CHAPTER II

REVIEWS OF RELATED LITERATURE

The literature in any field forms the foundation upon which all future works will be built. Many investigators in various fields recognize the importance and need of old literature for health and proper guidance for further research work. It tells which methods were used to collect the needed information (data) and which of the statistical techniques or operations were used to analyze it.

The findings and recommendations made in the old related literature provide theories and ideas for further investigation and explanations contributes to the general guidance to new investigators. Hence the present investigator decided to study the old literatures directly or indirectly related to this study and has recorded them in the present chapter.

A study of relevant literature is an essential step to get a good comprehension of what has been done with regard to the problem under study. Accordingly the researcher has gone through available literatures which are relevant to the present study.

Reviews of Related Literature on Resistance Training

Mahesh Yadav (2017) conducted a study to find out the effect of eight week circuit weight training on physical fitness variables of Gorakhpur University football players. A total of thirty (N=30) men university level football players were selected from Gorakhpur University. The age of the subjects ranged from 18 to 24 years and fifteen (N=15) players were acted as control group (Group A and (N=15) players acted as experimental group (Group B). Total duration was for eight weeks with three days per week. Control group

was not involved in any training. All the subjects were tested on the selected physical fitness variables such as leg strength, leg explosive power and abdominal strength endurance before and after eight weeks of circuit weight training. The data pertaining to the physical fitness variables were statistically analysed with analysis of covariance (ANCOVA). In all cases 0.05 level of confidence was fixed as a level of confidence to test the hypothesis. The finding of the study reviles that the experimental group had made a significant different in all the selected physical fitness variables such as leg strength, leg explosive power abdominal strength endurance when compared to control group. Hence it was concluded that eight weeks of circuit weight training improved the selected physical fitness variables of Gorakhpur University men foot ballplayers.

Antonio Paoli (2017) conducted a study to compare the effects of equal-volume resistance training performed with single-joint (SJ) or multi-joint exercises (MJ) on VO_2 Max, muscle strength and body composition in physically active males. Thirty-six participants were divided in two groups: SJ group (n = 18, 182.1 ± 5.2, 80.03 ± 2.78 kg, 23.5 ± 2.7 years) exercised with only SJ exercises (e.g., dumbbell fly, knee extension, etc.) and MJ group (n = 18, 185.3 ± 3.6 cm, 80.69 ± 2.98 kg, 25.5 ± 3.8 years) with only MJ exercises (e.g., bench press, squat, etc.). The total work volume (repetitions × sets × load) was equated between groups. Training was performed three times a week for 8 weeks. Before and after the training period, participants were tested for VO_2 Max, body composition, 1 RM on the bench press, knee extension and squat. Analysis of covariance (ANCOVA) was used to compare post training values between groups, using baseline values as covariates. According to the results, both groups decreased body fat and increased fat free mass with no difference between them. Whilst both groups significantly increased

cardio respiratory fitness and maximal strength, the improvements in MJ group were higher than for SJ in VO_2 Max (5.1 and 12.5% for SJ and MJ), bench press 1 RM (8.1 and 10.9% for SJ and MJ), knee extension 1 RM (12.4 and 18.9% for SJ and MJ) and squat 1 RM (8.3 and 13.8% for SJ and MJ). In conclusion, when total work volume was equated, RT programs involving MJ exercises appear to be more efficient for improving muscle strength and maximal oxygen consumption than programs involving SJ exercises, but no differences were found for body composition.

Soria-Gila (2015) et al. conducted a study to compare in a meta-analysis the effects of a long-term ($7weeks) VRT program using chains or elastic bands and a similar constant resistance program in both trained adults practicing different sports and untrained individuals. Intervention effect sizes were compared among investigations meeting our selection and inclusion criteria using a random-effects model. The published studies considered were those addressing VRT effects on the repetition maximum. Seven studies involving 235 subjects fulfilled the selection and inclusion criteria. Variable resistance training led to a significantly greater mean strength gain (weighted mean difference: 5.03 kg; 95% confidence interval: 2.26–7.80kg; Z= 3.55; p, 0.001) than the gain recorded in response to conventional weight training. Long-term VRT training using chains or elastic bands attached to the barbell emerged as an effective evidence-based method of improving maximal strength both in athletes with different sports backgrounds and untrained subjects.

Kim et al. (2015) conducted a study on effects of Swiss ball exercise and resistance exercise on respiratory function and trunk control ability in patients with scoliosis. This study compared the effects of Swiss ball exercise and resistance exercise on the respiratory function and trunk control ability of patients with scoliosis. Forty scoliosis

patients were randomly divided into the Swiss ball exercise group (n= 20) and resistance exercise group (n = 20). The Swiss ball and resistance exercise groups performed chest expansion and breathing exercises with a Swiss ball and a therapist's resistance, respectively. Both groups received training 30 min per day, 5 times per week for 8 weeks. Both groups exhibited significant changes in forced vital capacity, forced expiratory volume in one second, and trunk impairment scale after the intervention. However, there was no significant change in the forced expiratory volume in one second/forced vital capacity ratio after the intervention in either group. Meanwhile, forced expiratory volume in one second and trunk impairment scale were significantly greater in the resistance exercise group after the intervention. Both Swiss ball exercise and resistance exercise are effective for improving the respiratory function and trunk control ability of patients with scoliosis. However, resistance exercise is more effective for increasing the forced expiratory volume in one second and trunk control ability.

França et al. (2015) conducted a study on the effects of adding single-joint exercises to a multi-joint exercise resistance training program on upper body muscle strength and size in trained men. The aim of this study was compare changes in upper body muscle strength and size in trained men performing resistance training (RT) programs involving multi-joint plus single-joint (MJ+SJ) or only multi-joint (MJ) exercises. Twenty young men with at least 2 years of experience in RT were randomized in 2 groups: MJ+SJ (n = 10; age, 27.7 ± 6.6 years) and MJ (n = 10; age, 29.4 ± 4.6 years). Both groups trained for 8 weeks following a linear per iodization model. Measures of elbow flexors and extensors 1-repetition maximum (1RM), flexed arm circumference (FAC), and arm muscle circumference (AMC) were taken pre- and post-training period. Both groups significantly

increased 1RM for elbow flexion (4.99% and 6.42% for MJ and MJ+SJ, respectively), extension (10.60% vs 9.79%, for MJ and MJ+SJ, respectively), FAC (1.72% vs 1.45%, for MJ and MJ+SJ, respectively), and AMC (1.33% vs 3.17% for MJ and MJ+SJ, respectively). Comparison between groups revealed no significant difference in any variable. In conclusion, 8 weeks of RT involving MJ or MJ+SJ resulted in similar alterations in muscle strength and size in trained participants. Therefore, the addition of SJ exercises to a RT program involving MJ exercises does not seem to promote additional benefits to trained men, suggesting MJ-only RT to be a time-efficient approach.

