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 also brings out a deep and clear perspective of the overall field.

The relevant literature pertaining to the present study has been abstracted in this chapter to provide the background material to evaluate the significance of this study as well as to interpret its findings.

STUDIES ON PLYOMETRIC EXERCISE

Mullai (1987) conducted a study on the effect of selected plyometric exercise on the performance of long jump. At a random selection, 20 students from the YMCA sports high school, Madras were taken as subjects to accomplish the purpose of the study. The following were the results: the investigation showed to significant improvement in the subjects of the experimental group due to regular practice of plyometric exercise. The investigation reveals that the plyometric exercise contributed to the improvement of leg power, sprinting ability, co-ordination, balance in the flight which in turn improved the performance in long jump.

David Clutch (1983) – In recent years, a method of plyometrics (exercise that cause rapid lengthening of a muscle prior to contraction) called depth jumping has become a part of the training routine of many athletes. Two experiments are described in which the effectiveness of the exercise is examined. In experiments, undergraduate students in beginning weight training classes trained with three difference jumping programmes: (1) maximum vertical jumps (2) 0.3 m depth jumps and (3) 0.75 m and 1.10 m depth jumps. In addition, all groups also lifted weights. In experiment II, a
weight training class and the volleyball team at Brigham Young University – Hawai were divided into two groups. One group lifted weights and performed 0.75 and 1.10 depth jumps. The other group only lifted weights. In experiments I, the three training programmes resulted in increases in one repetition maximum (1 RM) squat strength isometric knee extension strength and in vertical jump; however there were no significant differences between treatments. In experimental II, All groups made significant increases in vertical jump, except the group of weight lifters, who did no jumping. It was concluded that depth jumps are effective but not more effective than a regular jumping routine.

Wilf and Evelyb (1984), thus different authors have made researchers on all aspects of training and their significance. Exercise are mostly designed with the part or the whole of the body, as resistance and they are repeatedly done for sometime. Any specific conditioning for a particular activity will bring a definite change, however, having this in mind a new set of exercise called plyometric exercise were developed specially to improve track and field events.

Saneyev (1979) felt that during the jump the athlete tries to take a tremendous strain. According to scientific data, in the first stage of the jump the hop – their strain reaches 900 kilograms. He also needs legs literally like steel in order to be able to carry the jump through to the end. To train with heavy weights, stride and hop hundreds of meters at a strength, jump with weight belt, with weights in his hands or a weight bar across his shoulders.

Vern Gambetta (1986) plyometric training has by no means been the exclusive domain of the sprinters, jumpers, throwers who have used plyometrics both for the upper body and lower body, upper body plyometric has mainly taken the form of a medicine ball exercise using 7 – 12 lb balls.
Janies Lusis former Javelin world record holder and Olympic champion, made extensive use of jump training in the form of hurdle jumps hopping and bounding to develop the explosive power in his legs. Gyula Zsivatsky of Hungary, who set world record in the hammer at a distance of 241’ 11.5” at a body weight of 205 Lbs would perform jump training exercise twice weekly.

Watson (1979) “The plyometrics are most frequently used as a means of increasing speed and anaerobic power output in sprinters and jumpers, but the technique may also be of value further types of sportsmen”.

He found that the programme of plyometric training produced favourable results when compared with the effects of two different types of weight training. Plyometric may be adapted for upper body work by the use of some heavy objects like medicine ball weight bags and weight jackets.

**STUDIES ON VARIED INTENSITIES OF TRAINING**

Maniazhagu (2001) conducted a study on the effects of varied intensities and frequencies of plyometric training on speed, stride length, stride frequency and anaerobic power among university men sprinters. To facilitate the study, forty men students from St. Joseph College, Trichy were selected as subjects at random and their age was between eighteen and twenty one years. They were divided into four groups namely experimental group I (80 percent intensity with 5 days frequency), experimental group II (80 percent intensity with 3 days frequency), experimental group III (70 percent intensity with 5 days frequency) and experimental group IV (70 percent intensity with 3 days frequency) respectively.

