Chapter - II

**REVIEW OF RELATED LITERATURE**

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Chapter-II

REVIEW OF RELATED LITERATURE

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

The review of related literature is a light of spirit of something for better understanding of the problem and to interpret the results. The search for reference material has been a time-consuming but fruitful phase of the research program. A familiarity with the literature in any problem area helps the investigator to discover what is already known, what others have attempted to find out, what methods have been promising or disappointing and what problems remain to be solved. John W. Best (1978).

The researcher had gone through the available literature related to this study. The literature was confined to the library of Department of Physical Education & Sports Sciences, Yogi Vemana University, Department of Physical Education and Sports, Acharya Nagarjuna University, Department of Physical Education & Sports Sciences, Annamalai University, Lakshmi Bai National Institute of Physical Education and Sports Sciences, Gwalior, Rayalaseema College of Physical Education, Proddatur and the latest literature related to the study by using Internet facilities.

The purpose of the study is to analyze the effect of resistance training and endurance training in series and parallel on selected physical and physiological variables among women. There were number of studies touching the topic that has been pursued and some of the most important reviews are presented in this chapter for clear understanding.

An elaborate study was conducted by Seshier (1998) conducted a study on the effects of pranayama and transcendental meditation on the pulse and blood
pressure of the male students of the Sowrashtra College, Madurai. For this purpose, 75 college students were randomly assigned to one of the three groups. Group I performed pranayama, Group II performed transcendental meditation. Group III performed pranayama and transcendental meditation. Subjects in each group were trained with respective program for a period of six weeks, 5 days/week, 2 sessions of 20 minutes duration both in the morning and evening, prior to and at the end of training period. All subjects were tested for pulse rate and B.P. Transcendental meditation has a positive effect on SBP only. Combined pranayama and transcendental meditation showed very good effect on pulse rate and B.P.

**Uppal A.K. & Rao, V.S.S.M (1980)** conducted a study to determine the effects of interval training and two continuous load methods on cardio respiratory and selected physiological parameters. One group was given interval training, the second Fartlek and third group was given slow continuous running for a period of 10 weeks, for 5 days/week. The load was increased progressively after every two weeks, and found that slow continuous running and interval training were superior to Fartlek in reducing the resting pulse rate.

**Nageswaran (1997)** conducted a study to find out the effects of interval and continuous running of cardio respiratory endurance, resting heart rate, respiratory rate and breath holding time of college students. For this study 45 physical education men students were randomly selected as subjects by lot method from the total one hundred and ten students. Group I was subjected to interval running (n=15), group II to continuous running and group III acted as control. The control group was not engaged in any activity other than the regular curriculum during the training period. Training was performed for 12 weeks, 3 days/week, 45 to 60 minutes duration approximately including warming-up and warming down. Measurements were obtained from pre-test, post-test. This study concludes that interval training and continuous running significantly reduced RHR compared with control group.
Subramanian (2000) has conducted a study to find out the effects of continuous running and combined training of continuous running and interval running on selected physical, physiological and haematological variables. For this study 40 bachelor degree men students were selected as subjects, age ranged between 18 and 20 years. Subjects were randomly divided into three groups of 10 each. Group I was subjected to continuous running (n=10), group II continuous and interval running (n=10) and group III acted as control (n=10). During training group I was trained for 12 weeks, 3 days/week, group II was trained continuous running for 6 weeks followed by interval training for 6 weeks, 3 days/week, group III did not participate in training. Workout lasted for 45 to 60 minutes including warming-up and warming down. Selected variables were measured prior to and after training program. The results of the study indicated that the reduction of RHR is better in continuous running group than other two groups. It may be due to the fact that the type of continuous running program is a steady process in improvement of changing the physiological status and also attributed the greater stress involved in continuous running.

Leicht, Allen and Hoey (2003) have examined the effects of intensive cycling training on heart rate variability (HRV) during rest and exercise. They have selected thirteen healthy untrained subjects, age 18-27 years. HR was measured before and after 8 weeks of cycling. The training includes 25-60 minutes/day, 5 days/week at >80% HR maximum. HR was recorded during supine rest and sub maximal exercise and was analyzed HRV components such as low frequency (LF) high frequency (HF), LF/HF ratio and total power. After 8 weeks of cycling HR was significantly reduced at rest and all absolute exercise work rates.

Wallis and Jason (1978) conducted a study to investigate the acute effects of strength training on various cardiovascular ventilators during subsequent aerobic exercise. Six fitness enthusiasts, previously trained in WL and cardiovascular conditioning, performed a weightlifting session consisting of three universal equipment leg exercises (leg press, leg extension and leg curl) immediately afterward,
the subjects exercised on a cycle ergometry at 65% of their VO₂ max for 30 minutes. Physiological parameters of HR, oxygen consumption, ventilation and RER were measured during sub maximal trails and compared to controls who performed cycle ergometry without a previous strength session. Only HR change significantly due to the intervention, whereas other variables were unaffected by the strength session. The mean difference between sub maximal exercise trials for HR with in the control was 1.0 bpm, whereas the experimental group showed an increase of 8.83 bpm.