Abidin and Adam (2013) conducted a study on prediction of vertical jump height from anthropometric factors in male and female martial arts athletes. Vertical jump is an index representing leg/kick power. The explosive movement of the kick is the key to scoring in martial arts competitions. It is important to determine factors that influence the vertical jump to help athletes improve their leg power. The objective of the present study is to identify anthropometric factors that influence vertical jump height for male and female martial arts athletes. Twenty-nine male and 25 female athletes participated in this study. Participants were Malaysian undergraduate students whose ages ranged from 18 to 24 years old. Their heights were measured using a stadiometer. The subjects were weighted using digital scale. Body mass index was calculated by kg/m(2). Waist-hip ratio was measured from the ratio of waist to hip circumferences. Body fat % was obtained from the sum of four skinfold thickness using Harpend encallipers. The highest vertical jump from a stationary standing position was recorded. The maximum grip was recorded using a dynamometer. For standing back strength, the maximum pull upwards using a handle bar was recorded. Multiple linear regression was used to obtain the relationship between

vertical jump height and explanatory variables with gender effect. Body fat % has a significant negative relationship with vertical jump height ($P < 0.001$). The effect of gender is significant ($P < 0.001$): on average, males jumped 26% higher than females did. Vertical jump height of martial arts athletes can be predicted by body fat %. The vertical jump for male is higher than for their female counterparts. Reducing body fat by proper dietary planning will help to improve leg power.

Benjamin et al. (2013**)** conducted a study on effects of systematic, heavy resistive exercise on range of joint movement in young male adults. A study was conducted on the effects of continual heavy, resistive exercise on the range of movement in certain selected joints of young male adults. An experimental group (n = 13) trained with weights for approximately six months during which time a control group (n = 13) participated in general physical education activities. Weight training did not have an appreciable effect upon range of joint movement throughout the body. A significant decrease did take place in the ability of the experimental group to move the extended arms, from a position at the side of the body, backward in the anterior posterior plane.

Distefano et al. (2013) conducted a study to compare the effects of an isolated resistance training program (ISO) and an integrated training program (INT) on movement quality, vertical jump height, agility, muscle strength and endurance, and flexibility. The ISO program consisted of primarily upper and lower extremity progressive resistance exercises. The INT program involved progressive resistance exercises, and core stability, power, and agility exercises. Thirty subjects were cluster randomized to either the ISO (n = 15) or INT (n = 15) training program. Each training group performed their respective programs 2 times per week for 8 weeks. The subjects were assessed before

(pre-test) and after (post-test) the intervention period using the following assessments: a jump-landing task graded using the Landing Error Scoring System (LESS), vertical jump height, T-test time, push-up and sit-up performance, and the sit-and-reach test. The INT group performed better on the LESS test (protest: 3.90 ± 1.02, post-test: 3.03 ± 1.02; $p = 0.02$), faster on the T-test (pre-test: 10.35 ± 1.20 seconds, post-test: 9.58 ± 1.02 seconds; $p = 0.01$), and completed more sit-ups (pre-test: 40.20 ± 15.01, post-test: 46.73 ± 14.03; $p = 0.045$) and push-ups (pre-test: 40.67 ± 13.85, post-test: 48.93 ± 15.17; $p = 0.05$) at post-test compared with pre-test, and compared with the ISO group at post-test. Both groups performed more push-ups ($p = 0.002$), jumped higher ($p < 0.001$), and reached further ($p = 0.008$) at post-test compared with that at pre-test. Performance enhancement programs should use an integrated approach to exercise selection to optimize performance and movement technique benefits.

Willis et al. (2012) conducted study on effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. Recent guidelines on exercise for weight loss and weight maintenance include resistance training as part of the exercise prescription. Yet few studies have compared the effects of similar amounts of aerobic and resistance training on body mass and fat mass in overweight adults. STRIDE AT/ RT, a randomized trial, compared aerobic training, resistance training, and a combination of the two to determine the optimal mode of exercise for obesity reduction. Participants were 119 sedentary, overweight or obese adults who were randomized to one of three 8-mo exercise protocols: 1) RT: resistance training, 2) AT: aerobic training and 3) AT/RT: aerobic and resistance training (combination of AT and RT). Primary outcomes included total body mass, fat mass and lean body mass. The AT and AT/RT groups reduced total

body mass and fat mass more than RT ($P < 0.05$), but they were not different from each other. RT and AT/RT increased lean body mass more than AT ($P < 0.05$). While requiring double the time commitment, a program of combined AT and RT did not result in significantly more fat mass or body mass reductions over AT alone. Balancing time commitments against health benefits, it appears that AT is the optimal mode of exercise for reducing fat mass and body mass, while a program including RT is needed for increasing lean mass in middle-aged, overweight/obese individuals.

Dietz et al. (2012) conducted a study on influence of exclusive resistance training on body composition and cardiovascular risk factors in overweight or obese children. Since the last decade, a significant increase in the prevalence of overweight and obesity among children has been reported. Low aerobic fitness and a low compliance with endurance sports in such children are theoretical reasons to favour the use of resistance training in intervention studies, even though positive effects of resistance training on morbidity without accompanying dietary modifications are a matter of debate. In this review we summarize the studies that have shown the isolated effect of resistance training on body composition and cardiovascular risk factors in overweight and obese children. We systematically reviewed interventional studies that exclusively applied resistance training to overweight and obese 3- to 18-year-old children. Outcome measurements were body composition or cardiovascular risk factors. Only six studies passed the inclusion criteria. All studies preferred an individually planned and supervised whole-body resistance training of moderate to sub maximal intensity during treatment. The mean compliance was 84%. Four studies reported significant changes in body composition, with an increase in fat free mass and BMI, along with a decrease in fat mass. Three studies

analyzed the effect of resistance training on cardiovascular risk factors, and only one study reported a significant decrease in systolic blood pressure. An individually planned and supervised whole-body resistance training of moderate to sub maximal intensity in children seems to be safe and tends to show positive effects on body composition. Similar to interventions based on endurance exercise alone or in combination with dietary modifications, the effects on cardiovascular risk factors cannot be substantiated. In consequence, we suggest to substantiate the effect of resistance training on cardiovascular risk factors in overweight and obese children in upcoming randomized controlled trials with high case numbers, applying both resistance training only and resistance training in combination with dietary intervention to get knowledge about whether resistance training alone is effectual in the treatment of overweight and obesity in youth or if a combination of resistance training and dietary interventions is actually needed.

