REVIEW OF RELATED LITERATURE
CHAPTER -2

REVIEW OF LITERATURE

Literature survey has served as a guideline to identify the general trends in the area of mode of treatment of obesity. Such a survey brings about a deep clear perspective of the overall field. Series and scholarly attempts have been made to go through the related literature with the support of e-journals, studies and abstracts of reputed journals and web sources. The salient aspects related to this study are briefly discussed below under suitable headings.

2.1 STUDIES ON LONG BOUTS AND SHORT BOUTS OF EXERCISE

Schachter et al.(2003) conducted a study with the purposes of (1) to assess the effectiveness of a 16-week progressive program of home-based, videotape-based, low-impact aerobic exercise on physical function and signs and symptoms of fibromyalgia in previously sedentary women aged 20 to 55 years and (2) to compare the effects of 1 long exercise bout versus 2 short exercise bouts per training day (fractionation) on physical function, signs and symptoms of fibromyalgia, and exercise adherence. As subjects One hundred forty-three sedentary women were randomly assigned to 1 of 3 groups: a group who trained using a long bout of exercise a group who trained using short bouts of exercise, and a group who performed no exercise. The SBE group exercised twice daily, and the LBE group worked out once daily. Both groups progressed in total daily training duration from 10 to 30 minutes, 3 to 5 times a week, for 16 weeks. Physical and psychological well-being, symptoms, and self-efficacy were evaluated using a multivariate analysis of variance. From the
results they were concluded as follows. Progressive, home-based, low-impact aerobics improved physical function and fibromyalgia symptoms minimally in participants who completed at least two thirds of the recommended exercise. Fractionation of exercise training provided no advantage in terms of exercise adherence, improvements in fibromyalgia symptoms or physical function. High attrition rates and problems with exercise adherence were experienced in both exercise groups.

Jakicicb et al. (1995) compared the effects of intermittent with traditional continuous exercise on weight loss, adherence, and fitness, and to examine the effect of combining intermittent exercise with that using home exercise equipment. Using the randomized trial from September 1996 through September 1998, a total of 148 sedentary, overweight women were selected for the university-based weight control program. Eighteen-month behavioral weight control program was administered with 3 groups namely long-bout exercise (LB), multiple short-bout exercise (SB), or multiple short-bout exercise with home exercise equipment (SBEQ) using a treadmill. Results showed that weight loss was significantly greater in subjects in the SBEQ group compared with subjects in the SB group. Weight loss for subjects in the LB group was not significantly different than for subjects in the SB or SBEQ groups. Subjects in the SBEQ group maintained a higher level of exercise than subjects in both the SB and LB groups at 13 to 18 months of treatment. All groups showed an increase in cardio respiratory fitness from baseline to 18 months, with no difference between groups. Mean weight loss at 18 months was significantly greater in individuals exercising more than 200 min/wk.
throughout the intervention compared with individuals exercising 150 to 200 min/wk or less than 150 min/wk. From the results the observed conclusions were as follows. Compared with the LB group, subjects in the SB group did not experience improved long-term weight loss, exercise participation, or cardio respiratory fitness. Access to home exercise equipment facilitated the maintenance of SB, which may improve long-term weight loss. A dose-response relationship exists between amount of exercise and long-term weight loss in overweight adult women.

Jakicicb et al. (1995) investigated whether prescribing exercise in several short-bouts versus one long-bout per day would enhance exercise adherence, cardio respiratory fitness, and weight loss in overweight adult females in a behavioral weight control program. Randomized controlled trial with subjects randomized to either a short-bout exercise group (SB) or a long-bout exercise group (LB), with subjects followed for a period of 20 weeks. Both groups were instructed to exercise 5 days per week with exercise duration progressing from 20 to 40 min per day. The LB group performed one exercise bout per day, whereas the SB group performed multiple 10 min bouts of exercise per day. The recommended caloric intake for all subjects was 5022-6277 kJ/day, with fat reduced to 20% of caloric intake. Fifty-six obese, sedentary females were used as subjects. The results of the study were as follows: Predicted VO2Peak increased by 5.6% and 5.0% for the LB and SB groups, respectively (P < 0.05). There was a trend for the weight loss to be greater in the SB group compared to the LB group. From the results it was concluded that short-bouts of exercise may enhance exercise adherence. Short-bouts of exercise may also enhance
weight loss and produce similar changes in cardio respiratory fitness when compared to long-bouts of exercise. Thus, short-bouts of exercise may be preferred when prescribing exercise.

DeBusk et al. (1991) evaluated the "threshold" duration of exercise required to produce training effects. 18 healthy men completing 30 minutes of exercise training/day were compared with 18 men completing three 10-minute bouts of exercise/day, each separated by at least 4 hours. Exercise training intensity was moderate (65 to 75% of peak treadmill heart rate). During the 8-week study period VO2 max increased significantly in both groups, from 33.3 +/- 3.2 to 37.9 +/- 3.5 ml/kg/min in men performing long exercise bouts and from 32.1 +/- 4.6 to 34.5 +/- 4.5 ml/kg/min in men performing short exercise bouts (p less than 0.05 within and between groups). Thus, multiple short bouts of moderate-intensity exercise training significantly increase peak oxygen uptake. For many individuals short bouts of exercise training may fit better into a busy schedule than a single long bout.