The conclusions were speed, stride length, stride frequency and anaerobic power were significantly improved due to the influence of 80 percent intensity with 5 days frequency, 80 percent intensities with 3 days frequency, 70 percent intensities with 5 days frequency and 70 percent
intensities with 3 days frequency of plyometric training among university men sprinters. This study reveals that high intensity and high frequency of plyometric training contributed to the improvement of speed, stride length, stride frequency and anaerobic power among the university men sprinters.

Williams (1999) stated that the purpose of this investigation was to determine whether there were differences in the magnitude of insular cortex activation across varying intensities of static and dynamic exercise. Eighteen healthy volunteers were studied: eight during two intensities of leg cycling and ten at different time periods during sustained static handgrip at 25% maximal voluntary contraction or post exercise cuff occlusion. Heart rate, blood pressure (BP) perceived exertion, and regional cerebral blood flow (rCBF) distribution data were collected. There were significantly greater increases in insular rCBF during lower 63. ± 1.7%; P<0.05) and higher (13.3 ± 3.8%; P<0.05) intensity cycling and across time during static handgrip 4-5 min, (8.6 ± 2.8%; P<0.05). Insular rCBF was decreased during post exercise cuff occlusion (5.5 ± 1.2%; P<0.05) with BP sustained at exercise levels. Right insular rCBF data, but no left, were significantly related, with individual BP changes (r2 = 0.80; P<0.001) and with ratings of perceived exertion (r2 = 0.79; P<0.01) during exercise. These results suggest that the magnitude of insular activation varies with the intensity of exercise, which may be further related to the level of perceived effort or central command.

Romijn (2000) studied eight endurance trained women at rest and during exercise at 25, 65 and 85% of maximal oxygen uptake. The rate of appearance (Ra) of free fatty acids (FFA) was determined by infusion of (2H2) palmitate, and fat oxidation rates were determined by indirect calorimetry. Glucose kinetics were assessed with (6, 6-2H2) glucose. Glucose Rate increased in relation to exercise intensity. In contrast, whereas
FFA Rate was significantly increased to the same extend in low and moderate intensity exercise, during high intensity exercise, FFA Ra was reduced compared with the other exercise values. Carbohydrate oxidation increased progressively with exercise intensity, whereas the highest rate of fat oxidation was during exercise at 65% of maximal oxygen uptake. After correction for differences in lean body mass, there were no differences between these results and previously reported data in endurance – trained men studied under the same conditions, except for slight differences in glucose metabolism during low – intensity exercise we conclude that the patterns of changes in substrate kinetics during moderate and high intensity exercise are similar in trained men and women.

Mulla et.al. (2000) conducted a study to examine whether the relative work load or the absolute work performed is the major determinant of the lipid mobilization from adipose tissue during exercise. A second purpose was to determine the co-ordination of skeletal muscle and adipose tissue lipid metabolism during a 3h post – exercise period. Six subjects were studied twice. In one experiment, they exercised for 90 min at 40% of maximal O₂ consumption (O₂ max) and in the other experiment they exercised at 60% O₂ max for 60 min. For both experiments, catheters were inserted in an artery, a subcutaneous abdominal vein and a femoral vein. Adipose tissue metabolism and skeletal muscle (leg) metabolism were measured using Fick’s principle. The results show that the lipolytic rate in adipose tissue during exercise was the same in each experiment. Post – exercise, there was a very fast decrease in lipolysis, but it began to increase about 1h post – exercise and remained elevated for the following 2 h. The increase in post – exercise non – esterified fatty acid (NEFA) mobilization was greater after 60% exercise than after 40% exercise. It is concluded that the lipolytic rate in abdominal subcutaneous adipose tissue during exercise is the same whether the relative workload is 40% or 60% of maximum. Post – exercise, there is a substantial lipid
mobilization from adipose tissue and only a small fraction of this taken up in the lower extremities. This leaves a substantial amount of NEFAs for either NEFA / TAG (triacylglycerol) recirculation post – exercise or immediate oxidation.

