Chapter II

REVIEW OF RELATED LITERATURE

The literature in any field forms the foundation upon which all future work will be built. The present chapter consists of various research studies relevant to the study under investigation. A search for the reference materials would assist the investigator to determine the effectiveness of the various combinations of the variables, methodology used and the results obtained. The review of related literature scanning may serve as an important adjunct to the investigator by assisting in the interpretation of his own study. Keeping in mind, the investigator has traced out different types of research works that have been undertaken by the physical educationists and sport scientists on criterion variables related to the study.

Studies on the importance of physical activity as a preventive medicine from several degenerative diseases like Cardiovascular diseases, etc.

There has been a general understanding and acceptance that regular involvement in physical activity could prevent several degenerative diseases through alterations in physiology of individuals. It is an accepted concept that enhancement of fitness and maintenance of certain level of physical fitness is also positively correlated to better health status leading to prevention of several degenerative diseases. Hence, it is essential to participate in physical activity
programs regularly to derive the desirable changes. Several studies have proved very constructively that physical activity in some form is essential to maintain the required health status to prevent diseases, though some studies favored specific form of exercises for specific adaptation, which is again accepted. Hence, the relationship between the regularity of physical activity and physical fitness and consequent health benefits been supported by many studies.

Kyrolainen H, Santtila M, et al., (2010) have presented a review of current physical fitness profiles of male children, adolescents and young adults. In addition, they tried to implicate the importance of physical fitness level in relation to obesity and health. They have suggested that collectively, studies examining physical fitness profiles of young men suggest a disturbing worldwide trend of decreased aerobic fitness and increased obesity. They recommended that continued efforts to foster improved physical fitness and healthy lifestyles should be encouraged to combat these trends and such efforts should include frequent and objective assessment of physical fitness rather than solely relying on subjective assessment of physical activity.

Fogelholm M (2010) conducted a systematic review to study the relative health risks of poor cardio-respiratory fitness (or physical inactivity) in normal-weight people vs. obesity in individuals with good cardio-respiratory fitness (or high physical activity). The core inclusion criteria were: publication year 1990 or later; adult participants; design prospective follow-up, case-control or cross-sectional; data on cardio-respiratory fitness and/or physical activity; data on BMI (body mass index), waist circumference or body composition; outcome
data on all-cause mortality, cardiovascular disease mortality, cardiovascular disease incidence, type 2 diabetes or cardiovascular and type 2 diabetes risk factors. He included thirty-six publications which filled the criteria for inclusion. The data indicate that the risk for all-cause and cardiovascular mortality was lower in individuals with high BMI and good aerobic fitness, compared with individuals with normal BMI and poor fitness. In contrast, having high BMI even with high physical activity was a greater risk for the incidence of type 2 diabetes and the prevalence of cardiovascular and diabetes risk factors, compared with normal BMI with low physical activity.

Though high BMI in itself a risk factor for cardiovascular mortality when associated with good aerobic fitness indicating regular exercising is essential to prevent cardiovascular disease symptoms. But, high BMI though with higher order physical activity associations, may be attributed as a risk factor for metabolic disorders like diabetes mellitus.

**Jago R, Drews KL, McMurray RG, et al., (2010)** examined whether cardio metabolic risk factors are predicted by fitness or fatness among adolescents. 4955 (2614 female) sixth-grade students with complete data from 42 US middle schools were participants. Fasting blood samples were analyzed for total cholesterol, HDL- and LDL-cholesterol, triglyceride, glucose, and insulin concentrations. Waist circumference and blood pressure were assessed. Body mass index (BMI) was categorized as normal weight, overweight, or obese as a measure of fatness. Fitness was assessed using the multistage shuttle test and was converted into gender-specific quintiles. Gender-specific regression
models, adjusted for race, pubertal status, and household education, were run to identify whether BMI group predicted risk factors. Models were repeated with fitness group and both fitness and fatness groups as predictors. They have found that means for each risk factor (except HDL, which was the reverse) were significantly higher ($P < 0.0001$) with increased fatness and differed across all BMI groups ($P < 0.001$). Waist circumference, LDL-cholesterol, triglycerides, diastolic blood pressure, and insulin were inversely associated with fitness ($P < 0.001$). When both fatness and fitness were included in the model, BMI was associated ($P < 0.001$) with almost all cardio-metabolic risk factors; fitness was only associated with waist circumference (both genders), LDL-cholesterol (males), and insulin (both genders). Other associations between fitness and cardio-metabolic risk factors were attenuated after adjustment for BMI group.