Murphy and Hardman (1998) compared the effects of short and long bouts of brisk walking in sedentary women. Forty seven women were randomly assigned to either three 10-min walks per day (short bouts), one 30-min walk per day (long bouts) or no training (control). Brisk walking was done on 5 d x wk(-1), at 70 to 80% of maximal heart rate, typically at speeds between 1.6 and 1.8 m x s(-1) (3.5 and 4.0 mph), for 10 wk. Subjects agreed not to make changes to their diet. Twelve short-bout walkers, 12 long-bout walkers, and 10 controls completed the study. Relative to controls, VO2max and the VO2 at a blood lactate concentration increased in walkers, with no
difference in response between walking groups. Neither heart rate during standard, sub maximal exercise nor resting systolic blood pressure changed in a different way in walkers and controls. The sum of four skin fold thicknesses decreased in both walking groups but body mass and waist circumference decreased significantly only in short-bout walkers. Changes in anthropometric variables did not differ between short- and long-bout walkers. Thus short bouts of brisk walking resulted in similar improvements in fitness and were at least as effective in decreasing body fatness as long bouts of the same total duration.

Osei-Tutu and Campagna (2005) compared the ACSM-CDC physical activity accumulation recommendation to the traditional recommendation, for impact on mood and physiological markers of fitness. Randomized controlled trial with sedentary male (n = 21) and female (n = 19) subjects assigned to walk either long bouts (LB; 30 min/day), short bouts (SB; 3 x 10 min/day), or a nonexercise control (CTL) group for 8 weeks. Pre- and post-measures were collected for VO2max and percent body fat. Pre-, mid-, and post-measures were collected for the Profile of Mood States (POMS). VO2max increased in the SB group. Percent body fat decreased in the LB group. Total mood disturbance (TMD) decreased in the LB and SB groups; only the LB group showed reductions compared to the CTL group. Tension-anxiety and vigor-activity were altered in the LB group compared to the other two groups (P < or = 0.05). Reductions in percent body fat correlated with TMD and Tension-anxiety reduction. In conclusion it was observed that LB and SB walking produced similar and significant improvements in VO2max LB walking was more
effective at reducing percent body fat, tension-anxiety and total mood disturbance, and increasing vigor compared to the control group.

Jurimae et al. (2000) compared the circulatory responses to circuit weight (CWT) and aerobic walking training sessions of similar energy cost in middle-aged overweight females. Thirty-three middle-aged pre-menopausal females participated in the experiment. They were divided into overweight (n=18) and non-overweight control (n=15) groups. The subjects performed four circuits at the maximal possible speed, using a work-to-rest ratio of 60 s. Blood pressure (BP) was measured during every rest period between the exercises, and the heart rate (HR) was recorded continuously during the whole CWT programme. During the walking training session, the subjects walked as fast as possible on the indoor track. The total energy cost of the walking training session was the same as during the CWT session, approximately 270 kcal, and was controlled by a CALTRAC accelerometer. HR and BP were measured every 5 min during the walking training session. The PWC index was significantly (P<0.05) higher in the overweight group in comparison with the control females. The resting BP was normal in both groups (<140/90 mmHg). HR was between 120 and 140 beats min⁻¹ during CWT and walking sessions. There were no differences in BP during both training sessions in overweight and control subjects. It was concluded that both CWT and walking training sessions were acceptable forms of physical activity to increase cardiovascular fitness in middle-aged overweight and normal body weight females.
According to Dunn (1999) even though the strong association between physical inactivity and ill health is well documented, 60% of the population is inadequately active or completely inactive. Traditional methods of prescribing exercise have not proven effective for increasing and maintaining a program of regular physical activity. Hence with the objective of comparing the 24-month intervention effects of a lifestyle physical activity program with traditional structured exercise on improving physical activity, cardio respiratory fitness, and cardiovascular disease risk factors. As subjects the sedentary men (n = 116) and women (n = 119) with self-reported physical activity of less than 36 and 34 kcal/kg per day, respectively were used. Six months of intensive and 18 months of maintenance intervention on either a lifestyle physical activity or a traditional structured exercise program were applied as treatment. The results of the study were: both the lifestyle and structured activity groups had significant and comparable improvements in physical activity and cardio respiratory fitness from baseline to 24 months. Adjusted mean changes were 0.84 and 0.69 for activity, and 0.77 and 1.34 for VO2peak for the lifestyle and structured activity groups, respectively. There were significant and comparable reductions in systolic blood pressure and diastolic blood pressure and for the lifestyle and structured activity groups, respectively. Neither group significantly changed their weight and 0.69, but each group significantly reduced their percentage of body fat in the lifestyle and structured activity groups, respectively. In his conclusion it was observed that previously sedentary healthy adults, a lifestyle physical activity intervention is as effective as a structured exercise program in improving physical activity, cardio respiratory fitness, and blood pressure.
Graves et.al (1996) investigated the effect of reduced training frequency on muscular strength. Subjects trained for 10-18 weeks at a higher frequency and then decreased frequency for 12 weeks. Subjects who trained 3X/week decreased to 2X/week and subjects who trained 2x/week decreased to IX/week. Results of the study showed that reduction in training frequency produced improved rates of strength gain.

