CHAPTER – II
REVIEW OF RELATED LITERATURE

A study of relevant literature is an essential step to get a full picture of what has been done with regard to the problem under study. Such a review brings out a deep and clear perspective of the overall field.

The review of literature is instrumental in selection of the topic, transaction of hypothesis and deductive reasoning leading to the problem. It helps to get a clear idea and support the findings with regard to the problem under study.

The following materials collected from the views expressed by various personalities provide background information to the study and help us to understand the effect of various combinations of yoga, aerobic and resistance training on selected, physical fitness, physiological and biochemical variables on college male students. The views of the experts and research workers in the field of physical education are given primary importance in the present study.

2.1 YOGA TRAINING

Ramos Jimenez et al. (2009) evaluate the effect of an intensive hatha yoga intervention (IHY) on cardiovascular risk factors in middle-aged and older women from Northern Mexico. In this prospective quasi experimental design, four middle-aged and nine older CHY practicing females (yoginis) were enrolled into an 11-week IHY program consisting of 5 sessions/week for 90 min (55 sessions). The program adherence, asana performance, and work intensity were assessed along the intervention. Anthropometric [body mass index (BMI), % body fat and $\sum$ skin folds], cardiovascular fitness [maximal expired air volume (VE max ), maximal O2 consumption (VO2 max ), maximal heart rate (HR max ), systolic (BPs) and diastolic blood pressure (BPd)], biochemical [glucose, triacylglycerols (TAG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-
density lipoprotein cholesterol (LDL-C)], and dietary parameters were evaluated before and after IHY. Daily caloric intake (~1,916 kcal/day), program adherence (~85%), and exercising skills (asana performance) were similar in both middle-aged and older women. The IHY program did not modify any anthropometric measurements. However, it increased VO2max and VE max and HDL-C while TAG and LDL-C remained stable in both middle-aged and older groups (P < 0.01). The proposed IHY program improves different cardiovascular risk factors (namely VO2max and HDL-C) in middle-aged and older women.

Bal, B.S et al. (2009) conducted a study to determine the effects of selected asanas in hatha yoga on agility and flexibility level. The subjects for the study were selected on the basis of random group design. Thirty (N=30) male students were selected as subject for the present study from D.A.V. Institute of Engineering and Technology, Jalandhar (Punjab), INDIA. All the subjects ranged between the chronological age of 18-25 years. The selected subjects were further divided into two groups. Experimental treatment was then assigned to group “A” while group “B” acts as control. “Hexagonal Obstacle Test” was used to measure Agility whereas “Sit and Reach Test” was used to measure Flexibility. The subjects were subjected to the six week yogasanas training programme that includes Swastikasana, Mayurasana, Matsyendrasana, Paschimottanasana and Gomukhasana. The difference in the mean of each group for selected variable was tested for the significance of difference by “t” test. The level of significance was set at 0.05. The results have shown the significant improvement in flexibility, since cal. t (≈ 8.122) > tab t .05 (14) (≈ 2.145). The treatment of six week yogasanas training programme also shown significant improvement in case of agility, since cal. t (≈ 7.376) > tab t .05 (14) (≈2.145).

Raju PS et al. (1997) observed the influence at the short-term effects of 4 weeks of intensive yoga practice on physiological responses in six healthy adult
female volunteers were measured using the maximal exercise treadmill test. Yoga practice involved daily morning and evening sessions of 90 minutes each. Pre- and post-yoga exercise performance was compared. Maximal work output (Wmax) for the group increased by 21%, with a significantly reduced level of oxygen consumption per unit work but without a concomitant significant change in heart rate. After intensive yoga training, at 154 Wmin(-1) (corresponding to Wmax of the pre-yoga maximal exercise test) participants could exercise more comfortably, with a significantly lower heart rate (p < 0.05), reduced minute ventilation (p < 0.05), reduced oxygen consumption per unit work (p < 0.05), and a significantly lower respiratory quotient (p < 0.05). The implications for the effect of intensive yoga on cardiorespiratory efficiency are discussed, with the suggestion that yoga has some transparently different quantifiable physiological effects to other exercises.

Ray US et al. (2001) a study was undertaken to observe any beneficial effect of yogic practices during training period on the young trainees. 54 trainees of 20-25 years age group were divided randomly in two group yoga and control group. Yoga group (23 males and 5 females) was administered yogic practices for the first five months of the course while control group (21 males and 5 females) did not perform yogic exercises during this period. From the 6th to 10th month of training both the groups performed the yogic practices. Physiological parameters like heart rate, blood pressure, oral temperature, skin temperature in resting condition, responses to maximal and submaximal exercise, body flexibility were recorded. Psychological parameters like personality, learning, arithmetic and psychomotor ability, mental well being was also recorded. Various parameters were taken before and during the 5th and 10th month of training period. Initially there was relatively higher sympathetic activity in both the groups due to the new work/training environment but gradually it subsided. Later on at the 5th and 10th month, yoga group had relatively lower sympathetic activity than the control
group. There was improvement in performance at submaximal level of exercise and in anaerobic threshold in the yoga group. Shoulder, hip, trunk and neck flexibility improved in the yoga group. There was improvement in various psychological parameters like reduction in anxiety and depression and a better mental function after yogic practices.

Sinha B et al. (2004) was undertaken a study to observe critically the energy cost and different cardiorespiratory changes during the practice of surya namaskara. Twenty-one male volunteers from the Indian Army practiced selected Yogic exercises for six days in a week for three months duration. The Yogic practice schedule consisted of Hatha Yogic Asanas (28 min), Pranayama (10.5 min) and Meditation (5 min). In the Yogic practice schedule 1st they practiced Kapal Bhathi (breathing maneuvers) for 2 min then Yogamudra (yogic postural exercise) for 2 min, after that they took rest until oxygen consumption and heart rate (HR) came to resting value. Subsequently subjects performed SN for 3 min 40 seconds on an average. After three months of training at the beginning of the fourth month subjects performed entire Yogic practice schedule in the laboratory as they practiced during their training session and experiments were carried out. Their pulmonary ventilation, carbondioxide output, Oxygen consumption, HR and other cardiorespiratory parameters were measured during the actual practice of SN. Oxygen consumption was highest in the eighth posture (1.22+/-.073 l min (-1)) and lowest in the first posture (0.35+/-0.02 l min (-1)). Total energy cost throughout the practice of SN was 13.91 kcal and at an average of 3.79 kcal/min. During its practice highest HR was 101+/-.13.5 b.p.m. As an aerobic exercise SN seemed to be ideal as it involves both static stretching and slow dynamic component of exercise with optimal stress on the cardiorespiratory system.

Clay CC et al. (2005) conducted a study to determine the metabolic and heart rate (HR) responses of hatha yoga, 26 women (19-40 years old) performed a
30-minute hatha yoga routine of supine lying, sitting, and standing asanas (i.e., postures). Subjects followed identical videotaped sequences of hatha yoga asanas. Mean physiological responses were compared to the physiological responses of resting in a chair and walking on a treadmill at 93.86 m.min(-1) [3.5 miles per hour (mph)]. During the 30-minute hatha yoga routine, mean absolute oxygen consumption ($vo_2$) relative $vo_2$), percentage maximal oxygen consumption (%$vo_2$r), metabolic equivalents (METs), energy expenditure, HR, and percentage maximal heart rate (%MHR) were 0.45 L.min(-1), 7.59 ml.kg(-1).min(-1), 14.50%, 2.17 METs, 2.23 kcal.min(-1), 105.29 b.min(-1), and 56.89%, respectively. When compared to resting in a chair, hatha yoga required 114% greater $o_2$ (L.min(-1)), 111% greater $o_2$(ml.kg(-1).min(-1)), 4,294% greater %$vo_2$r, 111% greater METs, 108% greater kcal.min(-1), 24% greater HR, and 24% greater %MHR. When compared to walking at 93.86 m.min(-1), hatha yoga required 54% lower $o_2$(L.min(-1)), 53% lower $o_2$(ml.kg(-1).min(-1)), 68% lower %$vo_2$r, 53% lower METs, 53% lower kcal.min(-1), 21% lower HR, and 21% lower %MHR. The hatha yoga routine in this study required 14.50% $vo_2$r, which can be considered a very light intensity and significantly lighter than 44.8% $vo_2$r for walking at 93.86 m.min(-1) (3.5 mph). The intensity of hatha yoga may be too low to provide a training stimulus for improving cardiovascular fitness. Although previous research suggests that hatha yoga is an acceptable form of physical activity for enhancing muscular fitness and flexibility, these data demonstrate that hatha yoga may have little, if any, cardiovascular benefit.

**TL Chen (2009)** was investigated the effect of yoga exercise on the health-related physical fitness of school-age children with asthma. The study employed a quasi-experimental research design in which 31 voluntary children (exercise group 16; control group15) aged 7 to 12 years were purposively sampled from one public elementary school in Taipei County. The yoga exercise program was practiced by the exercise group three times per week for a consecutive 7 week period. Each 60-
minute yoga session included 10 minutes of warm-up and breathing exercises, 40 minutes of yoga postures, and 10 minutes of cool down exercises. Fitness scores were assessed at pre-exercise (baseline) and at the seventh and ninth week after intervention completion. A total of 30 subjects (exercise group 16; control group 14) completed follow-up. Results included: 1. Compared with children in the general population, the study subjects (n = 30) all fell below the 50th percentile in all five physical fitness items of interest. There was no significant difference in scores between the two groups at baseline (pre-exercise) for all five fitness items. Research found a positive association between exercise habit after school and muscular strength and endurance among asthmatic children. Compared to the control group, the exercise group showed favorable outcomes in terms of flexibility and muscular endurance. Such favorable outcomes remained evident even after adjusting for age, duration of disease and steroid use, values for which were unequally distributed between the two groups at baseline. There was a tendency for all item-specific fitness scores to increase over time in the exercise group. The GEE analysis showed that yoga exercise indeed improved BMI, flexibility, and muscular endurance. After 2 weeks of self-practice at home, yoga exercise continued to improve BMI, flexibility, muscular strength, and cardiopulmonary fitness.

