REVIEW OF RELATED LITERATURE

The study related literature is an essential step to get a good comprehension of what has been done with regard to the problem under study. Such review is instrumental in the selection of topic, transaction of hypothesis and deductive reasoning lead in to the problem. It will bring out a deep and clear perspective of overall field.

Dudley GA, Djamil R (1985) conducted a study on the Incompatibility of endurance- and strength-training modes of exercise. Twenty-two male and female subjects trained for 7 wk for endurance (group E), for strength (group IS), or for both strength and endurance (group C) to evaluate the effect of concurrent performance of both modes of training on the in vivo force-velocity relationship of human muscle and on aerobic power. Endurance training consisted of five 5-min sessions three times a week on cycle ergometer with a work load that approached the subject's peak cycle-ergometer O2 uptake (peak CE VO2). Strength training consisted of two 30-s sets of maximal knee extensions per day performed on an isokinetic dynamometer three times a week at a velocity of 4.19 rad X s-1. Group C performed the same training as groups IS and E, alternating days of strength and endurance training. Subjects (groups C and IS) were tested pre- and post training for maximal knee-extension torque at a specific joint angle (0.52 rad below horizontal) for seven specific angular velocities (0, 0.84, 1.68, 2.81, 3.35, 4.19, and 5.03 rad X s-1). Groups C and E were tested for peak CE VO2 pre training, at 14-day intervals, and post training. Group IS showed significant increases in angle-specific maximal torque at velocities up to and including the training speed (4.19 rad X s-1). Group C showed increases (P less than 0.05) at velocities of 0, 0.84, and 1.68 rad X s-1 only. Peak CE VO2, when expressed in relative or absolute terms, increased (P less than 0.05) approximately 18% for both groups E and C.

Evans DL (1985) Conducted a study on The cardiovascular system provides the link between pulmonary ventilation and oxygen usage at the cellular level. During exercise, efficient delivery of oxygen to working skeletal and cardiac muscles is vital for maintenance of ATP production by aerobic mechanisms. The equine cardiovascular response to increased demand for oxygen delivery during exercise contributes largely to the over 35-fold increases in oxygen uptake that occur during submaximal exercise.
Cardiac output during exercise increases greatly owing to the relatively high heart rates that are achieved during exercise. Heart rate increases proportionately with workload until heart rates close to maximal are attained. It is remarkable that exercise heart rates six to seven times resting values are not associated with a fall in stroke volume, which is maintained by splenic contraction, increased venous return, and increased myocardial contractibility. Despite the great changes in cardiac output, increases in blood pressure during exercise are maintained within relatively smaller limits, as both pulmonary and systemic vascular resistance to blood flow is reduced. Redistribution of blood flow to the working muscles during exercise also contributes greatly to the efficient delivery of oxygen to sites of greatest need. Higher work rates and oxygen uptake at submaximal heart rates after training imply an adaptation due to training that enables more efficient oxygen delivery to working muscle. Such an adaptation could be in either blood flow or arteriovenous oxygen content difference. Cardiac output during submaximal exercise does not increase after training, but studies using high-speed treadmills and measurement of cardiac output at maximal heart rates may reveal improvements in maximal oxygen uptake due to increased stroke volumes, as occurs in humans. Improvements in hemoglobin concentrations in blood during exercise after training are recognized, but at maximal exercise, hypoxemia may reduce arterial oxygen content. More effective redistribution of cardiac output to muscles by increased capillarization and more efficient oxygen diffusion to cells may also be an important means of increasing oxygen uptake after training.

* Nelson AG, Arnall DA, Loy SF, Silvester LJ, Conlee RK (1990) conducted a study on the Consequences of combining strength and endurance training regimens. To test this premise, 14 healthy, untrained men trained four days per week for 20 weeks on a bicycle ergo meter for endurance (END Group, n = 4), on an iso kinetic device for increased torque production (ITP Group, n = 5), or on both devices (COMBO Group, n = 5). The ITP and COMBO groups had equal torque gains throughout the study (234 +/- 45 and 232 +/- 23 N.m, respectively). After 11 weeks, both END and COMBO groups had similar gains in maximal oxygen consumption (VO\textsubscript{2 max}) (in milliliters per kilogram of body weight per minute). During the last half of the study, however, the END Group had a significant gain in VO\textsubscript{2 max} (p less than .05) of 4.7 +/- 1.2 mL.kg-l.min-1, whereas the COMBO Group had a non significant gain (p greater than .05) of
1.8 +/- 0.6 mL.kg-1.min-1. In harmony with this finding, the END Group showed a significant increase (p less than .05) in citrate synthase activity (15.5 +/- 7.9 mumol.g-1.min-1), whereas the COMBO Group had no significant increase. The authors concluded that simultaneous training may inhibit the normal adaptation to either training program when performed alone. The extent of the interference probably depends on the nature and intensity of the individual training program.

**Panton LB, Graves JE, Pollock ML, Hagberg JM, Chen W (1990)** Conducted a study To evaluate the effect of aerobic and variable resistance exercise training on fractionated reaction time (RT) and speed of movement (SM) in elderly individuals, premotor time (PMT), motor time (MT), total RT, and SM were measured in 49 healthy, untrained men and women, 70 to 79 years of age, before and after 6 months of training. Subjects were randomized into either a walk/jog (n = 17), a strength training (n = 20), or a control group (n = 12). Improvements in aerobic capacity were only weakly related to reduced total RT (r = 0.30, p less than .05). Analysis of covariance revealed that there were no differences (p greater than .05) among the three groups after training with respect to PMT, MT, total RT, and SM. These findings indicate that 6 months of aerobic and strength training did not induce significant changes in RT or SM in this group.

**Sale DG, Jacobs I, MacDougall JD, Garner S. (1990)** conducted a study to compare the responses to doing strength (S) training on alternate days with endurance (E) training vs doing both types of training on the same days per week, seven young men (group A-2 d) did S and E training together in single sessions 2 d.wk-1 for 20 wk. A second group (B-4 d, N = 8) did the S training on 2 d.wk-1 and E training on 2 other d.wk-1. S training was six to eight sets of 15-20 RM on a leg press weight machine. E training was six to eight 3-min bouts of cycle ergometer exercise at 90-100% VO2 max. B-4 d (25%) increased leg press 1 RM more (P less than 0.05) than A-2 d (13%), but the groups increased similarly (A-2 d, B-4 d) in knee extensor (31%, 34%) and flexor (12%, 14%) cross-sectional area and vastuslateralis mean fiber area (33%, 25%). Increases in VO2 max (7%, 6%), repetitions with 80% 1 RM (39%, 64%), repetitions with the pre-training 1 RM (33, 55), and PFK (19%, 10%) and LDH (15%, 23%) activity did not differ (P greater than 0.05) between groups. CS activity increased
significantly only in A-2 d (26%; B-4 d, 6%). It is concluded that same day (vs different day) concurrent strength and endurance training may impede strength development without impeding hypertrophy. On the other hand, same day training may enhance increases in CS activity but not VO₂ max or weight lifting endurance.

**De Meersman RE (1992)** Conducted a study on Significant increases in maximum oxygen consumption (VO₂ max) were noted in nine young track athletes following an 8-week high-intensity running period (P less than 0.05). VO₂ max was measured, prior to and following the training program, using an on-line, open-circuit spirometry system. Parasympathetic activity was assessed using heart period variation (R-R interval in milliseconds) during carefully controlled breathing activity (R sinus arrhythmia). Following the training program, a 7.3% increase in aerobic capacity was associated with a 23.1% augmentation of efferent parasympathetic activity (P less than 0.01). These data suggest that enhanced aerobic capacity increases efferent parasympathetic tone.

**Morrissey MC, Harman EA, Johnson MJ (1995)** Conducted a study on considerable demand for information on the effectiveness of various resistance exercises for improving physical performance, and on how exercise programs must match functional activities to produce the greatest performance gains (training specificity). Evidence supports exercise-type specificity; the greatest training effects occur when the same exercise type is used for both testing and training. Range-of-motion (ROM) specificity is supported; strength improvements are greatest at the exercised joint angles, with enough carryover to strengthen ROMs precluded from direct training due to injury. Velocity specificity is supported; strength gains are consistently greatest at the training velocity, with some carryover. Some studies have produced a training effect only for velocities at and below the training velocity while others have produced effects around the training velocity. The little, mainly isokinetic, evidence comparing different exercise velocities for improving functional performance suggests that faster exercise best improves fast athletic movements. Yet isometric exercise can improve actions like the vertical jump, which begin slowly. The rate of force application may be more important in training than actual movement speed. More research is needed into the specificity and efficacy of resistance exercise. Test populations should include both males and females of various ages and rehabilitation patients.
Dolezal BA, Potteiger JA. (1998) conducted a study on the Concurrent resistance and endurance training influence basal metabolic rate in non dieting individuals. Thirty physically active healthy men (20.1 +/- 1.6 yr) were randomly assigned to participate for 10 wk in one of the following training groups: endurance trained (ET; 3 days/wk jogging and/or running), resistance trained (RT; 3 days/wk resistance training), or combined endurance and resistance trained (CT). Before and after training, basal metabolic rate (BMR), percent body fat (BF), maximal aerobic power, and one-repetition maximum for bench press and parallel squat were determined for each subject. Urinary urea nitrogen was determined pre-, mid-, and post training. BMR increased significantly from pre- to posttraining for RT (7,613 +/- 968 to 8,090 +/- 951 kJ/day) and CT (7,455 +/- 964 to 7,802 +/- 981 kJ/day) but not for ET (7,231 +/- 554 to 7,029 +/- 666 kJ/day). BF for CT (12.2 +/- 3.5 to 8.7 +/- 1.7%) was significantly reduced compared with RT (15.4 +/- 2.7 to 14.0 +/- 2.7%) and ET (11.8 +/- 2.9 to 9.5 +/- 1.7%). Maximal aerobic power increased significantly for ET (13%) but not RT (-0.2%) or CT (7%), whereas the improvements in one-repetition maximum bench press and parallel squat were greater in RT (24 and 23%, respectively) compared with CT (19 and 12%, respectively). Urinary urea nitrogen loss was greater in ET (14.6 +/- 0.9 g/24 h) than in RT (11.7 +/- 1.0 g/24 h) and CT (11.5 +/- 1.0 g/24 h) at the end of 10 wk of training. These data indicate that, although RT alone will increase BMR and muscular strength, and ET alone will increase aerobic power and decrease BF, CT will provide all of these benefits but to a lesser magnitude than RT and ET after 10 wk of training.