Mounier and others (2003) conducted a study to examine the effect of hyper volemia on HR during 4 days of prolonged exercise. The main aim of this study was to evaluate the cardio dynamic adjustment during 4 days of prolonged exercise and to check if the PV expansion, which is observer generally during such events plays a role in this adaptation. For this study 13 young adult men, age 24.1 ± 2.14, height 178.0 ± 5.0 cm were chosen. The study was divided into 3 main phases: the control period (during the week before the exercise period), the exercising period during 4 days (from D₁ to D₄) and the recovery period 15 hours after the end of the last exercise bout (R₁). The selected variables were HR and PV. Subjects exercised on the cycle ergometer alternately with the treadmill over 4 days in the laboratory under moderate temperature. The study indicates that HR decrease from 143 to 129 bpm for cycle and from 147 to 137 bpm for treadmill, as compared to D₁, PV increased gradually from D₂ to D₄. It concluded that 4 days prolonged exercise induced a HR decrease during sub maximal exercise. In this study ANOVA were performed.

Leicht, Allen and Hoey (2003) have made a study to examine the influence of age and moderate intensity exercise training on HRV in young and mature adults. For the purpose of this study 12 young (18 – 24 yrs) and 12 mature (29-43 yrs) were selected as subjects. HR was measured during supine rest and sub maximal moderate exercise. Recording was obtained prior to midway and follows 10 weeks of aerobic exercise training. Results of the study indicated that significant mean age difference, body mass was similar for the young (y) and mature (m) subjects at pertaining and
remain unchanged for both groups through out the study. HR during rest and all exercises, work rates were significantly reduced by training \((p<0.01)\). post-hoc analyses indicated that HR during each experimental condition was significantly lower at mid training and remained significantly lower at the end of the study for y and n subjects. It is estimated that VO\(_2\) max was significantly increased following training and of similar magnitude for y and n subjects.

**Ector & Verlinden et.al., (1984)** found that in trained athletes less than 50 bpm was recorded in 65% of the athletes, and heart rates decreased to less than 40 bpm during sleep. In another study **Kala, Viitasalo (1982)** compared the HR with 20 trained athletes with untrained control subjects. All the subjects underwent ambulatory ECG recording. The results showed a significantly lower HR \((p<0.01)\) in the athletes both during sleep and during other activities.

**Talan and his associates (1982)** have conducted a study on twenty four continuous ECG recording in long distance runners. For this study they took 20 long distance runners \((n=20)\) and 50 untrained professional students of similar age \((n=50)\). For both the group they have tested HR for 24 hours by using 24 hour Holter recording during normal activity. Study reveals that the Heart Rate was 10 bpm slower when compared with 50 untrained professional students. Average HR during sleep in the runners ranged from 31 to 43 bpm compared to 33 to 55 average HR in the untrained subjects. Further it concluded that the degree of bradycardia is most profound in athletes engaged in sports requiring the greatest endurance.

**Uusitalo and Rusko (1998)** have made a study to investigate the effects of progressively increased training load and over training on RHR and IHR and cardiac autonomic modulation (CAM) for this study the took nine athletes (ETG) increased training volume at 70-90% of VO\(_2\) max by 130% and training volume at <70% VO\(_2\) max by 100% during 6-9 weeks and six female as control athletes (CG). The results were analyzed by using two-way analysis of variance. VO\(_2\) max, IHR and RHR were
measured before and after training. Results of the study indicated that RHR has a tendency to decrease in the ETG and increase in the CG during the training period. In conclusion RHR rather decreased with heavy endurance training. Progressively increased training load and over training did not induce significant changes in IHR or CAM in female endurance athletes.

**Schmidt and Lotzerich (1999)** have conducted a study to analyze the changes in HR during rest and competition. For this study they took 12 elite cyclists. HR was measured during rest and competition. The results of the study indicates that a minor increase in the resting heart rate (48 ± 5.3, 51.7±7) and a significant decrease of the average (159±7, 139±6) and HR maximum (191±8, 183±7bpm) during competition. The results shows that a training exclusively controlled by HR can cause problems. In training camps similar changes of the HR as in this study can be observed.

**Rowland & Unnithan et.al., (1994)** have made a study evaluate clinical manifestations of the ‘athletes heart’ in pre pubertal male runners. For this study they took two groups. Group I (n=10) 10 male pre pubertal distance runners ages 11-13 years, Group II (n=18) physically active but untrained boys. In this study they found reducing RHR in runners 71 bpm and 73 bpm in control group. However this failed to identify clinical features of the athlete’s heart in competitive child endurance runners compared to non-trained subjects.

**Itamar Levinger & Rogerbronks et.al., (2004)** have conducted a study to examine the effect of resistance training on left ventricular function and structure of patients with chronic heart failure. In this study 15 males aged 57.0 ± 10.2 years with chronic heart failure volunteered to participate as subjects. Patients were matched according to their age and EF to either resistance training program (n=8) or non-training control group (n=7). All patients remained on their prescribed medication during the study. The training consisted of 9 different exercises for the major muscle
groups. The training group trained 3 days/week for 8 weeks. At least 48 hours separated each training session. Initial intensity of training was 40-60% of maximal strength, one set between 15 and 20 repetitions, and then gradually intensity was increased. Hence, the number of repetitions was decreased and at weeks 7-8 the number of repetitions corresponded to 8-12 for three sets. Results of the study indicated that 8 weeks of resistance training had no significant effect on the LV measurements. Post training comparisons, however it revealed that EF and FS of the training group was significantly higher than in the control group.