Yamonto (1995), stated that eight male subjects were examined for the transition from anaerobic to aerobic energy supplies during supramaximal pedalling for 120s on a cycle ergometer. The O₂ dept and O₂ deficit were measured for anaerobic supply. The lactic acid system was also observed through post exercise peak blood lactate concentration (1a-b) peak, since a continuous observation of O₂ dept and (1a-b) peak during a single period of pedalling is not possible, pedalling a seven varying durations (5, 15, 30, 45, 60, 90 and 120s) were repeated. Mechanical power output reached its peak immediately after the beginning of exercise, then rapidly declined, becoming of gradual after 60s. The O₂ dept and O₂ deficit were highest immediately after the beginning of exercise, then rapidly decreased to nil in 60s. The O₂ intake was small at the beginning then rapidly increased to attain a steady state in 30s at 80% - 90% of the maximal O₂ intake of the subject. Energy supply from the lactic acid system indicated by the increment in (1a-b) peak reached its highest value during the period between 5 and 15s, then rapidly decreased to nil in 60s. The results would suggest that anaerobic supply was the principal contributor during the initial stage of exercise, but the aerobic supply gradually took over. In 60s anaerobic supply ceased, and aerobic supply became the principal contributor. The cessation of anaerobic energy supply took place much sooner than the 2 min that is conventionally suggested.

Kalpana (2002) conducted a study on the effect of varied intensities of bench step training on selected motor ability components and physiological variables among university women volleyball players. To facilitate the study
forty women university volleyball players were selected at randoms from various colleges at Trichy and Alagappa University college of physical education. They were divided into four equal groups at random basis. After 6 weeks of training final test was conducted for the variables such as speed, agility, standing broad jump and resting pulse rate.

The result of the study, showed that the resting pulse rate, speed, agility and anaerobic power were not improved by the influence of the varied intensities of bench – step exercise.

Miura (1995) stated that the purpose of this study was to determine the aerobic training intensity from the maximal and submaximal running exercise in 21 untrained adult men. To accomplish this, we evaluated the relationship between physiological (oxygen intake and heart rate) and physical parameters (running speed) of training intensity, and determined the training intensity at the submaximal exercise. Oxygen intake and heart rate were measured by a treadmill test. The maximal oxygen intake (VO₂ max) and the aerobic threshold (Aer T) and anaerobic threshold (AT) were measured to determine respiratory gas exchange. Running capacity was measured by a 12-min running and treadmill test. For the maximal exercise, there was significant correlation (r = 0.88, P<0.01) between VO₂ max and 12 min running distance (speed). In addition, the oxygen intake and heart rate at Aer T and AT in the sub maximal exercise were linearly correlated with running speed. Three levels of training intensity submaximal exercise were termed light, moderate and heavy. Since Aer T was the lower limit intensity and AT was the upper limit, we took the middle of their values as the moderate intensity. The end point for the determination of the training intensity at the submaximal exercise was estimated to be 85% VO₂ max and 180 beats min −1.
Nakao et. al. (1995) investigated the effect of a long term weight lifting programme characterized by light intensity, low repetition and long rest period between sets on maximal oxygen consumption (VO₂ max) and to determine the advantage of this programme combined with jogging, 26 male untrained students were involved in weight training for a period of 3 years. The VO₂ max and body composition of the subjects were examined at beginning and 1 year, 2 years (T2) and three years after (T3) the training. Of the group, 19 subjects performed the weight lifting programme 5 days each week for 3 years (W-group), 4 subjects performed the same weight lifting programme for 3 years with an additional running programme consisting of 2 miles of jogging once a week during the 3rd year (R1 – group) and 3 subjects performed the weight lifting programme during the 1st year and the same combined jogging and weight lifting, programme as the R1 – group during the 2nd and 3rd years (R2- group). The average VO₂ max relative to their body mass of the W – group decreased significantly during the 1st year, followed by an insignificant decrease in the 2nd year and a leveling off in the 3rd year. The average VO₂ max of the W – group at T2 and T3 was 44.2 and 44.1 ml.kg⁻¹ m⁻¹ respectively.