Koller A, Mair J, Schobersberger W et al., (1998) conducted a study on evaluates creatine kinase, myosin heavy chain, and cardiac troponin blood levels following three types of exercise: 1) short-distance uphill or downhill running; 2) alpine ultramarathon; and 3) alpine long-distance cycling. Experimental design: Comparative field study; follow-up up to 10 days. Setting: Department of Sports Medicine. All biochemical markers were analysed at the Department of Medical Chemistry and Biochemistry. Patients or participants: Subjects included healthy, trained males (N = 53). All subjects were nonsmokers and free from medication prior to and during the study. Each volunteer was an experienced runner or cyclist, who had at least once successfully finished the Swiss Alpine Marathon of Davos or the Otztal-Radmarathon before. Interventions: Running or cycling. Measures: Plasma concentrations of creatine kinase, myosin heavy chain fragments and
cardiac troponins were measured to diagnose skeletal and cardiac muscle damage, respectively. Skeletal muscle protein release is markedly different between uphill and downhill running, with very little evidence for muscle damage in the uphill runners. There is considerable muscle protein leakage in the ultra marathoners (67 km distance; 30 km downhill running). In contrast, only modest amounts of skeletal muscle damage are found after alpine long-distance cycling (230 km distance). This study proves that there is slow-twitch skeletal muscle fiber damage after prolonged strenuous endurance exercise and short-distance downhill running. Exhaustive endurance exercise involving downhill running and short-distance downhill running lead to more pronounced injury than strenuous endurance exercise involving concentric actions. From our results there is no reason for suggesting that prolonged intense exercise may induce myocardial injury in symptom-fewer athletes without cardiac diseases.

**Millet GP, Jaouen B, Borrani F, Candau R. (2002)** conducted a study on suggested that endurance training influences the running economy (CR) and the oxygen uptake (.VO(2)) kinetics in heavy exercise by accelerating the primary phase and attenuating the .VO(2) slow component. However, the effects of heavy weight training (HWT) in combination with endurance training remain unclear. The purpose of this study was to examine the influence of a concurrent HWT+endurance training on CR and the .VO(2) kinetics in endurance athletes. Fifteen triathletes were assigned to endurance+strength (ES) or endurance-only (E) training for 14 wk. The training program was similar, except ES performed two HWT sessions a week. Before and after the training period, the subjects performed 1) an incremental field running test for determination of .VO(2)max and the velocity associated (VO2 max), the second ventilatory threshold (VT(2)); 2) a 3000-m run at constant velocity, calculated to require 25% of the difference between .VO(2)max and VT(2), to determine CR and the characteristics of the VO(2) kinetics; 3) maximal hopping tests to determine maximal mechanical power and lower-limb stiffness; 4) maximal concentric lower-limb strength measurements. After the training period, maximal strength were increased (P < 0.01) in ES but remained unchanged in E. Hopping power decreased in E (P < 0.05). After training, economy (P < 0.05) and hopping power (P < 0.001) were greater in ES than in E.(VO2max), leg hopping stiffness and the .VO(2) kinetics were not significantly affected by training either in ES or
E. Additional HWT led to improved maximal strength and running economy with no significant effects on the $\dot{V}O(2)$ kinetics pattern in heavy exercise.

_Tseh W, Bennett J, Caputo JL, Morgan DW (2002)_ Conducted a study to determine whether differences exist between the preferred transition speed (PTS) and the energetically optimal transition speed (EOTS) in a group of adolescents. Ten 11-, ten 13-, and ten 15-year-olds completed four testing sessions. Following 30 min of accommodation to treadmill walking and running (session 1), the PTS between walking and running was identified in session 2. In session 3, subjects walked on a level treadmill at 70%, 80%, 90%, 100%, and 110% of respective PTS, while in session 4, children ran on a level treadmill at 90%, 100%, 110%, 120%, and 130% of respective PTS. During the last 2 min of each 5-min walking and running bout, expired gas samples were collected in a meteorological balloon and analyzed to calculate VO$_2$ and the EOTS between walking and running. Data analyses revealed that mean EOTS was significantly higher than mean PTS within each age group. Furthermore, when subjects changed gaits, the aerobic demand needed to run at the PTS was not lower than the VO$_2$ measured while walking at the PTS. A moderately strong positive coefficient ($r = 0.71$) between leg length and PTS was also observed. Taken together, these data suggest factors other than govern the walk-run transition in adolescent boys and girls.

_Burkett LN, Phillips WT, Ziuraitis J (2005)_ Conducted a study to determine the effectiveness of specific and nonspecific warm-ups on the vertical jump test performed by athletic men. Twenty-nine men (18-23 years) in athletics (speed positions in football) performed vertical jump tests on 4 separate days after completing 4 different warm-up protocols. The 4 warm-up protocols were (a) submaximal jump warm-up, (b) weighted jump warm-up, (c) stretching warm-up, and (d) no warm-up. The weighted jump warm-up protocol required 5 countermovement jumps onto a box, with the athletes holding dumbbells equaling 10% of their body weight. The submaximal jump warm-up protocol required the athletes to perform 5 countermovement jumps at 75% intensity of their past maximum vertical jump score. The stretching warm-up protocol required the athletes to perform 14 different stretches, each held for 20 seconds. The no warm-up protocol required the athletes to perform no activity prior to being tested. Three vertical jumps were measured following each warm-up; the score for analysis was the best jump. The data were
analyzed with a repeated measures analysis of variance and Bonferroni post hoc tests. The Bonferroni post hoc tests showed a significant difference ($p < 0.001$) between the weighted jump warm-up and all other warm-ups. The effect size was 0.380 and the power was 1.00 for the statistical analyses. We concluded that utilizing a weighted resistance warm-up would produce the greatest benefit when performing the vertical jump test.

_Chtara M, Chamari K, Chaouachi Met.al.,(2005)_ conducted a study To examine the effects of the sequencing order of individualised intermittent endurance training combined with muscular strengthening on aerobic performance and capacity. Forty eight male sport students (mean (SD) age 21.4 (1.3) years) were divided into five homogeneous groups according to their maximal aerobic speeds ($VO_2_{max}$). Four groups participated in various training programmes for 12 weeks (two sessions a week) as follows: E (n = 10), running endurance training; S (n = 9), strength circuit training; E+S (n = 10) and S+E (n = 10) combined the two programmes in a different order during the same training session. Group C (n = 9) served as a control. All the subjects were evaluated before (T0) and after (T1) the training period using four tests: (1) a 4 km time trial running test; (2) an incremental track test to estimate $VO_2_{max}$; (3) a time to exhaustion test $t(lim)$ at 100% $VO_2_{max}$; (4) a maximal cycling laboratory test to assess $V*o2_{max}$. Training produced significant improvements in performance and aerobic capacity in the 4 km time trial with interaction effect ($p < 0.001$). The improvements were significantly higher for the E+S group than for the E, S+E, and S groups: 8.6%, 5.7%, 4.7%, and 2.5% for the 4 km test ($p < 0.05$); 10.4%, 8.3%, 8.2%, and 1.6% for ($VO_2_{max}$) ($p<0.01$); 13.7%, 10.1%, 11.0%, and 6.4% for ($VO_2_{max}$(ml/kg(0.75)/min) ($p<0.05$) respectively. Similar significant results were observed for $t(lim)$ and the second ventilatory threshold (%$VO_2_{max}$). Circuit training immediately after individualized endurance training in the same session (E+S) produced greater improvement in the 4 km time trial and aerobic capacity than the opposite order or each of the training programmes performed separately.

_Rotstein A, Inbar O, Berginsky T, Meckel Y(2005)_ Conducted a study to identify the preferred transition speed (PTS) between walking and running and the energetically optimal transition speed (ETOS), in runners and nonrunners. A total of 19 young men were asked to walk on a treadmill at 5 km.h(-1). Speed was then increased by 0.2 km.h(-1) every minute. Subjects were instructed to start running at a
particular speed they felt was easier. PTS for each subject was determined as the mean of the walk-run and the run-walk transitions. Subjects were also asked to walk and to run for 5 min at each of the following velocities: PTS - 1 km.h(-1), PTS - 0.5 km.h(-1), PTS, PTS + 0.5 km.h(-1), and PTS + 1 km.h(-1). This procedure was performed twice, once walking and once running, at all speeds. Physiologic measurements of oxygen consumption, heart rate, and rate of perceived exertion (RPE) were performed at each stage. EOTS was determined by plotting individual curves for each subject with the energy cost of locomotion as a function of velocity. Preferred transition speed was 7.23 +/- 0.25 and 7.42 +/- 0.25 km.h(-1) for nonrunners and runners, respectively (P > 0.05), and differed significantly (F = 16.47, alpha < 0.001) from the EOTS, which was 8.02 +/- 0.84 km.h(-1) for nonrunners and 7.90 +/- 0.48 km.h(-1) for the runners. No significant differences were found between runners and nonrunners in PTS or EOTS. Running at the PTS resulted in a significantly lower RPE and higher energy cost than walking at the PTS in both groups. This study indicates that 1) the preferred PTS is slower than the EOTS, and 2) the PTS and EOTS are not dependent on the aerobic capacity or the training status.