Carpinelli and Otto (1998) studied strength training with reference to effect of single versus multiple sets. Many exercise authorities claim that single set training is insufficient, however, the literature does not support this. This study out of Adelphi University surveyed all of the known literature that compared single set versus multiple set resistance training. Forty-five (45) studies showed that multiple sets resulted in no increase in results compared to single-set training, while only 2 studies showed a marginal improvement with multiple sets.

Almuzaini and Potteiger (1998) reported that after exercise, there is a period where an individual’s oxygen consumption is elevated from normal. This elevated period has been termed excess post exercise oxygen consumption (EPOC) and has also been associated with an increase in metabolic rate. Research results in this area have conflicted as to the EPOC magnitude and duration; how long after exercise the metabolic rate is increased; and what types and lengths of exercise influence EPOC more. The intention of this study was to examine the effects a split exercise session had on EPOC, resting metabolic rate, and energy expenditure. Ten physically active, healthy males performed both a continuous (30 minutes) and a split
exercise session (two, 15-minute sessions) aerobic exercise on separate days. Their EPOCs were measured at the end of each exercise session and resting metabolic rate measurements were taken the mornings before and after the exercise sessions. The combined EPOC for the split exercise periods was significantly greater than the EPOC for the continuous period. However, this is where statistics can be most misleading. The authors presented their results in milliliters of oxygen. When converted to kilocalories, the difference in the continuous versus the split exercise sessions is only 10 kcals. There were no significant differences for resting metabolic rate in either exercise protocol. Even though the findings of this study show no major significant differences, this study answers a very important question health and fitness professionals have been seeking. Dividing the workout into split sessions versus one continuous session did not have a practical difference in absolute post-exercise caloric expenditure. Therefore, the decision to split exercise sessions should be made based more on a person’s time schedule, as opposed to any physiological effect.

Marx, et al (2001) conducted a study to determine the training adaptations associated with low-volume circuit-type weight training versus a periodized high-volume resistance training program on muscular fitness and performance in women. To achieve this thirty-four women with an average age of 23 years were chosen to participate in the 6-month study. All of the women were considered active, but untrained in resistance exercise. As results the present study demonstrates that a 6-month high-volume, periodized multiple-set resistance training program will have a greater effect on muscular
fitness/performance and body composition when compared to a low-volume, single-set circuit program. The MS group had a much greater increase in 1-RM for bench press and leg press when compared to the SSC group. For the muscular endurance tests, the MS group out-performed the SSC group in bench press as well as leg press. The MS group also exhibited higher percent increases for sit-ups performed in one-minute, Wingate peak power, vertical jump power, and time improvement in the 40-yard dash, than the SSC group. At the end of the 6 months, the MS group showed a greater decrease in percent body fat (25% vs 10%) and a higher increase in fat-free mass (8% vs 2%) than the SSC group. The control group did not show any significant change in muscular performance or body composition.

2.2 STUDIES ON AEROBIC TRAINING

Aerobic exercise is often recommended for individuals who have stage 1 or 2 essential hypertension. The purpose of this study was to evaluate what effect age and gender has on the efficacy of aerobic exercise for lowering blood pressure. A sample of 103 men and 35 women were divided into control and treatment groups. These groups were further divided into groups based on age and gender. The control group maintained their normal, sedentary lifestyle. The physical activity group exercised at least 2 days per week at 50% maximal oxygen consumption. Exercises included 30 – 40 minutes of aerobic exercise and 10 – 20 minutes of conditioning/strength exercise. At the end of eight weeks, the range of reduction in systolic blood pressure for men (-10 to -16 mmHg) and women (-10 to -16 mmHg) was statistically and clinically significant. The range of reduction for diastolic blood pressure for men (-5 to -
11 mmHg) and women (-6 to -14 mmHg) was also relevant. Gender did not influence the effect of physical activity. It was noted that the older hypertensive subjects experience the smallest reductions.

According to Sesso et al. (1999) much of the research done on cardiovascular disease (CVD) has involved only male subjects. The studies that have included women have resulted in conflicting findings. Consequently, he was performed to determine if physical activity in women during their middle and late years influences the risk of CVD. For this a sample of 1,564 women who were initially free of CVD were periodically mailed questionnaires over a period of 31 years. The questionnaires assessed physical activity (daily number of stairs climbed and city blocks walked; type and number of hours involved in sports), diagnosis of CVD, and coronary risk factors. There were 181 new cases of CVD reported over the 31 years. There also appeared to be no overall association between higher levels of physical activity and CVD risk. However, walking approximately 6 miles per week was associated with a 33% decreased risk of CVD. The findings of this study supported that as an important health benefit, walking is reducing CVD risk in women.

