

## **CHAPTER II**

### **REVIEW OF RELATED LITERATURE**

It is an accepted fact that a thorough review of related literature is an important step in any successful research. The review of related literature is meant for better understanding of the study and to interpret the results that have been presented in this chapter. All good research includes a literature review. Research begins with ideas and concepts that are related to one another through questions or hypotheses anticipated relationships. Although these ideas and concepts are may simply pop into the researchers head. Quite often they are deriving from a careful exploration of the collective body of prior related literature.

In this chapter, the available research papers related to this particular study are presented. A serious and scholarly attempt has been made by the scholar to go through the related literature from the libraries of Tamilnadu Physical Education University, Chennai, Annamalai University, Chidambaram, Alagappa University College of Physical Education, Karaikudi, and some was also collected from web sources. A study of relevant literature is an essential step to get a full picture of what has been done and said on the problem of the topic in one's own country and abroad.

The reviews were classified and presented under following headings

1. Studies related to cardiovascular training
2. Studies related to resistance training
3. Studies related to concurrent training
4. Summary of Review of related Literature

## 2.1 STUDIES RELATED TO CARDIOVASCULAR TRAINING

### **Mathewos Hosiso, Sangeeta Rani and Shemelis Rekoninne, (2013)**

investigated the effect of aerobic exercise on improving health related physical fitness components of sedentary female community. According to analyzed data in 12 meter run 724.8 mean difference was recorded. The mean differences value boosted in push up performance by 5.4 after 12 weeks aerobic exercise. In sit up and sit and reach test 4.7 and 4.52 increments were observed respectively. But in body mass index 2.18 decrement and in body weight 5.8 reduction were observed throughout the study period. The result obtained in this study indicated that there were significant improvement in cardiovascular endurance, muscular endurance, muscular strength and flexibility but in the case of body mass index and body weight there were reduction. It was concluded that Moderate aerobic exercise has positive effect on improvement of health related physical fitness components of sedentary female communities.

**Shahana, Usha , and Hasrani, (2010)** studied the effect of a 12-week aerobic exercise programme on health-related physical fitness components, which are cardiorespiratory endurance, flexibility, abdominal strength endurance and body fat in middle-aged women. The results proved that there was significant difference seen on cardiorespiratory endurance, flexibility, muscular strength endurance and skin fold thickness (body fat %). In the case of control group no significant changes were seen in any of the selected variables. It was concluded that there was significant improvement in cardiorespiratory endurance, flexibility, muscular strength endurance and

decreased skin fold thickness (body fat %) among the experimental group of middle-aged women after 12 weeks of aerobic training.

**Chia-Lin Li et al. (2006)** conducted quasi-experimental study, the subjects in the exercise group participated in a 12-week aerobic exercise program, while subjects in the control group did not participate. The results of analysis of variance with repeated measures of health-related physical fitness showed that the subjects in the exercise group had significantly more improvements in abdominal muscle strength and endurance than the subjects in the control group. This study indicated that 12-week aerobic exercise program was effective in improving the abdominal muscle strength and endurance of employees of a high-tech company.

**Sasa Pantelic et al. (2013)** investigated the effects of twelve-week aerobic dance-training program on the body composition parameters of young women. The results indicated that significant decrease was noted on BF%, at the final measuring in relation to the initial one (20.37% compared to 22.66%), which was statistically significant ( $p < 0.05$ ). On the basis of results, they concluded that aerobic dance decreases subcutaneous fatty tissue and body composition of the young women.

**Aranga Panbilnathan and Kulothungan (2011)** studied effect of different intensity aerobic exercise on body composition variables among middle aged men. Sixty male subjects were selected randomly divided four groups and each group consists of fifteen subjects each. The result shows that high intensity aerobic exercises were significantly better than low and moderate aerobic exercises in percentage body fat. The moderate and high intensity aerobic exercises significantly influenced lean body mass of middle age men.