Dawn D (2005) was designed a study to investigate changes in VO2max, ventilation, maximal heart rate, muscular strength and endurance, flexibility, and balance after 8 weeks of thrice-weekly (50 min per session) yoga training. Healthy volunteers (age 20Y55) (n = 34) were randomly divided into an experimental group (yoga) and a control group (no exercise). Both groups were tested before and after the 8-week training period. The tests assessed VO2max, maximal heart rate, FVC, FEV1, muscular strength and endurance, flexibility, and balance. Results: The experimental group had significant (P G .05) improvements in trunk flexion (7-), trunk extension (8-), trunk rotation to the right (22-) and left (19-),
ankle range of motion (6-), sit and reach (3 in), back scratch on the right (1.2 in) and left (1.2 in), shoulder elevation (1.6 in), trunk lift (1.9 in), push-ups (6), curl-ups (14), and one-leg stand (17 sec) compared to the control group. There were no significant improvements in maximal heart rate, VO2max, FVC, FEV1, or functional reach as a result of training. When practiced regularly, Hatha yoga can significantly improve muscular strength and endurance, flexibility, and balance. However, the metabolic intensity of Hatha yoga does not appear to be sufficient to improve cardiorespiratory fitness.

Virginia S. et al. (2005) observed the Physical and Perceptual Benefits of Yoga Asana Practice. Twenty-six healthy adults aged 20–58 (Mean 31.8) participated in six weeks of either astanga yoga or hatha yoga class. Significant improvements at follow-up were noted for all participants in diastolic blood pressure, upper body and trunk dynamic muscular strength and endurance, flexibility, perceived stress, and health perception. The improvements differed for each group when compared to baseline assessments. The astanga yoga group had decreased diastolic blood pressure and perceived stress, and increased upper body and trunk dynamic muscular strength and endurance, flexibility, and health perception. Improvements for the hatha yoga group were significant only for trunk dynamic muscular strength and endurance, and flexibility. The findings suggest that the fitness benefits of yoga practice differ by style.

Hagins M, et al. (2007) was conducted a study to determine whether a typical yoga practice using various postures meets the current recommendations for levels of physical activity required to improve and maintain health and cardiovascular fitness; to determine the reliability of metabolic costs of yoga across sessions; to compare the metabolic costs of yoga practice to those of treadmill walking. In this observational study, 20 intermediate-to-advanced level yoga practitioners, age 31.4 +/- 8.3 years, performed an exercise routine inside a
human respiratory chamber (indirect calorimeter) while wearing heart rate monitors. The exercise routine consisted of 30 minutes of sitting, 56 minutes of beginner-level hatha yoga administered by video and 10 minutes of treadmill walking at 3.2 and 4.8 kmph each. Measures were mean oxygen consumption (VO2), heart rate (HR), percentage predicted maximal heart rate (%MHR), metabolic equivalents (METs), and energy expenditure (kcal). Seven subjects repeated the protocol so that measurement reliability could be established. Mean values across the entire yoga session for VO2, HR, %MHR, METs, and energy/min were 0.6 L/kg/min; 93.2 beats/min; 49.4%; 2.5; and 3.2 kcal/min; respectively. Results of the ICCs (2,1) for mean values across the entire yoga session for kcal, METs, and %MHR were 0.979 and 0.973 and 0.865, respectively. Metabolic costs of yoga averaged across the entire session represent low levels of physical activity, are similar to walking on a treadmill at 3.2 kmph, and do not meet recommendations for levels of physical activity for improving or maintaining health or cardiovascular fitness. Yoga practice incorporating sun salutation postures exceeding the minimum amount of 10 minutes may contribute some portion of sufficiently intense physical activity to improve cardio-respiratory fitness in unfit or sedentary individuals. The measurement of energy expenditure across yoga sessions is highly reliable.

Ray US et al. (2001) conducted a study on the effect of training in Hatha yogic exercises on aerobic capacity and PE after maximal exercise was observed. Forty men from the Indian army (aged 19-23 yr) were administered maximal exercise on a bicycle ergometer in a graded work load protocol. The oxygen consumption, carbon dioxide output, pulmonary ventilation, respiratory rate, heart rate (HR) etc., at maximal exercise and PE score immediately thereafter were recorded. The subjects were divided into two equal groups. Twelve subjects dropped out during the course of study. One group (yoga, n = 17) practiced Hatha yogic exercises for 1 hr every morning (6 days in a week) for six months. The
other group (PT, n = 11) underwent conventional physical exercise training during the same period. Both groups participated daily in different games for 1 hr in the afternoon. In the 7th month, tests for maximal oxygen consumption (VO2Max) and PE were repeated on both groups of subjects. Absolute value of VO2Max increased significantly (P < 0.05) in the yoga group after 6 months of training. The PE scores after maximal exercise decreased significantly (P < 0.001) in the yoga group after 6 months but the PT group showed no change. The practice of Hatha yogic exercises along with games helps to improve aerobic capacity like the practice of conventional exercises (PT) along with games. The yoga group performed better than the PT group in terms of lower PE after exhaustive exercise.

Mark D. Tran et al. (2001) conducted a study on ten healthy, untrained volunteers (nine females and one male), ranging in age from 18–27 years, were studied to determine the effects of hatha yoga practice on the health-related aspects of physical fitness, including muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition, and pulmonary function. Subjects were required to attend a minimum of two yoga classes per week for a total of 8 weeks. Each yoga session consisted of 10 minutes of pranayamas (breath-control exercises), 15 minutes of dynamic warm-up exercises, 50 minutes of asanas (yoga postures), and 10 minutes of supine relaxation in savasana (corpse pose). The subjects were evaluated before and after the 8-week training program. Isokinetic muscular strength for elbow extension, elbow flexion, and knee extension increased by 31%, 19%, and 28% (p<0.05), respectively, whereas isometric muscular endurance for knee flexion increased 57% (p<0.01). Ankle flexibility, shoulder elevation, trunk extension, and trunk flexion increased by 13% (p<0.01), 155% (p<0.001), 188% (p<0.001), and 14% (p<0.05), respectively. Absolute and relative maximal oxygen uptake increased by 7% and 6%, respectively (p<0.01). These findings indicate that regular hatha yoga practice can elicit improvements in the health-related aspects of physical fitness.
Yang K. (2007) conducted a study on a review of yoga programs for four leading risk factors of chronic diseases. Yoga, a form of physical activity, is rapidly gaining in popularity and has many health benefits. Yet healthcare providers have been slow to recognize yoga for its ability to improve health conditions, and few interventions have been developed that take full advantage of its benefits. The purpose of this article is to review published studies using yoga programs and to determine the effect of yoga interventions on common risk factors of chronic diseases (overweight, hypertension, high glucose level and high cholesterol). A systematic search yielded 32 articles published between 1980 and April 2007. The studies found that yoga interventions are generally effective in reducing body weight, blood pressure, glucose level and high cholesterol, but only a few studies examined long-term adherence. Additionally, not enough studies included diverse populations at high risk for diabetes and its related common health problems.

Raub JA (2002) conducted a study on psycho physiologic effects of Hatha Yoga on musculoskeletal and cardiopulmonary function: a literature review in time magazine April 2001 on “The Power of Yoga.” There is a need to have yoga better recognized by the health care community as a complement to conventional medical care. Over the last 10 years, a growing number of research studies have shown that the practice of Hatha Yoga can improve strength and flexibility, and may help control such physiological variables as blood pressure, respiration and heart rate, and metabolic rate to improve overall exercise capacity. This review presents a summary of medically substantiated information about the health benefits of yoga for healthy people and for people compromised by musculoskeletal and cardiopulmonary disease.
Rajakumar. J et al. (2010) studied the impact of yogic practices and physical exercises on selected physiological variables among the intercollegiate soccer players. To achieve this purpose, sixty (60) male intercollegiate soccer players from the various colleges of Chennai were selected at random. Their age ranged between 17 to 22. The selected subjects were divided into three equal groups of 20 each, namely yogic practice group (Group A), physical exercises group (Group B) and control group (Group C). The experimental groups have underwent 12 weeks of training namely; yogic practices and physical exercises respectively, whereas the control group (Group C) maintained their daily routine activities and no special training was given. The subjects of the three groups were tested using standardized tests and procedures on selected physiological variables before and after the training period to find out the training efforts in the following test items: Resting pulse rate through stethoscope, Breath holding time through digital stop watch, Peak flow rate through Wright's peak flow meter. The collected data were analyzed statistically through Analysis of Co-variance (ANACOVA) and Schiff's post - hoc test to find out the pre and post training performances, compare the significant difference between the adjusted final means and the better group. The yogic practice group showed significant improvement due to 12 weeks training on resting pulse rate, breath holding time and peak flow rate compared to the physical exercise and control group. In the overall training effects in terms of improved number of physiological variables and their magnitude of improvement through training, yogic practice group is found to be the better group when compared to the other two groups.