Tiana Weiss et al. (2010) conducted a study to find out the effectiveness of functional training compared to traditional resistance training. In this study, 38 healthy volunteers, aged 18–32 years, were randomly placed into a control group [traditional (n=19)] and an experimental group [functional (n=19)].The participants were tested prior to and after completing the 7-week training study. The testing battery included: weight, girth measurements, flexibility, agility, lower back flexion and extension endurance, push-up test, sit-up test, one-leg balance, one-repetition maximum (1-RM) bench press and squat. Results indicated significant ($p<0.05$) increases in push-ups, back extension endurance, 1-RMbench press, 1-RMsquat, and one-leg balance with in each group following training. Traditional training also elicited significant ($p<0.05$) increases in bicep girth, for arm girth, calf girth, and sit-ups, while the functional training group experienced

significant ($p<0.05$) increases in shoulder girth and flexibility. For arm girth and flexion test time changes following training were the only parameter where there were significant ($p<0.05$) differences between training groups. Collectively, these results suggest that both programs are equally beneficial for increasing endurance, balance, and traditional measures of strength. However, changes in various girth measures, torsos flex or endurance and flexibility appear to be program-specific.

Arent, Shawn et al. (2010) conduct a study to examine the effects of a structured resistance training program on strength, body composition, and self-concept in normal and overweight Hispanic adolescents. Male and female participants ($n = 28$; 16.1 ± 0.2 y; 164.5 ± 1.4 cm; 63.3 ± 2.5 kg; 20.0 ± 1.7% body fat [BF]) were recruited from a predominantly Hispanic high school. Prior to the 12-week program, strength, body composition, and self-concept were assessed. Subjects were randomly assigned to a control group (CON; $n = 15$) or to a resistance training group (RT; $n = 13$) that participated in supervised strength training 3 days/week. All measures were repeated at the end of the 12-week program. RT had significantly greater strength increases for bench press ($p < 0.001$), seated row ($p = 0.002$), shoulder press ($p < 0.001$), and squats ($p = 0.002$). RT had significant reductions in %BF ($p = 0.001$), whereas CON had slightly increased %BF. RT had an increase in condition/stamina competence ($p = 0.008$), attractive body adequacy ($p = 0.017$), and global self-worth ($p = 0.013$) from pre-test to post test, whereas no change was observed for CON. In conclusion, resistance training resulted in significant physiological and psychological improvements in Hispanic adolescents compared to typical school-based activities. These findings indicate that resistance training can be incorporated into the activities of Hispanic adolescents to promote improved health and fitness.

Sgro, Melissa et al. (2009) investigated the effects of different durations of resistance training on body composition and power in children. The study was a 24-week longitudinal design involving 31 preadolescent children who were overweight or obese (ages 7-12 years), divided into 3 groups and resistance trained 3 times per week. Group 8 (G8) trained for 8 weeks, group 16 (G16) trained for 16 weeks, and group 24 (G24) trained for 24 weeks. All participants were measured at weeks 0, 8, 16, and 24 for body composition and power. Subjects in G8 and G16 continued to be tested during the testing weeks after cessation of their training programs. Body composition and bone mineral content were measured by dual-energy X-ray absorptiometry. Significant improvements in body composition were seen in the initial 8-week training phase, and these improvements were maintained for the subsequent 16 weeks. Significant changes in percent body fat (~5-7%) were observed at 8 weeks in all 3 groups. Total fat mass decreased significantly at week 8 in G16 and G24 (5.9%). By week 24, total fat mass was significantly reduced by 8.1% in G24. Significant improvements were observed in static jump power, which improved by 10.5% at week 16 in G24. These results suggest that an 8-week resistance training program is sufficient time to significantly change body composition, strength, and power measures in children who are overweight or obese. However, further improvements are realized with longer-duration resistance training programs. On cessation of the training programs, the G8 and G16 groups maintained the benefits of the exercise program until the end of the study period.

Granacher, et al. (2009**)** investigated the effects of resistance training on strength performance and on postural control in seniors. Forty healthy seniors (67+/-1yrs) participated in this study. Subjects were randomly assigned to resistance training (n=20)

and a control group (n=20). Resistance training for the lower extremities lasted for 13 weeks at 80% of the one repetition maximum. Pre and post-tests included the measurement of maximal isometric leg extension force with special emphasis on the early part of the force-time-curve and the assessment of static (functional reach test) and dynamic (tandem walk test, platform perturbation) postural control. Resistance training resulted in an enhanced strength performance with increases in explosive force exceeding those in maximal strength. Improved performances in the functional reach and in the tandem walk test were observed. Resistance training did not have an effect on the compensation of platform perturbations. Increases in strength performance can primarily be explained by an improved neural drive of the agonist muscles. The inconsistent effect of resistance training on postural control may be explained by heterogeneity of testing methodology or by the incapability of isolated resistance training to improve postural control.

McGuigan et al. (2009) investigated the effect of an 8-week resistance training program on children who were overweight or obese. Forty-eight children (n = 26 girls and 22 boys; mean age = 9.7 years) participated in an 8-week undulating periodized resistance training program for 3 d•wk−1. Measures of body composition via dual-energy X-ray absorptiometry, anthropometry, strength, and power were made before and after the training intervention. There was a significant decrease in absolute percent body fat of 2.6% ($p = 0.003$) and a significant increase in lean body mass of 5.3% ($p= 0.07$). There were no significant changes in height, weight, body mass index, total fat mass, or bone mineral content. There were significant increases in 1-repetition maximum squat (74%), number of push-ups (85%), countermovement jump height (8%), static jump height (4%), and power (16%). These results demonstrate that the resistance training program implemented produces

significant changes in body composition and strength and power measures, as well as being well tolerated by the participants. An undulating periodized program provides variation and significantly increases lean body mass, decreases percent body fat, and increases strength and power in children who are overweight and obese.

Scott Trappe et al. (2008) conducted a study on maintenance of whole muscle strength and size following resistance training in older men. Following a progressive resistance training (PRT) program of 3 days per week, we sought to examine how effective a resistance training maintenance program of 1 day per week would be to preserve muscle strength and size in older men. Each subject's whole muscle strength (1 repetition maximum, or 1RM) and whole muscle size (determined by computed tomography scan) were measured before (T1) and after (T2) 12 weeks of PRT and again following 6 months (T3) of training (TR) or detraining (DT). During the 12-week PRT, older men (N = 10; age 70 ± 4 years) trained their knee extensors 3 days per week at 80% of their 1RM. The maintenance program consisted of older men (n = 5; TR; 75 ± 1 years) who completed 3 sets of 10 repetitions at 80% of their 1RM 1 day per week (this was equivalent to a single training session that was performed 3 days per week during the 12-week PRT). The other group of older men (n = 5; DT; 69 ± 1 years) resumed their normal lifestyle (no regular physical activity) following the 12-week PRT. From T1 to T2, muscle strength increased ($p < .05$) 45% (66 ± 10 to 94 ± 10 kg) in the TR group and 53% (50 ± 6 to 74 ± 7 kg) in the DT group. From T2 to T3, whole muscle strength of the TR group was unchanged (96 ± 11 kg), whereas strength decreased ($p < .05$) in the DT group by 11% (66 ± 6 kg). Muscle size demonstrated a similar pattern with a 7% increase ($p < .05$) in both groups from T1 to T2. No change in muscle size was found in the TR group from T2 to T3, whereas the

DT group had a 5% reduction ($p < .05$). These data indicate that resistance training 1 day per week was sufficient to maintain muscle strength and size in these older men following a 12-week PRT program. Furthermore, the men who resumed their normal lifestyle (no regular physical activity) experienced significant losses in muscle strength and size.