**Raghunandan (1995)** made a study to examine the effect of physical training on selected coronary heart disease risk factors among middle-aged men. For this study 20 men aged between 35 and 40 years working as teachers in various schools were randomly selected as subjects from a population of 60 men who volunteered for each experimental group I (n=10) subjects to physical training and group II (n=10) as control. Training includes walking, slow jogging, stretching and free hand exercise for 12 weeks, 3 days/week and 30 minutes per session, in the first 3 weeks and 45 minutes per session, four sessions per week from the beginning of the 4th week to the end of the 6th week. From the 7th week till end of the 12th week subjects exercised for 60 minutes per session and five sessions per week. Only one session was conducted per day, during early hours of the day. Selected variables were measured prior to and immediately after training. The results of the study indicated that the SBP and DBP in experimental group have reduced at the completion of the training. However when compared with control group reduction in SBP was significant.

**Boyer and Kasch (1998)** conducted a study on 23 essential and 22 normotensive men to determine the effect of controlled exercise program for six months on BP. There was no other change in the rapeutic management during exercise training period. The exercise medium used was the interval training of walk-jog type with training intensity based on the actual heart rate expressed as percent of working capacity. A drop means DBP of 11.8 mm Hg and mean SBP of 13.5 mm Hg
occurred in the hypertensive group. There was a mean decrease of 6 mm Hg in DBP of normotensive group. All men with BP of 140/90 mmHg below were considered normotensive. A DBP above 95 mm Hg was required for hypertensive group.

**Joji M. Philip (2003)** has made a study to analyze the effects of selected karate and kalarippayattu exercise on selected physical, physiological and psychological variables of men football players. For this study investigator took 48 football players who participated in inter collegiate men football tournament. The selected subjects were randomly divided into 3 groups of sixteen each. Group I underwent karate training, group II underwent kalarippayattu training and group III acted as control. Training consist of 3 days/week for 12 weeks. The subjects were tested on selected physiological variables such as resting pulse rate, SBP and DBP at prior and immediately after the training program as pre and post-tests. It concluded that there was significant reduction on resting pulse rate, SBP and DBP in favour of kalarippayattu training group. **Sally J. et.al., (1999)** has conducted a study on weight training attenuated of HR and BP during activities in older males. For this study they took 7 healthy older male subjects (X age 64 years). Subjects did 10 week of unilateral and bilateral leg press weight lifting training. Before and after training intra-brachial artery pressure was monitored during 12 repetitions of 1 and 2 leg press exercise at 80% of initial 1 RM, 10 minutes treadmill walking at 2.5 mph, carrying 20 and 30 pounds load between 4-6 and 8-10 minutes respectively. 4 minutes of treadmill walking at 30 mph up an incline of 8%, 12 flights of stair climbing at 60 steps/min on a stair master 6000 ergometer. This study concluded that after training the SBP max and HR in the leg press were significantly lower. HR and SBP values were also consistently lower throughout the 12 repetitions of leg press exercise. The values for all variables were consistently lower after training throughout the 10 minutes treadmill test and maximal values for SBP max and HR were 227 Vs 224 mm Hg and 107 Vs 97 bpm. Finally.
As a result of evidence gathered from test performed on Olympic athletes and others, there appears to be evidence that the trained individual has a lower pulse rate than the untrained person. One estimate has been made that the heart of a person decrease beats from six to eight than he or she is in training as compared to when he or she is out of training. In many athletes, pulse rate are ten to twenty and as much as thirty beats lower than in those individuals who follow sedentary pursuits Bucher (1975).

According to Kavanagh (1990) director of the largest cardiac rehabilitation program in the world, a number of exercise training effects can explain the mechanisms by which regular exercise protects against coronary heart disease. It has been shown that regular exercise training increases diastolic volume and that is associated with an enhanced SV and a resting and exercising bradycardia. Indeed the bradycardia is a hallmark of the trained state and is due to a variation in the influence of the autonomic nerve supply to the heart. The parasympathetic or vagal tone is increased at rest and the sympathetic tone decreased during intense and unexpected episodes of physical effort. A number of peripheral changes brought about by exercise training. BP is reduced as a result of increased skeletal muscle vascularity and consequent drop in peripheral resistance. It concludes that this is an imposing list of explanations for the clinical observations that exercise protects against cardiovascular disease.

Katoh M. et.al., (1993) were made a study to investigate the effects of physical training on obesity, hypertension, hyperlipidemia and disorders of glucose metabolism. For the study 359 male, 30-59 years of age were selected as subjects. BMI, SBP and DBP were measured before and after the 2 months period of physical training. It concluded that SBP, DBP after the training were significantly lower than before the training. It also concluded that in subjects with high SBP and high DBP decreased with increase of training time per week. Finally investigator observed differences for
measured values before and after the training of 2-3 hours per week were 15 mm Hg in SBP and 10 mm Hg in DBP.