Chanavirut. R et al. (2006) conducted a study on Yoga a method of breathing and chest expansion exercise, has been reported to improve respiratory function in healthy and respiratory diseases. The present study tested the hypothesis that short-term Yoga exercise increased chest wall expansion and lung volumes in young healthy Thais fifty-eight healthy young volunteers (20.1±0.6
years of age) were randomly allocated into Yoga training (n=29) and control (n=29). Five positions of Hatha Yoga (Uttita Kummersana, Ardha Matsyendrasana, Vrikshasana, Yoga Mudra, and Ushtrasana) were assigned because of their dominant effects on chest wall function. The Yoga practice was 20 min/session and 3 sessions/week for 6 weeks. The matching control subjects were designed and stayed free without Yoga exercise in a similar period. Before and after training lung expansion was measured by a standard tape at three levels: upper (sternal angle), middle (rib 5), and lower (rib 8). Lung volumes (tidal volume, FEV1, FEV25-75%, and FVC) were measured by a standard spirometer. Compared to pre-training, Yoga exercise significantly increased (p<0.05) chest wall expansion in all levels (upper 3.2±0.1 versus 4.4±0.1 cm, middle 5.0±0.1 versus 5.9±0.1 cm, lower 5.9±0.2 versus 6.8±0.1 cm), FEV1 (2.5±0.1 versus 2.8±0.1 L), FEV25-75% (4.1±0.2 versus 4.8±0.2 L/sec), and FVC (2.5±0.1 versus 2.8±0.1 L). The upper chest wall expansion improved better than the other two levels. Resting tidal volume was not altered by Yoga (0.53±0.03 versus 0.55±0.03 L). In contrast, the control subjects did not show any change in all measured parameters through the study. The present data suggest that short-term Yoga exercise improves respiratory breathing capacity by increasing chest wall expansion and forced expiratory lung volumes.

2.2 AEROBIC TRAINING

Stone Nick (2007) conducted a study on physiological response to sport-specific aerobic interval training in high school male basketball players. The aim of the present study was to evaluate the effectiveness of a basketball specific endurance circuit on improving measures of aerobic fitness. Ten male high school basketball players, age 16.4 ± 1.2 years, ranked by fitness level and randomly assigned to a training group (N = 6) or control group (N = 4) participated in the study. The sport-specific aerobic endurance training replaced the fitness component of regular training and was performed during the competitive season.
The sport-specific training consisted of interval training using a basketball specific endurance circuit, four times 4 min at 90-95% HR peak with a 3 min recovery at 60-70% HR peak, twice per week for 6 weeks. During this time the control group performed regular basketball training. Results: For both the training and control groups the actual mean training intensity for total training duration were 77.4 ± 2.9% HR peak and 74.1 ± 6.7% HR peak, respectively. The actual mean training intensity during the work intervals in the training group was 84.1 ± 2.3% HR peak. There were no clear differences between effects of the two training approaches for measures of maximal oxygen uptake (3.3%; 90% confidence limits, ± 19.3%), running economy (-3.3%; 90% confidence limits, ± 14.2%), repeated sprint ability (0.6%; 90% confidence limits, ± 5.7%) and anaerobic power maintenance during the repeated sprints (-13.7%; 90% confidence limits, ± 49.0%). However, a clear non-trivial effect on sub-maximal heart rate was observed (-7.3%; 90% confidence limits, ± 2.0%) suggesting a beneficial training effect after training. Some evidence for attenuation of speed (-1.8 to -2.8%; 90% confidence limits, ± 3.4 to 5.7%) and power (-1.7%; 90% confidence limits, ± 17.1%) was apparent. Although clear changes in sub-maximal HR responses were observed in the training group, the data in the present study suggests that a basketball specific endurance circuit has little effect on other laboratory and field-based measures of aerobic fitness. In fact, the basketball specific endurance circuit may lead to reduced improvements in jumping and sprinting performances. Further research is required to clarify the effect of aerobic training approaches on basketball-specific fitness and performance.

Hoff J et al. (2002) to examine the effects of maximal strength training with emphasis on neural adaptations on strength- and endurance-performance for endurance trained athletes. Nineteen male cross-country skiers about 19.7 ± 4.0 years of age and a maximal uptake VO2 max) of 69.4 ± 2.2 ml x kg~1 x min~1 were randomly assigned to a training group (n =9) or a control group (n = 10).
Strength training was performed, three times a week for 8 weeks, using a cable pulley simulating the movements in double poling in cross-country skiing, and consisted of three sets of six repetitions at a workload of 85% of one repetition maximum emphasizing maximal mobilization of force in the concentric movement. One repetition maximum improved significantly from 40.3 ± 4.5 to 44.3 ± 4.9 kg. Time to peak force (TPF) was reduced by 50 and 60% on two different sub maximal workloads. Endurance performance measured as time to exhaustion (TTE) on a double poling ski ergometer at maximum aerobic velocity, improved from 6.49 to 10.18 min; 20.5% over the control group. Work economy changed significantly from 1.02 ± 0.14 to 0.74 ± 0.10 ml x kg⁻¹ x min⁻¹ Maximal strength training with emphasis on neural adaptations improves strength, particularly rate of force development, and improves aerobic endurance performance by improved work economy.

Yoshiyuki Sunami et al. (1999) conducted a study on concentration of high-density lipoprotein cholesterol (HDL-C) is inversely correlated with the risk of coronary heart disease. The effects of low-intensity aerobic training on serum HDL-C and other lipoprotein concentrations were examined in healthy elderly subjects. The subjects were randomly assigned to two groups matched for sex, age, height, and weight. The training group (n = 20, 10 men and 10 women aged 67 ± 4 years) participated in a supervised physical exercise regimen using a bicycle ergometer at an intensity of 50% estimated maximal oxygen consumption (Vo2max) for 60 minutes two to four times per week for 5 months. In contrast, the control group (n = 20, 10 men and 10 women aged 68 ± 4 years) did not perform any particular physical training. The training protocol resulted in significant increases in the Vo2max (P < .05), HDL-C, HDL2-C, and HDL2-C/HDL3-C ratio (P < .01). The change in HDL2-C (r = .57, P < .01) and HDL2-C/HDL3-C (r = .63, P < .01) was positively associated with an increase in the total exercise
duration per week. In addition, the total weekly exercise duration also showed a significant positive relationship with HDL-C ($r = .75$, $P < .01$), HDL2-C ($r = .81$, $P < .01$), and HDL2-C/HDL3-C ($r = .71$, $P < .01$) after the training period. The changes in body weight and the Vo2max were not significantly correlated with any lipid parameters. Low-intensity aerobic training may improve the profile of HDL-C and its subfractions in healthy elderly subjects. Also, the total exercise duration may be an important factor for improving HDL-C and HDL2-C in elderly subjects.

Francois-Xavier Gamelin et al. (2009) was designed a study to examine peak Vo2 responses of prepubescent children following a 7-week aerobic training. Twenty-three boys and thirty girls (9.7 ± 0.8 years) were divided into a high intensity experimental group (HIEG: 20 girls and 13 boys) and a control group (CG: 10 girls and 10 boys). A graded 20-m shuttle run with measurement of gas exchange values was performed prior to and after the 7-week training program. The test consisted of a 3-min run at 7 km × h-1 to determine energy cost of running, immediately followed by a 20-meter shuttle run test. HIEG had two 30 min-sessions of short intermittent aerobic training per week at velocities ranging from 100 up to 130 % of the maximal aerobic speed. For HIEG, absolute peak Vo2 (9.1 %) and relative to body mass peak Vo2 (8.2 %) increased significantly ($p < 0.001$); it was unchanged in the CG. Similarly, maximal shuttle run improved significantly in HIEG (5.1 %, $p < 0.001$). In contrast, there was no significant change for CG. For both groups energy cost of running remained unchanged. These findings show that prepubescent children could significantly increase their peak Vo2 and maximal shuttle velocity with high intensity short intermittent aerobic exercises.
**Sonia Katyal et al. (2003)** Was conducted a study on short-term aerobic training (STAT) was used to probe the effects of age and hormone-replacement therapy (HRT) on women’s ability to rapidly change peak uptake ($V_{O_2\text{max}}$), plasma volume and cardiac function. A total of 39 females participated in the STAT programme: 15 younger (Y; aged 19±29 years), 12 postmenopausal women undergoing HRT and 12 no medicating postmenopausal (PM) women (aged 60±75 years). Training consisted of ten sessions of cycling over a 2-week period, which progressed in duration from 20 to 60 min and in intensity from 60±75% of maximum heart rate. Plasma volume (PV; as determined by Evan's Blue dye dilution), $V_{O_2\text{max}}$ (cycle ergometry) and cardiac function (radionuclide ventriculography) were analysed using analysis of covariance or repeated measures ANOVA. All groups demonstrated similar increase in $V_{O_2\text{max}}$ (Y, 13%; PM, 17%; HRT, 13%), but without a significant change in left ventricular ejection fraction and diastolic function or volumes during supine exercise. PV expansion was observed among the Y group (7%; $P<0.05$) but not the PM group (2%; $P>0.05$) or women undergoing HRT (1%; $P>0.05$). Age and hormone-replacement status did not affect the magnitude of $V_{O_2\text{max}}$ change. This study suggests that STAT improves $V_{O_2\text{max}}$, independent of central adaptations.