Martim Bottaro et al., (2007) conducted a study on effect of high versus low-velocity resistance training on muscular fitness and functional performance in older men. This study investigated the effect of a 10-week power training (PT) program versus traditional resistance training (TRT) on functional performance, and muscular power and strength in older men. Twenty inactive volunteers (60–76 years old) were randomly assigned to a PT group (three 8–10 repetition sets performed as fast a possible at 60% of 1-RM) or a TRT group (three 8–10 repetition sets with 2–3 s contractions at 60% of 1-RM). Both groups exercised 2 days/week with the same work output. Outcomes were measured with the Rikli and Jones functional fitness test and a bench and leg press test of maximal power and strength (1-RM). Significant differences between and within groups were analyzed using a two-way analysis of variance (ANOVA). At 10 weeks there was a significantly ($P < 0.05$) greater improvement in measures of functional performance in the PT group. Arm curling improved by 50 versus 3% and a 30 s chair-stand improved by 43 versus 6% in the PT and TRT groups, respectively. There was also a significantly greater improvement in muscular power ($P < 0.05$) in the PT group. The bench press improved by 37 versus 13%, and the leg press by 31 and 8% in the PT and TRT groups, respectively. There was no significant difference between groups in improved muscular strength. It appears that in older men there may be a significantly greater improvement in functional performance and muscular power with PT versus low velocity resistance training.

Pescatello, et al. (2007) conducted a study on the muscle strength and size response to upper arm, unilateral resistance training among adults who are overweight and obese. Overweight and obesity result in musculoskeletal impairments that limit exercise capacity. We examined if the muscle strength hand size response to resistance training (RT) differed among 687 young (mean +/- SEM, 24.2 +/- 0.2 years) overweight and obese (OW) compared to normal weight (NW) adults as denoted by the body mass index (BMI). Subjects were 449 NW (22.0 +/- 0.1 kg.m(-2), 23.4 +/- 0.3 years) and 238 OW (29.2 +/- 0.2 kg.m(-2), 25.6 +/- 0.4 years) men (n = 285) and women (n = 402) who underwent 12 weeks (2 d.wk(-1)) of RT of the non dominant arm. Maximum voluntary contraction (MVC) and 1 repetition maximum (1RM) assessed peak elbow flexor strength. Magnetic resonance imaging measured the biceps muscle cross sectional area (CSA). Multiple dependent variable analysis of covariance tested if muscle strength and size differed among BMI groups pre-, post-, and pre-to-post-RT. Overweight and obese had greater MVC, 1RM, and CSA than NW pre- and post-RT ($p < 0.001$). Maximum voluntary contraction and 1RM gains were not different between BMI groups pre- to post-RT ($p >or= 0.05$). When adjusted for baseline values, NW had greater relative MVC (21.2 +/- 1.0 vs. 17.4 +/- 1.4%) and 1RM (54.3 +/- 1.5 vs. 49.0 +/- 2.0%) increases than OW ($p < 0.05$). Normal weight also had greater algometric MVC (0.48 +/- 0.02 kg.kg (-0.67) vs. 0.40 +/- 0.03 kg.kg(-0.67)) and 1RM (0.25 +/- 0.00 vs. 0.22 +/- 0.01 kg.kg(-0.67)) gains than OW ($p < 0.05$). CSA gains were greater among OW than NW (3.6 +/- 0.2 vs. 3.2 +/- 0.1 cm (2)) ($p < 0.001$); however, relative CSA increases were not different between BMI groups (19.4 +/- 0.5 vs. 18.4 +/- 0.7%) ($p >or= 0.05$). Despite similar relative muscle size increases, relative and algometric strength gains were less among OW than NW. These findings indicate the short-term

relative and algometric muscle strength response to RT may be attenuated among adults who are overweight and obese.

Toshihiko Tsutsumi et al. (1997) conducted a study on physical fitness and psychological benefits of strength training in community dwelling older adults. In the present study, psychological and behavioural adaptations in response to 12-weeks of strength training were examined in medically healthy but sedentary 42 older adults (mean age=68 years). The purpose of this study was to evaluate the effects of high and low intensity resistance training intensity on a) muscular fitness, b) psychological effect, and c) neurocognitive functioning. Subjects were randomly assigned to high intensity/low volume (EXH: 2 sets of 8 to 10 repetitions for 75 to 85% of 1 RM), low intensity/high volume (EXL: 2 sets of 14 to 16 repetitions for 55 to 65% of 1 RM), or no exercise control programs. Prior to and following the 12-week program, subjects underwent comprehensive physiological and psychological evaluations. Physiological assessment included measurements of blood pressure, heart rate, arm and leg muscle strength, body composition, and oxygen consumption (VO_2 Max). Psychological measures included evaluations of mood, anxiety, and physical self-efficacy as well as cognitive functioning. The results of this study indicated that both high and low intensity strength programs were associated with marked improvements in physiological fitness and psychological functioning. Specifically, subjects in the strength training programs increased overall muscle strength by 38.6% and reduced percent body fat by 3.0%. Favourable psychological changes in the strength-trained subjects included improvements in positive and negative mood, trait anxiety, and perceived confidence for physical capability. The treatment effects of neurocognitive functioning were not significant. In summary, this study demonstrated that participation in

12-weeks of high or low intensity strength training can improve overall physical fitness, mood, and physical self-efficacy in older adults while cognitive functioning remains constant.

Lyle et al. (1986) conducted a study on strength training for children. The indications for progressive resistive strength training for prepubescent children in sports training and rehabilitation have been a source of controversy. Eighteen prepubescent children, two at Tanner Stage II and the remainder at Tanner Stage I, were studied. Examination included anthropometric upper and lower extremity strength and flexibility measurements. The study group participated in progressive resistive strength training sessions on machines three times per week. The study group had a mean increase in strength of 42.9%, whereas strength in the control group increased 9.5% ($p < 0.05$). The study group had a mean increase in flexibility of 4.5% compared with 3.6% in the control group. The study group showed a mean decrease in body weight during the training period of 0.51% and then gained 3.48% over the subsequent 9 weeks. The control group's body weight increased an average of 6.66% during the 18 weeks. There were no injuries during the training period. It is concluded that prepubescent children can make significant gains in muscle strength in response to progressive resistive training.