*Murray A, Delaney T, Bell C (2006)* Conducted a study on Chronic aerobic exercise lowers blood pressure (BP), peripheral resistance and cardiac work, and is used widely in antihypertensive and cardiac rehabilitation programmes. In this study, we tested the hypothesis that the cardiovascular benefits of training would occur progressively over several weeks and would diminish over a similar time course on termination of training. In all, 17 young, healthy men undertook a 4-week programme of cycle ergometry (30 min at 60% VO2peak 3-4 times/week) and 13 subjects matched for age, body mass index and fitness acted as controls. Resting BP and rate-pressure product (RPP) had fallen significantly after only 1 week's training and reached a nadir after 2 weeks training. At this time, BP had fallen from 121+/-7/66+/-6 to 110+/-5/57+/-7 mmHg and resting RPP had fallen from 85+/-10 to 71+/-9 (mmHg (beats min-1))^-2 (P<0.001 each). In parallel, resting forearm conductance had risen from 0.026+/-0.010 to 0.052+/-0.029 (ml min-1) 100 ml-1 mmHg-1 and peak reactive hyperaemia following 3 min brachial artery occlusion was increased from 0.105+/-0.031 to 0.209+/-0.041 (ml min-1) 100 ml-1 mmHg-1 (P<0.001 each). No significant further circulatory changes occurred over weeks 3-4 of training. On cessation of training, all
values returned to pretraining levels within between 1 (SBP, RPP, vascular conductance) and 2 (DBP, MAP, heart rate, reactive hyperaemia) weeks. The results indicate that the optimal cardiovascular benefits of moderate exercise occur rapidly. At least with short training programmes, the benefits regress once training stops just as quickly as they appeared.

Manini T, Marko M, VanArnam T, Cook S, Fernhall B, Burke J, Ploutz-Snyder L (2007) Conducted a study to determine the efficacy of 10 weeks of resistance (RT), functional (FT), or functional plus resistance (FRT) training in older adults who modify tasks of everyday life and are at risk for subsequent disability. Thirty-two older adults (75.8 +/- 6.7 years) were tested following a control period and training. The primary outcome of the study was the number of task modifications and timed performance on eight tasks of daily life. Secondary outcomes included knee and elbow strength (extension and flexion), body composition, self-reported physical function, single-leg balance time, walking speed, and time to vacuum a carpet. The RT group performed progressive intensity training, and the FT group performed task-specific exercises 2 days per week. The FRT group performed 1 day of each training type. No changes occurred in the control period. All three training groups reduced the need to modify tasks of everyday life (RT: 21%, FRT: 26%, and FT: 28%) and improved self-rated function and time to vacuum a carpet. Individuals who performed FT either 1 or 2 days per week also reduced their timed performance (RT: 2.5% [p = 0.48], FRT: 18.5%, and FT: 23%). Strength gains were primarily found in groups that performed RT either 1 or 2 days per week (RT and FRT). No significant changes occurred in walking speed, single-leg balance, or body composition. The benefits of exercise are dependent on tasks performed during training. Exercise recommendations for low-functioning older adults should reflect task-specific exercise to prevent the onset of disability.

Sagiv M, Goldhammer E, Ben-Sira D, Amir R (2007) Conducted a study on investigated exercise oxygen utilization during maximal aerobic exercise in trained and untrained elderly. Fifteen trained (59.3 +/- 1.1 years) and 15 untrained (60.1 +/- 1.1 years) elderly underwent a peak cardiopulmonary exercise test on a bicycle ergometer. Arterial O2 was defined from echocardiograph and venous oxygen content. At rest,
trained compared to untrained elderly had significantly (p < 0.05) higher values of end diastolic volume (108.1 +/- 5.8 and 100.7 +/- 6.2 ml, respectively) and stroke volume (68.1 +/- 4.3 and 57.3 +/- 6.5 ml, respectively), while heart rate (68.7 +/- 9.3 and 81.3 +/- 8.2 beats . min(-1), respectively), and mean arterial blood pressure (90.6 +/- 6.9 and 95.4 +/- 7.2 mm Hg, respectively) were significantly lower. At peak aerobic test, the trained elderly, compared to the untrained subjects, achieved significantly (p < 0.05) higher values of end diastolic volume (156.1 +/- 8.2 and 134.1 +/- 7.6 ml, respectively), stroke volume (123.0 +/- 7.9 and 96.0 +/- 4.8 ml, respectively), cardiac output (20.2 +/- 1.5 and 15.0 +/- 1.3 liters.min(-1), respectively) and oxygen uptake (42.1 +/- 2.1 and 31.1 +/- 2.4 ml.kg(-1).min(-1), respectively), while diastolic blood pressure (70.3 +/- 5.6 and 77.5 +/- 4.2 mm Hg, respectively) and total peripheral resistance [4.3 +/- 0.8 and 5.9 +/- 1.41 (dyn.s(-1).cm(-5)).10(-1), respectively], were significantly (p < 0.05) lower. The present study suggests that the differences between trained and untrained elderly in absolute oxygen uptake of the working muscles and peak power output at maximal exercise test are due to physical activity status. The higher aerobic capacity in the trained elderly is related to increased cardiovascular function and to a lesser extent to increased muscle mitochondria concentration and capillarity. Although untrained elderly have reduced maximal oxygen uptake at peak aerobic exercise, intrinsic regulation of mitochondrial function does not seem to be significantly altered because of aging associated physical inactivity. Therefore, untrained elderly can partially compensate for their lower cardiac output by increasing oxygen extraction to levels comparable with those of trained elderly.

**Davis WJ, Wood DT, Andrews RG, Elkind LM, Davis WB(2008)** Conducted a study on evaluated the effects of concurrent strength and aerobic endurance training on cardiovascular and cardio respiratory adaptations in college athletes and compared two concurrent exercise (CE) protocols. Separate experiments were performed on 30 women (mean age 19.6 years) and 20 men (20.4 years). In both experiments, subjects were divided into two groups (serial CE and integrated CE) matched for initial physical condition and trained in a vigorous 3-day per week CE program of 9 (men) to 11 (women) weeks. The two CE training protocols were equilibrated for exercise mode, intensity, and volume, differing only in the timing and sequence of exercises. During training, serial CE discernibly (p < 0.05) increased cardiovascular adaptation in women,
indicated by reduction (-5.7%) in active heart rate (HR) (HR/aerobic exercise intensity), whereas integrated CE discernibly reduced active HR in women (-10.7%) and men (-9.1%). Before and after comparisons in the larger sample of women showed that serial CE discernibly reduced systolic and diastolic blood pressure (BP) (-8.7% and -14.0%, respectively), increased estimated [\( V'\) with dot above]o2max (18.9%), and produced a trend (0.10 > p > 0.05) toward reduced resting HR (-4.9%). Integrated CE in women discernibly reduced systolic and diastolic BP (-13.2% and -12.6%, respectively), increased estimated [\( V'\) with dot above]o2max (22.9%), and produced a trend toward reduced resting HR (-2.4%). Integrated CE produced discernibly larger gains than serial CE or a trend for four of six training adaptations. Effect sizes were generally large (60.0% of discernible differences). We conclude that, for cardiovascular and cardio respiratory adaptations in athletes, strength and endurance training are compatible and that exercise timing and sequence significantly influence training adaptations, complementing our previous similar conclusions for strength, muscle endurance, body composition, and flexibility.

Meckel Y, Eliakim A, Seraev M, Zaldivar F, Cooper DM, Sagiv M, Nemet D (2009) Conducted a study on Exercise. Training efficiency depends on the intensity, volume, duration, and frequency of training, as well as on the athlete's ability to tolerate it. Recent efforts to quantify the effects of aerobic exercise training on hormonal response have suggested that exercise leads to simultaneous changes of antagonistic mediators. The effects of anaerobic exercise on these mediators are not known. Therefore, the aim of the present study was to evaluate the effects of a brief sprint interval session on the balance between anabolic (growth hormone [GH]--> insulin-like growth factor [IGF]-I axis) and catabolic hormones (cortisol), and circulating inflammatory cytokines such as interleukin (IL)-6. Twelve healthy elite junior handball players (17-20 years) participated in the study. Exercise consisted of a 4 x 250-m run on a treadmill, at a constant intensity of 80% of the personal maximal speed. Each run was separated by 3 minutes of rest. Blood samples were collected before, immediately after each 250-m run, and 1 hour after the last run. Exercise led to significant increases in GH (0.3 +/- 0.2 to 5.1 +/- 2.2 ngxml, p < 0.05), IGF binding protein (IGFBP)-3 (4191 +/- 2.48 to 4875 +/- 301 ngxml, p < 0.05), IL-6 (1.3 +/- 0.2 to 2.1 +/- 0.3 pgxml, p < 0.002), testosterone, and testosterone/cortisol ratio, and to a significant decrease in
IGFBP-1 levels. Levels of IL-6 remained elevated 1 hour after the end of exercise. Exercise had no significant effects on IGF-I and cortisol levels. Changes in the GH-IGF-I axis and testosterone/cortisol ratio after the brief sprint interval exercise suggested exercise-related anabolic adaptations. The increase in IL-6 may indicate its important role in muscle tissue repair after anaerobic exercise. Changes in the anabolic-catabolic hormonal balance and in inflammatory mediators can be used as an objective tool to gauge the training intensity of different types of anaerobic exercises and training periods.