**Samits and Bachl (1991)** have conducted a study to examine the effects of physical training program on aerobic capacity and coronary risk profiles in sedentary individuals. They have reviewed 27 studies on exercise training program for reducing BP. Totally 1153 subjects were studied in these 27 experimental studies with all the subjects being either middle aged or older sedentary individuals. It concluded that 9 studies out of 27, reporting BP at rest, 6 showed a significant reduction in SBP ($x=-9$ mm Hg) and DBP ($x=-7$ mm Hg).

**Cononie and others (1991)** made a study to analyze the effects of endurance training program on VO$_2$ max and BP. They have conducted the investigation for individuals who have moderately elevated BP or hypertension (SBP/DBP of 140 to 180/190 to 105 mm Hg). The training includes low to moderate intensity (40 to 75% VO$_2$ max) and 20 to 60 minutes, 3 to 5 days/week. It concluded that there was maximal reduction in BP associated with this training approximate 10 mm Hg for both SBP and DBP. **Hagberg J.M. and others (1989)** also found that the BP lowering effect of endurance exercise training appears similar for hypertensive men and women of all ages.

**Mikkelsson et.al., (2004)** have conducted a study to examine whether aerobic fitness measured by a maximal endurance running test at adolescence predicts prevalence of blood pressure levels in adulthood. For this study 29 subjects (15 very low runner and 14 very fast runners) participated in a clinical follow-up study in 2001. Compared to those who were fast runners in adolescence, those who were slow runners tended to have higher age adjusted risk of hypertension at follow-up Diastolic blood pressure was higher for very slow runners at adolescence compared to very fast runners, the age adjusted mean diastolic blood pressure being 90 mm Hg vs 83 mm
Hg. Findings of the study reveals that high endurance type fitness in adolescence predict low risk of hypertension and low resting DBP levels in adult men.

**Vaithianathan (1988)** has conducted a study to examine the effects prior to and after training on selected physical, physiological variables. For this purpose 70 physical fit and untrained boys were randomly assigned to one of the two groups. Group I (experimental group) performed circuit training five days a week for a period of 12 weeks, group II (control group) were restricted to participate in any of the training program. Prior to and at the end of training period all subjects were tested for muscular strength, muscular endurance, cardio respiratory endurance, blood pressure, vital capacity and respiratory rate. The results of the study indicated that circuit training improved the efficiency significantly in physical fitness variables and physiological variables such as BP, vital capacity and respiratory rate.

**Carmen .C et.al., (1991)** conducted a study on the effect of exercise training on blood pressure in 70 to 79 yr old men and women. For this study men and women 70-79 yr of age (n=49) were studied the effect of 6 months of resistance or endurance exercise training on their blood pressure, hemodynamic parameters and pressure hormone levels. RT consisted of one set of 8-12 repetitions on ten nautilus machines 3 times/week. The ET group progressed to training at 75-85% VO₂ max for 35-45 min 3 times/week for the last 2 months of training. Upper and lower body strength increased with RT, while VO₂ max increased by 20% in the ET group. BP did not change with RT in individuals with normal or some what elevated BP. DBP and mean BP decreased significantly by 5 and 4 mm Hg, With ET. subjects with BP> 140/90 reduced their SBP, DBP and mean BP by 8,9 and 8 mm Hg respectively with endurance exercise training. Resistance exercise training does not adversely affect, or reduce BP while endurance exercise training produces modest reduction in BP in 70-79 yr old individuals.
Clausell et.al., (1991) has conducted a study to determine whether the response of LV diastolic function to incremental exercise is similar to the response of systolic function. In these 12 healthy men performed exercise radionuclide gated ventriculography, with previous determination of the lactate threshold (Lact.). HR, EF and Peak Filling Rate (PFR) were measured at rest, at lact intensity and at peak exercise. Both EF and PFR increased significantly from rest to lact and did not change significantly from lact to peak. The absolute values of PFR correlated with EF. Thus study concluded that during incremental exercise diastolic function respond similarly to systolic function, probably die to different mechanisms.

Fitton and others (1991) have conducted an investigation on blood pressure response to dynamic and static exercise among sprinters and endurance runners. For this study 3 sprinters and 4 endurance runners from a David I track program performed submaximal cycle ergometry (CE) and static handgrip exercise (SE) was selected as subjects. For CE the work stages were sequential, consecutive and each lasted 5 min. during CE at 40, 60 and 80% VO₂ max sprinters exhibited significantly greatered DBP and MAP responses (p<0.05). SE was performed at 30% of maximal voluntary contraction to fatigue. Response were expressed relative to % during of fatigue time. During SE at 20, 40, 60 and 80% of fatigue duration sprinters exhibited greater SBP, DBP and MAP responses (p<0.05). The results of the lend support to the importance of muscle fiber type in determining BP response to both dynamic exercise and static exercise.