Hickson et al. (1980) conducted a study on strength training effects on aerobic power and short-term endurance. Nine men participated in an exercise program (five days a week for 10 weeks) that was designed to strengthen the quadriceps muscles. This study was undertaken to determine if heavy resistance training results in an increase in endurance, VO_2 Max and whether the differences that are normally observed during bicycle and treadmill VO_2 Max measurements in the same individuals are strength-related.

Following training, endurance time to exhaustion significantly increased while cycling (47%) and while running (12%), when the subjects exercised at 100% of their pre training VO_2 Max. There was a small increase in VO_2 Max (4%, $P < 0.05$) during bicycle exercise co (3.40 l.min-1 to 3.54 l.min-1) after training, but no significant differences were observed when expressed in (ml.kg-1.min-1). Strength training had no effect on VO_2 Max when measured during treadmill exercise. Absolute differences between bicycle and treadmill VO_2 Max were essentially the same after training as before. Lactate concentration in blood after the bicycle and treadmill endurance tests were not elevated to a greater extent after training. Thigh girth increased significantly and muscle strength increased 40% with the training. These findings provide evidence that HRT is capable of dramatically increasing short-term endurance, when the muscles involved in the training are used almost exclusively during the testing without an accompanying increase in VO_2 Max. These data also suggest that the differences in VO_2 Max between bicycle and treadmill exercise are not the result of inadequate muscle strength.

Wilmore et al., (1978) conducted a study on physiological alterations consequent to circuit weight training. The efficacy of a 10-week program of circuit weight training to elicit specific physiological alterations was evaluated in a group of men (n = 16) and a group of women (n = 12), with an additional group of men (n = 10) and a group of women (n = 11) serving as controls. The circuit consisted of 10 stations performed on a Universal Gym, 3 circuits per day (approximately 22.5 min/day), 3 days/week. The subjects exercised at 40-55% of 1-RM, executing as many repetitions as possible in 30 sec on each of the lifts, followed by a 15 sec rest as the subject moved to the next station. Following the training program, the experimental groups demonstrated significant increases in lean body weight,

flexed biceps girth, treadmill endurance time, VEmax (women only), VO_2 Max in ml/kg-min (women only), flexibility and strength. Significant decreases were found in selected skin fold measurements, and in resting heart rate (control group showed similar decreases). No change was found in body weight or in relative or absolute body fat. Generally, the women exhibited equal or greater changes when compared to the men for all variables assessed, which could be a function of their lower initial starting levels, or a more intense training program. It was concluded that circuit weight training is a good general conditioning activity, i.e., attends to more than one component of fitness.

Amit Patel and Rakesh Bharti (2016) conducted a study to find out the effect of resistance training and circuit training on selected physical and physiological variables among college male basketball Players. To achieve the purpose of the study, thirty male basketball players were randomly selected as subjects from Sarvajanik Education Society, Surat. The age of the subjects were ranged between 18 to 25 years. The study was formulated as pre and post-test random group design, in which forty five subjects were divided into three equal groups. Experimental Group-I (n=10; RT Group) performed the Resistance training Group. The Experimental Group-II (n=10, CT group) performed Circuit Training programme. Control group (n=10; CG) did not undergo any specific training programmed but there practiced the regular game. The following physical and physiological parameters are Explosive Strength and Resting Pulse rate. The analysis of covariance was used to analyse the significant difference, if any among the groups. Si, three groups were compared, whenever they obtained ‘F’ ratio for adjusted post-test was found to be significant, the Scheffe’s test to find out the paired mean differences, if any. The 0.05 level of confidence was fixed as the level of significance to test the ‘F’ ratio

obtained by the analysis of covariance, which was considered as an appropriate. The result of the study indicates due to training on Explosive Strength and Resting Pulse rate has been improved significantly.

Kavita Sharma (2014) The purpose of the present study was to find out the effect of nine weeks resistance training program on selected physical fitness variables of Basketball players. For this purpose twenty female basketball players from Delhi University were selected to act as subjects for the study, the age of the subjects ranged from 17 to 21 years. The minimum level of participation was Inter-University. The subjects were further divided into two groups i.e. Control and Experimental group, group-I underwent resistance training and group-II acted as control and continued with their regular physical activity. The training period for the study was three days in a week for nine weeks. Pre data of both the groups were taken prior to the training period; the subjects were tested for speed, back strength and abdominal strength. The dependent's` test and analysis of covariance was applied as statistical tool. In all cases 0.05 level was fixed as significance. It was concluded from the results of the study that training groups had improved on back strength, and had no significant improvement on the speed and abdominal strength

Reviews Related Literature on Swiss ball Training

Kim et al. (2015) conducted a study on effects of swiss ball exercise and resistance exercise on respiratory function and trunk control ability in patients with scoliosis. This study compared the effects of Swiss ball exercise and resistance exercise on the respiratory function and trunk control ability of patients with scoliosis. Forty scoliosis patients were randomly divided into the Swiss ball exercise group (n= 20) and resistance exercise group (n = 20). The Swiss ball and resistance exercise groups performed chest

expansion and breathing exercises with a Swiss ball and a therapist's resistance, respectively. Both groups received training 30 min per day, 5 times per week for 8 weeks. Both groups exhibited significant changes in forced vital capacity, forced expiratory volume in one second, and trunk impairment scale after the intervention. However, there was no significant change in the forced expiratory volume in one second/forced vital capacity ratio after the intervention in either group. Meanwhile, forced expiratory volume in one second and trunk impairment scale were significantly greater in the resistance exercise group after the intervention. Both swiss ball exercise and resistance exercise are effective for improving the respiratory function and trunk control ability of patients with scoliosis. However, resistance exercise is more effective for increasing the forced expiratory volume in one second and trunk control ability.

Eltanahinagla (2011) conducted a study on the effect of swiss ball exercises on the abdominal, back and leg muscles strength, hip and spine flexibility, static and dynamic balance and Vital Capacity in addition to their relationship of Gankaku Kata performance level. (12) Women Karate at aged (18-20) years from Zagazig University karate first- team participated in 8 weeks Swiss Ball exercises. The present study included Sit- Up legs-straight, Back Lift Strength, leg lift strength, grand car flexibility, Trunk Extension Flexibility, stroke Stand, Modified Bass Test of Dynamic Balance and Vital Capacity Tests, surface electromyography (EMG) was used to assess abdominal and back muscles activity during kata skills, The level of performance was evaluated by five Judgers accredited by the Egyptian Federation of Karate. Results showed significant differences between the two measures of physical and physiological variables with improvement of Gankaku Kata performance.