**Rhea MR, Kenn JG, Dermody BM (2009)** Conducted a study to assess the effect of heavy/slow movements and variable resistance training on peak power and strength development. Forty-eight National Collegiate Athletic Association (NCAA) Division I athletes (age: 21.4 +/- 2.1 years, all men) were recruited for this 12-week training intervention study. Maximum strength and jumping power were assessed before and after the training program. Athletes were randomly assigned to 1 of 3 training groups: heavy resistance/slow movement (Slow), lighter resistance and fast movement (Fast), or fast movements with accommodated resistance (FACC). All training groups performed similar training programs comprising free weight resistance training with lower-body compound exercises. The only difference among the training interventions was the speed at which subjects performed the squat exercise and the use of bands (Slow group: 0.2-0.4 meters/second; Fast group: 0.6-0.8 meters/second; FACC group trained 0.6-0.8 meters/second with the addition of accommodated resistance in the form of large elastic bands). Post-test data revealed a significant difference between power improvements between the Slow and FACC groups (p = 0.02). Percent increases and effect sizes (ES) demonstrated a much greater treatment effect in the FACC group (17.8%, ES = 1.06) with the Fast group (11.0%, ES = 0.80) adapting more than the Slow group (4.8%, ES = 0.28). The FACC and Slow groups improved strength comparatively (FACC: 9.44%, ES = 1.10; Slow: 9.59%, ES = 1.08). The Fast group improved strength considerably less, 3.20% with an effect size of only 0.38. Variable resistance training with elastic bands appears to provide greater performance benefits with regard to peak force and peak power than heavy, slow resistance exercise. Sports conditioning professionals can utilize bands, and high-speed contractions, to increase power development.
Brown GA, Ray MW, Abbey BM, Shaw BS, Shaw I (2010) Conducted a study to investigate the oxygen consumption, heart rate, and blood lactate responses to a single session of plyometric depth jumps. Twenty recreationally trained college-aged subjects (10 men, 10 women) participated in a single session of 8 sets of 10 box depth jumps from a height of 0.8 m with 3 minutes of passive recovery between each set. Plyometric depth jumping elicited 82.5 +/- 3.1% and 77.8 +/- 3.1% of the measured maximal oxygen consumption (O2max) for women and men, respectively, with no difference in oxygen consumption in ml/kg/min or percent O2max between sexes or sets. Heart rate significantly increased (p < 0.05) from 68.1 +/- 2.9 beats/min-1 at rest to 169.6 +/- 1.2 beats/min-1 during depth jumping. Sets 5 to 8 elicited a higher (p < 0.05) heart rate (173.3 +/- 1.3 beats/min-1) than sets 1 to 4 (164.6 +/- 1.8 beats/min-1). Women exhibited a higher heart rate (p < 0.05) during sets 1 and 2 (169.9 +/- 2.8 beats/min-1) than men (150.7 +/- 4.4 beats/min-1). The blood lactate concentrations were significantly (p < 0.05) increased above resting throughout all sets (1.0 +/- 0.2 mmol/L compared with 2.9 +/- 0.1 mmol/L), with no differences between sexes or sets. Plyometric depth jumping significantly increased oxygen consumption, heart rate, and blood lactate in both men and women, but no significant difference was found between the sexes. Plyometric depth jumping from a height of 0.8 m has similar energy system requirements to what Wilmore and Costill termed "Aerobic Power" training, which should enhance O2max, lactate tolerance, oxidative enzymes, and lactate threshold.

Ferrauti A, Bergermann M, Fernandez-Fernandez J. (2010) conducted a study to investigate the effects of a concurrent strength and endurance training program on running performance and running economy of middle-aged runners during their marathon preparation. Twenty-two (8 women and 14 men) recreational runners (mean ± SD: age 40.0 ± 11.7 years; body mass index 22.6 ± 2.1 kg·m⁻²) were separated into 2 groups (n = 11; combined endurance running and strength training program [ES]: 9 men, 2 women and endurance running [E]: 7 men, and 4 women). Both completed an 8-week intervention period that consisted of either endurance training (E: 276 ± 108 minute running per week) or a combined endurance and strength training program (ES: 240 ± 121-minute running plus 2 strength training sessions per week [120 minutes]). Strength training was focused on trunk (strength endurance program) and leg muscles.
(high-intensity program). Before and after the intervention, subjects completed an incremental treadmill run and maximal isometric strength tests. The initial values for VO$_2$ peak (ES: 52.0 ± 6.1 vs. E: 51.1 ± 7.5 ml·kg$^{-1}$·min$^{-1}$) and anaerobic threshold (ES: 3.5 ± 0.4 vs. E: 3.4 ± 0.5 m·s$^{-1}$) were identical in both groups. A significant time × intervention effect was found for maximal isometric force of knee extension (ES: from 4.6 ± 1.4 to 6.2 ± 1.0 N·kg$^{-1}$, p < 0.01), whereas no changes in body mass occurred. No significant differences between the groups and no significant interaction (time × intervention) were found for VO$_2$ (absolute and relative to VO$_2$ peak) at defined marathon running velocities (2.4 and 2.8 m·s$^{-1}$) and submaximal blood lactate thresholds (2.0, 3.0, and 4.0 mmol·L$^{-1}$).Stride length and stride frequency also remained unchanged. The results suggest no benefits of an 8-week concurrent strength training for running economy and coordination of recreational marathon runners despite a clear improvement in leg strength, maybe because of an insufficient sample size or a short intervention period.

Hiruntrakul A, Nanagara R, Emasithi A, Borer KT (2010) Conducted a study To study whether 3-months aerobic exercise training at moderate intensity once a week can increase fitness status in healthy sedentary young men. Randomized controlled study was performed in 37 sedentary young men, 18 to 25 years old. The exercise group (19) was assigned to work on bicycle ergometry at 60% of maximal effort, once a week for 12 weeks. The control group (18) lived a normal lifestyle. Before and after training, aerobic fitness (VO$_2$max), resting heart rate, lipid profile, and isokinetic power and strength of shoulder and knee were evaluated. In the exercise group, there was a significant increase in most fitness parameters compared with control, VO$_2$max(19.7%), isokinetic power and strength of shoulder and knee (14.9%), and resting heart rate decreased (7.4%). Moderate-intensity training once a week for at least 12 weeks was sufficient to increase aerobic fitness in sedentary young men. This low frequency of exercise training may be used to encourage sedentary individuals for more compliance with physical activity.

Petrović-Oggiano G, Damjanov V, Gurinović M, Glibetić M (2010) Conducted a study on The effect of physical activity on the lipid status is achieved by affecting the enzymes of lipoprotein metabolism including the lipoprotein and liver lipase and
transport protein of cholesterol esters. Epidemiological investigations on the effect of physical activity in prevention of cardiovascular diseases point to the fact that the persons who have a higher degree of cardio-respiratory endurance have a much lower mortality rate than those with a lower degree. The positive effect of physical activity on the cardiovascular system is reflected on the improved aerobic capacity, metabolic function, amplification of lipid profile, insulin sensitivity, immunological functions: it increases the perfusion of myocardium and the fibrinolytic activity, and reduces the adherence of thrombocytes due to increased synthesis of prostaglandin (PGI2), it also enhances the energy consumption, which is important in the maintenance of ideal bodyweight, prevention and treatment of obesity, and it has a positive effect on the control of stress. CONCLUSION: With respect to the effects on the lipid status, aerobic physical exercises like running, swimming, cycling, with the intensity of training of a medium (65% VO2) load, have a positive effect on lipid status. The best form of physical activity is the one in which the endurance and power are increased.

Kanegusuku H, Queiroz AC et.al(2011) Conducted a study on determined whether different resistance training regimens, strength training (ST, constant movement velocity) or power training (PT, concentric phase performed as fast as possible) can blunt the increase in cardiovascular load during an aerobic stimulus. Older adults (63.9 ± 0.7 years) were randomly allocated to: control (N = 11), ST (N = 13, twice a week, 70-90% 1-RM) and PT (N = 15, twice a week, 30-50% 1-RM) groups. Before and after 16 weeks, oxygen uptake (VO(2)), systolic blood pressure (SBP), heart rate (HR), and rate pressure product (RPP) were measured during a maximal treadmill test. Resting SBP and RPP were similarly reduced in all groups (combined data = -5.7 ± 1.2 and -5.0 ± 1.7%, respectively, P < 0.05). Maximal SBP, HR and RPP did not change. The increase in measured VO(2), HR and RPP for the increment in estimated VO(2) (absolute load) decreased similarly in all groups (combined data = -9.1 ± 2.6, -14.1 ± 3.9, -14.2 ± 3.0%, respectively, P < 0.05), while the increments in the cardiovascular variables for the increase in measured VO(2) did not change. In elderly subjects, ST and PT did not blunt submaximal or maximal HR, SBP and RPP increases during the maximal exercise test, showing that they did not reduce cardiovascular stress during aerobic tasks.
Kargarfard M, Poursafa P, Rezanejad S, Mousavinasab F (2011) Conducted a study to assess the effects of exercise on the aerobic power, serum lactate level, and cell blood count among active individuals in the environments with similar climatic characteristics differing in their level of air pollution. This trial comprised 20 volunteer students of Physical education in The University of Isfahan, Iran. Two places with the same climate (altitude, temperature, and humidity), but low and high level of air pollutants air were selected in Isfahan, Iran. Participants underwent a field Cooper test with a 12-minute run for fitness assessment. Then the aerobic power, serum lactate, and cell blood counts were measured and compared between the two areas. The study participants had a mean (SD) age of 21.70 (2.10) years and body mass index (BMI) of 24.44 (2.32) Kg/m². We found a significant decrease in mean Vo₂ max, red blood cell count, hemoglobin, hematocrit, and mean corpuscular hemoglobin, as well as significant increase in mean lactate level, white blood cell count and mean corpuscular volume in the higher-polluted than in the lower-polluted area. No significant difference was documented for other parameters as platelet counts or maximum heart rate. Exercise in high-polluted air resulted in a significant reduction in the performance at submaximal levels of physical exertion. Therefore, the acute exposure to polluted air may cause a significant reduction in the performance of active individuals. The clinical importance of these findings should be assessed in longitudinal studies.