The tendency of VO₂ max changes the R1 and R2 – groups was similar to the W- group until they started the jogging programme, after which they recovered significantly to the initial level within a year of including that programme and they then leveled off during the next year. Lean body mass estimated from skin fold thickness had increased by about 8% after 3 years of weight lifting. The maximal muscles strength, defined by total Olympic lifts (swatch and clean and Jerk), of these three groups increased significantly and there was no significant difference among the amounts of the increase in the three groups.
Yasuda et al. (1994) conducted a study on the effect of exercise intensity on the power spectral properties of the periodic oscillation of the skin blood flow was investigated with respect to the variability of heart rate in 7 healthy male subjects. The skin blood flow (SBF) and heart rate were measured by a laser. Doppler flow meter on the forehead skin, and by an ECG, at rest and during bicycle exercise in three different intensities, unloaded 50 and 100W. An alcohol ingestion test was additionally performed on two subjects in the resting condition. Power spectral density (PSD) was calculated by means of fast Fourier Transform (FFT). The peak frequency (PF) and integration of PSD (IPSD) of each component was estimated to compare conditions and parameters. In the SBF fluctuation, two major components were usually observed: one synchronous with cardiac contraction rhythm (HFF) which shifted to a higher frequency land with exercise, the other was located in a lower frequency land (LFF) ranging from about 0.1 to 0.2Hz and did not shift with exercises. The PF of the LFF in the SBF was significantly different from that of the HR, called Mayer Waves. The IPSD of the LFF in the SBF increased with increasing intensity of exercise but finally decreased at the highest intensity for which the HFF exhibited a marked increase. The LFF in the SBF disappeared after oral ingestion of alcohol that induced on increase of the SBF. From these spectral analysis, it is proposed that the LFF in the SBF is mainly related to the vasoconstrictor activity through the skin sympathetic pathway, and that the intensity of exercise does not modulate the periodicity of this fluctuation.

STUDIES ON VARIED FREQUENCIES OF TRAINING

Dressendorfer et al. (1995) conducted study on the convalescent period after myocardial infarction (MI) that has been associated with a “spontaneous” improvement in functional aerobic capacity which may be because of normal recovery process unrelated to formal exercise training. The purpose of this study was to determine whether the frequency of formal
training sessions is an important variable affecting the magnitude of improvement in cardio-respiratory fitness during phase II cardiac-rehabilitation. The effect of exercise training frequency on cardio-respiratory fitness was evaluated during a 5 weeks early (phase II) cardiac-rehabilitation programme in 50 low risk, male patients recovering from acute M1. Baseline graded treadmill tests to fatigue endpoints with direct measurement of maximal oxygen uptake (VO$_2$ max), were administered 4 weeks after M1. The subjects were the randomly assigned to either a control group (n = 12) and restricted to “very light” physical activity (requiring < 50% of VO$_2$ max) at home, or to one of three training groups which, in addition to very light home activity, performed moderately intense (approximately 70% of VO$_2$ max) aerobic exercise for 30 to 35 minutes either once per week (n = 13), or three times per week (n = 12) in the hospital based phase II programme. The four groups were similar in age, clinical status and use of beta and calcium channel blockers. Submaximal and maximal cardio-respiratory responses were initially similar in all four groups. Each of the four groups demonstrated significant (P<0.05) increases in maximal treadmill duration at follow up. However, VO$_2$ max increased significantly only in the three training groups. The spontaneous improvement in treadmill duration in the control group, in the absence of formal exercise training, may simply reflect recovery from the acute cardiac event. Those training two and three sessions per week also should significant comparable decreases in submaximal exercise heart rate and rate pressure product and similar increases in maximal treadmill duration and VO$_2$ max. Results suggest that two exercise sessions per week is as effective as three per week for cardio-respiratory conditioning in the early weeks of phase II cardiac rehabilitation.

Mahendran (2000) conducted a study on “effect of varied intensities are frequencies of wind sprints training on selected motor ability components, physiological variables and performance of 100 meters sprint of school boys.
To facilitate the study 45 students of Muthiah Alagappa Matriculation School, Kottaiyur were selected as subjects at random and they were divided with nine equal groups.

The homogenity of variance was found out for the pretest scores. The significance of difference among the post test scores were analysed by 3 x 3 factorial ANOVA. The F - ratio obtained was tested for significance at 0.05 level of confidence. If the interaction was significant, the simple test was used to find out the overall cell mean difference. The scheffe’s post hoc test was used to test the paired mean significant difference.