2.3 STUDIES ON ANTHROPOMETRIC AND OBESITY

Juryman (1998) investigated a study to determine the possible relationships between anthropometrical and health-related fitness parameters in obese middle-aged women. Twenty one obese (BMI > 27 kg/m2) and 12 control (BMI < 27 kg/m2) middle-aged females (35-45 yrs) participated in this investigation. While the differences in somatotype indices were not statistically
significant (p > 0.05) between obese and control groups, the transformation of somatotype characteristics to the effect sizes (ESs) revealed that these differences were large (ectomorphy: ES = 1.73; endomorphy: ES = 1.64; mesomorphy: ES = 1.71). Relative aerobic fitness (VO2max/kg, calculated from PWC) and dynamic sit-up were higher (p < 0.05) in control subjects, while obese women presented significantly higher values for hand grip strength. The thicker skinfold thicknesses increased the absolute value of PWC in obese group (r = 0.39-0.57; p < 0.05). In contrast, the thinner skinfold thicknesses in suprailiac and mid-thigh significantly increased the absolute value of PWC in control women. There were only a few significant correlations between girth and breadth measures, and health-related fitness parameters. In addition, somatotype characteristics seldom influenced the results of health-related fitness tests. Stepwise multiple regression analysis demonstrated that health-related fitness test items were more dependent on the anthropometrical parameters in obese than in control women.

2.4 STUDIES ON VARIED INTENSITIES OF RESISTANCE TRAINING

Donnelly et al. (2003) examined the long-term effects of a supervised program of moderate-intensity exercise on body weight and composition in previously sedentary, overweight and moderately obese men and women. He hypothesized that a 16-month program of verified exercise would prevent weight gain or provides weight loss in the exercise group compared with controls. Participants were recruited from 2 midwestern universities and their surrounding communities. One hundred thirty-one participants were
randomized to exercise or control groups, and 74 completed the intervention and all laboratory testing. Exercise was supervised, and the level of energy expenditure of exercise was measured. Controls remained sedentary. From the results he concluded that moderate-intensity exercise sustained for 16 months is effective for weight management in young adults.

Cris et al. (2004) conducted a study on obesity with the aim to determine the effects of different amounts and intensities of exercise training. As subjects sedentary, overweight men and women (aged 40-65 years) with mild to moderate dyslipidemia were recruited. The main outcome measures were body weight, body composition (via skinfolds), and waist circumference. They were treated with the interventions of eight-month exercise programme with 3 groups: (1) high amount/vigorous intensity (calorically equivalent to approximately 20 miles [32.0 km] of jogging per week at 65%-80% peak oxygen consumption); (2) low amount/vigorous intensity (equivalent to approximately 12 miles [19.2 km] of jogging per week at 65%-80%), and (3) low amount/moderate intensity (equivalent to approximately 12 miles [19.2 km] of walking per week at 40%-55%). Subjects were counseled not to change their diet and were encouraged to maintain body weight. Results of 302 subjects screened, 182 met criteria and were randomized and 120 completed the study. There was a significant (P<.05) dose-response relationship between amount of exercise and amount of weight loss and fat mass loss. The high-amount/vigorous-intensity group lost significantly more body mass (in mean [SD] kilograms) and fat mass (in mean [SD] kilograms) (-2.9 [2.8] and -4.8 [3.0], respectively) than the low-amount/moderate-intensity group (-0.9 [1.8])
and -2.0 [2.6], respectively), the low-amount/vigorous-intensity group (-0.6 [2.0] and -2.5 [3.4], respectively), and the controls (+1.0 [2.1] and +0.4 [3.0], respectively). Both low-amount groups had significantly greater improvements than controls but were not different from each other. Compared with controls, all exercise groups significantly decreased abdominal, minimal waist, and hip circumference measurements. There were no significant changes in dietary intake for any group. The conclusions of the present study are: In no dieting, overweight subjects, the controls gained weight, both low-amount exercise groups lost weight and fat, and the high-amount group lost more of each in a dose-response manner. These findings strongly suggest that, absent changes in diet, a higher amount of activity is necessary for weight maintenance and that the positive caloric imbalance observed in the overweight controls is small and can be reversed by a modest amount of exercise. Most individuals can accomplish this by walking 30 minutes every day.

2.5 RELATIONAL STUDIES BETWEEN PHYSICAL ACTIVITY AND OBESITY

Rhodes et.al.(2000) investigated the effects of one year of progressive resistance exercise (PRE) on dynamic muscular strength and the relations to bone mineral density (BMD) in elderly women. His main aim is to study the paucity of long term studies on exercise training in elderly women. Forty four healthy sedentary women (mean age 68.8 years) volunteered for this study and were randomly assigned to either an exercise group or a control group. The exercise group was involved in three one hour sessions a week for 52 weeks of supervised PRE to strengthen the large muscle groups of the body, while the
control group were instructed to continue their normal lifestyle. The exercise circuit included three sets of eight repetitions at 75% of one repetition maximum focused on the large muscle groups. Statistical analyses (analysis of covariance) showed significant strength gains (p<0.01) in bilateral bench press (>29%), bilateral leg press (>19%), and unilateral biceps curl (>20%). No significant difference between groups was evident in body weight, grip strength, flexibility, waist to hip ratio, or the sum of eight skinfolds. Significant relations (p<0.05) were recorded between dynamic leg strength and the BMD of the femoral neck, Ward's triangle, and the lumbar spine. From the results it was concluded that significant strength changes, after one year of PRE, were evident in elderly women, and the muscle increases may parallel changes in BMD.