Pryor RR, Sforzo GA, King DL (2011) Conducted a study on examined in 24 college-aged resistance trained men. On 6 separate occasions, subjects performed a set of bench press at 80% 1 repetition maximum until volitional fatigue. For each of the 6 repetition tempo trials, the bench press set was placed by metronome to a unique repetition tempo involving a combination of the following: inter repetition rest of 0 or 4 seconds; eccentric velocity of 1 or 4 seconds and bottom rest of 0 or 3 seconds. The velocity of concentric contraction was maximal during all 6 tempo trials. During each trial, video data were captured to determine PO variables and number of successful repetitions completed at each tempo. One-way repeated measures analysis of variance showed tempos with a fast eccentric phase (1 second), and no bottom rest produced significantly greater (p ≤ 0.05) PO and repetitions than tempos involving slower eccentric velocity (4 seconds) or greater bottom rest (4 seconds). This combination of greater repetitions and PO resulted in a greater volume of work. Varying interrepetition rest (1 or 4 seconds) did not significantly affect PO or repetitions. The results of this study support the use of fast eccentric speed and
no bottom rest during acute performance testing to maximize PO and number of repetitions during a set of bench press.

*Ruiz RJ, Simão R, Saccomani MG et al. (2011)* Conducted a study to examine blood pressure (BP), heart rate (HR), and cardiac vagal reactivation (VR) after an aerobic training session (ATS), a strength training session (STS), and a combined aerobic and strength training session (ASTS) in normotensive men. Eleven healthy men (age 26.8 ± 2.9 years, body mass index 24.3 ± 1.6 kg·m) with at least 6 months of strength and aerobic training experience performed an STS, an ATS, and an ASTS in a counterbalanced crossover design. Blood pressure and HR were measured at rest and at 15-minute intervals post-training for 1 hour. Vagal reactivation was measured during the first minute immediately post-exercise. After STS and ASTS, systolic BP (SBP) and mean arterial BP (MAP) remained significantly lower than at rest at all time intervals (p < 0.05). After ATS, SBP was significantly lower than at rest at 30 minutes and beyond (p < 0.01); however, no significant differences were observed for MAP. Post-training HR remained high after STS and ASTS at all intervals (p < 0.01). However, after ATS, the HR remained high only at the 15-minute post-exercise interval (p < 0.01). Vagal reactivation was significantly less pronounced after the first 30 seconds post-exercise (p < 0.01) in ASTS (531.3 ± 329.6 seconds) than in ATS (220.7 ± 88.5 seconds) and in STS (317.6 ± 158.5 seconds). The delta of the HR decrease at 60 seconds post-exercise was greater (p < 0.00) in ATS (33.4 ± 12.7 b·min) than in STS (14.1 ± 7.2 b·min) and in ASTS (11.4 ± 7.1 b·min).

In conclusion, post-exercise BP reduction was independent of the type of exercise; however, HR remained significantly greater after combination of strength and aerobic exercise, implying a reduction in cardiac VR after this type of training. Therefore, strength and conditioning professionals may prescribe aerobic, strength, or a combination of aerobic and strength exercise to assist individuals concerned with BP control, thus allowing for variety in training while similarly impacting post-exercise SBP regardless of desired exercise modality.

*Libardi CA, De Souza GV, Cavaglieri CR, Madruga VA, Chacon-Mikahil MP (2012)* conducted a study to evaluate the effects of 16 wk of resistance training (RT), endurance training (ET), and concurrent training (CT) on inflammatory markers, C-reactive protein (CRP), and functional capacity in sedentary middle-age men. Healthy subjects were
randomized into RT (n = 11), ET (n = 12), CT (n = 11), and a control group (n = 13). The subjects performed three weekly sessions lasting about 60 min for 16 wk. Maximal strength was tested in bench press and leg press. The peak oxygen uptake (VO₂ peak) was measured in an incremental exercise test. Plasma tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and CRP levels were determined by an enzyme-linked immunosorbent assay. Maximal strength was increased after 16 wk, with no differences between RT and CT. VO₂ peak increased in ET and CT comparing before and after training. There were no significant differences in TNF-α, IL-6, and CRP comparing before and after training. Sixteen weeks of RT, ET, or CT in middle-age healthy men has not affected low and moderate IL-6, TNF-α, and CRP levels. CT performed in the same weekly frequency and session duration of ET and RT was effective in increasing both maximal strength and VO₂ peak, in addition to improvements in lipid profile.

Mikkola J, Rusko H, Izquierdo M, Gorostiaga EM, Häkkinen K. (2012) Conducted a study on examined the effects of concurrent strength and endurance training on neuromuscular and endurance characteristics compared to strength or endurance training alone. Previously untrained men were divided into strength (S: n=16), endurance (E: n=11) or concurrent strength and endurance (SE: n=11) training groups. S and E trained 2 times and SE 2 + 2 times a week for strength and endurance during the 21-week period. Maximal unilateral isometric and bilateral concentric forces of leg muscles increased similarly in S and SE by 20-28% (p<0.01) and improvements in isometric forces were accompanied by increases (p<0.05) of maximal muscle activation. Rate of force development of isometric action (p<0.05) improved only in S. The increase in muscle cross-sectional area of the quadriceps femoris in SE (11%, p<0.001) were greater than in S (6%, p<0.001) or in E (2%, p<0.05). SE and E increased maximal cycling power (SE: 17% and E: 11%, p<0.001) and VO₂ MAX (SE: 17%, p<0.001 and E: 5%, ns.). These results suggest that the present moderate volume 21-week concurrent SE training in previously untrained men optimizes the magnitude of muscle hypertrophy, maximal strength and endurance development, but interferes explosive strength development, compared with strength or endurance training alone.
Santos AP, Marinho DA, Costa AM, Izquierdo M, Marques MC. (2012) conducted a study to compare the effects of an 8-week training period of resistance training alone (GR), or combined resistance and endurance training (GCOM), followed by 12 weeks of detraining (DT) on body composition, explosive strength, and VO₂max adaptations in a large sample of adolescent school boys. Forty-two healthy boys recruited from a Portuguese public high school (age: 13.3 ± 1.04 years) were assigned to 2 experimental groups to train twice a week for 8 weeks: GR (n = 15), GCOM (n = 15), and a control group (GC: n = 12; no training program). Significant training-induced differences were observed in 1- and 3-kg medicine ball throw gains (GR: +10.3 and +9.8%, respectively; GCOM: +14.4 and +7%, respectively), whereas no significant changes were observed after a DT period in both the experimental groups. Significant training-induced gains in the height and length of the counter movement (vertical-and-horizontal) jumps were observed in both the experimental groups. No differences were perceived after a DT period in lower limb power. Time at 20 m decreased significantly for both intervention programs (GR: -11.5% and GCOM: -12.4%, <0.00), but either GR or GCOM groups kept the running speed after a DT period of 12 weeks. After training, the VO₂max increased only significantly for GCOM (4.6%, p = 0.01). A significant loss was observed after a DT period in GR but not in GCOM. Performing resistance and endurance training in the same workout does not impair strength development in young school boys. As expected, strength training by itself does not improve aerobic capacity. Our results also suggest that training program effects even persist at the end of the DT period.

Silva RF, Cadore EL, Kothe G, et al. (2012) Conducted a study to compare the effects of using different intensities and types of aerobic exercise (i.e., cycle ergometer or running) during concurrent training on neuromuscular adaptations. A total of 44 young women were randomly assigned to 1 of 4 groups: concurrent strength and continuous running training (SCR, n=10), concurrent strength and interval running training (SIR, n=11), concurrent strength and continuous cycle ergometer training (SCE, n=11), or strength training only (STO, n=12). Each group trained twice a week during 11 weeks. The following strength measurements were made on all subjects before and after training period: maximal strength (1RM) in knee extension, bench press and leg press exercises; local muscular endurance (number of repetitions at 70% of 1 RM) in knee extension and bench press exercises; and isometric and isokinetic peak torque of knee extension. There were
significant increases in the upper and lower-body 1 RM, isometric and isokinetic peak torque in all training groups (p<0.001), with no differences between groups. The present results suggest that in young women, concurrent training performed twice a week promotes similar neuromuscular adaptations to strength training alone, regardless of the type and the intensity in which the aerobic training is performed.

Romero-Arenas S, Blazevich AJ et al. (2013) Conducted a study on the efficacy of a program of high-resistance circuit (HRC) training, and to compare the effects of HRC to traditional heavy strength (TS) training on strength, muscle size, body composition and measures of cardiovascular fitness in a healthy elderly population. Thirty-seven healthy men and women (61.6±5.3 years) were randomly assigned to HRC (n=16), TS (n=14), or a control group (CG, n=7). Training consisted of weight lifting twice a week for 12 weeks. Before and after the training, isokinetic peak torque in the upper and lower body, and body composition (dual X-ray absorptiometry) were determined. In addition, cardiovascular parameters were evaluated during an incremental treadmill test. Both HRC and TS groups showed significant increases in isokinetic strength (p<0.001), and the increase was significantly greater in the experimental groups than in CG (p<0.03). There were significant increases in lean mass (HRC, p<0.001; TS, p=0.025) and bone mineral density (HRC, p=0.025; TS, p=0.018) in the experimental groups. Only HRC showed a significant decrease in fat mass (p=0.011); this decrease was significantly greater in HRC than in CG (p=0.039). There were significant improvements in walking economy in the HRC group (p<0.049), although there were no statistical differences between groups. There were no changes in any variables in CG. Hence, HRC training was as effective as TS for improving isokinetic strength, bone mineral density and lean mass. Only HRC training elicited adaptations in the cardiovascular system and a decrease in fat mass.