**Ramesh and Subramaniam (2010)** conducted a study on the effect of aerobic and calisthenics exercise on health related physical fitness variables such as muscular strength, muscular endurance, flexibility, cardio respiratory endurance and body mass index (BMI) of obese adolescents. The result of this study indicated that muscular strength, muscular endurance, cardio respiratory endurance was significantly improved, and also it was observed that Body mass Index significantly reduced.

**Vitartaite et al. (2004)** evaluated the cardiovascular functional parameter changes for 30-40 year old women following the aerobics exercise program. The bicycle ergometry work was performed applying 50 Watt intensity in the beginning and increasing the power every minute by 25 Watt. It was established that heart beat rate of participants statistically significantly decreased ( $p < 0.05$ ) at rest and in each level of functional load after one year of regular aerobics exercise. The systolic blood pressure of women, who were engaged in the aerobics exercise, did not change; the diastolic blood pressure statistically significantly decreased ( $p < 0.05$ ), when participant achieved 75 Watt and 100 Watt intensity. Aerobics exercise is the proper physical activity form for 30-40 year old women for the developing of cardiovascular functional parameters.

**Mughal et al., (2001)** examined the influence of 12-weeks aerobic exercise intervention (brisk walking) on resting systolic and diastolic blood pressure, pulse pressure, mean arterial blood pressure, body weight and body mass index in patients with essential hypertension. The results indicated that reduced pulse pressure from baseline value of  $-3.7\text{mmHg}$ , ( $p < 0.01$ ) and mean arterial pressure of  $-3.4\text{ mmHg}$  ( $p < 0.01$ ). No discernible

effects on mean body mass index was observed although mean body weights decreased  $-1.1\text{kg}$ , ( $p<0.05$ ). Brisk walking exercise yielded significant increase in  $\text{VO}_2$  max ( $p<0.05$ ). Aerobic exercise caused small reduction in resting systolic and diastolic blood pressures in men with stage 1 or 2 essential hypertension. A lifestyle change such as exercising may play a role in reducing the risk of hypertension.

**Habibzadeh and Rahmani-nia, (2010)** investigated whether walking exercise can positively effect on BMR and anthropometric variables in young thin women. Each walking session was 30 min walking at 50-75% of maximal heart rate, 3 days per week, for 2 months. Percent body fat, fat mass and lean mass changes in response to training were significant in the exercise group (all  $p=0.000$ ). Also BMR in exercise group significantly increased ( $p= 0.022$ ). This study demonstrated that walking exercise improved the Anorexia Nervosa in young thin women. If done on a regular basis, this type of training can be efficient, safe way of reducing this illness.

**Ramesh and Subramaniam (2011)** conducted a study on the effects of physical exercise training at different intensities on Body Mass Index (BMI), Basel metabolic rate (BMR) and body fat percentage (BF%) of obese adolescents. The result of study reported that aerobic and calisthenics exercises has significant reduction on body mass index and body fat percentage. Basel metabolic rate has significant increased exercise in burning capacity for calories reduce in aerobic exercise for three month period. There was no significant reduction in the performance of selected BMI, BMR and BF% after three months yogic exercise training programme when compared with aerobic exercise as well as control group.

**Evrin Cakmakc, et al., (2011)** assessed the effects of aerobic dance exercise on body composition in sedentary overweight women. There were significant differences between pretest and posttest for weight, body mass index, waist circumference, waist hip ratio, metabolic and body composition parameters in exercise group ( $p < 0,05$ ). Furthermore, there were no significant differences between pretest and posttest for waist circumference, waist hip ratio, body composition parameters, Lean Body Mass, Basal Metabolic Rate, body weight and body fat percentage in control group ( $p > 0,05$ ). As a result, it proved that aerobic dance exercise at a moderate intensity and duration can improve physical fitness and can decrease body fat percentage, Lean Body Mass and Basal Metabolic Rate during weight loss.