**Gillett PA et al. (1987)** was conducted a study to determine the effect of intensity controlled exercise on the aerobic capacity of overweight, middle-aged women. Thirty-eight moderately overweight women, ages 35-57, participated in a 16-week dance-exercise program. Random assignment was made to an experimental group ($n = 20$) in which intensity of exercise was controlled and prescribed, and a control group ($n = 18$) in which exercise was of an intensity typical to commercial aerobic classes. Prior to the onset of training, and at the completion of 16 weeks, the following fitness tests were administered: Aerobic capacity expressed as VO2 max, body composition analysis, blood chemistry,
blood pressure, resting heart rate, muscular endurance, and flexibility. T-tests, ANCOVA, and gain-score analyses were utilized to evaluate data. Both groups showed small changes in weight, percent fat, resting systolic and diastolic blood pressure, resting heart rate, high density lipoprotein-cholesterol (HDL-C), muscular endurance, and flexibility, but these changes were statistically non significant. The VO2 max for the experimental group increased 41%, while the VO2 max for the control group increased 22% (p < 0.05). The results suggest that the cardiovascular fitness changes for overweight, middle-aged women are greater when exercise intensity and progression are tailored to their age and fitness level.

**Blessing DL et al. (1987)** was designed a study to determine the changes in maximum oxygen uptake (VO2 max) and body composition following 8 weeks of aerobic dance using hand-held weights (Heavyhands, AMF, Jefferson, IA). Twenty-eight college females volunteered for the study. All subjects were given a pre oxygen and post oxygen uptake (VO2 max) treadmill test. Body composition was measured by taking the sum of five skin fold sites and determining the percent change following training. Subjects were randomly assigned to a hand-held weight or nonhand held weight group. No significant differences (P < 0.05) existed between groups for VO2 max and body composition after 8 weeks of training. However, a significant improvement (P < 0.05) in VO2 max was found within the hand-held weight (37.7 to 42.6) and in the nonhand held weight group (36.5 to 41.9). Complaints from subjects included transient aches and pains in the shoulder area during the first 3 weeks as a result of hand-held weight use. These findings suggest that hand-held weights may be used safely but do not increase the work load sufficiently above that of aerobic dance alone to significantly modify VO2 max or body composition.

**Kelley GA et al. (2006)** adapted the meta-analytic approach to examine the effects of aerobic exercise on high-density lipoprotein two cholesterol (HDL2-C)
in adults. Study selection randomized controlled trials; aerobic exercise ≥8 weeks; adults ≥18 years of age; studies published in journal, dissertation, or master's thesis format; studies published in the English-language between January 1, 1955 and January 1, 2003; and assessment of HDL2-C in the fasting state. Data abstraction all coding conducted by both authors, independent of each other. Discrepancies were resolved by consensus. Nineteen randomized controlled trials representing 20 HDL2-C outcomes from 984 males and females (516 exercises, 468 control) were pooled for analysis. Using random-effects modeling and bootstrap confidence intervals (BCI), a statistically significant increase of approximately 11% was observed for HDL2-C (2.6 ± 0.9 mg/dl, 95% BCI, 1.0–4.4 mg/dl). With each study deleted from the model once, results remained statistically significant. Increases in HDL2-C were independent of decreases in body weight, body mass index (kg/m2), and percent body fat. Aerobic exercise increases HDL2-C in adults.

Okura T et al. (2003) was tried to determine whether low-intensity exercise (walking) and high-intensity exercise (aerobic dance), when added to a weight loss diet, have different effects on coronary heart disease (CHD) risk factors and physical fitness. Ninety obese women were divided into diet only (DO), diet plus walking (DW), and diet plus aerobic dance (DA) groups. DXA was used to evaluate segmental body composition. Leg-extension strength and maximal oxygen uptake (vo₂ max) were the indicators of physical fitness. Blood pressure, lipoproteins, and fasting glucose were used as indices for CHD risk factors. These items were measured before and after a 14-week intervention period. Whole-body plus all segmental fat masses were significantly reduced (p < 0.001). Reductions in whole-body and lower-limb fat- and bone-free masses were significantly less (p < 0.01) in the DA group (-1.5 and -0.1 kg, respectively) compared with the DO (-2.1 and -0.4 kg, respectively) and DW (-2.5 and -0.5 kg, respectively) groups. Improvements in leg-extension strength and vo₂ max were
significantly greater (p < 0.05) in the DA group compared with the DO group. The CHD risk factors clearly improved (p < 0.05) within each group. Reductions in low density lipoprotein-cholesterol and fasting glucose were significantly greater (p < 0.05) in the DA group compared with the DO and DW groups. Adding higher intensity aerobic dance to a weight-loss diet program may help maintain fat- and bone-free mass and may be more effective in improving CHD risk factors compared with low-intensity walking.

Quiona Stephens et al. (2007) was conducted a study to determine the effectiveness of a 10-week aerobic exercise training intervention on blood pressure, cardiorespiratory fitness, and workload in African American women with prehypertension. After we obtained informed consent and medical clearance, each participant underwent baseline measurements, an aerobic exercise-training regimen, and post intervention assessments. This investigation took place in Columbus, Ohio, on the campus of The Ohio State University. Twelve sedentary African American women with prehypertension volunteered to participate. Study participants trained three days per week for 30 minutes per session at an intensity of 70% maximal oxygen consumption (VO2 peak) for 10 weeks. Main Outcome Measures: Blood pressure, cardiorespiratory fitness, and workload achieved. Exercise training resulted in a significant improvement in cardiorespiratory fitness and workload capacity. However, no significant reductions in blood pressure were seen after the 10-week aerobic exercise period. Ten weeks of 30 minutes of aerobic exercise, three times a week at 70% VO2 peak, is a sufficient stimulus to improve cardiorespiratory fitness and workload achieved. However, this exercise regimen was not adequate in eliciting a simultaneous reduction in systolic, diastolic, or mean arterial blood pressure in this cohort of prehypertensive African American women. Additional studies are needed to determine specific exercise protocols that would be effective in lowering blood pressure in various
populations. These exercise protocols may vary across ethnicity, sex, and disease status.

Patricia CH Wong et al. (2008) administered a study to determine the effects of a 12-week twice weekly additional exercise training, which comprised a combination of circuit-based resistance training and aerobic exercises, in addition to typical physical education sessions, on aerobic fitness, body composition and serum C-reactive protein (CRP) and lipids were analysed in 13-to 14-year-old obese boys contrasted with a control group. Both the exercise group (EG, n = 12) and control group (CG, n = 12) participated in the typical 2 sessions of 40-minute physical education (PE) per week in schools, but only EG participated in additional 2 sessions per week of 45 to 60 minutes per session of exercise training, which comprised a combination of circuit-based resistance training and aerobic exercises maintained at 65% to 85% maximum heart rate (HRmax = 220 - age). Body composition was measured using dual energy X-ray absorptiometry (DEXA). Fasting serum CRP and blood lipids were analyzed pre- and post exercise programme. Aerobic fitness was measured by an objective laboratory submaximal exercise test, PWC170 (Predicted Work Capacity at HR 170 bpm). Exercise training significantly improved lean muscle mass, body mass index, fitness, resting HR, systolic blood pressure and triglycerides in EG. Serum CRP concentrations were elevated at baseline in both groups, but training did not result in a change in CRP levels. In the CG, body weight increased significantly at the end of the 12-week period. This study supports the value of an additional exercise training programme, beyond the typical twice weekly physical education classes, to produce physiological benefits in the management of obesity in adolescents, including prevention of weight gain.
2.3 RESISTANCE TRAINING

Kraemer WJ et al. (2004) was conducted a study on adaptations of arm and thigh muscle hypertrophy to different long-term periodized resistance training programs and the influence of upper body resistance training were examined. Eighty-five untrained women (mean age = 23.1 +/- 3.5 yr) started in one of the following groups: total-body training [TP, N = 18 (3-8 RM training range) and TH, N = 21 (8-12 RM training range)], upper-body training [UP, N = 21 (3-8 RM training range) and UH, N = 19, (8-12 RM training range)], or a control group (CON, N = 6). Training took place on three alternating days per week for 24 wk. Assessments of body composition, muscular performance, and muscle cross-sectional area (CSA) via magnetic resonance imaging (MRI) were determined pretraining (T1), and after 12 (T2) and 24 wk (T3) of training. Arm CSA increased at T2 (approximately 11%) and T3 (approximately 6%) in all training groups and thigh CSA increased at T2 (approximately 3%) and T3 (approximately 4.5%) only in TP and TH. Squat one-repetition maximum (1 RM) increased at T2 (approximately 24%) and T3 (approximately 11.5%) only in TP and TH and all training groups increased 1 RM bench press at T2 (approximately 16.5%) and T3 (approximately 12.4%). Peak power produced during loaded jump squats increased from T1 to T3 only in TP (12%) and TH (7%). Peak power during the ballistic bench press increased at T2 only in TP and increased from T1 to T3 in all training groups. Training specificity was supported (as sole upper-body training did not influence lower-body musculature) along with the inclusion of heavier loading ranges in a periodized resistance-training program. This may be advantageous in a total conditioning program directed at development of muscle tissue mass in young women.