Hassinen et.al.(2005) studied the relationships of body composition, physical activity, and muscular fitness with balance and walking ability. For this men and women, age 70 to 74 y (n = 146), were randomly selected from the Finnish population register. Body composition [body weight, body-mass index (BMI), waist circumference], physical activity (questionnaire), muscular fitness (hand-grip strength), balance (commonly used field tests), and walking ability (20 m walking test) were assessed. As results he observed that : BMI (r = −0.287, P < 0.001), waist circumference (r = −0.260, P = 0.002), physical activity (r = 0.206, P = 0.013), and hand-grip strength (r = 0.244, P = 0.003) correlated with balance. BMI (r = 0.330, P < 0.001), waist circumference (r = 0.237, P = 0.004), physical activity (r = −0.252, P = 0.002), and hand-grip strength (r = −0.307, P < 0.001) also correlated with walking time. From the
results he concluded that overweight and central obesity as well as low muscular fitness associate with impaired balance and walking ability in the elderly.

Hui (2005) studied the impact of physical activity, aerobic fitness, and body composition on coronary heart disease (CHD) risk factors in Hong Kong Chinese adults has not been previously investigated. Methods: The study surveyed 707 middle-age Hong Kong Chinese by telephone for Physical Activity Rating (PAR). Three hundred and sixteen respondents (age: 45.1 ± 8.1 y) participated in subsequent aerobic fitness testing (and CHD risk factor screening. More than 70% of respondents did not have sufficient levels of physical activity. Fifty percent of the men and 19.5% of the women had two or more CHD risk factors. PAR correlated poorly with and CHD risk factors, showed significant associations with CHD risk factors. The adjusted odds ratios of having CHD risk factors for unfit participants ranged from 1.11 to 6.61 as compared to fit participants. Obese but fit individuals demonstrated lower odds of CHD risk factors than the obese and unfit individuals. WC was found to be a stronger predictor for CHD risk factors than BML Conclusions: The prevalence of CHD risk factors in middle-age Chinese in Hong Kong was high and was related to levels of aerobic fitness and obesity.

Hageman et al. (2005) investigated physical activity and fitness of midlife and older rural women. Random-digit dialing was used to recruit 225 women (57.9 ± 5.6 years old). Self-reported activity (moderate activity, flexibility, and strength) and fitness (body composition, flexibility, strength, and estimated VO_{2max}) were assessed. The women demonstrated low daily
energy expenditure and estimated \( VO_{2\text{max}} \) with 51.5% reporting fair or poor health. Few women reported meeting Healthy People 2010 targets for moderate activity, flexibility, or strength. When classified by estimated \( VO_{2\text{max}} \) into three categories, differences were observed for body-mass index, percent body fat, sit and reach, and timed chair stands, with the poorest performance by those with low cardio respiratory fitness. Adherence to Healthy People 2010 targets for moderate activity and strengthening was associated with higher cardio respiratory fitness. These rural women are targets for physical activity interventions because of their sedentary behaviors and low cardio respiratory fitness.

### 2.6 STUDIES ON RESISTANCE TRAINING

Walberg, (1989) commented on the value of weight training in the treatment of obesity. He noted that resistance exercise appeared to prevent the loss of or even increase muscle mass during energy restriction. Walberg argued that resistance exercise is less likely than aerobic exercise to acutely increase lipid and energy utilization but may indirectly aid weight reduction by increasing lean tissue and metabolic rate. He concluded that the value of aerobic exercise during weight loss was apparent but the potential of resistance exercise in weight remained unclear.

According to Stone et al (1991) regular physical activity can improve cardiovascular fitness and may reduce the likelihood and debilitating effects of cardiovascular disease. Weight-training has generally been believed to have limited value in modifying risks of cardiovascular disease. Effects shown of resistance training on parameters associated with cardiovascular fitness and
disease include: heart rate decreases for maximal work and recovery from short term weight-training, increased ventricular mass, and increased ventricular wall and septum thickness. Studies suggest that myocardial hypertrophy resulting from resistive training can be accompanied by positive myocardial adaptations.

According to Verill et.al (1992) circuit weight training has been recommended and has been reported to improve strength, lean body mass, self-efficacy, and may decrease risk factors for coronary artery disease. There appears to be considerable benefit and minimal risk of resistive exercise training for patients with cardiovascular impairment. This mode of exercise may allow patients to perform daily strength tasks safely, more efficiently, and with greater self confidence."

O'Hagan et al.(1995) studied the response towards the resistance training in young women and men. Six women and 6 men trained the elbow flexors 3 days per week for 20 wks, one arm performing in each session 3 5 sets of 10 maximal concentric actions on an accommodating resistance device, the other arm 3 5 sets of 8 12 coupled eccentric/concentric actions on a weight training device. With results collapsed across the two training modes, the women made significantly (p less than 0.05) greater relative increases than men in strength measured on the weight (116 vs. 46 percent) and accommodating (99 vs. 46 percent) resistance devices, and greater absolute (3.5 vs. 1.3 N.m) and relative (13.7 vs. 3.2 percent) increases in strength measured on an isokinetic dynamometer. Absolute (cm2) and relative (percent) biceps, brachialis, and total elbow flexor cross sectional area (from CT scans)
increased significantly, however, the women's vs. men's respective relative and absolute increases did not differ significantly: biceps (13 vs. 7 percent, 0.9 vs. 1.0 cm²), brachialis (53 vs. 31 percent, 2.1 vs. 2.3 cm²), and total (26 vs. 15 percent, 3.1 vs. 3.3 cm²) flexor area. Biceps type I and II fiber area, and the II/I area ratio did not increase significantly. The data indicate that in response to the same short term training program, muscle size increases similarly in women and men but women make greater relative increases in strength.