**Mridula Mittal et al., (2011)** assessed different levels of physical activity in the general population to measure body mass index, Waist Circumference and mean arterial pressure. In this study, a significant decline in waist circumference (WC), body mass index (BMI) and mean arterial pressure was observed in physically active population as compared to the sedentary life style population. Physical activity is the best road to good health.

**Ashira Hiruntrakul, et al., (2010)** conducted a study whether 3-months aerobic exercise training at moderate intensity once a week can increase fitness status in healthy sedentary young men. In the exercise group, there was a significant increase in most fitness parameters compared with control,  $VO_2\text{max}$  (19.7%), isokinetic power and strength of shoulder and knee (14.9%), and resting heart rate decreased (7.4%). Moderate-intensity training once a week for at least 12 weeks was sufficient to increase aerobic fitness in

sedentary young men. This low frequency of exercise training may be used to encourage sedentary individuals for more compliance with physical activity.

**Sanjeev Kumar, (2013)** investigated the effect of two modes of aerobic training (Aerobic dance and Cardio fitness) on respiratory variables between sedentary people. The results of the study indicated that there was significant improvement on breath holding capacity and resting respiratory rate and significant difference was found between aerobic dance group and cardio fitness group, it means aerobic dance program was more effective than Cardio fitness program in both the respiratory variables.

**Sinku, (2012)** examined the effects of health related physical fitness programmes that are covered in the academic programme of physical education department on the cardio respiratory functions of sedentary students. In the study it was found that twelve weeks of health related physical fitness programme resulted in a significant decrease in the resting heart rate and respiratory rate with significant increase in the vital capacity.

**Fatma Arslan,(2011)** investigated the effects of an eight-week step-aerobic dance exercise programme on weight loss and body composition parameters in middle-aged sedentary obese women. The results of the study proved that after the eight weeks of the step-aerobic dance exercise programme, significant differences were found in the subjects' weight, BMI, body composition parameters, waist-hip ratio (WHR), waist circumference (WC), fat percentage, lean body mass (LBM) and basal metabolic rate (BMR) in the experimental group ( $p < 0.05$ ). There were no significant differences in the control group after the experiment in terms of the same measures ( $P > 0.05$ ).

Harsoda & Geetanjali Purohit,(2013) studied the effect of whole body exercise, walking exercise, upper and lower limb exercise and combined exercise on sedentary males. The result of the study shows that increase in cardiorespiratory efficiency was found significantly higher in response to whole body, combined and walking exercise. The other mode like only upper limb or lower limb exercises are not as beneficial. In conclusion cardio-respiratory efficiency and exercise performance both are improved by regular exercise training and whole body exercise is the best among all.

Bassi, et al, (2015) studied the effect of aerobic exercises on peak expiratory flow rate (PEFR), body mass index (BMI), and physical fitness index (PFI) in apparently healthy female subjects. The result of the study shows that there were significant changes in all the parameters while comparing with the baseline values at the three time intervals; an increase in peak expiratory flow rate, fall in body mass index, and rise in physical fitness index was seen. While comparing the values between the two groups, no significant difference could be found. Any form of aerobic exercise proves to be beneficial if followed consistently. Both the groups experienced an improvement in peak expiratory flow rate, body mass index, and physical fitness index, but labeling as which aerobic regimen was better could not be done.

Sakthignanavel, (2017) studied the effects of yogic training, aerobic training and detraining on flexibility of college male students. The results of the present study indicates that flexibility can be improved significantly due to twelve of yogic training and aerobic training during mid and post test period. The yogic training group is better improved compare than the aerobic training group, during the testing periods namely pre to mid and mid to post



test. The pre to mid test results reveal to be better than mid to post test period. The effect on flexibility for both the training groups has gradually decreased up to third cessation period during the detraining period, the effect of flexibility of yogic training group has decreased faster when compare to the aerobic training group.