The finding of the interaction effects showed that there was significant improvement in speed, leg explosive power, anaerobic power, pulse rate and 100 meter dash performance.

Mary Reethamal (1994) conducted a study on effects of varied frequencies of circuit training on muscular performance of college women. For the purpose of the study, ninety girls were selected at random and their age ranged equal groups of 30 each as one control and two experimental group strength and agility as the variables for the study. To compare the statistical data ANOCOVA was employed. It was found out that the muscular performance such as speed, explosive power, muscular strength and agility were significantly improved due to the influence of 3 days and 5 days circuit training among college women.

Anbunath (1996) conducted a study on effects of varied intensities and frequencies of bench step training on selected motor ability components physiological and performance variables of school sprinters. To facilitate the study sixty three male students in the age group of twelve to thirteen years were selected as subjects. In the first factorial analysis the significant difference between the post hoc test was used to find at the paired mean
difference. Four days of frequencies of training improved the speed, anaerobic power and pulse rate greater than three and two days frequencies.

Stanley (1984) compared the effectiveness of interval training programme of running at frequencies of two times a week and four times a week as reflected by the ability of each programme to produce changes on the of the mile run the 220 yards run, and the 50 yards dash on the basis of best timing on three separate mile run, he divided 36 male high school athletes into two groups. Each group participated in the pre established interval training programme of running for a period of 7 weeks. The first group participated in training session four times a week and the second groups participated twice a week. But no significant difference were found on the improvement of the mean difference of both the groups.

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

Cearley and others (1984) conducted a study on the effect of two day and three day per week aerobic dancing programme on maximal oxygen uptake. In this study, 18 female college students enrolled in an aerobic dance class were randomly assigned to one of his experimental group. A group of seven students enrolled in physical education badminton courses volunteered to serve as sedentary controls. Individuals who had been previously trained or those engaged in any type of physical training were excluded from the
study. Training for both group was conducted between the hours 4.00 p.m. to 6.00 p.m. two or three times weekly for the period of ten weeks. The subjects were also instructed not to participate in outside class activities. He concluded that three days aerobic dance group per week improved better in maximal oxygen uptake than two days aerobic dance training per week.

Thirumalaisamy (1995) has conducted a study on the effect of varied intensities and frequencies of treadmill training on selected motor ability, physiological and performance variables. Sixty inter collegiate male long distance runners were selected as subjects at random and their age was between 18 to 25 years. Two different intensities and frequencies selected for this study were 10 km / hour and 15 km / hour and also 2 days training and 3 days per week training respectively. Initial test was conducted for selected motor ability components such as speed, leg explosive power and agility, physiological variables such as pulse rate, anaerobic power and cardio-respiratory endurance and also 1500 mts running performance. The post test were conducted after six weeks of treatment in the above variables (2 x 2) factorial design was used to analyse the result. The finding of the study shows that 15 km / hour intensities of treadmill training is better for the improvement of the above said variables. Also the three days frequency is better for the improvement of the above variables than two days frequency training. The combined effect of 2 days and 3 days training showed that the above variables were improved significantly due to the influence of varied intensities and frequencies of training.

STUDIES ON PHYSIOLOGICAL VARIABLES

Wilkinson (2000) stated that arterial stiffness is an important determinant of cardiovascular risk. Augmentation index (Alx) is a measure of systemic arterial stiffness derived from the ascending aortic pressure waveform. The aim of the present study was to assess the effect of heart rate
on Alx, which elected to use cardiac pacing rather than chronotropic drugs to minimize confounding effects on the systemic circulation and myocardial contractility. Twenty-two subjects (13 male) with a mean age of 63 years and permanent cardiac pacemakers in situ were studied. Pulse wave analysis was used to determine central arterial pressure waveforms, non-invasively, during incremental pacing (from 60 to 110 beats min⁻¹), from which Alx and central blood pressure were calculated. Peripheral blood significant, inverse, linear relationship between Alx and heart rate ($r = 0.76; P<0.001$). For a 10 beats min⁻¹ increment, Alx fell by around 4%. Ejection duration and heart rate were also inversely related ($r = -0.57; P<0.001$). Peripheral systolic, diastolic and mean arterial pressure increased significantly with pacing, central systolic pressure did not. There was a significant increase in the ratio of peripheral to central pulse pressure ($P<0.001$), which was accounted for by the observed change in central pressure augmentation. These results demonstrate an inverse, linear relationship between Alx and heart rate. This is likely to be due to alternations in the timing of the reflected pressure wave, produced by changes in the absolute duration of systole consideration by wave reflection and aortic pressure augmentation may explain the lack of rise in central systolic pressure during incremental pacing despite an increase in peripheral pressure.