E. Marques et al. (2009) conducted a study to compare the effects of two exercise programs of 8 months duration on lipid profiles in older women. Aged 60–79 years were randomly assigned into a multi component exercise (ME)
program or resistance exercise (RE) program. Before- and after-training, body composition, daily physical activity (DPA), aerobic endurance, plasma concentrations of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and triglycerides (TG) were assessed. Training was performed twice weekly. The protocol for the ME included aerobic exercise, muscular endurance exercises and activities targeted to improve balance and flexibility. The RE protocol included leg press, leg extensions and curls, double chest raises, lateral raises, overhead press and abdominal exercises. Significant decreases in TG (−5.1%, p = 0.006), and significant increases in HDL-C (9.3%, p < 0.001) were observed in the ME group. Following 8 months no significant changes were observed on lipid profile in RE group, although lipid- and lipoprotein-related variables tended to alter favorably. Both regimens resulted in significant improvements on 6-min walk test (6.4%, p = 0.001 for ME; and 6.0%, p = 0.044 for RE). No significant changes were observed in total DPA and body fat in either group after exercise interventions. No significant correlations were found between body composition, physical activity, aerobic endurance, and lipid profile. The data suggested that 8 months of ME may be more effective than RE for inducing favorable changes in plasma lipoprotein and lipid profiles.

Campos et al. (2002) conducted a study on thirty two untrained men [mean (SD) age 22.5 (5.8) years, height 178.3 (7.2) cm, body mass 77.8 (11.9) kg] participated in an 8-week progressive resistance-training programme to investigate the "strength-endurance continuum". Subjects were divided into four groups: a low repetition group (low rep, n = 9) performing 3-5 repetitions maximum (RM) for four sets of each exercise with 3 min rest between sets and exercises, an intermediate repetition group (int rep, n = 11) performing 9-11 RM for three sets with 2 min rest, a high repetition group (high rep, n = 7) performing 20-28 RM for two sets with 1 min rest, and a non-exercising control group (con, n = 5). Three
exercises (leg press, squat, and knee extension) were performed 2 days/week for the first 4 weeks and 3 days/week for the final 4 weeks. Maximal strength [one repetition maximum, 1RM], local muscular endurance (maximal number of repetitions performed with 60% of 1RM), and various cardio respiratory parameters (maximum oxygen consumption, pulmonary ventilation, maximal aerobic power, time to exhaustion) were assessed at the beginning and end of the study. In addition, pre-training and post-training muscle biopsy samples were analyzed for fiber type composition, cross-sectional area, myosin heavy chain (MHC) content, and capillarization. Maximal strength improved significantly more for the low rep group compared to the other training groups, and the maximal number of repetitions at 60% 1RM improved the most for the high rep group. In addition, maximal aerobic power and time to exhaustion significantly increased at the end of the study for only the high rep group. All three major fiber types (types I, IIA, and IIB) hypertrophied for the low repetitions and intermediate repetitions groups, whereas no significant increases were demonstrated for either the high repetitions or control groups. However, the percentage of type IIB fibers decreased, with a concomitant increase in IIAB fibers for all three resistance-trained groups. These fiber-type conversions were supported by a significant decrease in MHC II accompanied by a significant increase in MHC II. No significant changes in fiber-type composition were found in the control samples. Although all three training regimens resulted in similar fiber-type transformations (IIB to IIA), the low to intermediate repetition resistance-training programmes induced a greater hypertrophic effect compared to the high repetition regimen. The high repetitions group, however, appeared better adapted for sub maximal, prolonged contractions, with significant increases after training in aerobic power and time to exhaustion. Thus, low and intermediate RM training appears to induce similar muscular adaptations, at least after short-term training in previously untrained subjects. Overall, however, these data demonstrate that both physical performance and the associated physiological adaptations are linked to the
intensity and number of repetitions performed, and thus lend support to the strength-endurance continuum.

**Anderson, T et al. (1982)** conducted a study on resistance training. Three sets of a) high–resistance-low repetition (HL) group (N=15) performed three sets of 6-8 Rm per session; b) medium-resistance–medium-repetition (MM) group (N=16) performed two sets of 30-40Rm per session; and c) low resistance–high repetition (LH) group (N=12) performed one set of 100-150 Rm, trained three times per week for nine weeks. Strength (1 Rm) absolute and relative endurance were assessed before and after the training period. Low repetitions and high resistances favour strength, whereas moderate to high repetitions using a moderate weight that can be accommodated produce endurance and minor strength changes. It is anticipated that the specificity of these effects will be more evident at the higher levels and training states of athletes who engage in this type of exercise.

**Nakao (1995)** investigated the effects of high Intensity weight training on aerobic capacity a long term weight lifting programme characterized by high intensity, low repetition and long rest period between sets on maximal oxygen consumption (Vo$_{2\text{max}}$) and to determine the advantage of this programme combined with jogging. Male untrained students were involved in weight training for a period of 3 years. The Vo$_{2\text{max}}$ and body composition of the subjects were examined at beginning and 1 year, 2 years (T2) and 3 years after (T3 the training of the group 19 subjects performed the weight lifting programme 5 days each week for 3 years (W – group), 4 subjects performed the same weight lifting programme for 3 year with an additional running programme consisting of 2 miles jogging once a week during the 3rd year (R1 – group) and 3 subject performed the weight lifting, programme during the 1st year and the same combined jogging and weight lifting, programme as the RI group during the 2nd and 3rd years (R2 – group). The average Vo$_{2\text{max}}$ relative to their body mass of the W – group
decrease significantly during the 1st year followed by an insignificant decrease in the 2nd year and a leveling off in the 3rd year. The average \( \text{Vo}_2 \text{max} \) of the W – group at T2 and T3 was 44.2 and 44.11 ml kg \(^{-1}\) min\(^{-1}\), respectively. The tendency of \( \text{Vo}_2 \text{max} \) changes in the R, and R2 group was similar to the W – group until they started the jogging programme, after which they recovered significantly to the initial level within a year of including that programme and they then leveled off during the next year. Lean body mass estimated from skin fold thickness has increase by about 8% after 3 years of weight lifting. The maximal muscles strength, defined by total Olympic lifts (snatch and clean jerk) of these three groups increased significantly and there was no significant difference among the amounts of the increase in the three groups.

Goto (2004) studied the acute and long-term effects of resistance-training regimens with varied combinations of high- and low-intensity exercises. Acute changes in the serum growth hormone (GH) concentration were initially measured after 3 types of regimens for knee extension exercise. They were a medium intensity (approximately 10 repetition maximum [RM]) short inter set rest period (30 s) with progressively decreasing load (hypertrophy type) 5 sets of a high-intensity (90% of 1RM) and low-repetition exercise (strength type); and a single set of low-intensity and high-repetition exercise added immediately after the strength-type regimen (combination-type). Post exercise increases in serum GH concentration showed significant regimen dependence: hypertrophy-type > combination-type > strength-type \((p < 0.05, n = 8)\). Next, the long-term effects of periodized training protocols with the above regimens on muscular function were investigated. Male subjects \((n = 16)\) were assigned to hypertrophy/combination (HC) or hypertrophy/ strength (HS) groups and performed leg press and extension exercises twice a week for 10 weeks. During the first 6 weeks, both groups used the hypertrophy-type regimen to gain muscular size. During the subsequent 4 weeks, HC and HS groups performed combination-type and strength-type
regimens, respectively. Muscular strength, endurance, and cross sectional area CSA) were examined after 2, 6, and 10 weeks. After the initial 6 weeks, no significant difference was seen in the percentage changes of all variables between the groups. After the subsequent 4 weeks, however, 1RM of leg press, maximal Isokinetic strength, and muscular endurance of leg extension showed significantly (p < 0.05) larger increases in the HC group than in the HS group. In addition, increases in CSA after this period also tended to be larger in the HC group than in the HS group (p = 0.08). It was finalized that a combination of high- and low-intensity regimens is effective for optimizing the strength adaptation of muscle in a periodized training program.

Sale DG et al. (1990) conducted a study by alternating strength training on one day, with endurance training on the other and compared doing both types of training on the same days per week. Young men (N = 7) experienced strength and endurance training together for two days per week for 20 weeks. A second group (N = 8) performed strength and endurance work two days per week but on different days. Strength training consisted of six to eight bouts of 15-20 RM on a leg press machine. Endurance training consisted of six to eight 3-min bouts on a cycle ergometer at 90-100% VO2max. Both groups improved similarly in strength measures except that the strength-alone training significantly increased the leg press 1 RM more. The reactions to endurance training were similar between the groups with the exception of citrate synthase increased significantly more in the combined training group. Generally, there was little that differed between the groups indicating that the training volume was possibly too low to produce differentiation, although both groups did improve across the duration of the study. Implication made by him was that the mixed and separate strength and endurance training has mainly similar training effects when the volume and frequency of training are low.
Florian Bobeuf et al. (2009) derived a study to examine the effects of resistance training on hematological blood markers in older individuals. Twenty-nine men and women participated in this study. Subjects were randomized in 2 groups: (1) control ($n = 13$) and (2) resistance training ($n = 16$). At baseline and after the intervention, subjects were submitted to a blood sample to determine their hematological profile (red blood cells, hemoglobin, hematocrit, platelets, leukocytes, neutrophils, lymphocytes, monocytes, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, red cell distribution width). At baseline, no difference was observed between groups. Moreover, we found no significant difference after the intervention on any of these markers. A 6-month resistance program in healthy older individuals seems to have no beneficial nor deleterious effects on hematological blood parameters. However, resistance training was well tolerated and should be recommended for other health purposes. Further studies are needed to confirm these results in a large population.