Balachandran A, Krawczyk SN, Potiaumpai M, Signorile JF (2014) Conducted a study on Progressive loss of muscle and strength with age is often coincident with increases in adiposity, leading to a condition called sarcopenic obesity. Studies have shown sarcopenic obese adults to be at higher risk for declines in physical function. Despite this rising public health concern, no intervention studies currently exist in this population. A total of 21 sarcopenic obese adults, 60 years or older, were randomized into two groups, strength/hypertrophy (SH, n=9) and high-speed circuit (HSC, n=8) and were trained for
15 weeks. The primary outcome was the SPPB modified as a measure of physical function, assessed by assessors blinded to randomization. Secondary outcomes were lower body and upper body power and strength, instrumental activities of daily living (IADL), ratings of perceived exertion (RPE), body fat % (BF%), skeletal muscle index (SMI), and grip strength (GRP). For the SPPB results favored HSC over SH (1.1, 95% CI (-0.1 to 2.4), p=.08) and showed a moderate effect size (Hedge g=0.6, 95% CI (-0.4, 1.6)). For secondary outcomes, lower body power (mean difference=158W, 95% CI (2, 315); p=.01) and RPE (mean difference=-1.5, 95% CI (-2.9, -0.12); p=.04) also favored HSC. IADL, SMI, BF%, upper and lower body strength and upper body power, showed no statistically significant differences between groups. Considering the moderate effect size, the large treatment effect shown by the upper limit of the 95% CI, the low perceived exertion, and no adverse effects, HSC training should be further investigated with a larger sample size in sarcopenic obese adults.

**Bento PC*1, Rodacki AL. (2014)** Conducted a study on the effects of a water-based exercise program on muscle function compared with regular high-intensity resistance training. Older women (n=87) were recruited from the local community. The inclusion criteria were, to be aged 60 years or older, able to walk and able to carry out daily living activities independently. Participants were randomly assigned to one of the following groups: water-based exercises (WBG), resistance training (RTG) or control (CG). The experimental groups carried out 12 weeks of an exercise program performed on water or on land. The dynamic strength, the isometric peak, and rate of torque development for the lower limbs were assessed before and after interventions. The water-based program provided a similar improvement in dynamic strength in comparison with resistance training. The isometric peak torque increased around the hip and ankle joints in the water-based group, and around the knee joint in the resistance-training group (P<0.05). The rate of torque development increased only in the water-based group around the hip extensors muscles (P<0.05). Water-based programs constitute an attractive alternative to promote relevant strength gains using moderate loads and fast speed movements, which were also effective to improve the capacity to generate fast torques.
Deprez D, Fransen J, Lenoir M, Philippaerts RM, Vaeyens R (2014) Conducted a study on expose the anthropometrical, physical performance and motor coordination characteristics that influence drop out from a high-level soccer training program in players aged 8-16 years. The mixed-longitudinal sample included 388 Belgian youth soccer players who were assigned to either a 'club group' or a 'drop out group'. In the second study, cross-sectional data of anthropometry, physical performance and motor coordination were retrospectively explored to investigate which characteristics influence future contract status (contract vs. no contract group) and first-team playing time for 72 high-level youth soccer players (mean age=16.2 y). Generally, club players outperformed their drop out peers for motor coordination, soccer-specific aerobic endurance and speed. Anthropometry and estimated maturity status did not discriminate between club and drop out players. Contract players jumped further (p=0.011) and had faster times for a 5m sprint (p=0.041) than no contract players. The following prediction equation explains 16.7% of the variance in future playing minutes in adolescent youth male soccer players: -2869.3 + 14.6 * standing broad jump. Practitioners should include the evaluation of motor coordination, aerobic endurance and speed performances to distinguish high-level soccer players further succeeding a talent development program and future drop out players, between 8 and 16 years. From the age of 16 years, measures of explosivity are supportive when selecting players into a future professional soccer career.

Di Blasio A¹, Izzicupo P et.al. (2014) Conducted a study on characterize both heart rate and hormonal responses elicited by three different protocols of HIIRT having the same exercises, the same load and number of repetitions for each exercise. Eight healthy trained men (28.61 ±3.51 yrs) performed three different workouts: exercise order, recovery and speed of execution were differently organized according to workout. Salivary samples were collected before and after each workout, at 11:00 p.m. and at 7:00 a.m. of the following day. Salive was also collected during a non-training day. Before and after the workout, plasma lactate was measured while a beat-to-beat heart rate recording was executed during each workout. Cortisol (C) and testosterone (T) were measured in salivary samples. RESULTS: Workouts elicited the same heart rate response while random organization seems to elicit the highest lactate, C and T increases. Also when we studied the effects of workouts on prolonged hormones production we observed that workout organization influenced post--exercise hormonal production until the following morning.
modifying their physiological trend. CONCLUSIONS: Even if exercises, load and number of repetitions were maintained fixed, exercise order, structured recovery and speed of execution determined different acute and prolonged effects. The knowledge of these responses is very important because may positively or negatively influence performance and health.

_Donath L, Faude O, Roth R, Zahner L_ (2014) Conducted a study on Stair-climbing serves as a feasible opportunity to remain physically active within everyday-life. Data on neuromuscular and cardiorespiratory performance after regular stair-climbing in seniors are scarce. Forty-eight seniors were stratified to a one- (taking every step, INT1) or two-step strategy (every second step, INT2) or a control group (CON). Thirty-nine seniors [females: n = 22, males: n = 17; age: 70.5 (SD 5.1) years; BMI: 25.8 (3.1) kg/m(2)] completed the 8-week intervention (three weekly sessions). Before and after the intervention, balance, gait, strength, and submaximal endurance (at different intensities) were assessed. Maximal strength and explosive power did not improve significantly (0.10 < P < 0.78). Resting heart rate was significantly reduced in INT2 (-8/min) compared with INT1 (0/min, P = 0.02) and CON (0/min, P = 0.03). Compared with CON, perceived exertion for all intensities (0.007 < P < 0.03) and submaximal exercise heart rate during moderate uphill walking significantly decreased (-11/min; P < 0.05) in INT2. Step counts for forward beam balancing (4.5 cm width) increased in INT2 (P = 0.007) compared with CON. With more pronounced effects in INT2, stair-climbing significantly improved resting and exercise heart rates, perceived exertion, and dynamic balance performance in healthy seniors and may contribute to better overall fitness, reduced fall risk, and less perceived strain during daily life activities.

_Faigenbaum AD, Bush JAet.al.,(2014)_ Conducted a study on examine the effects of integrative strength and skill-based training on measures of physical fitness in children during primary school PE. Children from two fourth grade PE classes were cluster randomized into either a fundamental integrative training (FIT) group (n=20) or a control (CON) group (n=21). The 8 week FIT program was performed twice per week during the first ~15 min of each PE class and consisted of a circuit of strength and skill-based exercises. All participants were assessed for health- and skill-related fitness before and after the intervention. The outcome variables were analyzed via 2x2 repeated measures ANOVA
with post hoc analysis. A significant ($p \leq 0.05$) interaction of group by time was observed in FIT participants with improvements in aerobic capacity, push-ups, sit and reach flexibility, and single leg hop. There was no group by time effects for the sit-up and long jump tests. No injuries were reported. These findings highlight the potential benefits of integrating both health and skill-related fitness components into primary school PE as evidenced by improvements in measures of aerobic capacity and muscular fitness in children.

**Fiatarone Singh MA, Gates Net.al. (2014)** Conducted a study on Mental and Resistance Training was a randomized, double-blind, double-sham controlled trial of adults with MCI. Participants were randomized to 2 supervised interventions: active or sham physical training (high intensity progressive resistance training vs seated calisthenics) plus active or sham cognitive training (computerized, multidomain cognitive training vs watching videos/ quizzes), 2-3 days/week for 6 months with 18-month follow-up. Primary outcomes were global cognitive function (Alzheimer's Disease Assessment Scale-cognitive subscale; ADAS-Cog) and functional independence (Bayer Activities of Daily Living). Secondary outcomes included executive function, memory, and speed/attention tests, and cognitive domain scores. One hundred adults with MCI [70.1 (6.7) years; 68% women] were enrolled and analyzed. Resistance training significantly improved the primary outcome ADAS-Cog; [relative effect size (95% confidence interval) -0.33 (-0.73, 0.06); $P < .05$] at 6 months and executive function (Wechsler Adult Intelligence Scale Matrices; $P = .016$) across 18 months. Normal ADAS-Cog scores occurred in 48% (24/49) after resistance training vs 27% (14/51) without resistance training [$P < .03$; odds ratio (95% confidence interval) 3.50 (1.18, 10.48)]. Cognitive training only attenuated decline in Memory Domain at 6 months ($P < .02$). Resistance training 18-month benefit was 74% higher ($P = .02$) for Executive Domain compared with combined training [z-score change = 0.42 (0.22, 0.63) resistance training vs 0.11 (-0.60, 0.28) combined] and 48% higher ($P < .04$) for Global Domain [z-score change = .45 (0.29, 0.61) resistance training vs 0.23 (0.10, 0.36) combined]. Resistance training significantly improved global cognitive function, with maintenance of executive and global benefits over 18 months.