They have concluded that both fatness and fitness are associated with cardio-metabolic risk factors among sixth-grade youth, but stronger associations were observed for fatness. They have indicated from the above that, although maintaining high levels of fitness and preventing obesity may positively affect cardio-metabolic risk factors, greater benefit may be obtained from obesity prevention.

Maintaining high level fitness through regular involvement in aerobic activities has been highly recommended to maintain the cardio metabolic risk factors at low levels and prevent cardiovascular problems. Prevention of obesity has been postulated as one important measure than the fitness enhancement. Hence, the studies have revealed that prevention of obesity along with high
physical fitness is better option to keep at bay of the cardiovascular problems. Regular involvement in scientifically designed physical activity alone can improve the physical fitness to the desired level leading to enhanced health status for prevention of degenerative diseases.

**Studies on various forms of physical activity/exercise on the body fat Percentage or body composition**

There have been different forms of exercise and these exercises depend on different metabolic cascades and may show different impact on the metabolism of glucose, lipids, protein and other blood proteins like fibrinogen etc. Aerobic form of exercise utilise maximum amount of fats during the exercise, where as the resistance form of exercise like strength training utilise more of muscle glycogen and phosphocreatine than the lipids. But, there may be difference in metabolic status after the exercise programmes of these forms. When it comes to the anaerobic sprints the metabolic pathway is more or less like the resistance form of exercise and in addition it may use some lipids and even the lactate. During these different forms of exercises and after the physiological status of individual changes and may lead to different effects on the different physiological variables of individuals. The effect of these three different forms of exercises independently and in combination may work differently on the body composition.

*Wong PC, Chia MY, Tsou IY, et al., (2008)* have examined the effects of a 12-week twice weekly additional exercise training, which comprised a combination of circuit-based resistance training and aerobic exercises, in
additional to typical physical education sessions, on aerobic fitness, body composition and serum C-reactive protein (CRP) and lipids were analyzed 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 (HR max = 220 - age). Body composition was measured using dual energy X-ray absorptiometry (DEXA). Fasting serum CRP and blood lipids was analyzed pre and post exercise program. Aerobic fitness was measured by an objective laboratory sub maximal exercise test, PWC170 (predicted work capacity at HR 170 bpm). They have observed that the 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. They have suggested that increase in physical activity should be hallmark at schools apart from the regular physical education programs to gain fitness and also to bring favorable changes among children in their body composition. Aerobic training is a popular mode of exercise to derive health benefits and several studies have showed significant results with respect to body composition through aerobic exercise training.
Stasiulis A, Mockiene A, et al., (2010) have conducted a study to assess changes in body composition, blood lipid and lipoprotein concentrations in 18-24 year old women during the period of two-month aerobic cycling training. Young, healthy, nonsmoking women (n=19) volunteered to participate in this study. They were divided in two groups: experimental (E, n=10) and control (C, n=9). The subjects of group E exercised 3 times a week with intensity of the first ventilatory threshold and duration of 60 min. The group C did not exercise regularly over a two-month period of the experiment. The subjects of group E were tested before and after 2, 4, 6 and 8 weeks of the experiment. The participants of group C were tested twice with an eight-week interval. Body weight, body mass index, body fat mass, and triacylglycerol (TAG) concentration decreased and high-density lipoprotein cholesterol (HDL-ch) concentration increased after the 8-week training program in the experimental group (P<0.05). Blood total cholesterol (Tch) and low-density lipoprotein cholesterol (LDL-ch) concentrations did not change significantly. Body weight and body mass index started to decrease after 2 weeks of the experiment, but significant changes were observed only after 6 and 8 weeks. Body fat mass was significantly decreased after 2 and 8 weeks of aerobic training. A significant increase in HDL-ch concentration was observed after 4, 6, and 8 weeks. A significant decrease in TAG concentration was observed after 2-week training. No significant changes in all the parameters except TAG (it was slightly increased) were seen in the control group. They have concluded that the two-month aerobic cycling training (within VT1, 60-min duration,
three times a week) may induce significant changes in the parameters of body composition—body weight, body mass index, body fat mass, and blood lipids—in young women. Hence, independently the aerobic endurance training is beneficial in bringing positive changes in body composition and lean mass of the individuals especially when the exercise training is longer.