Kubendran (2002) conducted a study on the effects of anaerobic and plyometric training on health, speed, explosive power, agility, breath holding time, resting pulse rate, anaerobic power among college men athlete. To achieve the purpose of this study 45 men students from American college, Madurai was selected. They are assigned into three groups of which one group served as anaerobic training group, second group served as plyometric training group and the third group served as control group. After six weeks of training, the study was conducted that the breath holding time and speed were significantly improved due to the influence of six weeks anaerobic training.
Anaerobic training significantly improved the selected dependent variables such as breath holding time and speed greater than the plyometric training. Anaerobic training and plyometric training did not improve the selected dependent variables such as resting pulse rate, anaerobic power, explosive power and agility among college men athletes.

Ton (1994) conducted a study on the effect of seat to pedal distance on anaerobic power and capacity in recumbent cycling. The purpose of this investigation was to determine the effect of systematic changes in seat to pedal distance on cycling peak anaerobic power (PA) and anaerobic capacity (AC) in recumbent cycling. Nineteen male recreational cyclists (ages 20 – 33 years) were tested in five seat to pedal distance (90, 95, 100, 105 and 110 of the total leg length from the greater trochanter of the right femor to the grand). The seating position was defined by a 75 degree angle formed between the seat tube and a vertical line, with the seat – back rest perpendicular to the ground. Minimum maximum mean and range of his, knee and ankle angles were determined for each condition. All subjects were tested in each of the five condition according to a randomly determined, sequence, with a minimum of 16 hours rest between test session. The wintage anaerobic cycling test was used to Monark cycle ergometer with a resistance of 8\textsuperscript{th} gm / kg of the subjects body mass (5.0 Joules Pedal rev / kg bm). During the test each subjects was strapped to the seat back rest at the Waist and hips, Pedal toe – clips were worn and a micro switch on – line with a Macpaq analog to digital convert interfaced to a Maclntons SE micro-computer was used to monitor and record ergometer pedal revolutions. Repeated measures ANOVA and post hoc test revealed that AP and AC in the 100, 105 and 110\%. Seat the pedal distance were significantly greater than that in the 90 and 95\% condition. No significant difference were found in AP or AC between the 100, 105 or 110\% seat to pedal distance with changes in seat to pedal distance, a quadratic and linear function was found to best
describe the trend in AP and AC respectively. It was concluded that there is a range of seat to pedal distance that will maximize AP and AC in a recumbent cycling position, and it is suggested that these seat to pedal distance be considered in the development of faster and more effective human powered vehicles power. The trained women had significantly lower resting pulse rate.

Tossavainen (1994) conducted a study on new maximal anaerobic pedalling power test. The purpose of this study was to develop a new maximal anaerobic pedalling power (MAPP) test and to compare two MAPP test protocols with the MARP test. The MAPP and MARP tests included in - 20s sprints with 100s recovery between sprints. Blood lactate concentration was measured 40s the MARP – test the initial pedalling power (4.09 kg) was increased by .48 w.kg -1 for each consecutive sprint until exhaustion. In the MAPP 1 test the pedalling frequency was set to 100rpm while in the MAPP2 test the resistance was set to 1/13 kg.

