were found in the means of VO2 max. (ml.kg/min), percentage of Co2 max. anaerobic threshold, supine resting blood pressure, resting heart rate and right leg strength.

Thomas, T. R., Adeniran, S. B., & Etheride, G.L., (1984). studied that interval training benefits aerobic capacity more than continuous running. In this study interval training and continuous running were compared for effects on physiological adaptations. Untrained men and women were randomly assigned to four groups: 1) running continuously at 75 %HR max for four miles; 2) running continuously at 75 %HR max for two miles; 3) eventually running eight one minute intervals at 90 % HR max with three minute recovery intervals; and 4) no exercise control. 24 males and 35 females completed the study. Training sessions were conducted three times per week for 12 weeks.

Priest (1984) designed a study to determine which measures significantly change after seven weeks of aerobic training. A further purpose of this investigation was to determine the degree of relationship of these variables to 10,000 meters run times in university cross country runners. The study concluded that training for 10,000 meters run produced improvement in 1500 meters, 6,000 meters, 10,000 meters and 20 miles performance. Training for 10,000 meters also improved Cardio-respiratory functions. The effect of training was comparatively less to body composition.

Wallin (1984) studied the effects of ten weeks jogging programme on selected physiological variables, blood pressure was
one of these variables. The subjects for the study were 21 middle aged male. Blood pressure was measured before and after ten weeks jogging programme during a three-minute pre exercise period a six-minute sub maximal bicycle ergometer side and a 5 minutes fast exercise period. An analysis of data revealed no significant differences between initial and final tests.

Mathur and Toriola (1984) conducted a study on 40 untrained volunteer male university graduates. The subjects were randomly assigned to four different groups, i.e. first, a control group (N=10); second, one of joggers of 1.6 km (N=10); third, joggers of 3.2km (N=10); and fourth a group of joggers of 4.8 km (N=10). The control subjects were not involved in any kind of vigorous physical activity during the entire experimental period. The remaining three experimental groups jogged and prescribed distances three times per week for 12 weeks. In order to ensure the intensity of jogging, Mathew and Fox made the subjects to work at about 85% HR MAX as suggested. The blood pressure, blood glucose and serum uric- acid were tested in the pre and post training period. The results indicated that there was no significant difference in the systolic and diastolic blood pressure readings among the three experimental groups. However, insignificant but large reductions in blood pressure values were observed among the joggers as compared to those of the inactive controls. The fourth groups (4.8 km jogging) had a significantly reduced blood glucose values after 12 weeks of training. Serum uric acid levels were lowered more in the exercise groups as compared to the controls. These reductions were, on the whole, insignificant.
Mosher and his Coworkers (1985) conducted a study to determine the effects of a 12 weeks interval fitness-training programme on 13 pre-pubertal, elite level male soccer players, who served as the experimental group, 11 age-matched players from a team in the same league acted as controls. All subjects were tested prior to and following a 12-week training programme. The tests included an anaerobic speed test in which the subjects performed a treadmill run at 7mph. On a 18% grade until volition fatigue, seven repeats of 40 yards every 20 seconds and a timed one-mile endurance run. The 12 weeks anaerobic training programme for the experimental group consisted of four different high-speed activities performed over 15-20 minutes thrice a week at a work-rest ratio of between 1:2 and 1:3. An analysis of variance found that the experimental group significantly increased its performances on the one-mile run and on the anaerobic treadmill test as compared to the age matched group. Although no significant change was noted on their 40-yard sprint time, a significant improvement was evident on their drop-off between the fastest and slowest times. Thus, the findings of this study clearly indicate that improvement in the bioenergetic systems can occur in pre-pubertal athletes.

Cisar and his associates (1986) studied 32 young adult males during a 14-week training programme to determine the relationship between distance running performances and metabolic responses during treadmill running. Endurance training resulted in significant increases in the anaerobic threshold and maximal oxygen uptake as well as decreases in two-mile, six-mile and 10-mile runs times.
Herbert A. Devies (1986) stated that the interval training for athletes may have an advantage over continuous training, in that the faster pace of interval training may come closer to game conditions and therefore involve using the same muscle, fiber types, and muscle recruitment patterns utilised in the competitive situations. Until more scientific evidence is available, we must conclude that although interval training may have some small advantages over continuous training for the competitive athlete, continuous exercise at lower intensity levels is both safer and better received for purposes of health and fitness in both young and older adults.

Obert, P., Mandigut, M., Vinet, A., & Courieix, D.(2001) compared interval running and continuous running. In this study 10-11 years boys and girls participating in physical education and out side-of-school physical activities, served as subjects. One group, 9 males and 8 females participated in an extra one-hour aerobic training session twice a week for 13 weeks, while others 8 males and 8 females served as controls. A force velocity test was performed n a friction loaded cycle ergometer. Experimental training consisted on one set of interval runs (intensity 90 +% of HR max) and a continuous run (intensity 75-80 % of HR max).