Sasi Kumar, Sivapriya & Shyamala Thirumeni,(2011) evaluated the effects of a 45 days daily practice of suryanamaskar on blood pressure(BP), heart rate(HR), respiratory rate (RR), forced vital capacity(FVC) and peak expiratory flow rate (PEFR) in school students of both sexes. The results of the study showed that the Systolic blood pressure, peak expiratory flow rate and forced vital capacity increased significantly and respiratory rate, heart rate and diastolic blood pressure decreased significantly after the practice of suryanamaskar. The beneficial effects of suryanamaskar can be applied to all schools to improve the physical health and sports activities of the students.

Khan et.al., (2019) examined the effect of interval training with moderate intensity continuous training on aerobic capacity ( $VO_2$  max). The results of the study indicated that  $VO_2$ max (ml/kg/min) improved significantly in both the groups. There was reduction in resting heart rate, resting respiratory rate and resting blood pressure in both the groups post 6 weeks of training intervention. It was observed that both the groups showed significant improvements in aerobic capacity ( $VO_2$ max). There was reduction in resting heart rate, resting respiratory rate and resting blood pressure in both the groups post 6 weeks of training intervention.

Indranil Manna, (2017) examined the effects of yoga on body composition, cardiovascular parameters and lipid profile on healthy adult

males. The results of the study shows there was significant reduction in percentage of body fat, systolic blood pressure and resting heart rate, were noted among the experimental group after 12 weeks of yoga training when compared to baseline data. These changes might be due to yoga training. Regular yoga practice improves body composition and cardiovascular status and maintains lipid profile.

Ramkumar (2011) conducted a study to determine the effect of aerobic exercise on resting pulse rate and breathe holding time among middle age men. The result of the study revealed that there was a significant difference between experimental group and the control group before and after the training period on resting pulse rate and breath holding time. There was a significant decrease on resting pulse rate and there was a significant improvement in breath holding time. However the improvement was in favor of experimental group due to eight weeks of aerobic exercise programme.

Karthikeyan (2011) studied the effect of interval and continuous running on cardiorespiratory endurance. The result of the study revealed that there was a significant difference among interval training group, continuous running group and control group on cardiorespiratory endurance. And also it was found that there was a significant improvement on cardiorespiratory endurance due to interval training and continuous running whereas the improvement was in favor of continuous running group.

Sinku,(2012) examined the effect of Health-Related Physical Fitness Programmes on the Cardio-Respiratory Function of Sedentary Students. The result of the study shows significant decrease in the resting heart rate and respiratory rate with significant increase in the vital capacity. According to the

results it can be concluded that health related physical fitness programme in physical education department is not only beneficial to increase the cardiorespiratory functions and improve physical fitness of sedentary students.

Upadhyay Dhungel, et al., (2008) Studied the responses of Alternate Nostril Breathing (ANB) the Nadisudhi Pranayama on some cardio-respiratory functions in healthy young adults. A significant increment in Peak expiratory flow rate (PEFR L/min) and Pulse pressure (PP) was noted. Although Systolic blood pressure (SBP) was decreased insignificantly and the decrease in pulse rate (PR), respiratory rate (RR), diastolic blood pressure (DBP) were significant.

Aly, El-Mohsen, & Hafez, (2017), investigated the effect of six weeks of core stability exercises on trunk and hip muscles' strength in college students. The results of this study showed a significant improvement in peak torque of trunk flexors, extensors, hip flexors, extensors, and adductors post testing in the study group with no significant change in hip abductors' peak torque. However, there were no significant differences in the post testing peak torque of trunk flexors, extensors, hip flexors, and abductors between groups. Six weeks of core stability exercises have significant effects on trunk and hip muscles strength, especially hip extensors and adductors.