Antenello et.al., (2002) have conducted a study to analyze left ventricular structure and cardiac performance during effort in two morphological forms of athlete’s heart. The main aim of this study was to find out the correlation between changes induced by different sport activities in LV structure and cardiac response during maximal physical effort. To achieve this purpose a total of 160 top level endurance athletes (ATE: swimmers, runners 28±4 years, 98 male) and 103 strength trained athletes (ATS: weight-lifters, body builders, 27± 5 years, male) were selected
on the basis of training protocol (DE Vs SE). Both the groups underwent Doppler echocardiograph, HRV analysis and maximal exercise stress test were assessed during effort: measured variables were HR max, SBP max and maximal workload (bicycle test). The results of the study indicated that the two groups were comparable for age and sex, but ATS at rest showed higher HR, SBP and body surface area. LV mass index and EF did not significantly differ between the two groups. However, ATS showed increased wall thickness, relative wall thickness and LV end-systolic stress, while LVSV and LVEDD (p<0.01) was greater in ATE. During maximal physical effort ATE showed a better functional capacity with greater maximal workload (p<0.001) reached with lower HR max and SBP. After adjusting for HR, age BSA and SBP distinct multiple linear regression models evidenced in ATE independent associations of maximal effort workload with LV EDD (p<0.001), HR (p<0.001) at rest and LV end-diastolic stress were found in ATE. On the other hand independent direct correlation of SBP max during effort will sum of wall thickness and LV end-systolic stress (p<0.001) was evidenced in ATS.

It concluded that structural changes in competitive athletes represent adaptation to hemodynamic overload induced by training and consistent with different kinds of sports activity. Work capacity during exercise is positively influenced by preload exercise in ATE, while increased after load due to isometric training in ATS determines higher systemic resistance during physical effort.

Jose Kutty (2001) designed a study entitled effect of continuous running and alternate high and low intensity running on cardio respiratory endurance resting heart rate, systolic and diastolic blood pressure positive and negative breath holding time of boys. To achieve this purpose 90 medically fit students age ranged between 16 and 18 years were selected as subjects. The subjects were randomly divided into three groups and each group contain 30 subjects. Group I underwent continuous running, group II underwent alternate high and low intensity running, group III acted as control. The experimental groups were trained for five days/week for 14 weeks, 45 to 60 minutes
including warm-up ad cooling down exercise. RHR, SBP and DBP were measured before and after exercise. ANCOVA was employed. It concluded that continuous running and alternate high and low running groups were significantly lowered the SBP, DBP and RHR.

**Yeo S. et.al., (2000)** analyzed to determine whether moderate exercise during pregnancy lower blood pressure. A randomized controlled trial with one test group and one control group. After 4 weeks of observation, the subjects were randomly assigned to either the exercise or control. The exercise group visited the laboratory three times a week for 10 weeks to perform 30 minutes of exercise at rating of perceived exertion up to level 13. The results were analyzed from a total of 16 pregnant women (X age, 30 years) who participated in the study. BP measurements were compared before and after the 10 weeks exercise period in two groups. SBP did not change significantly, but DBP in the exercise group decreased by 3.5 m Hg, while that in the control group increased by 1.1 mm Hg. Thus, the pre, post changes in DBP differed by 4.6 mm Hg between groups. This study concluded that 10 week moderate exercise treatment reduced the DBP to a near significant level among pregnant women and it also concluded that exercise early in pregnancy evoke a decrease in vascular resistance and increase in venous and arterial capacitance, simultaneously blood volume rise and Q is increased due to exercise.

**M.Rajashekaram (1999)** made a study to analyze the effects of series and parallel training on elastic strength components among physical education and sports male students. Forty-five students were selected on random basis and they were divided in to three groups of 15 each. Group I underwent series training, group II underwent parallel training and group III acted as control. The period of training was 12 weeks and 4 sessions per week. It was concluded that parallel training group have significantly increase elastic strength components when compared with series and control group.
Oluseye K.A (1990) designed a study entitled cardiovascular responses to exercise in Nigerian women. For this, forty-two sedentary Nigerian women participated in the exercise program aimed at investigating the value of two different methods influencing resting SBP, DBP and HR. The subjects were randomly divided into three groups of 15 each. Group I exercised under interval training protocol (ITP), group II exercised under continuous training protocol (CTP). The last group was the control. The training period lasted for 12 weeks. Analysis of covariance was employed. It revealed significant difference between the pre and post training resting SBP and DBP as well as the HR measurement. The ITP group demonstrated superior cardiovascular response over that of the CTP group.

Louis Peruse & Ingrid et.al., (2001) have conducted a study on genetic determinations of exercise BP and HR in response to 20 week endurance exercise training in whites and blacks. For this study a total of 463 participants from 99 sedentary white nuclear families and a total of 249 individuals from 105 sedentary black nuclear families were selected as subjects. The study was analyzed by using a familiar correlation model. 20 week endurance training was given for both the groups. BP and HR were measured before and after training program. The pre training values of exercise SBP, DBP and HR phynotypes at 50w and 80% of VO₂ max by sex, generation and race. Study found that maximal heritabilities in whites reached 27%, 25% and 38% for exercise SBP, DBP and HR training responses at 50w, respectively. However, the estimates for these phenotypes were not only non-significant in blacks at 50w, but were also negligible in both whites and blacks at 80% of VO₂ max. This study concluded that exercise BP and HR training response at 50w in whites were influenced a modest, but significant. The lack of similar familiar effect in blacks may be due to a smaller size.