Parker et al (1996) studied the effects of strength training on cardiovascular responses during a sub maximal walk and weight-loaded walking test in older females. After 16 weeks of weight training women aged 60-77 showed reduced heart rate, systolic blood pressure, and rate pressure product while treadmill walking with and without a weight load of 40% bodyweight. They concluded that strength training reduces cardiovascular stress during daily tasks in healthy older women.

According to Evans (1996) progressive resistance exercise can produce substantial increases in strength and muscle size, even in the oldest old. For many older patients, resistance training represents the safest, least expensive means to lose body fat, decrease blood pressure, improve glucose tolerance, and maintain long-term independence.

Kerr, D et al (1996) conducted a study to find out the exercise effects on bone mass in postmenopausal women are site-specific and load-dependent. Fifty-six (56) subjects were randomized to either heavy or light resistance training. Only resistance training that involved heavier loads increased mineral density.
Cullinen and Caldwell (1998) recommended that a part of an adult fitness program should include strength training because of the additional benefits it provides. Also he stated that much of the strength training research has been done on male subjects. Consequently, he attempted to determine what effects weight training had on untrained healthy, young women. Twenty-three healthy, normal-weight women participated in the weight training program and 10 women served as the control group. The program consisted of two sessions per week and included two sets of 10 reps for each exercise. At the end of 12 weeks, the weight-trained group demonstrated no change in body weight. However, percent body fat significantly decreased and fat-free mass) significantly increased. This represents an impressive 10% loss in percent body fat. Muscular strength also increased for the weight-trained women. From his study, the major findings of increased strength, fat-free mass, resting metabolic rate and decreased body fat indicate the potential favorable effect of resistance training in weight management programs.

Ballor, et al. (1998) assessed the effects weight training on body composition in a 8 week weight loss study. Forty obese women were randomly assigned to one of four groups: diet without exercise; diet plus weight training; and weight training without diet. The authors concluded that caloric restriction diet supplemented with a resistive weight training program results in maintenance of lean body weight compared with dieting alone. Furthermore, they found that weight training resulted in comparable gains in muscle area and strength in the both weight training groups; with and without diet.
Cullinen, and Caldwell (1998) studied the weight training that increases muscle & strength, and decreases body fat. 20 females participated in a weight-training program to determine the effects of training on resting metabolic rate, fat-free mass, strength, and dietary intake. 10 subjects trained for 12-weeks (2 total-body workouts/week; 6 exercises x 3 sets x 10 reps) program and ten subjects were controls. The results indicated a low-volume of moderate-intensity resistance training increased strength and decreased body fat without dieting. All women should incorporate resistance training in their fitness regimens, especially young women seeking improvements in their body composition. Furthermore, the total time commitment for an improvement in body composition was only 2 hours per week, making weight training a time efficient training method.

Westcott (2001) conducted a study to assess the way to increase the intensity and effectiveness of resistance training by comparing training with a slower repetition speed to training with a conventional repetition speed. Slower repetition speed may effectively increase intensity throughout the lifting phase while decreasing momentum. Two studies were done with untrained men (N=65) and women (N=82), (mean age=53.6) who trained two to three times per week for eight to 10 weeks on a 13 exercise Nautilus circuit performing one set of each exercise. Participants exclusively trained using regular speed repetitions for 8 to 12 repetitions per set at 7 sec each (2 sec lifting, 1 sec pause, 4 sec lowering) or a slow(R) training protocol where they completed 4 to 6 repetitions per set at 14 sec each (10 sec lifting, 4 sec lowering). All of the participants were tested for either the 10 repetition-maximum (RM) weight
load (regular-speed group) or the 5-RM weight load (slow-speed group). The results of the study were: In both studies, slow training resulted in about a 50% greater increase \((p<0.001)\) in strength for both men and women than regular speed training. In Study 1, the slow training group showed a mean increase of 12.0 kg and the regular speed group showed an increase of 8.0 kg increase \((p<0.001)\). In Study 2, the slow training group showed a 10.9 kg increase and the regular speed group showed an increase of 7.1 kg \((p<0.001)\). From the results he concluded that slow training is an effective method for middle-aged and older adults to increase strength.

Abe et al (2003) examined the absolute and relative changes in skeletal muscle (SM) size using whole body magnetic resonance imaging (MRI) in response to heavy resistance training (RT). For this three young men trained three days a week for 16 weeks. MRI measured total SM mass and fat free mass (FFM) had increased by 4.2 kg and 2.6 kg respectively after resistance training. From the results he concluded that RT induces larger increases in SM mass than in FFM. RT induced muscle hypertrophy does not occur uniformly throughout each individual muscle or region of the body. Therefore the distribution of muscle hypertrophy and total SM mass are important for evaluating the effects of total body RT on muscle size.