Farahani , Mansournia & Asheri, (2010) investigated the effects of a 10-week water aerobic exercise on the resting blood pressure in patients with stage 1 or 2 hypertension referring to Tehran University Clinics. The results of the study indicated that exercise lowered systolic blood pressure and mean arterial pressure. The lowering effect of exercise on diastolic blood pressure was neither statistically significant nor clinically important. There was no significant effect of age, baseline body mass index and stage of hypertension

on the exercise-induced changes in blood pressure. They Concluded, A 10-week course of water aerobic exercise markedly reduced the systolic and mean arterial blood pressure of patients with essential hypertension and is especially recommended for the obese and the elderly who have orthopedic problems or bronchospasm.

Burnham and Wilcox (2010) studied the effect of low intensity aerobic training on physical and physiological function in athlete's performance. A second purpose was to evaluate the differential effects of low- and moderate-intensity exercise on these variables. After the exercise training, there were no statistically significant differences between the two exercise groups on any of the physiological variables. The results revealed statistically significant increases in aerobic capacity and lower-body flexibility, a significant decrease in body fat, and a significant increase in quality of life when compared with the control group.

Mughal, et al., (2001) examined the influence of brisk walking on resting systolic and diastolic blood pressure, pulse pressure, mean arterial blood pressure, body weight and body mass index in patients with essential hypertension. The results of the study proved that statically significant decrease in resting systolic and diastolic blood pressure were found. Reduced pulse pressure from baseline value of  $-3.7\text{mmHg}$ , ( $p < 0.01$ ) and mean arterial pressure of  $-3.4\text{ mmHg}$  was noted. No discernible effects on mean body mass index was observed although mean body weights decreased. Brisk walking yielded significant increase in  $\text{VO}_2\text{max}$ . Aerobic exercise caused small reduction in resting systolic and diastolic blood pressures in men with stage 1

or 2 essential hypertension. A lifestyle changes such as exercising may play a role in reducing the risk of hypertension.

## **2.2 STUDIES RELATED TO STRENGTH TRAINING**

**James Fisher, et al. (2011)** Stated that Resistance training produces an array of health benefits, as well as the potential to promote muscular adaptations of strength, size, power and endurance. The American College of Sports Medicine (ACSM) regularly publishes a position stand making recommendations for optimal achievement of the desired training goals. They recommend that appreciably the same muscular strength and endurance adaptations can be attained by performing a single set of ~8-12 repetitions to momentary muscular failure, at a repetition duration that maintains muscular tension throughout the entire range of motion, for most major muscle groups once or twice each week. All resistance types (e.g. free-weights, resistance machines, bodyweight, etc.) show potential for increases in strength, with no significant difference between them, although resistance machines appear to pose a lower risk of injury.

**Ralph, Robert and Richard, (2004)** American College of Sports Medicine (ACSM) published a Position Stand entitled Progression Models in Resistance Training for Healthy Adults. The ACSM claims that the programmed manipulation of resistance-training protocols such as the training modality, repetition duration, range of repetitions, number of sets, and frequency of training will differentially affect specific physiological adaptations such as muscular strength, hypertrophy, power, and endurance. The ACSM also asserts that for progression in healthy adults, the programs

for intermediate, advanced, and elite trainees must be different from those prescribed for novices.

**Adams, et al, (2001)** investigated effects of an 8-week, low-frequency and low-volume, supervised, progressive strength training program emphasizing free weight, multijoint movements on the muscular power, strength, endurance, and flexibility of African American women 44 to 68 yr of age. The subjects trained 2 day/week using free weight (barbells and dumbbells) and machine (plate loaded) exercises for two to three sets of 8 to 10 repetitions on both primary and assistance exercises. The result of the study shows that significant increases ( $P < 0.000$ ) in 1RM muscle strength occurred in the strength training group. Absolute endurance and flexibility significantly increased ( $P < 0.000$ ) in the strength training group. No significant changes occurred in power, strength, absolute endurance, or flexibility in the Control group.