Boutcher S.H. and others (2003) have conducted a study to examine the SV response to incremental sub maximal exercise. For this purpose they have selected trained cyclists (n=10), active but untrained men (n=10) and sedentary men (n=10).
For the trained at a HR of 90 beats/min, SV increased by 27% compared to baseline levels, where as SV of active and sedentary group did not significantly increase. Throughout the exercise indices of ventricular emptying and filling of trained were significantly greater than that of the other two groups where as ventricular rates of the active were significantly greater than those of the sedentary. Throughout exercise cardiac contractility of the trained was significantly greater than the other two groups. Results indicated that despite similar RHR, SV and body mass, trained compared to active men significantly enhanced SV, ventricular filling and cardiac contractility during incremental ergometry exercise. Active compared to sedentary men, however, displayed significantly larger SV. It concluded that impedance cardiography indices of ventricular performance of aerobically trained men were superior to those of active, untrained men possessing similar resting SV and HR further more, the ventricular performance of the active men possessing large resting SV was superior to that of sedentary men.

Wijen J.A.G et.al., (1994) have made a study on effect of exercise training on ambulatory blood pressure. For this study 19 sedentary male subjects, aged 22 to 44 years with normal or slightly elevated blood pressure. Measurements were performed before the study, after 6 weeks of sedentary life style (S) and after 6 weeks of training (T) on a cycle ergometer 3 times/week from 45 min at 75% VO₂ max. ABP was measured with a space labs 90207 monitor and Q at rest with echo-Doppler. Training increases VO₂ max from 3.13± 0.09 to 3.40±0.08 L/min. (p < 0.01). RHR decreased from 60 ± 2 to 57 ± 2 (p<0.05). Resting SV increase from 82 ± 3 to 89 ± 3ml (p>0.02). it concluded that moderate physical training for six weeks increased SV and Significantly reduced HR.

Parameswara Kumar .B (2004) has conducted a study on effect of aerobic dance on selected physical, physiological and psychological variables of sedentary women. For this study 40 sedentary females were randomly selected as subjects from women’s club of Trivandrum, Kerala, aged from 30 to 40 years. Selected subjects
were randomly derived into experimental group I (n=20) subjected to aerobic training program and group II (n=20) remained as control. The training protocol includes warm-up, aerobic dance and cool down session for duration of 35 minutes. Training intensity was fixed to 75-80% maximum heart rate. The intensity was gradually increased by more vigorous and difficult movements during workout session after every 1½ weeks. The training group consisted seven work periods, which lasted for 3 to 5 minutes in length during the course of training period. Under physiological variables resting heart rate, blood pressure (SBP&DBP), peak expiratory flow rate (PEFR) and cardio respiratory endurance work measure before and after cardio respiratory endurance were influenced after 26 weeks training period and reduced resting heart rate, SBP, DBP and increased cardio respiratory endurance.

**Schwartz R.S. and Hirth (1995)** revealed that there is a substantial clinical data supporting a blood pressure lowering effect of endurance training. Though the effect is modest (5-10 mm Hg), epidemiologic studies indicate the possibility of protection against the development of hypertension and also indicate significantly reduced cardiovascular mortality and increased longevity associated with chronic endurance exercise. **M.Rajashekaram (1999)** conducted a study to find out the effects of maximum strength and speed training in series and parallel an elastic strength components among physical education and sports male students, forty-five (N=45) students were selected at random and were divided into three groups. Group I underwent series training, group II underwent parallel training and group III acted as control, speed, explosive power, stride frequency, leg strength back strength and anaerobic capacity were selected as criterion variables, ANACOVA was applied to find out the significance difference for all dependent variables. The results of the study indicates that training groups have significantly improved on speed, explosive power, stride frequency, leg strength back strength and anaerobic capacity when compared to control group. Further it also concludes that parallel training group is better than series training group in improving selected variables.
Maddalazyo (2000) compared the effects of a moderate intensity seated resistance training program with high intensity standing free weight exercises program in healthy older men and women. This conclude that although resistance training of moderate to high intensity produced similar muscle changes in older adults a higher magnitude is necessary to stimulate osteogenesis at the spine.

A number of studies have been conducted in the effect of exercise on Heart Rate. HR is considered to be one of the most useful and common cardiovascular parameters in sports medicine. Dixie and other (1993) says that it can be measured at rest, during exercise and after recovery from exercise either directly or by tele transmission and it is the most simple and efficient test. The weight of the athlete’s heart does not generally exceed 500 grams. Training has good impact on heart rate, training reduces resting heart rate. But work load given in the training period has a correlation with the reduction in heart rate. As Davaries (1994) explains other training being equal, the trained individual has a lower heart rate for any given work load.

Mc Dougal and others (1991) says that there are controversial opinions on the resting heart rate as an index of fitness and considering the low resting heart rate and as index of large cardiac out put and higher aerobic fitness.