Sillanpaa E, Hakkinen A, Nyman K, Mattila M, Cheng S, Karavita, et al., (2009) have investigated the adaptations in body composition, physical fitness and metabolic health during 21 weeks of endurance and/or strength training in 39 to 64 year old healthy women. Subjects (n = 62) were randomized into endurance training (E), strength training (S), combined strength and endurance training (SE), or control groups (C). S and E trained 2 and SE 2 + 2 times in a week. Muscle strength and maximal oxygen uptake (VO$_2$max) were measured. Leg extension strength increased 9 ± 8% in S (P < 0.001), 12 ± 8% in SE (P < 0.001) and 3 ± 4% in E (P = 0.036), and isometric bench press 20% only in both S and SE (P < 0.001). VO$_2$max increased 23 ± 18% in E and 16 ± 12% in SE (both P < 0.001). The changes in the total body fat (dual X-ray absorptiometry) did not differ between groups, but significant decreases were observed in E (-5.9%, P = 0.022) and SE (-4.8%, P = 0.005). Lean mass of the legs increased 2.2-2.9% (P = 0.004-0.010) in S, SE and E. There were no differences between the groups in the changes in blood lipids, blood pressure or serum glucose and insulin. Total cholesterol and low-density lipoprotein cholesterol decreased and high-density lipoprotein cholesterol increased in E. Both S and SE showed small decreases in serum fasting
insulin. Both endurance and strength training and their combination led to expected training-specific improvements in physical fitness, without interference in fitness or muscle mass development. All training methods led to increases in lean body mass, but decreases in body fat and modest improvements in metabolic risk factors were more evident with aerobic training than strength training.

LeMura LM, von Duvillard SP, Andreacci J, et al., (2000) have conducted a study to evaluate the effects of various modes of training on the time-course of changes in lipoprotein-lipid profiles in the blood, cardiovascular fitness, and body composition after 16 weeks of training and 6 weeks of detraining in young women. A group of 48 sedentary but healthy women [mean age 20.4 (SD 1) years] were matched and randomly placed into a control group (CG, n = 12), an aerobic training group (ATG, n = 12), a resistance training group (RTG, n = 12), or a cross-training group that combined both aerobic and resistance training (XTG, n = 12). The ATG, RTG and XTG trained for 16 weeks and were monitored for changes in blood concentrations of lipoprotein-lipids, cardiovascular fitness, body composition, and dietary composition throughout a 16 week period of training and 6 weeks of detraining. The ATG significantly reduced blood concentrations of triglycerides (TRI) (P < 0.05) and significantly increased blood concentrations of high-density lipoprotein-cholesterol (HDL-C) after 16 weeks of training. The correlation between percentage fat and HDL-C was 0.63 (P < 0.05), which explained 40% of the variation in HDL-C, while the correlation between maximal oxygen uptake (VO\textsubscript{2max}) and HDL-C was 0.48 (P
< 0.05), which explained 23% of the variation in HDL-C. The ATG increased VO$_2$ max by 25% (P < 0.001) and decreased percentage body fat by 13% (P < 0.05) after 16 weeks. Each of the alterations in the ATG had disappeared after the 6 week detraining period. The concentration of total cholesterol (TC), TRI, HDL-C and low density lipoprotein-cholesterol in the blood did not change during the study in RTG, XTG and CG. The RTG increased upper and lower body strength by 29% (P < 0.001) and 38%, respectively. The 6 week detraining strength values obtained in RTG were significantly greater than those obtained at baseline. The XTG increased upper and lower body strength by 19% (P < 0.01) and 25% (P < 0.001), respectively. The 6 week detraining strength values obtained in XTG were significantly greater than those obtained at baseline. The RTG, XTG and CG did not demonstrate any significant changes in either VO$_2$ max, or body composition during the training and detraining periods.

Basing on the results of this study they have suggested that aerobic-type exercise improves lipoprotein-lipid profiles, cardio respiratory fitness and body composition in healthy, young women, while resistance training significantly improved upper and lower body strength only.

The comparison among the individualized endurance, strength and combined training brought significant results in the body composition of individuals and more positive changes have been observed when the individuals practiced both strength and endurance exercises simultaneously. More combinations of training like aerobic, anaerobic and strength training need to be examined on the status of body composition, body fat, etc. Some
studies have showed that only the aerobic training brings positive change in body composition and not other training forms and hence more extensive studies are needed in this direction.