**Kaukab Azeem and Abdulhameed Al Ameer, (2013)** investigated the effect of weight training program on the selected fitness variables among males from pre to post test. The analysis of data shows that the body mass index of the participants from pre to post test shows insignificant performance. It is concluded that the effect of five weeks weight training program had not shown any effective means in reduction of the body weight of the participants from pre to post test. Furthermore the effect of five weeks weight training program had shows improved performance with regard to free squats, push-ups, squats and bench press, which is very encouraging and significant.

**Tiana Weiss, et al,(2010)** studied whether functional training has similar effects as traditional resistance training on muscular strength and

endurance, flexibility, agility, balance, and anthropometric measures in young adults. The results indicated that significant ( $p < 0.05$ ) increases in push-ups, back extension endurance, 1-RM bench press, 1-RM squat, and one-leg balance within each group following training. Traditional training also elicited significant ( $p < 0.05$ ) increases in bicep girth, forearm girth, calf girth, and sit-ups, while the functional training group experienced significant ( $p < 0.05$ ) increases in shoulder girth and flexibility. Forearm girth and flexion test time changes following training were the only parameter where there were significant ( $p < 0.05$ ) differences between training groups.

**Rahman Rahimi (2006)** examined the effect of 12 weeks of high intensity versus moderate intensity weight training of equal work output on body composition in overweight men (BMI = 25-29.9 kg/m<sup>2</sup>). The results showed statistically significant decrease ( $p < 0.05$ ) in the relative body fat (BF), percent of body fat (%BF), Body mass index and body weight in the high intensity group during the course of the study than in the moderate intensity weight training groups group. It is concluded that 12 weeks of high intensity weight training may be more effective in improving body composition than moderate intensity weight training in overweight young men with physical characteristics similar to the ones found in the present study.

Stavres et al., (2018) examined the effect of a functional resistance exercise program on the Basal metabolic rate of a group of previously sedentary adult women in a free-living condition. Results from this study suggest that 6 weeks of functional, progressive, resistance exercise can elicit significant improvements in Basal metabolic rate in previously sedentary adult

women; but does not elicit significant changes in body composition, Fat free mass, or Fat mass.

Aristizabal et al., (2015) investigated the effects of resistance training combined with protein supplementation on RMR and whether RMR responses could be estimated by a dual-energy X-ray absorptiometry (DXA) metabolic map. The results of the study indicate that 9 months of resistance training significantly increased resting metabolic rate, but there was wide variability between individuals, which can be partially accounted for by changes in fat free mass and thyroid hormones.

### **2.3 STUDIES RELATED TO CONCURRENT TRAINING**

**Sarsan et al. (2006)** compared the effects of aerobic and resistance exercise on weight, muscle strength, cardiovascular fitness, blood pressure and mood in obese women. The results of the study proved after a 12-week training period, subjects in the resistance group and aerobic exercise group showed significant improvement in  $VO_2$  max compared with the control group. Both aerobic exercise and resistance exercise resulted in improved performance and exercise capacity in obese women. While aerobic exercise appeared to be beneficial with regard to improving maximum oxygen consumption, resistance exercise was beneficial in increasing muscle strength.

**Ademola Olasupo Abass and Monday Omoniyi Moses, (2013)**, examined the effectiveness of aerobic exercise (AE) and progressive resistance exercise (PRE) trainings on the body composition measured in terms of percent body fat and body mass index of primary school children in Ibadan, Nigeria. The results of the study finally exposed that there were significant differences in the effect of the training regimens on body mass



index and that aerobic exercise enhanced better improvement in percent body fat and body mass index.

**Mengistie Alemayehu Belay, Reddy and Syam Babu (2013)** investigated the effect of combined aerobic and resistance exercise training (CART) on weight control and body composition, blood and metabolic variables, muscle strength and cardio respiratory fitness in obese adults. The results of the study finally exposed that after 12 weeks training significant reduction was observed on body weight, BMI, body fat percentage, Visceral fat, systolic blood pressure, Fasting blood glucose and total cholesterol. It was concluded that there was significant changes on weight loss and body fat control. Moreover, significant parallel improvement on cardio-respiratory and muscular strength fitness was resulted due to combined exercises intervention. Combining the two types of exercises in a session gives a chance the participants to enhance their aerobic and strength fitness simultaneously.