Based on the ACSM equations the oxygen demands of all test protocols were equal. Ten male PE – students served as subtracts. The maximal power (The oxygen demand of last sprint) was similar in MARP, MARP 1 and MARP 2 (107 ± 8, 107 ± 8 and 105 ± 6 ml kg⁻¹ min⁻¹, respectively) Peak blood lactate was 12.8 ± 1.3, 15.6 ± 1.7 and 14.7 ± 2.1 mm, respectively with significant difference (P<0.05) between MARP and MARP 1. Blood lactate at sub maximal intensities (VO₂ demand 86 Ml kg⁻¹ min⁻¹) was higher (P .05 – 0.01) in MARP 1 than MARP 2 and both pedalling test elicited higher lactate levels than MARP at equal spinning intensities (VO₂ demand 98 ml kg⁻¹ min⁻¹). It is conducted that MARP test can be modified for bicycle ergometer and the maximal anaerobic power is similar in pedalling and running exercise.
Coleman et. al. (1994) studied nine college basketball athletes to determine the effects of season of computation on the aerobic and anaerobic energy resources pre and post season variables of resting and recovery heart rates performances of treadmill test (time) maximal oxygen intake and the scores of Margaria anaerobic capacity test (vertical jumping velocity) were studied. Analysis of data yielded non – significant decrease in recovery heart rate. Treadmill performance time, VO₂ max a non – significant increase in resting heart rate and anaerobic power and significant increase in vertical velocity from pre and post test. The result of this investigation suggest that the training in basketball was of efficient intensity to maintain cardio respiratory functions and improve anaerobic performance.

O’Neill (1993) compared to sedentary women, with the trained pregnant women and found that pregnant women higher stroke volume and lower heart rate during low and moderate intensity exercise. There was a non – significant trend (P < 0.025) for the resting heart to be lower in trained women. In this study 39 healthy non – smokers with in complicated singleton pregnancies were tested between 23 and 28 weeks of gestation. The women who were classified as “trained” (n = 10) had attended aerobics classes at last weekly for the prior 20 weeks.

Paavolainen et. al. (1994) stated that the purpose of the study was to investigate neuro-muscular and energy performance characteristics of anaerobic power and capacity and the development of fatigue. Ten endurance and ten sprint athletes performed a new maximal anaerobic running power test (MARP), which consisted of n x 20-s runs on a treadmill with 100 – s recovery between the runs. Blood lactate concentration (1a-) b was measured after each run to determine sub maximal and maximal indices of anaerobic power (P 3 mm 01. 1 – 1, P5 mm cl. 1 – 1, P 10 mm 01. 1 – 1 and P max) which was expressed as the oxygen demand of the runs according to
American college of Sports Medicine equation: the oxygen uptake (ml kg\(^{-1}\) min\(^{-1}\)) = 0.2 \times \text{velocity} (M. \text{mm}^{-1}) + 0.9 \times \text{slope of treadmill} (\text{frac}) \times \text{velocity} (M. \text{min}^{-1}) + 3.5. The height of rise of the center of gravity of the counter movement jumps before (CMJ rest) and during (CMJ) the MARP test, as well as the time of force production (t f) and electromyographic (EMG) activity of the leg muscles of (M) performed after each run were used to describe the neuromuscular performance characteristics. The maximal oxygen uptake (VO\(_2\) max) anaerobic and aerobic thresholds were determined in the VO\(_2\) max test, which consisted of n x 3 – min runs on the treadmill.

Nindl et.al. (1995) conducted a study on little data that exist for upper and lower body mechanical power capability of adolescent athletes. This study compared arm (A) and leg (L) anaerobic peak and mean power (PP and MP) of 20 male and 20 female adolescent athletes after normalization for body mass (Bm), fat – free mass (FFM) and lean A and L cross sectional area (CSA). Power outputs were assessed by the Wingate anaerobic test. FFM and CSA were estimated via anthropometry. No significant (P<0.05) differences existed between the sexes in Tanner sexual maturity, chronological age or overall training activity, males and higher (P<0.001) absolute PP (W) (L 694 vs 442; A 494 vs 309) and MP (L 548 vs 307; A 337 vs 214). Ratio normalization and ANCOVA were used to remove the influence of body size differences. Ratio normalization showed that males had greater leg PP / BM, MP / FFM, MP/CSA, as well as arm PP/ BM and MP / BM, where as all leg and arm PP and MP ANCOVA adjusted means for BM, FFM and CSA, except arm MP adjusted for FFM, were significantly (P<0.01) higher for males than Females. It was concluded that factors other than muscle mass, possibly qualitative in nature are responsible for the sex difference in anaerobic performance of adolescent athletes.