Davis WJ et al. (2008) evaluated the effects of concurrent strength and aerobic endurance training on muscle strength and endurance, body composition, and flexibility in female college athletes and compared two concurrent exercise (CE) protocols. Twenty-eight women (mean age, 19.6 years) were divided into two matched groups and evaluated before and after a vigorous, 11-week, 3-days per week CE training program. One group did serial CE consisting of a warm-up, resistance exercises at low heart rate (HR), aerobics, and a range of motion cool down. The other group did integrate CE consisting of aerobics, the same resistance exercises at high HR achieved by cardio acceleration before each set, and the same range of motion cool down. The two protocols were balanced, differing only in the timing and sequence of exercises. Serial CE produced discernible ($p < 0.05$) increases in lower- (17.2%) and upper- (19.0%) body muscle strength and fat-free mass (FFM) (1.8%) and trends toward greater lower-body muscle endurance (18.2%) and reduced upper-body flexibility (-160.4%). Integrated CE produced
discernible increases in lower- (23.3%) and upper- (17.8%) body muscle strength, lower-body muscle endurance (27.8%), FFM (3.3%), and lower-body flexibility (8.4%) and a decline in fat mass (-4.5%) and percent body fat (-5.7%). Integrated CE produced discernibly larger gains than serial CE for six of nine training adaptations. Effect sizes were generally moderate (44.4% of discernible differences) to large (33.3%). concluded that serial CE produces adaptations greater than those reported in the literature for single-mode (strength) training in athletes, whereas integrated CE produces discernibly greater gains than serial CE. The results suggest synergy rather than interference between concurrent strength and aerobic endurance training, support prescription of CE under defined conditions, establish the importance of exercise timing and sequence for CE program outcomes, and document a highly effective athletic training protocol.

Richard A. Winett *et al.* (2003) conducted study on effects of low volume resistance and cardiovascular training on strength and aerobic capacity in unfit men and women a threshold model postulates that prescriptively applying the appropriate cardiorespiratory and strength stimulus at a designated threshold of intensity for a brief time results in the targeted adaptations. A randomized control group design was used with 17 unfit males and females (mean age D 37:1§6:5 year) assigned to an exercise group (n D 9) who performed a progressive cardiovascular graded exercise protocol and resistance training twice a week for 12 weeks or a non exercising control group (n D 8). The intervention included a graded exercise protocol involving a 3-min warm-up, exercising 3–4 min at 70–80% of maximum heart rate, and a 3-min cool down. Progressive resistance exercise consisted of one set of six repetitions on each of six resistance machines. Results showed that the exercise group increased predicted aerobic capacity by 13.4% (p < 0:05), decreased submaximal rate pressure product by 17.2% (p < 0:05), and increased strength by 34% (p < 0:01). The results support a threshold model and show that time for effective exercise can be substantially reduced.
2.4 COMBINED AEROBIC AND RESISTANCE

Andrew Maiorana et al. (2002) investigated the effect of an 8 week circuit training (CT) program, combining aerobic and resistance exercise, on indices of glycemic control, cardiorespiratory fitness, muscular strength and body composition in 16 subjects (age 52±2 years) with type 2 diabetes using a prospective randomized crossover protocol. Submaximal exercise heart rate and rate pressure product were significantly lower after training (P<0.05), whilst ventilatory threshold increased (11.8±0.7 vs 13.8±0.6 ml kg⁻¹ min⁻¹, P<0.001). Muscular strength also increased with training (403±30 to 456±31 kg, P<0.001), whilst skinfolds (148.7±11.5 vs 141.1±10.7 mm, P<0.05), % body fat (29.5±1.0 vs 28.7±1.1%, P<0.05) and waist hip ratio (99.2±1.5 vs 97.9±1.4%, P<0.05) significantly decreased. Concurrently, peak oxygen uptake (P<0.05) and exercise test duration (P<0.001) increased following training, whilst glycated hemoglobin (P<0.05) and fasting blood glucose (P<0.05) decreased. CT is an effective method of training that improved functional capacity, lean body mass, strength and glycemic control in subjects with type 2 diabetes.

Takeshima. N et al. (2004) conducted a study to determine the physiological effects of a programmed accommodating circuit exercise (PACE) program consisting of aerobic exercise and hydraulic-resistance exercise (HRE) 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 PACE group 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. programmed accommodating circuit exercise increased (P<0.05) oxygen uptake (V̇O₂) at lactate threshold [PG, pre 0.79 (0.20) l min⁻¹, post 1.02 (0.22) l min⁻¹],
29%; control group, pre 0.87 (0.14) l min(-1), post 0.85 (0.15) l min(-1), -2%] and at peak \( \text{Vo}_2 \) [PACE group, pre 1.36 (0.24) l min(-1), post 1.56 (0.28) l min(-1), 15%; control group, pre 1.32 (0.29) l min(-1), post 1.37 (0.37) l min(-1), 4%] in PG measured using an incremental cycle ergometer. Muscular strength evaluated by a hydraulic-resistance exercise 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 skinfolds) decreased (16%), and high-density lipoprotein cholesterol (HDLC) increased (10.9 mg dl (-1)) for PACE group. There were no changes in any variables for control group. These results indicate that programmed accommodating circuit exercise training incorporating aerobic exercise and HRE elicits significant improvements in cardiorespiratory fitness, muscular strength, body composition, and HDLC for older adults. Therefore, programmed accommodating circuit exercise 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.

Park SK et al. (2003) investigated the effect of combined aerobic and resistance training on abdominal fat. Our participants in the study consisted of thirty obese women. They were separated into three groups: a control group (n=10), an aerobic training group (n=10) and a combined training group (n=10). The aerobic training group was composed of 60–70% HRmax (intensity), 60 minutes a day (duration) for 6 days a week (frequency). The combined training group was separated into resistance training (3 days a week, Mon, Wed, Fri) and the aerobic training (3 days a week, Tue, Thu, Sat). The levels for abdominal fat volume were measured by determining the subcutaneous fat volume (SFV), visceral fat volume (VFV), and VFV/SFV by CT (computed tomography). The VO2max was significantly (p<0.05) increased in both groups. The subcutaneous
fat and visceral fat levels were decreased in the combined training group more
than in the aerobics training group. Also, the lean body mass (LBM) was
significantly increased only in the combined training group. In addition, the total
cholesterol, triglyceride and LDL-C were significantly (p<.05) decreased and the
HDL-C was significantly (p<.05) increased in both groups. In conclusion, our
results observed that combined training decreased abdominal subcutaneous fat and
visceral fat more than aerobic training only.

Mandic S et al. (2009) examined the effects of different training modalities
on exercise capacity (VO 2peak), systolic function, muscular strength and
endurance and quality of life in heart failure patient randomized controlled trial.
Forty-two individuals with heart failure (62 ± 12 years i—iii).aerobic training (n =
14), combined aerobic and resistance training (n = 15) or usual care (n = 13) three
times per week for 12 weeks. vo 2peak measured by symptom-limited graded
exercise test on cycle ergometer; systolic function assessed by two-dimensional
echocardiography; muscular strength and muscular endurance measured by one-
repetition maximum procedure; and quality of life assessed by questionnaires. In
the intention-to-treat analysis, neither aerobic nor combined aerobic and resistance
training significantly improved vo 2peak, systolic function or quality of life
compared with usual care. However, combined aerobic and resistance training
significantly improved upper extremity strength (40.7 (14.0)—48.5 (16.0) kg,
p<0.05) and muscular endurance (5.7 (2.7)—11.6 (7.6) reps, p<0.05) compared
with aerobic training or usual care. In compliant participants (exercise adherence
80%), vo 2peak increased in the aerobic group (16.9 (6.0)—19.0 (6.8), p= 0.026)
and tended to increase in the combined training group (15.9 (5.0)—17.6 (5.6), p=
0.058) compared with usual care. Quality of life was improved in the aerobic
group only. Both aerobic and combined aerobic and resistance training are
effective interventions to improve vo 2peak in compliant heart failure patients.
Combined training may be more effective in improving muscle strength and endurance.

Claire Gavin et al. (2010) examined exercise effect on remnant-like lipoprotein particle cholesterol (RLP-C) in type 2 diabetes. Participants were randomized to control (Control), aerobic (Aerobic), resistance (Resistance), or both (Combined) exercise groups. Baseline and 6-month fasting RLP-C and apolipoprotein B48 concentrations were measured. Data analysis was on an intention-to-treat basis. At 6 months, RLP-C was lower in all groups; ∆RLP-C mg/dl, (95% confidence interval), Control −3.91, (−6.21 to −1.6), p = 0.001; Aerobic −3.89, (−6.41 to −1.36), p = 0.003, Resistance −7.52, (−9.89 to −5.15), p = 0.0001, Combined −7.50, (−9.87 to −5.13), p = 0.0001. Total triglycerides were significantly lower in Resistance and Combined groups only; −17.7 mg/dl (−32.8 to −2.7), p = 0.02 and −27.5 (−42.5 to −11.5), p = 0.001, respectively. Inter-group comparisons showed no difference in RLP-C change between Aerobic and Control and a significant difference in RLP-C change only where groups incorporating resistance exercise were compared with those without. There was no significant difference in RLP-C change between Resistance and Combined. Inter-group comparisons of total triglycerides change were significant only between Combined and Control. Changes in apolipoprotein B48 were not significant in inter-group comparisons; the data indicate that resistance exercise training, not aerobic, lowers RLP-C in type 2 diabetes. This effect was not revealed by changes in total triglycerides and apolipoprotein B48. The discordance between changes in RLP-C and apolipoprotein B48 in response to resistance exercise may indicate (a) a decrease in VLDL remnant and not chylomicron remnant particle number and/or (b) a depletion of cholesterol in chylomicron and/or VLDL remnants.