Morehouse and others (1991) have also the same opinion in this regard. They say that numerous tabulations of heart rate as related to physical fitness fail to show any clear correlation except in some highly trained athletes. During sleep there is progressive showing of the rate during the first seven hours followed by an increase before awakening. More-house says that the average heart rate at rest (basal) is about 78 beats for men and 84 beats for women per minute. Heart rate diminishes progressively from birth to adolescence but slightly increases again in old age.

Mc Ardle and Williams (1985) even though there are controversial opinions regarding resting heart rate and human performance, many of the authors opined that
between the trained in resting heart rates. They prepared a chart of resting, anticipatory and maximum exercise heart rates in competitive runners and untrained subjects. This chart is still quoted by various authors as a criterion for the heart rates of trained and untrained athletes.

**Uppal A.K. & Rao, V.S.S.M (1980)** conducted a study to determine the effect of interval training and continues load method on cardio respiratory and selected physiological parameters, group-I was given interval training, group-II fartlek and group-III was slow continuous running for period of 10 weeks, 5 days/week. The load was increased progressively after every 2 week. He found that (I) all the three groups had equal training effect on maximal oxygen uptake, vital capacity, leg strength, positive breath holding, negative breaths holding time (II) slow continuous and fartlek method results significantly higher improvement in cardio respiratory endurance when compared to interval training and (III) slow continuous running and interval training were superior to fartlek in reducing the resting PR.

**Thomas Kirk (1969)** has studied the influence of progressive training program on the cardiovascular measurements taken from an experimentation by Du Toit working with cureton at the University of Illinois physical fitness research laboratory in urbana, this groups trained for an hour, there times per week. The same amount of time was spent by both the groups. The changes are impressively greater for the running group compared to the weight training group. There was a greater reduction in pulse rate and diastolic pressure.

**Choquette and Forguson (1973)** submitted 165 middle aged apparently normal men to a six month conducting program on the basis of casual blood pressure measurement during the pre-training e evaluation 37 individuals were classified as “border line” hypertensive. The remaining subjects were normotensive. At the conclusion of the program both group exhibited significant reduction in systolic and diastolic blood pressure at rest and after sub maximal systolic pressure was
significantly greater for hypertensive. It was expected that the hypertensives would have a greater BMI. However, the observed reductions in blood pressure cannot be attributed to body weight since this was essentially content during training.

Sajwan (1986) compared the effect on Cardio respiratory endurance and related physiological variables caused by jogging and rope skipping. 45 male students aged 14 to 16 years have been analyzed on the basis of their pre and post test results on Cooper’s 12 minutes run/walk, Basel blood pressure, vital capacity, conventional pulse rate and positive breath holding time. The subjects were assigned to one of the three groups. Group I jogging for 25-40 minutes, group II rope skipping for 10 to 25 minutes and group III acted as control group. After analyzation, it was revealed that both the training groups improved significantly on Cardio respiratory endurance and other selected physiological variables and the jogging groups is better than rope skipping group in all manner.

Stone .W.J. and Coulter.S.P (1994) studied the effects from there resistance training protocol on strength/endurance with women. Fifty collected women (N=50) were randomly assigned to one of the three resistance training protocols that employed progressive resistance with high resistance/low repetition (HRLR), medium resistance/medium repetitions (MRMR), and low resistance/high repetitions (LRHR). The three groups trained on the same resistance exercises for nine weeks at three sets of six to eight RM, two sets of fifteen to twenty RM and one set of thirty to forty RM, respectively. There was significant pre/post strength increase in both upper and lower body tests, but no post-treatment in muscular strength among the three protocols. Absolute muscular endurance increased significantly I four of six pre/post comparison, while relative endurance increased significantly on only four of twelve comparisons. HRLR training yielded greater strength gains. LRHR training generally produced greater muscular endurance gains and the percentage increase in absolute endurance was approximately twice the increase in strength for all groups.
Majdell R and Alexander (1991) conducted a study to determine the effects of regular sprint training and combined over-speed and overload training on the sprinting speed of college male athletes. Eighteen male varsity football player were divided into three groups of six subjects (n=6) per group. The control group (c) participated in sprint training, free of any external loading, a second group (OS) participated in over speed two training using a Sprint master towing device and the third group (OSW) participated in over speed two training while wearing a ten-pound weight vest. The subjects were timed for a maximal 40 mete sprint, as well as being filmed while sprinting at maximum speed both before and after the six-week training program. The 40 meter sprint time as well as the most important kinematic variables in sprinting were calculated for each subject. Only seven of the twenty kinematic variables measured in this study were significantly different from the pre test to post test in one of the groups. The results of the ANCOVA indicated that there were significant differences between post test means for the three groups for eight of the variables, but the least squares means test failed to produce significant between group differences for all of these. Sprinting g speed can be improved by a sc week program of sprint training including conventional sprint exercised and over speed low training. There were no significant increased in sprinting g speed or technique resulting form the specific over speed training regime used in his study, compared to other methods.