Sekendiz et al., (2010) investigated the effects of Swiss-ball core strength training on trunk extensor (abdominal)/flexor (lower back) and lower limb extensor (quadriceps)/flexor (hamstring) muscular strength, abdominal, lower back and leg endurance, flexibility and dynamic balance in sedentary women (n = 21; age = 34 ± 8.09; height = 1.63 ± 6.91 cm; weight = 64 ± 8.69 kg) trained for 45 minutes, 3 d•wk-1 for 12 weeks. Results of multivariate analysis revealed significant difference ($p \leq 0.05$) between pre and post measures of 60 and 90° s trunk flexion/extension, 60 and 240° s-1 lower limb flexion/extension (Biodex Isokinetic Dynamometer), abdominal endurance (curl-up test), lower back muscular endurance (modified Sorensen test), lower limb endurance (repetitive squat test), lower back flexibility (sit and reach test), and dynamic balance (functional reach test). The results support the fact that Swiss-ball core strength training exercises can be used to provide improvement in the aforementioned measures in sedentary women. In conclusion, this study provides practical implications for sedentary individuals, physiotherapists, strength and conditioning specialists who can benefit from core strength training with swiss balls.

Marshall P Wand Desai (2010) conducted a study on electromyography analysis of upper body, lower body, and abdominal muscles during advanced swiss ball exercises. Although there is now some evidence examining the use of a Swiss ball during core stability and resistance exercises, this has commonly been performed using basic or isometric exercises. There is currently no evidence examining more advanced Swiss ball exercises. The purpose of this study was to determine whether or not muscle activity measured during advanced Swiss ball exercises was at an approximate intensity recommended for strength or endurance training in advanced, or novice individuals.

After a familiarization session, 14 recreationally active subjects performed 6 different "advanced" Swiss ball exercises in a randomized order. The primary dependent variables in this study were the activity levels collected from anterior deltoid, pectoralis major, rectus abdominous (RA), external oblique's, lumbar erector spine, vastus lateral is (VL), and biceps femur is using surface electromyography. All signals were normalized to maximal voluntary isometric contractions performed before testing for each muscle. The results of this study showed that the Swiss ball roll elicited muscle activity in triceps brachii (72.5+/-32.4%) and VL (83.6+/-44.2%) commensurate with the intensity recommended for strength exercises in advanced trainers. Rectus abdomen's activity was greatest during the bridge exercise (61.3+/-28.5%, p<or=0.01). This was the only exercise to elicit RA muscle activity commensurate with a strength training effect. The remainder of the exercises elicited abdominal activity that would require a higher number of repetitions to be performed for an endurance training adaptation. Although this study has provided evidence for one advanced Swiss ball exercise providing a significant whole-body stimulus, the practical difficulty and risks of performing these more complicated Swiss ball exercises may outweigh potential benefits.

Kim, Tae-Un (2009) conducted a study on the effects of rope jumping and Swiss ball exercise on young children's bone formation marker. The purpose of this study was to elucidate the effects of 12 weeks rope jumping and Swiss ball exercise (55 to 75% HRR: 3 times a week) on body composition and bone formation markers in young children. Forty eight participants were divided into two groups, the exercise group (n=24) and the control group (n=24). All items were assessed before and after exercise program. The results of this study are as follows; 1. Body composition: In the comparison of mean changes before

and after exercise program execution on body composition within each group, the exercise group showed significant increases in height, weight, fat mass and %fat. The control group showed significant increases in all items. The interaction effect between groups and time didn't appear a significant difference. 2. Osteocalcin: In the comparison of mean changes before and after exercise program execution in osteocalcin within each group, the exercise group didn't appear a significant change and the control group were significantly decreased in girl children. The interaction effect between groups and time didn't appear a significant difference. 3. Alkaline phosphatase: In the comparison of mean changes before and after exercise program in alkaline phosphatase within each group didn't appear a significant difference in exercise group and control group. The interaction effect between groups and time showed a significant difference. In conclusion, for young children in the stage of the formation of bone mineral contents, rope jumping and Swiss ball exercise are positive effect in promoting their growth and bone health, but osteocalcin concentration did not changes.

Duncan (2009**)** conducted a study on muscle activity of the upper and lower rectus abdomens during exercises performed on and off a Swiss ball. This study sought to examine any differences in upper rectus abdomens (URA) and lower rectus abdomens (LRA) muscle activity during four abdominal exercises, the curl-up, Swiss ball curl-up, Swiss ball jack knife and Swiss ball rollout. Fourteen healthy adults (7 males, 7 females, mean age+/-S.D.=21.8+/-3.8 years) performed abdominal exercises in a randomised order following maximal voluntary isometric contraction. Muscle activity of the URA and LRA was assessed using surface electromyography. Results indicated that activity of the URA was significantly greater than muscle activity of the LRA for the curl-up, Swiss ball

curl-up and Swiss ball rollout. LRA muscle activity was greater than URA during the jack-knife exercise. Muscle activity during the curl-up was significantly lower than muscle activity during the other exercises. To conclude, muscle activity was greater when exercises were performed on a Swiss ball in comparison to a stable surface and LRA muscle activity was maximized during the Swiss ball jack knife.

Marshall and Murphy (2006) conducted a study on increased deltoid and abdominal muscle activity during swiss ball bench press. The swiss ball is widely used in the recreational training environment as a supplement to conventional resistance training. One such application is to use the Swiss ball as a bench support for bench press exercise. There is no evidence to indicate that the use of a Swiss ball is beneficial for resistance training exercise. This study investigated muscle activity using surface electromyography of upper-body and abdominal muscles during the concentric and eccentric phases of the bench press on and off a Swiss ball. Volunteers for this study were 14 resistance-trained subjects who performed isolated concentric and eccentric bench press repetitions using the 2 test surfaces with a 2-second cadence at a load equivalent to 60% maximum force output. The average root mean square of the muscle activity was calculated for each movement, and perceived exertion during the tasks was collected using a Borg Scale. The results of the study showed that deltoid and abdominal muscle activity was increased for repetitions performed using the Swiss ball. Increased deltoid muscle activity supports previous findings for increased activity when greater instability is introduced to the bench press movement. Abdominal muscle activity increases were not hypothesized, but this finding provides scientific evidence for anecdotal reasoning behind swiss ball use as a potential core stability training device.