Sarika Chaudhary et al. (2010) was designed a study to evaluate the effects of aerobic and strength training on cardiac variables such as blood
pressure, heart rate (HR), and metabolic parameters like cholesterol, high density lipoprotein (HDL), and triglycerides and anthropometric parameters of obese women of Punjab. This study was performed as an experimental study, in which subjects were randomly selected. There were thirty obese women, aged between 35-45yrs with body mass index (BMI) of above 30. Subjects were grouped into control (n=10), aerobic training (n=10) and resistance training (n=10). Aerobic training was given for three days a week at 60-70% of maximum heart rate for 6 weeks. Resistance training (Delorme and Watkins Technique) was given for alternate days for 6 weeks. Heart rate and blood pressure were measured before and after the exercise. Recovery heart rate was also measured. The findings of the study indicate statistically significant differences in recovery heart rate [Pre-exercise: 97.40± 5.378 (mean± standard deviation (SD)), post-exercise: 90.70±4.599, t=8.066, P<0.001] and in post-diastolic blood pressure [Pre-exercise:85±3.265, post-exercise: 86.20±2.820, P<0.001] in aerobic training and in systolic blood pressure [Pre- and post-exercise] in both training groups (P<0.001). Significant differences were observed in very low-density lipoprotein [pre-exercise: 28.10±1.415, post exercise: 26.86±0.760, t=5.378] and HDL [pre-exercise: 45.40±3.533, post-exercise: 53.60±3.134, t=6.318] levels in aerobic training group with P<0.001. BMI and body fat percentage showed significant improvements in both training groups. Aerobic training is more beneficial and can be used as a preventive measure in patients who are at risk of developing cardiovascular diseases due to obesity.

Irfan Moinuddin et al. (2008) conducted study morbidity and mortality associated with chronic kidney disease (CKD) is primarily caused by atherosclerosis and cardiovascular disease, which may be in part caused by inflammation and oxidative stress. Aerobic exercise and resistance training have been proposed as measures to combat obesity, inflammation, endothelial dysfunction, oxidative stress, insulin resistance, and progression of chronic kidney
disease. In non-chronic kidney disease patients, aerobic exercise reduces inflammation, increases insulin sensitivity, decreases microalbuminuria, facilitates weight loss, decreases leptins, and protects against oxidative injury. In nondialysis chronic kidney disease, aerobic exercise decreases microalbuminuria, protects from oxidative stress, and may increase the glomerular filtration rate (GFR). Aerobic exercise in hemodialysis patients has been reported to enhance insulin sensitivity, improve lipid profile, increase hemoglobin, increase strength, decrease blood pressure, and improve quality of life. Resistance training, in the general population, decreases C-reactive protein, increases insulin sensitivity, decreases body fat content, increases insulin-like growth factor-1 (IGF-1), and decreases microalbuminuria. In the nondialysis chronic kidney disease population, resistance training has been reported to reduce inflammation, increase serum albumin, maintain body weight, increase muscle strength, increase IGF-1, and increase GFR. Resistance training in hemodialysis increases muscle strength, increases physical functionality, and improves IGF-1 status. Combined aerobic exercise and resistance training during dialysis improves muscle strength, work output, cardiac fitness, and possibly dialysis adequacy. There is a need for more investigation on the role of exercise in chronic kidney disease. If the benefits of aerobic exercise and strength training in non-chronic kidney disease populations can be shown to apply to chronic kidney disease patients as well, renal rehabilitation will begin to play an important role in the approach to the treatment, prevention, and slowed progression of chronic kidney disease.

Guarantor; William J et al. (2004) conducted a study to determine the effects of high intensity endurance training (ET) and resistance training (RT) alone and in combination on various military tasks. Thirty-five male soldiers were randomly assigned to one of four training groups: total body resistance training plus endurance training (RT + ET). Upper body resistance training plus endurance training (UB + ET). Resistance training only and endurance training only.
Training was performed 4 days per week for 12 weeks. Testing occurred before and after the 12-week training regimen. All groups significantly improved push-up performance, whereas only the RT - ET group did not improve sit-up performance. The groups that included ET significantly decreased 2-mile run time, however, only resistance training - endurance training and UB t ET showed improved loaded 2-mile run time. Leg power increased for groups that included lower body strengthening exercises (RT and RT + ET). Army Physical Fitness Test performance, loaded running, and leg power responded positively to training, however, it appears there is a high degree of specificity when concurrent training regimens are implemented.

Sevgi Sevi Subaşı et al. (2009) was compared the effects of two different types (aerobic and resistance) of acute exercise on plasma homocysteine level and lipid profiles. Material and 51 students were included. Resistance exercise group (n=20) performed moderate resistance and aerobic exercise group (n=18) performed sub-maximal aerobic exercise for one session. Control group (n=13) did not join any exercise. The plasma homocysteine level and lipid profiles were measured. Two-way ANOVA with repeated measures yielded a significant time by group interaction for homocysteine level. Homocysteine level in aerobic exercise group was statistically different from the control group (p=0.04). We found that the increase for plasma homocysteine level in aerobic exercise group was higher than the percentage of biological variation of the plasma homocysteine (p<0.05). Acute exercises did not considerably change lipid profiles (p>0.05). Our findings indicate that although the acute moderate aerobic exercise increases plasma homocysteine level the acute resistance exercise does not. Independently from the type of exercise, acute exercises do not considerably change lipid profiles.
Panton LB et al. (1990) conducted a study to determine 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 reaction time or speed of movement in this group.

2.5 COMBINED YOGA AND AEROBICS

Chandrasekar et al. (2011) was investigated the impact of yogic practice and aerobic exercise among overweight school boys. To achieve this purpose, sixty overweight school boys from various schools in Tiruchirappalli district were selected at random. Their age ranged between 14 and 17. The selected subjects were divided into three equal groups of 20 each, namely yogic practice group (group A), aerobic exercise group (group B) and control group (group C). The group A had undergone yogic practice; group B had undergone aerobic exercise for 12 weeks, five days a week, whereas the control group (group C) maintained their daily routine activities and no special training was given. The subjects of the three groups were tested using standardized tests and procedures on selected physical and physiological variables before and after the training period to find out the training efforts in the following test items: physical variables abdominal muscular strength and physiological variables breath holding time. The collected data were analyzed statistically through analysis of Co Variance (ANACOVA) and Scheffe’s post hoc test to find out the pre and post training performances.
Compare the significant difference between the adjusted final means and better group.

Uthirapathy et al. (2007) the purpose of the study was to find out the relative influence of yogic practices and aerobic exercises on serum protein level. Forty five players were randomly selected as subjects. The subjects were divided equally into three groups namely control group, aerobic exercise group and yogic practices group. The aerobic exercise group and yogic practices group underwent selected aerobic exercises and yogic practices respectively. The experimental period was 12 weeks, six days a week, 40 minutes per day. But the control group was not given any sort of special training. The criterion measure selected for this study was serum protein level and it was tested before and after the experimental period. The initial and final scores of all three groups were obtained. To find out the significant mean differences, the analysis of co-variance statistical technique was employed. Further the scheffe’s post-hoc test was used to identify which group has shown better. The training effect of yogic practices and aerobic exercises evidenced significant influence over the serum protein level. When compared, the yogic practices group had better impact than aerobic exercise group.

Senthilkumar et al. (2011) was determined whether aerobic interval training with yogic practices (AEIYG) or anaerobic interval training with yogic practices (ANIYG) has greater effect on selected physical fitness variables, speed and agility among high school football players. For this purpose, the investigator selected find out the influence of aerobic and anaerobic interval 90 football players divided into three groups, namely, AEIYG, ANIYG and control group (CG). The subjects were tested for speed and agility initially and after 12 weeks of experiment on respective training on the subjects. The results proved that there was significant improvement in speed (F: 45.52) and agility (F 8.37) on adjusted
means, against required F value of 3.1. The post hoc analysis proved that AEIYG was better than CG and ANIYG in improving speed and agility of school level football players. It was concluded that aerobic interval training with yogic practices significantly improved speed and agility of the school level football players than anaerobic power with yogic practices.