Pethan S.M (1995) studied effects of training in strength shoes (TM) on speed, jumping ability and calf girth. Seventy two collegiate males between 19-25 years of age were randomized in to one of the three groups (n=24), control group (CG), a strength shoe group (SSG) or a regular shoe group (RSG). SSG and RSG trained 3 x per week for ten weeks and followed identical programs as prescribed by manufacturer. SSG were the strength shoe (TM ) while RSG were their own athletic shoes. All SSG were tested before and after the ten weeks for forty yard dash time (40 TIME). Vertical Jump, Broad jump and right and left calf girth. The result showed that
significant change from pre-testing (P<0.05). SSG had significant (P<0.05) increasing right and left girth from pre to post testing. However, this change was not significantly (P<0.05) different than either C or RSG. There were no within or between group differences for 40 TIME, vertical jump or broad jump as a result as a result of training. These results indicate that even though there was a tendency for training in strength shoes (TM) to improve performance. The increase were not significantly greater than training in regular athletic shoes. Additionally the chances of injury appeared to be greater when training in strength shoes(TM).

Conroy et.al., (1994) conducted a study to examine the effectiveness of plyometric training for inter collegiate athletes in a training setting on the variables of Speed, Strength and Power. Twenty one female and thirty male track and field athletes server as subjects. The subjects were divided by gender, track group (Power or Endurance), and randomly assigned to either an experimental group which participated in plyometric training or a control group which did not perform any of these drills. The experimental group trained 3 times per week with each session lasting 20 to 40 minutes. Each subject was tested 3 times during the 40 week study. A repeated measures of analysis of variance with three between factors and one within factor was used in comparing the variables among the groups for pre-test, mid-test and post testing periods. The 40 yard dash showed a three-way interaction for the experimental group between gender and between track groups. The test for flexibility also showed a three-way interaction between test period between gender and between track group. Isokinetic testing for power and the standing long jump showed a significant result for gender and track group. Isokinetic testing for strength and the vertical jump test showed significant result for gender, test period and track group.

Morehouse and miller (1991) find the influence on systolic, diastolic blood pressure. There is a sharp increase of systolic pressure during the lime of puberty. After the age of 20 there is a steady rise in both systolic and diastolic pressure. It is observed that critical pressure varies with age and sex.
**KRS REDDY (2009)** has conducted a study on the effect of endurance training and resistance training in series and parallel on selected cardiovascular parameters. He selected 30 (N=30) Bachelor of Physical Education students were randomly selected and they were divided in to three equal groups of ten (n=10) in each. This study consisted of two experimental variables such as resistance training and endurance training in series and resistance training and endurance training in parallel. Among the three selected groups, group-I (n=10) underwent series training, group-II (n=10) underwent parallel training and group III (n=10) acted as control group. Both the experimental groups had undergone respective training for four sessions per week for twelve weeks. He concluded that there is a significant difference between the experimental group and control group and also a significant difference between the two experimental groups.

**Shamsher Singh (2006)** has conducted a study on the effects of selected yoga practices on physical and psychological variables of deaf and dumb children. To meet the purpose of the study one hundred students were randomly selected as subjects and they were divided into 50 each (n=50). In this group I underwent yoga practices for 9 weeks where as group II acted as control the variables selected for this study were physical (Speed, Strength endurance, Agility, Flexibility and coordination) variables, psychological variables (Self confidence and mental health). The level of significance was fixed at 0.05 level.

**Guzolic & Gerald L (1997)** the purpose of this study was to determine the effect of caffeine ingestion on heart rates, Systolic and Diastolic Blood pressure and Physical work capacities during sub maximal cycle ergometry. The investigation included a total of 15 male subjects who were members of the Howard Long Wellness Center in Wheeling, WV, between the ages of 18 to 25 heard old, who were habituated to the effects of caffeine. The study consisted of a caffeine, placebo and control trial. A two-way analysis of variance with repeated measures was used to analyze the data for heart rates and blood pressures and a one-way analysis of variance with repeated
measures was used to analyze the data for physical work capacities. All data were analyzed at 0.05 level of significance. This study was conducted to test the following null hypotheses: there will be no significant differences in heart rates, blood pressures or physical work capacities in male college students after the ingestion of caffeine. The analysis of data indicated that there were no significant differences in heart rates, blood pressure or physical work capacities in male subjects after the ingestion of caffeine.

Prem Kumar (2002) has conducted a study on effects of progressive plyometric training and progressive plyometric training followed by reversibility. For these forty five (N=45) men studying bachelor degree course were randomly selected as subjects. All the subjects were tested on Speed, Stride frequency, Anaerobic power, Explosive power in terms of vertical and horizontal distance prior to and after 12 weeks of training with 3 times/week/45 minutes to one hour which includes warm-up and warm down. In this study group I underwent progressive plyometric training, group II underwent progressive plyometric training for 9 weeks and followed by reversibility for two days per week for remain three weeks. The principle of overload for group I has been applied at every four weeks up to the 12 week to reach the high intensity where as group II was attained the high intensity at the ninth week itself and then for remaining three weeks the load was deliberately reduced. Group III acted as control. It concluded that both progressive plyometric training and progressive plyometric training followed by reversibility groups have significantly improved Speed, Stride frequency, Anaerobic power, Explosive power in terms of Vertical and Horizontal as compared to the control group. The results of the study concluded that experimental group has significantly improved selected physical and psychological variables as compared to control group.

In this chapter, the researcher has given reviews of related literature which helped the researcher for the better understanding of the problem and to interpret the result.