**González-Badillo JJ, Pareja-Blanco Fet.al. (2014)** Conducted a study on the effect of velocity based-resistance training (RT) with moderate load and few repetitions per set combined with jumps and sprints on physical performance in young soccer players of
different ages. A total of 44 elite youth soccer players belonging to three teams participated in this study: an under-16 team (U16, n = 17) and an under-18 team (U18, n = 16) performed maximal velocity RT program for 26 weeks in addition to typical soccer training, whereas an under-21 team (U21, n = 11) did not perform RT. Before and after the training program all players performed: 20-m running sprint (T20); countermovement jump (CMJ); a progressive iso-inertial loading test in squat to determine the load which players elicited ~1 m·s (V1LOAD); and an incremental field test to determine maximal aerobic speed (MAS). U16 showed significantly (P = .000) greater gains for V1LOAD than U18 and U21 (100/0/0%). Only U16 showed significantly (P = .01) greater gains than U21 (99/1/0%) for CMJ height. U18 obtained a likely better effect on CMJ performance than U21 (89/10/1%). The beneficial effects on T20 between groups were unclear. U16 showed a likely better effect on MAS than U21 (80/17/3%), whereas the rest of comparisons were unclear. The changes in CMJ correlated to the changes in T20 (r = -.49) and V1LOAD (r = .40). In conclusion, velocity-based RT with moderate load and few repetitions per set seems to be an adequate methodology to improve the physical performance in young soccer players.

Kirmizigil B, Ozcaldiran B, Colakoglu M. (2014) Conducted a study on evaluate 3 different flexibility techniques: (a) ballistic stretching (BS), (b) proprioceptive neuromuscular facilitation stretching (PNF) + BS, and (c) PNF + static stretching (SS) on vertical jump (VJ) performance and to determine the most appropriate stretching method during warm-up period before explosive force disciplines. One hundred voluntary male athletes participated in this study. All subjects performed aerobic warm-up (5-minute jog) followed by BS (5 seconds for each stretching exercise), PNF + BS (PNF performed followed by 5 seconds of BS), and PNF + SS (PNF performed followed by 30 seconds of SS) treatment protocol, respectively in the same day. Each stretching treatment was applied for 4 sets bilaterally. In all stretching treatments, lumbar extensor, gluteus maximus, and hamstring muscles were stretched with a single stretching exercise. After a 2-minute brief rest period, participants performed 3 trials of VJ test followed by one of the treatment protocols. Vertical jump performance was evaluated by countermovement jump (CMJ). Participants were divided into 3 groups according to their flexibility and prejump performances after warm-up. For each individual group and the whole group, after all treatments, differences in CMJ values were obtained (p ≤ 0.05). Ballistic stretching
increased the VJ performance in the groups with low and average flexibility, poor prejumping performance, and also in the whole group (p ≤ 0.05). Proprioceptive neuromuscular facilitation stretching + BS affected VJ performance in the group of participants with high flexibility (p ≤ 0.05). Proprioceptive neuromuscular facilitation + SS decreased VJ performance in groups of participants with high flexibility, moderate, and high prejumping performance and in whole group (p ≤ 0.05). Ballistic stretching method increased VJ height, therefore seems to be more suitable than PNF + SS and PNF + BS before events that rely on explosive power as a part of warm-up period.

**Kressler J, Burns PA, Betancourt L, Nash MS (2014)** Conducted a study on investigate whether a modified 40-45 min CRT program will improve fitness attributes in individuals with tetraplegia and whether these changes are enhanced by PS. Eleven individuals with chronic tetraplegia underwent 6 months of CRT performed three times per week. Six randomly assigned participants received PS (whey protein = 36-37 g) in split doses immediately before and after exercise sessions. Others consumed a matched protein dose 24 h post exercise. Measurements of one-repetition maximum (1-RM) strength for six different resistance exercises, arm peak oxygen consumption (VO2peak), and arm anaerobic power (Wingate) were obtained 3 months before (-3mo), at the beginning (0mo), 3 months into (3mo), and 6 months after (6mo) the beginning of CRT. One-repetition maximum increased by 8%-11% ± 6%-12% for each successive 3-month period (P ≤ 0.001-0.012), independent of PS group (P = 0.105). VO2peak increased significantly from 0mo to 6mo with immediate PS (35% ± 29%, P = 0.020) but failed to reach significance for delayed PS (15% ± 8%, P = 0.147). Power drop changes during the Wingate test were also only significant for the immediate PS (median difference 40W, P = 0.028) and not for delayed (10W, P = 0.500). CRT effectively increased muscular strength, aerobic capacity, and anaerobic fatigue resistance in persons with chronic tetraplegia. The latter two conditioning benefits were further enhanced by timely PS.

**Maté-Muñoz JL, Monroy AJ, Jodra Jiménez P, Garnacho-Castaño MV (2014)** Conducted a study on the effects of a traditional and an instability resistance circuit training program on upper and lower limb strength, power, movement velocity and jumping ability. Thirty-six healthy untrained men were assigned to two experimental groups and a control group. Subjects in the experimental groups performed
a resistance circuit training program consisting of traditional exercises (TRT, n = 10) or exercises executed in conditions of instability (using BOSU® and TRX®) (IRT, n = 12). Both programs involved three days per week of training for a total of seven weeks. The following variables were determined before and after training: maximal strength (1RM), average (AV) and peak velocity (PV), average (AP) and peak power (PP), all during bench press (BP) and back squat (BS) exercises, along with squat jump (SJ) height and counter movement jump (CMJ) height. All variables were found to significantly improve (p <0.05) in response to both training programs. Major improvements were observed in SJ height (IRT = 22.1%, TRT = 20.1%), CMJ height (IRT = 17.7%, TRT = 15.2%), 1RM in BS (IRT = 13.03%, TRT = 12.6%), 1RM in BP (IRT = 4.7%, TRT = 4.4%), AP in BS (IRT = 10.5%, TRT = 9.3%), AP in BP (IRT = 2.4%, TRT = 8.1%), PP in BS (IRT=19.42%, TRT = 22.3%), PP in BP (IRT = 7.6%, TRT = 11.5%), AV in BS (IRT = 10.5%, TRT = 9.4%), and PV in BS (IRT = 8.6%, TRT = 4.5%). Despite such improvements no significant differences were detected in the post training variables recorded for the two experimental groups. These data indicate that a circuit training program using two instability training devices is as effective in untrained men as a program executed under stable conditions for improving strength (1RM), power, movement velocity and jumping ability. Key Points Similar adaptations in terms of gains in strength, power, movement velocity and jumping ability were produced in response to both training programs. Both the stability and instability approaches seem suitable for healthy, physically-active individuals with or with limited experience in resistance training. RPE emerged as a useful tool to monitor exercise intensity during instability strength training.

Myers TR, Schneider MG, Schmale MS, Hazell TJ. (2014) conducted a study on determine if a time-effective whole-body aerobic resistance-training circuit using only body-weight exercises is as effective in improving aerobic and anaerobic fitness, as well as muscular strength and endurance as a traditional concurrent style training combining resistance and endurance training. Thirty-four sedentary females (20.9±3.2 y; 167.6±6.4 cm; 65.0±15.2 kg) were assigned to either: 1) a combined resistance and aerobic exercise group (COMBINED; n=17); or 2) a circuit-based whole-body aerobic resistance-training circuit group (CIRCUIT; n=17). Training was 3 days per week for 5 weeks. Pre- and post-training measures included a VO2peak test, anaerobic Wingate cycling test,
and muscular strength and endurance tests. Following training, VO2peak improved with CIRCUIT by 11% (p=0.015), with no change for COMBINED (p=0.375). Both relative peak power output and relative average power output improved with CIRCUIT by 5% (p=0.027) and 3.2% (p=0.006) respectively and with COMBINED by 5.3% (p=0.025) and 5.1% (p=0.003). Chest and hamstrings 1-RM improved with CIRCUIT by 20.6% (p=0.011) and 8.3% (p=0.022) and with COMBINED by 35.6% (p<0.001) and 10.2% (p=0.004) respectively. Only the COMBINED group improved back (11.7%; p=0.017) and quadriceps (9.6%; p=0.006) 1-RM. The COMBINED group performed more repetitions at 60% of their pre-training 1-RM for back (10.0%; p=0.006) and hamstring (23.3%; P=0.056) vs CIRCUIT. Our results suggest that a circuit-based, whole-body aerobic resistance-training program can elicit a greater cardio respiratory response and similar muscular strength gains with less time commitment, compared to a traditional resistance training program combined with aerobic exercise.