Gregory Lehman et al. (2005) conducted a study on trunk muscle activity during bridging exercises on and off a Swiss ball. A Swiss ball is often incorporated into trunk strengthening programs for injury rehabilitation and performance conditioning. It is often assumed that the use of a Swiss ball increases trunk muscle activity. The aim of this study was to determine whether the addition of a Swiss ball to trunk bridging exercises influences trunk muscle activity. Surface electrodes recorded the my electric activity of trunk muscles during bridging exercises. Bridging exercises were performed on the floor as well as on a labile surface (Swiss ball). During the prone bridge the addition of an exercise ball resulted in increased my electric activity in the rectus abdominals and external oblique. The internal oblique and erector spine were not influenced. The addition of a Swiss ball during supine bridging did not influence trunk muscle activity for any muscles studied. The addition of a Swiss ball is capable of influencing trunk muscle activity in the rectus abdominals and external oblique musculature during prone bridge exercises. Modifying common bridging exercises can influence the amount of trunk muscle activity, suggesting that exercise routines can be designed to maximize or minimize trunk muscle exertion depending on the needs of the exercise population.

Stanton et al. (2004) investigated the effect of a short-term Swiss ball training on core stability and running economy. Eighteen young male athletes (15.5 +/- 1.4 years; 62.5 +/- 4.7 kg; sigma9 skin folds 78.9 +/- 28.2 mm; VO_2 Max 55.3 +/- 5.7 ml.kg(-1).min (-1)) were divided into a control (n = 10) and experimental (n = 8) groups. Athletes were assessed before and after the training program for stature, body mass, core stability, electro myographic activity of the abdominal and back muscles, treadmill VO_2 Max, running economy, and running posture. The experimental group performed 2 Swiss ball training

sessions per week for 6 weeks. Data analysis revealed a significant effect of Swiss ball training on core stability in the experimental group ($p < 0.05$). No significant differences were observed for myoelectric activity of the abdominal and back muscles, treadmill VO_2 Max, running economy, or running posture in either group. It appears Swiss ball training may positively affect core stability without concomitant improvements in physical performance in young athletes. Specificity of exercise selection should be considered.

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Reviews of related literature on aerobic dance training

Senthilkumar and Sebastian (2019) conducted a study to find out the effect of aerobics training on selected physical and physiological variables among female volley ball players. To achieve the purpose of the present study, thirty female from Fatima college, Madurai, were randomly selected as subjects and their age was between 18 and 25 years. Thursday was formulated as a true random group design, consisting of a pre-test and post-test. The subjects (N=30) were randomly assigned to two equal groups off fifteen female each. The groups were assigned as Aerobics Training group and control group in an equivalent manner. The group I underwent Aerobics Training and group II actedasa control group. The experimental group participated the training for a period of twelve weeks to find out the outcome of the training packages and the control group did not participated in any training programme. The variable to be used in the present study was collected from all subjects before they have to treat with the respective treatments. It was assumed as pre-test. After completion of treatment they were tested again as it was in the pre-test on all variables used in the present study. This test was as summed as post-test. To test the obtained results on variables, level of significance 0.05was chosen and considered as sufficient for the study. The Aerobics Training group produced significant improvement in physical and physiological variables among female volleyball players. In the control group the obtained 't' value on all the variables were failed to reach the significant level.

Syed Shakil Ur Rehman (2016) conducted a study to determine the effects of supervised structured aerobic exercise training programme on level of exertion, dyspnoea, maximum oxygen consumption, and body mass index in type 2 diabetics. The randomized,

controlled trial was carried out at Riphah Rehabilitation and Research Centre, Islamic International medical College Trust, Pakistan Railways General Hospital, Rawalpindi, Pakistan, from January 2015 to June 2016, and comprised type 2 diabetics. Sedentary individuals of both genders, aged 40-70 years, diagnosed on World Health Organization's criteria were included. Participants were randomly divided into two groups, i.e. A (experimental) and B (control), by toss and trial method. Intervention in the experimental group were supervised structured aerobic exercise training programme, routine medication and dietary, while the control group was treated by routine medication and dietary plan for 25 weeks at 3 days per week for both groups. Level of exertion, dyspnoea, maximum oxygen consumption and body mass index were assessed and documented at baseline (0 week) and at the completion of intervention (after 25 weeks). SPSS 20 was used for data analysis. Out of the 102 participants, there were 51(50%) in each group. Pre- and post-intervention analysis showed that a 25-week training programme, routine medication, and dietary plan significantly improved level of exertion, dyspnoea, maximum oxygen consumption and body mass index.

Sulistyoningrum and Candrawati (2016) determined the effect of programmed aerobic dance on body mass index and waist circumference. This pre-and post-test experimental study was conducted on 33 female individuals aged 15-30 years of Jenderal Soedirman University Purwokerto, Central Java. Programmed aerobic dance as intervention was given for twelve weeks in Sisca's Gymnasium. Health status and PAR-Q (Physical Activity Readiness Questionnaire) were assessed before enrolling this study. Body mass index and waist circumference were measured before and after intervention. For statistic analyses, basic descriptive statistics and paired t-test or Wilcoxon analyses were applied

for dependent variables. Programmed aerobic dance significantly reduced body mass index from 22, 89 (before intervention) to 22, 34 (after intervention), $p<0.05$. Subjects had lower waist circumference after intervention (75 cm compared with 72cm, $p<0,001$). Twelve weeks programmed aerobic dance reduce body mass index and waist circumference.

Kim, et al., (2016) conducted a study to reveal the effects of aerobic training (AT) and resistance training (RT) on circulating levels and their associations with change of body composition in overweight/obese adults. Twenty eight overweight/obese adults (BMI>23 kg/m^2) were included in this study and compared before and after 8 weeks of exercise program (60 min/day, 5 times in a week). The subjects, in both aerobic and resistance training, showed significant improvement in anthropometric parameters and exercise capacities including maximal oxygen uptake and muscle strength. Interestingly, the circulating levels was significantly increased in resistance training group ($p=0.002$) but not in aerobic training ($p=0.426$) compared to control group. In addition, we found the positive correlation between change of the circulating levels and muscle mass ($r=0.432$, $p=0.022$) and the negative correlation between change of the circulating levels and fat mass ($r=-0.407$, $p=0.031$). In the present pilot study, we found that circulating level was increased by 8 weeks of resistance training in overweight/obese adults, suggesting that resistance training could be the efficient exercise type in overweight/obese considering positive change of body composition concomitant with increase of circulating levels.