**Studies on the effects of aerobic training on LDL, HDL and Triglyceride cholesterol**

Aerobic training improves the lipid metabolism and may bring changes in the resting LDL, HDL and triglyceride cholesterol among individuals. It may also show impact on the proteolysis and hence on the fibrinogen. The fibrinolysis status may be changed due to the metabolic preference during the aerobic endurance exercise programs and training. Endurance exercise training improves plasma lipoprotein and lipid profiles and reduces cardiovascular disease risk. However, the effect of endurance exercise training, independent of diet and body fat phenotypes, on plasma lipoprotein subfraction particle concentration, size and composition as measured by nuclear magnetic resonance (NMR) spectroscopy is not known.

**Jennifer A. McKenzie, Sarah Witkowski, et al., (2011)** have conducted a study on the influences of metabolic variables and their responses to aerobic exercise training. Following dietary stabilization, healthy, sedentary, 50 to 75 year-old Caucasian men \((n = 51)\) and women \((n = 58)\) underwent 6 months of aerobic exercise training. Before and after completing the intervention, dual-energy X-ray absorptiometry was used to measure percentage body fat, computed tomography to measure visceral and subcutaneous fat, and oral
glucose tolerance testing to measure glucose total area under the curve (AUC), insulin AUC and insulin sensitivity. Taqman assay was used to determine \( AKT1 \) \( G205T \) genotypes. At baseline, men with the GG genotype \( (n = 29) \) had lower maximal oxygen consumption \( (\text{VO}_2 \max) \) values \( (P = 0.026) \) and higher percentage body fat \( (P = 0.046) \), subcutaneous fat \( (P = 0.021) \) and insulin AUC \( (P = 0.003) \) values than T allele carriers \( (n = 22) \). Despite their rather disadvantageous starting values, men with the GG genotype seemed to respond to exercise training more robustly than men with the T allele, highlighted by significantly greater fold change improvements in insulin AUC \( (P = 0.012) \) and glucose AUC \( (P = 0.035) \). Although the GG group also significantly improved \( (\text{VO}_2 \max) \) with training, the change in \( (\text{VO}_2 \max) \) was not as great as that of the T allele carriers \( (P = 0.037) \). In contrast, after accounting for hormone replacement therapy use, none of the variables differed in the women at baseline. As a result of exercise training, women with the T allele \( (n = 20) \) had greater fold change improvements in fasting glucose \( (P = 0.011) \), glucose AUC \( (P = 0.017) \) and insulin sensitivity \( (P = 0.044) \) than GG genotype women \( (n = 38) \). Our results suggest that the \( AKT1 \) \( G205T \) polymorphism influences metabolic variables and their responses to aerobic exercise training in older, previously sedentary individuals.

**Eric P Plaisance1, Michael L Mestek1, et al., (2008)** have found that the aerobic exercise and niacin are frequently used strategies for reducing serum triglycerides, and yet, there is no information regarding the combined effects of these strategies on postprandial triglycerides. In this study they
compared the effects of aerobic exercise and 6 wk of extended-release niacin on postprandial triglycerides in men with the metabolic syndrome. For this study fifteen participants underwent each of 4 conditions: control—high-fat meal only (100 g fat); exercise—aerobic exercise performed 1 h before a high-fat meal; niacin—high-fat meal consumed after 6 wk of niacin; and niacin + exercise—high-fat meal consumed after 6 wk of niacin and 1 h after aerobic exercise. Temporal responses for triglyceride and insulin concentrations were measured and total (AUC$_T$) and incremental (AUC$_I$) areas under the curve were calculated. Differences were determined by using a 2-factor repeated-measures analysis of variance ($P < 0.05$ for all). The results show aerobic exercise lowered the triglyceride AUC$_I$ by 32% compared with control (724 ± 118 and 1058 ± 137, respectively). Niacin had no influence on the triglyceride AUC$_I$ and attenuated the triglyceride-lowering effect of exercise when combined. Niacin + exercise had no effect on the triglyceride AUC$_I$ but decreased the insulin AUC$_I$ after niacin administration.