Bowman AJ et al. (1997) conducted a study on the effects of aerobic exercise training and yoga, a non-aerobic control intervention, on the baroreflex of elderly persons was determined. Baroreflex sensitivity was quantified by the alpha-index, at high frequency (HF; 0.15-0.35 Hz, reflecting parasympathetic activity) and mid-frequency (MF; 0.05-0.15 Hz, reflecting sympathetic activity as well), derived from spectral and cross-spectral analysis of spontaneous fluctuations in heart rate and blood pressure. Twenty-six (10 women) sedentary, healthy, normotensive elderly (mean 68 years, range 62-81 years) subjects were studied. Fourteen (4 women) of the sedentary elderly subjects completed 6 weeks of aerobic training, while the other 12 (6 women) subjects completed 6 weeks of yoga. Heart rate decreased following yoga (69 +/- 8 vs. 61 +/- 7 min^-1, P < 0.05) but not aerobic training (66 +/- 8 vs. 63 +/- 9 min^-1, P = 0.29). VO2 max increased by 11% following yoga (P < 0.01) and by 24% following aerobic training (P < 0.01). No significant change in alpha MF (6.5 +/- 3.5 vs. 6.2 +/- 3.0 ms mmHg^-1, P = 0.69) or alpha HF (8.5 +/- 4.7 vs. 8.9 +/- 3.5 ms mmHg^-1, P = 0.65) occurred after aerobic training. Following yoga, alpha HF (8.0 +/- 3.6 vs. 11.5 +/- 5.2 ms mmHg^-1, P < 0.01) but not alpha MF (6.5 +/- 3.0 vs. 7.6 +/- 2.8 ms mmHg^-1, P = 0.29) increased. Short-duration aerobic training does not modify the alpha-index at alpha MF or alpha HF in healthy normotensive elderly subjects. alpha HF but not alpha MF increased following yoga, suggesting that these parameters are measuring distinct aspects of the baroreflex that are separately modifiable.
2.6 THEMATIC

Reasner CA (2008) conducted a study on reducing cardiovascular complications of type 2 diabetes by targeting multiple risk factors. Insulin resistance syndrome is characterized by hyperglycemia, atherogenic dyslipidemia, hypertension, and abdominal obesity. Hyperglycemia is the major risk factor for microvascular complications in type 2 diabetes. However, 70% to 80% of patients with type 2 diabetes will die of macrovascular disease. Atherogenic dyslipidemia—characterized by elevated triglyceride levels, low high-density lipoprotein cholesterol (HDL-c) levels, and a preponderance of small, dense, low-density lipoprotein (LDL) particles—is the major cause of atherosclerosis in individuals with type 2 diabetes. Therefore, treatment of type 2 diabetes must address hyperglycemia to prevent microvascular disease (retinopathy, neuropathy, and nephropathy) and atherogenic dyslipidemia to prevent macrovascular complications. Emerging evidence indicates lipid and glucose homeostasis are interrelated via bile acid-activated nuclear hormone receptor signaling pathways. Agents that act on these pathways could simultaneously address hyperglycemia and dyslipidemia in patients with type 2 diabetes. Recent studies have shown that bile acid sequestrants, including cholestyramine, colestimide, and colesevelam HCl, significantly improve glycemic control and reduce LDL cholesterol levels in patients with type 2 diabetes. This paper will review the effects of bile acid sequestrants on both glucose and lipid metabolism in patients with type 2 diabetes.

Kirk A et al. (2003) evaluated the effect of exercise consultation on physical activity and resultant physiological and biochemical variables at 6 months in people with type 2 diabetes. A total of 70 inactive people with type 2 diabetes were given standard exercise information and were randomized to receive an exercise consultation (n = 35) or not (n = 35). Exercise consultation, based on the transtheoretical model, combines motivational theory and cognitive behavioral
strategies into an individualized intervention to promote physical activity. Changes from baseline to 6 months were assessed in physical activity (7-day recall, accelerometer, cardiorespiratory fitness, stage, and processes of change), physiological variables (blood pressure and BMI), and biochemical variables (HbA(1c), lipid profile, and fibrinogen). Between-group differences were recorded for the change in minutes of moderate activity (P < 0.001) and activity counts (P < 0.001) per week. Experimental participants recorded an increase in activity counts per week and minutes of moderate activity per week (P < 0.001). The control group recorded no significant changes. More experimental participants increased stage of change (chi(2) = 22.6, P < 0.001). Between-group differences were recorded for the change in total exercise duration and peak gradient (P < 0.005), HbA(1c) (P = 0.02), systolic BP (P = 0.02), and fibrinogen (P = 0.03). Exercise consultation increased physical activity and improved glycemic control and cardiovascular risk factors in people with type 2 diabetes.

Kirk A et al. (2004) was investigated the effectiveness of physical activity counselling in promoting physical activity in people with Type 2 diabetes and to evaluate resultant physiological and biochemical effects. A total of 70 inactive people with Type 2 diabetes were given standard exercise information and randomised to receive physical activity counselling (n=35, experimental) or not (n=35, control). Physical activity consultations were delivered at baseline and after 6 months, with follow-up phone calls after 1, 3, 6 and 9 months. Changes from baseline after 6 and 12 months were assessed for physical activity (7-day recall and accelerometer), for physiological characteristics (body mass index and blood pressure) and for biochemical variables (HbA(1)c, lipid profile, fibrinogen, tissue plasminogen activator and microalbuminuria). Significant differences between groups were recorded for physical activity after 6 and 12 months (p<0.01). The experimental group had increased levels of physical activity from baseline to 6 months (p<0.01), with no decrease from 6 to 12 months (p>0.05). In the control
group, accelerometer counts per week decreased from baseline to 12 months (p=0.03). Between-group differences (p<0.05) were recorded for the change in HbA(1)c (experimental: 0.26% decrease; control: 0.15% increase), for systolic blood pressure (experimental: 7.7 mm Hg decrease; control: 5.6 mm Hg increase) and for fibrinogen (experimental: 0.28 mmol/l decrease; control: 1.43 mmol/l increase) from baseline to 6 months, and for total cholesterol (experimental: 0.33 mmol/l decrease; control: 0.04 mmol/l increase) from baseline to 12 months (p<0.05). No significant differences were recorded in other measured variables. Physical activity counselling was effective in promoting physical activity in people with Type 2 diabetes. The counselling improved glycaemic control as well as the status of cardiovascular risk factors in these patients.

Adres do korespondencji (2010) conducted a study on the main cause of the excessive deposition of fat is the destruction of the mechanisms controlling the expenditure of energy. Pathological increase of adipose tissue leads to disorders of the body, and lipid – carbohydrate parameters, promotes the development of vascular diseases and increases the risk of morbidity and mortality. The aim of the study is to demonstrate the impact of diet and physical activity changes in the parameters lipid-carbohydrate of adolescents. The study included obese boys (n = 35), undergoing weight reduction. A low-energy diet and regular physical activity were applied. At the beginning and after four weeks were performed anthropometric measurements and indicators of the composition of venous blood was determined. In the venous blood was determined total cholesterol, HDL-cholesterol, triacylglycerols (TG), glucose and insulin. LDL-cholesterol was calculated. It was found that the applied treatment improved the lipid profile of blood. Only for triglyceride change was not statistically significant. Statistically significant was the reduction of the concentration of glucose. Reduction of body mass resulted in positive changes in blood lipidogramme and reduction of waist hip ratio, which can reduce the risk of cardiovascular disease in the future.
Reduction in serum insulin and glucose demonstrates improved carbohydrate metabolism and indicates a reduced risk for type II diabetes.

**Indranil Manna et al. (2010)** conducted a study on to find out the effect of training on selected physiological and biochemical variables of Indian soccer players of different age groups. A total of 120 soccer players volunteered for the study, were divided (n=30) into 4 groups: (i) under 16 years (U16), (ii) under 19 years (U19), (iii) under 23 years (U23), (iv) senior (SR). The training sessions were divided into 2 phases (a) Preparatory Phase (PP, 8 weeks) and (b) Competitive Phase (CP, 4 weeks). The training program consisted of aerobic, anaerobic and skill development, and were completed 4 hrs/day; 5 days/week. Selected physiological and biochemical variables were measured at zero level (baseline data, BD) and at the end of PP and CP. A significant increase (P<0.05) in lean body mass (LBM), \( \text{V} \text{o}_2\text{m} \text{a} \text{x} \), anaerobic power, grip and back strength, urea, uric acid and high density lipoprotein cholesterol (HDL-C); and a significant decrease (P<0.05) in body fat, hemoglobin (Hb), total cholesterol (TC), triglyceride (TG) and low density lipoprotein cholesterol (LDL-C) were detected in some groups in PP and CP phases of the training when compare to BD. However, no significant change was found in body mass and maximal heart rate of the players after the training program. This study would provide useful information for training and selection of soccer players of different age groups.

**Deborah R. Young et al. (2005)** conducted a study on physical activity, cardiorespiratory fitness, and their relationship to cardiovascular risk factors in African Americans and non-African Americans with above-optimal blood pressure.

This report describes cross-sectional associations among physical activity, cardiorespiratory fitness, dietary habits, and cardiovascular disease (CVD) risk factors in a large sample (n ¼ 810) of African Americans (n ¼ 279) and non-African Americans (n ¼ 531) with above optimal blood pressure. Participants in
PREMIER, a clinical trial for blood pressure control through lifestyle approaches, underwent baseline assessments to determine physical activity level, cardiorespiratory fitness category, dietary intake, and CVD risk factors. Mean levels of body mass index (BMI), total cholesterol, LDL cholesterol, HDL cholesterol, daily percent calories from fat and saturated fat, daily serving’s of fruits and vegetables, and daily fiber intake were examined across three physical activity levels and two fitness categories. Hypertension status was also assessed. Data were stratified by sex and ethnicity. For all participants, those in the low fitness category had higher BMI levels. Total cholesterol was lower in African American women in the high fitness category. Mean values of more than five daily servings of fruits and vegetables were reported by non-African American women and African American men in the high activity category. Higher intake of dietary fiber was found for non-African American women at the high activity level, with a similar trend observed for African American women. Future work examining these associations prospectively should include sufficient minority representation to enhance generalizability to all population groups and determine the beneficial effects from increased physical activity and improved cardiorespiratory fitness.