2.7 STUDIES ON COMBINED AEROBIC AND RESISTANCE TRAINING

Resistance exercises involving weightlifting may prove as important as aerobic exercise for women in fighting fat. Health scientists at Johns Hopkins University in Baltimore and Arizona State University in Tempe found that
resistance exercises push the body to burn calories for up to two hours after the workout. Aerobic exercises typically burn more calories during the workout than weightlifting but increase energy expenditure for less than an hour afterward. "Resistance training could have a more lasting effect on metabolism than aerobic exercise," says researcher Carol Binzen. "It burns fat and increases muscle mass." Researchers studied a dozen women ages 24 to 34. On one day, the women did weightlifting exercises such as chest presses, leg presses, and bicep curls, while on another day, they sat still and watched a movie. On average, the exercises burned more than three times as many calories that were burned while watching the movie. "They studied regular women, not super fitness enthusiasts, so these results may apply to most moderately active women," Binzen says. For maximum workout, the researchers suggest a combination of both aerobic exercises and resistance training. (http://www.ensureyoursuccess.net/weightlosswomen.html).

The purpose of the study was to determine the effects of a ten-week concurrent resistance and endurance-training programme for improving physical fitness of middle-aged obese females. Eleven obese (body mass index BMI>27.0 kg/m²) and 13 control (BMI<27.0 kg/m²) females participated in the investigation. Three series of anthropometrical measurements were taken according to the O-scale Physique Assessment System. The ratio of waist to hip circumference (WHR) was calculated. Body composition was measured with the bioelectrical impedance method (Bodystat 500, UK). Individual physical working capacity (PWC) was measured with the cycle ergometer test. One repetition maximum leg extension (1RM LE) was used to assess maximal
isoinertial strength. Training sessions were performed three times per week and resistance training consisted of four exercises (leg extension, bench press, sit-ups, leg press). The subjects performed four circuits at maximal possible speed, using a work-to-rest ratio of 60 sec. The 75% 1RM load and 8-12 repetitions per set were used. The duration of resistance exercises was 32 min, which was followed by 30 min of continuous walking at the intensity of 75% maximum heart rate. Obese women had significantly higher (p<0.05) values for skin-fold, girth and breadth measurements. PWC and 1RM LE strength was also significantly higher in the obese group. WHR was significantly negatively related to all measured physical fitness indices in obese but not the control subjects. While lean body mass was significantly positively related to all measured physical fitness values in obese but not controls subjects. Body weight, body fat %, body fat amount and sum of 8SF were significantly decreased as a result of the training programme in middle-aged obese females. While no significant effects of training programme on body composition characteristics were observed in middle-aged control women. PWC values were significantly increased in both groups studied as a result of training programme. While 1RM LE strength was significantly increased after the training only in control subjects. In conclusion, the concurrent resistance and endurance training programme for the improvement of physical fitness of middle-aged obese females appears to be an acceptable form of physical activity to reduce body weight and increase cardiovascular fitness.

Pierson et al (2001) examined the effects of performing combined resistance and aerobic training, versus aerobic training alone, in patients with
coronary artery disease. For this thirty-six patients with coronary artery disease were randomized to either an aerobic-only training group (AE) or a combined aerobic and resistance training group (AE + R). Both groups performed 30 minutes of aerobic exercise 3 days/week for 6 months. In addition, AE + R group performed two sets of resistance exercise on seven different Nautilus machines after completion of aerobic training each day. Twenty patients (AE: n = 10; AE + R: n = 10) completed the training protocol with > 70% attendance. The results of the study are: strength gains for AE + R group were greater than for AE group on six of seven resistance machines (P < 0.05). VO2peak increased after training for both AE and AE + R (P < 0.01) with no difference in improvement between the groups. Resting and submaximal exercise heart rates and rate-pressure product were lower after training in the AE + R group (P < 0.01), but not in the AE group. AE + R increased lean mass in arm, trunk, and total body regions (P < 0.01), while AE increased lean mass in trunk region only (P < 0.01). Percent body fat was reduced for AE + R after training (P < 0.05) with a between group trend toward reduced body fat (P = 0.09). Lean mass gain significantly correlated with strength increase in five of seven resistance exercises for AE + R. From the results he concluded that resistance training adds to the effects of aerobic training in cardiac rehabilitation patients by improving muscular strength, increasing lean body mass, and reducing body fat.

According to Joseph (1990) concurrent strength and endurance training reportedly compromises strength gains and the ability to produce explosive movements. Possible reasons for compromises in strength-power adaptations
with concurrent training are an increased likelihood of overtraining; differences in the organization of neuromuscular recruitment patterns; alterations in the concentrations of various hormones and differences in activation or repression of various anabolic/catabolic processes at the muscular level; and shifts in protein isozymes such as myosin. Recent research suggests that strength training may enhance endurance performance.