Maximum power increased significantly in the trained group even when muscle mass change was accounted for. The increase was due mainly to force production because the velocity was not altered. No changes were noted in the control group.

It was concluded that aerobic training in Prepubertal children actually altered the anaerobic performance factors of force and power
production. This finding coincides with the known phenomenon that any training form in prepubertal children generally changes both aerobic and anaerobic performance characteristics. At young ages, children’s bodies do not seem to differentiate response or energy delivery mechanisms in training.

If the aim is to burn fat while also increasing your metabolic rate, this is achieved through aerobic work. Constant pace training, where you train at a steady pace for a long period, builds endurance, interval training, where you train for short period periods at high intensity, builds stamina and also boosts the metabolic rate, so you burn fat quickly for as long as 20 hours after your session (Matt Roberts, 2002).

Interval training is where you work for a short period at a high intensity, recover by working for short period at low intensity, and then repeat the cycle. Interval training builds aerobic strength and stamina because it enables you work the respiratory and cardiovascular system at a very intense level. The effect of this is to overload the heart and lungs—they has to become stronger to meet the physical challenge, and, as a result, you become fitter. Interval training places high-energy demands on your body. It is a more effective method of burning fat than constant pace training because it raises your base metabolic rate (bmr), the rate at which you burn calories when rest. Interval training also as an “afterburn effect”, which means that it raises your metabolic rate for as long as 18 hours after your exercise session (Matt Roberts, 2002).
Quinn et al (2002) studied the continuous running and interval running exercise group. 11 male and 16 female were randomly assigned two training work out One was continuous running at 30 minutes per day and 4 days per week, second group was interval running 2 X 15 minutes per day for 4 days per week. The training lasted 12 weeks and than group changes to the other protocol for an addition 12 weeks.

After 24 weeks, VO2 max noticed more improvement in the continuous- interval (CI) group at 7.4 %, than in the interval – continuous (IC) group noticed 3.6 % improvement. Maximum time to execution improved 15 % in the (CI) group but only 5.3 % in the (IC) group. Exercise economy improved at two different speeds in the CI group but did not change in the IC group. It was concluded that changing from continuous to interval training produces more and betters benefits than changing from interval to continuous training.

Seiler, K.S., & Sjursen, J. E.(2002).stated that interval training produces different physiological effects depending upon work duration. This investigation measured physiological responses to varied intensity interval training. 13 subjects were assigned (male and 3 female) for this study. After pre test, performed four interval training conditions of 24X1, 12X2, 6X4, or 4X6 minute buts with equal work and rest duration, resulting in a total of 48 minutes of involvement for each condition.

Average running velocity decreased with increased in interval duration. Peak VO2 was significantly higher for 2, 4, and 6 minute intervals (92 % VO2max) than for 1 minute intervals (82% VO2max).
Blood lactates and RPE were similar across all conditions, both increasing as each exercise bout progressed. The greatest physiological load was experienced in the 4-minute intervals. It was revealed that physiological loading in interval training is greatest when work intervals are four minutes. The shorter the interval, the less demanding is the work, but the greater is the work, but the greater is the potential volume of a particular work quality.

Only the interval-training group improved significantly more than the control group in VO2 max. The response to training was similar between genders, although values differed between them. There were no differences in percent body fat changes, triglycerides, cholesterol, and high-density lipoproteins. In this study it was concluded that interval training more benefits when compared to continuous training.

Tsampoukos, A., Peryebrune, M.C., Davies, J., & Nevill, M.E.(2003), this study was conducted on 15 females university students. Two 30-s sprints with two minutes of passive recovery were performed followed by a VO2 max test before and after six weeks of endurance training. 8 subjects were consisted of endurance training of three sessions per week of 30-min. of treadmill running at 80-85% VO2 max. 7 subjects continued with normal training.

VO2 max increased in the endurance-training group and decreased in the normal training group. Mean power output recovery improved after endurance training but not in the normal training group. There were no differences in recovery of peak power output or
peak lactate. The endurance-training group tended to have higher pH values after the sprints.

It was concluded that endurance training results in significant improvement of recovery power output. Sprinters should experience some endurance training to facilitate performing a greater volume of higher intensity work in interval training.

An overview of the researches done in the area of physiological variables showed that a good number of studies have been conducted to find out the effects of different training method on Cardio-respiratory fitness, blood pressure, vital capacity, resting heart rate etc. it has been found that regular exercise increase vital capacity, which is higher in case of athletes as compared to non-athletes. Systematic conditioning lowering systolic as well diastolic blood pressure decreases heart rate and increases maximal oxygen uptake.

Running has been proved superior to isometric exercises, while fartlek and interval training are more effective than sprinting for the development of Cardio-vascular efficiency. Jogging and cycling lower systolic as well diastolic blood pressure increase the maximal oxygen uptake and improve Cardio-vascular fitness.

In our country research in this field is catching up. The effects of different training and conditioning methods on all the physical, physiological and regarding body composition variables are not yet known. Researches in this context need the attention of physical educationists and sports scientists.