**Napoli NJ, Mixco AR, Bohorquez JE, Signorile JF(2014)** Conducted a study on High-speed resistance training is used to increase power; however, momentum can reduce the effectiveness of high-speed (HS) training when using weight-stack (WS) machines. This study used a non-linear scaled wavelet analysis to assess differences between pneumatic (P) and WS during seven HS or controlled speed (CS) repetitions. Vastusmedialis (VM) and lateralis (VL), and rectus femoris (RF) EMG data were collected during leg extension exercises performed by five regular weight-trainers (mean age±SD, 23.2±2.9years). Data were analyzed using continuous wavelet analysis to assess temporal Intensity distribution across eight frequency bands. Significant differences occurred due to speed for all muscles (p<.0001). P produced higher Intensity than WS for all muscles during HS (p<.0001), and VM and RF during CS (p<.001). The CON phase produced higher Intensity than ECC for the vasti muscles during CS (p<.0003), and VM and RF during HS (p<.0001). Intensity increased across repetitions plateauing earlier for the vasti than RF during CS. Regardless of the machine, Intensity levels peaked between the 25-53Hz and 46-82Hz (2nd and 3rd wavelets) bands. The results indicate that when the objective is increasing power through isoinertial training, P machines at HS appear to be the most effective alternative.
Nicholson VP, McKean MR, Burkett BJ (2014) Conducted a study on the effect of 26 weeks of low-load high-repetition resistance training (BodyPump™) on maximal strength, gait speed, balance and self-reported health status in healthy, active middle-aged and older adults. Two-group randomised control trial. Sixty-eight apparently healthy, active adults aged over 55 years completed either 26 weeks of BodyPump™ training (PUMP) or served as control participants (CON). The BodyPump™ group (n=32, age=66±4 years) trained twice per week for 26 weeks while the control group (n=36, age=66±5 years) continued with their normal activities. Leg-press and Smith-machine bench-press one repetition maximum (1RM), gait speed, balance, and self-reported health status were all assessed at baseline and follow-up. Significant group-by-time interactions in favour of the BodyPump™ group were found for leg-press 1RM (PUMP +13%, CON +3%, p=0.007, partial eta²=0.11), Smith-machine bench-press 1RM (PUMP +14%, CON +5%, p=0.001, partial eta²=0.18), normal gait speed (PUMP +23%, CON +9%, p=0.028, partial eta²=0.08) and single leg balance right (PUMP +24%, CON -7%, p=0.006, partial eta²=0.12). There were no group-by-time interactions for health status measures. Three participants in the BodyPump™ group withdrew from training due to injury or fear of injury related to training. Low-load high-repetition resistance training in the form of BodyPump™ is effective at improving maximal strength, gait speed and some aspects of standing balance in adults over 55 years. The training was well tolerated by the majority of participants.

Parmenter BJ, Dieberg G, Phipps G, Smart NA (2014) Conducted a study on a systematic search (PubMed, CINAHL, Cochrane Central Register of Controlled Trials; 1966 - 31 August 2014). We only included randomized controlled trials (RCTs) of exercise training versus usual medical care in persons with PAD that included the Walking Impairment Questionnaire (WIQ) and Short-Form Health Survey component summary scores as outcomes. Of 15 RCTs, 1257 participants were studied: 543 participated in supervised exercise, with only 61 undertaking resistance training and 316 unsupervised exercise. When compared to controls, participants who completed any form of exercise training significantly improved their WIQ speed [mean difference (MD) 9.60 (95% CI 6.98 to 12.23, p<0.00001)]; WIQ distance [MD 7.41 (95% CI 4.49 to 10.33, p<0.00001)] and WIQ stair-climbing [MD 5.07 (95% CI 3.16 to 6.99, p<0.00001)]. Walking also significantly improved the Short-Form Physical Component Summary (SF-PCS) score when compared to controls [MD 1.24 (95% CI 0.48 to 2.01, p=0.001)], but not
the Mental Component Summary (SF-MCS) score [MD -0.55 (95% CI -1.27 to 0.18, p=0.14)]. Exercise training improves the SF-PCS dimension, as well as perceived walking distance, speed and stair-climbing as measured by the WIQ, but not the SF-MCS score. Future studies should aim to blind assessors of such subjective measures, and study alternative modes and prescriptions of exercise alternative to walking.

**Skovgaard C, Christensen PMet.al.,(2014)** Conducted a study on examine whether speed endurance training (SET, repeated 30-s sprints) and heavy resistance training (HRT, 80-90% of 1 repetition maximum) performed in succession are compatible and lead to performance improvements in moderately trained endurance runners. For an 8-wk intervention period (INT) 23 male runners [maximum oxygen uptake (VO2max) 59 ± 1 ml·min(-1)·kg(-1); values are means ± SE] either maintained their training (CON, n = 11) or performed high-intensity concurrent training (HICT, n = 12) consisting of two weekly sessions of SET followed by HRT and two weekly sessions of aerobic training with an average reduction in running distance of 42%. After 4 wk of HICT, performance was improved (P < 0.05) in a 10-km run (42:30 ± 1:07 vs. 44:11 ± 1:08 min:s) with no further improvement during the last 4 wk. Performance in a 1,500-m run (5:10 ± 0:05 vs. 5:27 ± 0:08 min:s) and in the Yo-Yo IR2 test (706 ± 97 vs. 491 ± 65 m) improved (P < 0.001) only following 8 wk of INT. In HICT, running economy (189 ± 4 vs. 195 ± 4 ml·kg(-1)·km(-1)), muscle content of NHE1 (35%) and dynamic muscle strength was augmented (P < 0.01) after compared with before INT, whereas (VO2max), muscle morphology, capillarization, content of muscle Na(+)K(+) pump subunits, and MCT4 were unaltered. No changes were observed in CON. The present study demonstrates that SET and HRT, when performed in succession, lead to improvements in both short- and long-term running performance together with improved running economy as well as increased dynamic muscle strength and capacity for muscular H(+) transport in moderately trained endurance runners.

**Taipale RS, Mikkola Jet.al.,(2014)** conducted a study on Supervised periodized mixed maximal and explosive strength training added to endurance training in recreational endurance runners was examined during an 8-week intervention preceded by an 8-week preparatory strength training period. Thirty-four subjects (21-45 years) were divided into experimental groups: men (M, n = 9), women (W, n = 9), and control groups: men (MC, n = 7), women (WC, n = 9). The experimental groups performed mixed maximal and
explosive exercises, whereas control subjects performed circuit training with body weight. Endurance training included running at an intensity below lactate threshold. Strength, power, endurance performance characteristics, and hormones were monitored throughout the study. Significance was set at \( p \leq 0.05 \). Increases were observed in both experimental groups that were more systematic than in the control groups in explosive strength (12 and 13% in men and women, respectively), muscle activation, maximal strength (6 and 13%), and peak running speed (14.9 ± 1.2 to 15.6 ± 1.2 and 12.9 ± 0.9 to 13.5 ± 0.8 km L h). The control groups showed significant improvements in maximal and explosive strength, but Speak increased only in MC. Submaximal running characteristics (blood lactate and heart rate) improved in all groups. Serum hormones fluctuated significantly in men (testosterone) and in women (thyroid stimulating hormone) but returned to baseline by the end of the study. Mixed strength training combined with endurance training may be more effective than circuit training in recreational endurance runners to benefit overall fitness that may be important for other adaptive processes and larger training loads associated with, e.g., marathon training.

**Taipale RS, Mikkola J, Vesterinen V, Nummela A, Häkkinen K. (2014)** conducted a study on The effects of mixed maximal strength and explosive strength training combined with endurance training over an 8-week training intervention. Male subjects (age 21-45 years) were divided into three strength training groups, maximal (MAX, \( n = 11 \)), explosive (EXP, \( 10 \)) and mixed maximal and explosive (MIX, 9), and a circuit training control group, (CON, 7). Strength training one to two times a week was performed concurrently with endurance training three to four times a week. Significant increases in maximal dynamic strength (1RM), countermovement jump (CMJ), maximal muscle activation during 1RM in MAX and during CMJ in EXP, peak running speed (S (peak)) and running speed at respiratory compensation threshold (RCT(speed)) were observed in MAX, EXP and MIX. Maximal isometric strength and muscle activation, rate of force development (RFD), maximal oxygen uptake [Formula: see text] and running economy (RE) at 10 and 12 km hr(-1) did not change significantly. No significant changes were observed in CON in maximal isometric strength, RFD, CMJ or muscle activation, and a significant decrease in 1RM was observed in the final 4 weeks of training. RE in CON did not change significantly, but significant increases were observed in S (peak),
RCT(speed) and [Formula: see text] Low volume MAX, EXP and MIX strength training combined with higher volume endurance training over an 8-week intervention produced significant gains in strength, power and endurance performance measures of S (peak) and RCT(speed), but no significant changes were observed between groups.

Tapp LR, Signorile JF. (2014) Conducted a study on the effectiveness of whole body vibration (WBV) training as a modality for inducing changes in body composition, cardiovascular condition, and muscular strength in sedentary postmenopausal women. WBV training was compared with other training regimens, ie, aerobic training and circuit resistance training, commonly used to promote weight loss, cardiovascular conditioning, and muscular strength. Postmenopausal women (aged 48-60 years) were randomly assigned to WBV training, circuit resistance training, or aerobic training. Participants trained three times per week for 8 weeks. The training regimens were progressive in nature, with increases in training intensity and duration occurring throughout the 8-week period. Body composition was assessed using dual-energy X-ray absorptiometry analyses. A modified Bruce treadmill protocol was used to assess aerobic capacity (VO2peak) and time to peak exhaustion. Upper and lower body strengths were determined by one repetition maximum (1-RM) chest and leg presses, respectively. Variables were analyzed using separate 3 (exercise mode) × 2 (time) repeated-measures analysis of variance with effect sizes due to the small sample size. No significant main effects or interactions were seen for any body composition variable; however, moderate to large effect sizes ($\eta^2=0.243$ and $\eta^2=0.257$) were detected regarding interactions for percent body fat and lean body mass favoring aerobic training and circuit resistance training. For VO2peak, no significant main effects or interactions were detected (time, $\eta^2=0.150$; $P=0.11$; time × group, $\eta^2=0.139$; $P=0.30$); but a significant time effect was observed for time to peak exhaustion ($\eta^2=0.307$; $P=0.017$). A significant interaction for upper body strength ($\eta^2=0.464$; $P=0.007$), and main effect for time in lower body strength ($\eta^2=0.663$; $P=0.0001$) was detected. Post hoc analysis indicated a significant increase in upper bodystrength for circuit resistance training ($P=0.023$) and a decrease for WBV training ($P=0.015$). Our results indicate that WBV may not be an effective alternative to traditional training with regard to body composition or aerobic capacity, but could have a positive impact on lower body strength.