**Shawn Philip Glowacki, (2003)** examined the endurance training and resistance training performed concurrently would produce different performance and physiological results when compared to each type of training alone. Percent body fat was significantly ( $p \leq .05$ ) decreased in both the endurance training and concurrent training groups. Only the endurance training group significantly improved  $VO_2$ max. No group showed a significant change in vertical jump or 40-yard dash time. Findings indicate that endurance training does not interfere with strength development, but resistance training appears to hinder development of maximal aerobic capacity.

**Chaudhary, et al., (2010)** evaluated the effects of aerobic and strength training on cardiac variables such as blood pressure, heart rate (HR), and anthropometric parameters of obese women of Punjab. The findings of the study indicate statistically significant differences in recovery heart rate and post-diastolic blood pressure in aerobic training and in systolic blood pressure in both training groups ( $P < 0.001$ ). Body mass index and body fat percentage showed significant improvements in both training groups.

**Patricia, et al., (2008)** conducted a study on the effects of a 12-week twice weekly combination of circuit-based resistance training and aerobic exercises, in addition to typical physical education sessions, on aerobic fitness, body composition and serum C-reactive protein (CRP) and lipids were analysed. Exercise training significantly improved lean muscle mass, body mass index, fitness, resting HR, systolic blood pressure and triglycerides in aerobic exercises group. In the combination of circuit-based resistance training, body weight increased significantly at the end of the 12-week period. This study supports the value of an additional exercise training programme, beyond the typical twice weekly physical education classes, to produce physiological benefits in the management of obesity in adolescents, including prevention of weight gain.

**Strasser et al., (2009)** investigated to know whether systematic ET can augment muscle strength and/or whether systematic RT can augment the aerobic power of healthy elderly adults. After 6 months of RT, maximum strength increased, ET showed no effect on maximum strength except for the 1-RM in bench pull. Aerobic power improved by 6% in the ET group and by 2.5% in the RT group, neither of which was significant. ET resulted in a

significant 5.3% reduction of body fat ( $P < 0.05$ ), whereas only RT increased lean body mass by  $1.0 \pm 0.5$  kg. RT leads to a genuine increase in lean body mass and muscle strength in healthy elderly adults and is therefore the best method for treatment of amyotrophias. ET appears to be the most efficacious training mode for maintaining and improving maximum aerobic power in the elderly and should be viewed as a complement to RT.

**Willis, et al., (2012)** compared the effects of similar amounts of aerobic and resistance training on body mass and fat mass in overweight adults. The aerobic training and aerobic and resistance training groups reduced total body mass and fat mass more than resistance training ( $P < 0.05$ ), but they were not different from each other. Resistance training and aerobic and resistance training increased lean body mass more than aerobic training ( $P < 0.05$ ). While requiring double the time commitment, a program of combined aerobic training and resistance training did not result in significantly more fat mass or body mass reductions over aerobic training alone. Balancing time commitments against health benefits, it appears that aerobic training is the optimal mode of exercise for reducing fat mass and body mass, while a program including resistance training is needed for increasing lean mass in middle-aged, overweight/obese individuals.

**Andrea Di Blasio, et al., (2012)** conducted a study to verify whether the order of execution of endurance and resistance exercises, in concurrent training, has different effects on the metabolic responses during recovery. Alternating endurance resistance training elicited a significantly greater increase of energy expenditure, oxygen consumption, and ventilation and a greater decrease of proportion of oxygen in expired air. Resistance training

elicited a lower increase of ratings of perceived exertion. Acute post-exercise physiological responses to concurrent endurance and resistance physical exercise seem to depend on the order of execution of the two parts: among the selected protocols, Alternating endurance resistance training seems to elicit the best responses.