Nobuo Takeshima et al., (2004) conducted a study on effect of concurrent aerobic and resistance circuit exercise training on fitness in older adults. Thirty-five volunteers were randomly divided into two groups [PACE group (PG) 8 men and 10 women, 68.3 (4.9) years, and non-exercise control group (CG) 7 men and 10 women, 68.0 (3.4)

years). The PG participated in a 12-week, 3 days per week supervised program consisting of 10 min warm-up and 30 min of PACE (moderate intensity HRE and aerobic movements at 70% of peak heart rate) followed by 10 min cool-down exercise. PACE increased ($P<0.05$) oxygen uptake ($\dot{V}O2$) at lactate threshold [PG, pre 0.79 (0.20) l min−1, post 1.02 (0.22) l min−1, 29%; CG, pre 0.87 (0.14) l min−1, post 0.85 (0.15) l min−1, −2%] and at peak $\dot{V}O2$ [PG, pre 1.36 (0.24) l min−1, post 1.56 (0.28) l min−1, 15%; CG, pre 1.32 (0.29) l min−1, post 1.37 (0.37) l min−1, 4%] in PG measured using an incremental cycle ergo meter. Muscular strength evaluated by a HRE machine increased at low to high resistance dial settings for knee extension (9–52%), knee flexion (14–76%), back extension (18–92%) and flexion (50–70%), chest pull (6–28%) and press (3–17%), shoulder press (18–31%) and pull (26–85%), and leg press (21%). Body fat (sum of three skin folds) decreased (16%), and high-density lipoprotein cholesterol (HDLC) increased (10.9 mg dl−1) for PG. There were no changes in any variables for CG. These results indicate that PACE training incorporating aerobic exercise and HRE elicits significant improvements in cardio respiratory fitness, muscular strength, body composition, and HDLC for older adults. Therefore, PACE training is an effective well-rounded exercise program that can be utilized as a means to improve health-related components of fitness in older adults.

Lemura et al., (2002) conducted a study to quantify the effects of exercise treatment programs on changes in body mass, fat-free mass, and body fat in obese children and adolescents. By using the meta-analytic approach, studies that met the following criteria were included in our analyses: 1) at least six subjects per group; 2) subject groups consisting of children in the 5- to 17-yr age range; 3) pre-test and post-test values for either body mass, percent body fat, or fat-free mass (FFM); 4) used exercise as a mode of

treatment (e.g., walking, jogging, cycle ergometer, high-repetition resistance exercise, and combinations); 6) training programs >or= 3 wk. 7) full-length publications (not conference proceedings); 8) apparently "healthy" children (i.e., free from endocrine diseases and disorders); and 9) published studies in English language journals only. A total of 120 investigations were located that addressed the issue of exercise as a method of treatment in paediatric obesity. Of those, 30 met our criteria for inclusion. Across all designs and categories, fixed-effects modelling yielded significant decreases in the following dependent variables: 1) percent body fat (mean = 0.70 +/- 0.35; 95% CI = 0.21 to 1.1); 2) FFM (mean = 0.50 +/- 0.38; 95% CI = 0.03 to 0.57); 3) body mass (mean = 0.34 +/- 0.18; 95% CI = 0.01 to 0.46); 4) BMI (mean = 0.76 +/- 0.55; 95% CI = 4.24 to 1.7), and 5) VO_2 Max (mean = 0.52 +/- 0.16; 95% CI = 0.18 to 0.89), respectively. Significant differences were found as a function of the type intervention groups (exercise vs exercise + behavioural modification; $P < 0.04$); body composition assessment methods (skinfold vs hydrostatic weighing, DEXA, and total body water; $P < 0.006$); exercise intensity (60-65%, vs>or= 71% VO_2 Max; $P < 0.01$); duration (<or= 30 min vs> 30 min; $P < 0.03$); and mode (aerobic vs aerobic + resistance training; $P < 0.02$). Stepwise linear regression suggested that initial body fat levels (or body mass), type of treatment intervention, exercise intensity, and exercise mode accounted for most of the variance associated with changes in body composition after training. Exercise is efficacious for reducing selected body composition variables in children and adolescents. The most favourable alterations in body composition occurred with 1) low-intensity, long-duration exercise; 2) aerobic exercise combined with high-repetition resistance training; and 3) exercise programs combined with a behavioural-modification component.

Geliebter et al. (1997) conducted study on the effects of strength or aerobic training on body composition, resting metabolic rate and peak oxygen consumption in obese dieting subjects. Given that resting metabolic rate (RMR) is related largely to the amount of fat-free mass (FFM), the hypothesis was that strength training, which stimulates muscle hypertrophy, would help preserve both FFM and RMR during dieting. In a randomized controlled intervention trial, moderately obese subjects (aged 19-48 y) were assigned to one of three groups: diet plus strength training, diet plus aerobic training, or diet only. Sixty-five subjects (25 men and 40 women) completed the study. They received a formula diet with an energy content of 70% of RMR or 5150 +/- 1070 kJ/d (x +/- SD) during the 8-wk intervention. They were seen weekly for individual nutritional counselling. Subjects in the two exercise groups, designed to be isoenergetic, trained three times per week under supervision. Those in the strength-training group performed progressive weight-resistance exercises for the upper and lower body. Those in the aerobic group performed alternate leg and arm cycling. After 8 wk, the mean amount of weight lost, 9.0 kg, did not differ significantly among groups. The strength-training group, however, lost significantly less FFM ($P < 0.05$) than the aerobic and diet-only groups. The strength-training group also showed significant increases ($P < 0.05$) in anthropometrically measured flexed arm muscle mass and grip strength. Mean RMR declined significantly, without differing among groups. Peak oxygen consumption increased the most for the aerobic group ($P = 0.03$). In conclusion, strength training significantly reduced the loss of FFM during dieting but did not prevent the decline in RMR.

Henry Williford et al. (1989) conducted a study on the physiological effects of aerobic dance. Aerobic dance exercise is currently one of the most commonly practiced

adult fitness activities. If however, the participant is interested in modifying body composition, training frequency, duration, or efforts toward caloric restriction may need to be increased or altered beyond those employed in the aerobic dance training investigations. The amount of energy expended during a bout of aerobic dance can vary dramatically according to the intensity of the exercise. 'Low intensity' dance exercise is usually characterized by less large muscle activity and/or less lower extremity impact, and music of slower tempo. Dance exercise representative of this variety requires a cost of approximately 4 to 5 kcal/minute. Several trials, however, have shown that vigorous 'high intensity' aerobic dance which entails using the large muscle groups can require 10 to 11 kcal/minute. The associated training outcomes could be affected by such differences in dance exercise intensity and style.

Summary

The reviews of related literature facilitated the investigator to select relevant topics and variables. Further the literature support the investigator to setting the resistance training, swiss ball training and aerobic dance training leading to the research problems. The latest literatures of resistance training, swiss ball training and aerobic dance training also assisted the investigator to keep his findings with regard to the problem. All the reviews were presented in the chronological order. The research scholar has presented the 23 reviews of related literate on resistance training 11 reviews of related literate on Swiss ball training, 8 reviews of related literate on aerobic dance. Further the literature collected in the study was also helped the research scholar to have understandings the similar areas.