With the purpose of investigating the comprehensive physiological alterations that take place during the combination of bench-step aerobics (BSA) and resistance exercise training Kraemer et al. (2001) conducted a study on resistance training combined with bench-step aerobics enhances women's health profile. For this he has selected thirty-five healthy, active women and they were randomly assigned to one of four groups that either a) performed 25 min of BSA only (SA25); b) performed a combination of 25 min of BSA and a multiple-set upper and lower body resistance exercise program (SAR); c) performed 40 min of BSA only (SA40); or d) served as a control group (C), only performing activities of daily living. Direct assessments for body composition, aerobic fitness, muscular strength, endurance, power, and cross-sectional area were performed 1 wk before and after 12 wk of training. The results of the study were: All training groups significantly improved peak O2 (3.7 to 5.3 mL O2[middle dot]kg-1[middle dot]min-1), with the greatest improvement observed in the SAR group (P = 0.05). Significant reductions in preexercise heart rates (8-9 bpm) and body fat percent (5-6%) were observed in all training groups after training. Significant reductions in resting diastolic blood pressure were observed for the SAR and SA40 groups (6.7 and 5.8 mm
Muscular strength and endurance only improved significantly in the SAR group (21 and 11% respectively). All groups demonstrated increased lower body power (11-14%), but only the SAR group significantly improved upper body power (32%). Thigh muscle cross-sectional areas measured via magnetic resonance imaging (MRI) increased primarily for the SAR group. From the results he concluded as follows. BSA is an exercise modality effective for improving physical fitness and body composition in healthy women. The addition of resistance exercise appears to enhance the total fitness profile by improving muscular performances, muscle morphology, and cardiovascular fitness greater than from performing BSA alone. Therefore, the inclusion of both modalities to an exercise program is most effective for improving total body fitness and a woman's health profile.

Banz et al. (2003) performed a randomized trial to compare the effects of aerobic and resistance training regimens on coronary risk factors. Twenty-six volunteers who exhibited android obesity and at least one other risk factor for coronary artery disease were randomized to aerobic or resistance training groups. Body mass index, waist-to-hip ratio, glucose, insulin, body composition, 24-hr urinary albumin, fibrinogen, blood pressure, and lipid profile were measured at baseline and after 10 weeks of exercise training. Both groups showed a significant reduction in waist-to-hip ratio and the resistance training group also showed a reduction in total body fat. There was no significant change in mean arterial blood pressure in either group. Fasting plasma glucose, insulin, total cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides were unchanged in both groups. High-density
lipoprotein (HDL) cholesterol increased (13%) with aerobic training only. Plasma fibrinogen was increased (28% and 34%, P < 0.02) in both groups and both groups showed a significant decrease (34% and 28%, P < 0.03) in microalbuminuria after their respective training regimen. In conclusion, resistance training was effective in improving body composition of middle-aged obese sedentary males. Only aerobic training was effective in raising HDL cholesterol.

Comparing an aerobic only exercise routine versus an aerobic and strength training routine. Total weight loss increases by 56% with aerobic and strength. The fat weight loss with aerobic and strength is plus 70%. Muscle weight changes with aerobic and strength is plus 40%. Increasing muscle composition of the body increases the body's ability to burn fat. Muscle workout sessions promote metabolism while at rest. Long term aerobic training helps muscles utilize oxygen more efficiently. Cardiovascular and respiratory endurance - the sustained ability of the heart and lungs to transport oxygen through the blood vessels to and from the cells is the most important element of fitness. There is less risk of over stress to the cardiovascular system when the workload is spread over more muscle groups. An extended movement range is more work performed. Research shows that exercising arms and legs together is aerobically more efficient and less stressful. Fat loss is 9 times greater with high intensity interval training. Pound for pound, muscles burn 25 times more calories than fat. One pound of muscle uses about 350 - 500 calories per week to survive - a pound of fat needs about 14 calories per week. Since muscle is metabolically active tissue, losing muscle slows your
metabolism and so to counter this slowdown, build up calorie-burning muscle tissue. A very important reason for maintaining muscle mass is very recent evidence that muscle supports immunity, hence resistance to disease. The coordination of aerobics and strength exercise in conditioning is essential - aerobic exercise for producing oxygen to release fatty acids and oxygen for the body's cells and strength exercise for muscle development, reduce body fat and maintain bone mass.

Gregory Haff (2003) investigated the effects of no training, aerobic training program, and combined resistance and aerobic training on middle aged women. The aerobic training group trained 6 days a week for 60 minutes at an intensity of 60 – 70% maximum heart rate, while the combination group performed resistance training 3 days per week (Monday, Wednesday, and Friday) and aerobic training 3 days per week (Tuesday, Thursday, and Saturday). Abdominal fat volume was evaluated with computed tomography before and after 24 weeks of training. Both the aerobic and combined groups experienced increases in maximal aerobic capacity (VO2max) and high-density lipoprotein-cholesterol. Of particular interest is the finding that only the combined group experienced significant increases in lean body mass. Also, the combined group experienced the greatest declines in subcutaneous fat and abdominal visceral fat when compared to the aerobic only training group (subcutaneous: -23.1 cm; abdominal visceral fat: -82.6 cm). The findings of this study suggest that utilizing a combination of aerobic and resistance training produces the greatest alterations in body composition.
Park et al. (2003) conducted a study to determine the effect of different training programs on body image in young women. One group performed aerobic training only and the other group performed aerobic training plus strength training and a third group performed no training. Body image was assessed with a Body Self-Image Questionnaire. Results indicated that the combined aerobics plus strength-training group had greater improvements in strength and fitness than the other 2 groups. The combined training group also had a better decrease in body fat. Most importantly, the combined training group had significantly more positive body image profiles than the group that did not exercise. Females should perform both aerobic training and resistance training for health and body image reasons.

With the thought of weight training improves body image in women, Henry, and Michael investigated the effect of aerobic and aerobic/strength training on body image in females. 49 women participated in a strength-training program for 12 weeks. At the completion of the study most subjects reported feeling healthier and more fit and had a better attitude about their physical selves. A regular weight-training program can improve your quality of life and self esteem.