Senthil and Arul, (2012) Studied the effect of concurrent strength and endurance training on selected endurance parameters namely Cardio-respiratory endurance and Resting pulse rate. The results of the study showed that there was significant differences exist between concurrent strength and endurance training group and control group. Also, concurrent strength and endurance training group showed significant improvement on Cardio-respiratory endurance and Resting pulse rate compared to the control group.

Wise Blessed Singh (2011) evaluated the effect of concurrent strength and endurance training and detraining on selected bio-motor abilities. The result of the study indicated that muscular strength, cardio respiratory endurance and aerobic power can be improved significantly due to twelve weeks of concurrent strength and endurance training. It was also concluded that the muscular strength, cardio respiratory endurance and aerobic power can be maintained for ten days during the detraining period, there after these improved performance started declined towards the base line. Hence it is suggested that athletes should not undergo detraining for not more than ten days in a row. However this improved performance can be maintained for prolong by undergoing limited amount of training during the detraining.

Sambhaji Gunjal, et al.,(2013) examined the effect of Aerobic Interval Training on Blood Pressure and Myocardial function in Hypertensive Patients. The results indicated that Aerobic Interval Training reduced systolic BP by 12mmhg and diastolic BP was reduced by 8mmhg.the AIT achieved a reduction in HR mean with 4 b/min. In echocardiograph findings were improved the ejection fraction, stroke volume, cardiac output, end-diastolic volume and total peripheral resistance decreased by 17%. This is a study mainly showing the physiological effects of training in hypertension. This study indicated that aerobic interval training is effective to reduce blood pressure & heart rate and improve myocardial function in hypertensive patient.

Boeno et al.,(2019), investigated and compare post-exercise hypotension (PEH) in response to continuous aerobic exercise (CONT) and high-intensity interval exercise (HIIE), matched by volume, in sedentary individuals. The results of the study shows both exercise protocols promoted significant post-exercise hypotension, with reductions in systolic blood pressure (SBP) and mean arterial pressure (MAP). High-intensity interval exercise promoted a reduction of SBP and MAP at the 15th minute, whereas the same effect was observed at the 30th minute following continuous aerobic exercise.

Lehri, and Mokha, (2006), investigated the effectiveness of Aerobic and Strength Training in Causing Weight Loss and Favourable Body Composition in Females. Based on the results of the study, it is concluded that both the strength training and aerobic exercise programs exhibit great potentials for weight management. Aerobic training has been observed to decrease body weight from both the fat and muscle compartments while strength training

conserved the lean body mass and reduced the fat compartment and thus caused favourable body composition in females.

Devi Vara Prasad, (2016) investigated the changes on mean arterial pressure in response to aerobic and anaerobic training among type 2 diabetic patients. The result of the study reveals that due to the effect of aerobic and anaerobic training the mean arterial pressure of the diabetic patients was significantly reduced. It is also concluded that no significant differences existed between aerobic and anaerobic training groups in altering mean arterial pressure.

Ji-Woon Kim, et al., (2018), investigated the effect of circuit training on body composition, physical fitness, and metabolic syndrome risk factors in obese female college students. The result of this study proved that the body weight, % body fat, and body mass index in the circuit training group was significantly decreased compared to the control group.

## **2.4 SUMMARY OF RELATED LITERATURE**

The investigator in this chapter, reviewed related literature on Health related physical fitness variables such as Cardiorespiratory endurance, Muscular Strength, Muscular Endurance, Flexibility and Body Composition and Cardiopulmonary Parameters such as Mean arterial blood pressure, Resting Respiratory Rate, Resting Heart rate, Basal Metabolic rate and Body surface area of sedentary men. Through these reviews the researcher found scope in finding out the influence of resistance cardiovascular and concurrent training on selected health related physical fitness and cardiopulmonary parameters among middle aged men.

Hence, this research attempt was made. Based on the experience gained the researcher formed suitable methodology to be adapted for this study, which is presented in Chapter III.