**Halverstadt A, Phares DA, et al., (2007)** have hypothesized that 24 weeks of endurance exercise training would independently improve plasma lipoprotein and lipid profiles as assessed by both conventional and novel NMR measurement techniques. One hundred sedentary, healthy 50 to 75 year old following standardized diets were studied before and after 24 weeks of aerobic exercise training. Lipoprotein and lipid analyses, using both conventional and NMR measures were performed at baseline and after 24 weeks of exercise training. Relative and absolute maximum oxygen consumption increased 15%
with exercise training. Most lipoprotein and lipid measures improved with 24 weeks of endurance exercise training, and these changes were consistently independent of baseline body fat and body fat changes with training. For example, with exercise training, total cholesterol, triglycerides, and low-density lipoprotein cholesterol (LDL-C) decreased significantly (2.1 ± 1.8 mg/dL, P = .001; -17 ± 3.5 mg/dL, P < .0001; and -0.7 ± 1.7 mg/dL, P<.0001, respectively), and high-density lipoprotein cholesterol subfractions (HDL3-C and HDL2-C) increased significantly (1.9 ± 0.5 mg/dL, P=.01, and 1.2 ± 0.3 mg/dL, P=.02, respectively). Particle concentrations decreased significantly for large and small very low-density lipoprotein particles (-0.7 ± 0.4 nmol/L, P<.0001, and -1.1 ± 1.7 nmol/L, P < .0001, respectively), total, medium, and very small LDL particles (-100 ± 26 nmol/L, P = .01; -26 ± 7.0 nmol/L, P=.004; and -103 ± 27 nmol/L, P=.02, respectively), and small HDL particles (-0.03 ± 0.4 micromol/L, P=.007). Mean very low-density lipoprotein particle size also decreased significantly (-1.7 ± 0.9 nm, P < .0001) and mean HDL particle size increased significantly with exercise training (0.1 ± 0.0 nm, P = .04). These results show that 24 weeks of endurance exercise training induced favorable changes in plasma lipoprotein and lipid profiles independent of diet and baseline or change in body fat.

In general the aerobic exercise training could bring significant increments in HDL cholesterol and decrements in LDL cholesterol independent of certain other factors like baseline body fat. There may be different effect on these factors when there is change in the intensity during the aerobic exercise
training. Different intensities like low, medium and high are generally recognized for aerobic exercises and these intensities are generally fixed as percentage to the maximum heart rate (MHR). There was also studies conducted basing on this concept. Regular exercise training is recognized as a powerful tool to improve work capacity, endothelial function and the cardiovascular risk profile in obesity, but it is unknown which of high intensity aerobic exercise, moderate-intensity aerobic exercise or strength training is the optimal mode of exercise.

Schjerve IE, Tyldum GA, Tjønna AE, Stølen T, Loennechen JP, Hansen HE, et al., (2008) have conducted a study to understand the intensity effects of aerobic training and strength training on lipid profiles of individuals. A total of 40 subjects were randomized to high-intensity interval aerobic training, continuous moderate-intensity aerobic training or maximal strength training programmes for 12 weeks, three times/week. The high-intensity group performed aerobic interval walking/running at 85-95% of maximal heart rate, whereas the moderate-intensity group exercised continuously at 60-70% of maximal heart rate; protocols were isocaloric. The strength training group performed 'high-intensity' leg press, abdominal and back strength training. Maximal oxygen uptake and endothelial function improved in all groups; the greatest improvement was observed after high-intensity training, and an equal improvement was observed after moderate-intensity aerobic training and strength training. High-intensity aerobic training and strength training were associated with increased PGC-1alpha (peroxisome-proliferator-activated
receptor gamma co-activator 1alpha) levels and improved Ca (2+) transport in the skeletal muscle, whereas only strength training improved antioxidant status. Both strength training and moderate-intensity aerobic training decreased oxidized LDL (low-density lipoprotein) levels. Only aerobic training decreased body weight and diastolic blood pressure. They have concluded that the, high-intensity aerobic interval training was better than moderate-intensity aerobic training in improving aerobic work capacity and endothelial function. An important contribution towards improved aerobic work capacity, endothelial function and cardiovascular health originates from strength training, which may serve as a substitute when whole-body aerobic exercise is contra-indicated or difficult to perform.

Hence, high intensity aerobic training may be better when compared to the low or medium intensity aerobic training but there seems no answer about the effect of the combined effects of these trainings with some other form of training. There have been several studies with aerobic training on women and lipid profiles and other cardio protective aspects.

**Kelley GA, Kelley KS, and Tran ZV, et al., (2004)** have conducted a meta analysis approach to examine the effects of aerobic exercise on lipids and lipoproteins in women. Studies were retrieved via computerized literature searches, review of reference lists, hand searching selected journals, and expert review of our reference list. The inclusion of studies was limited to randomized controlled trials published in the English language literature between January 1955 and January 2003 in which aerobic exercise was used as the primary
intervention in adult women aged > or =18 years. One or more of the following lipids and lipoproteins were assessed: total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG). Using a random effects model, statistically significant improvements were observed for all lipids and lipoproteins (TC, ± SEM, -4.3 ± 1.3 mg/dl, 95% CI -6.9 to -1.7 mg/dl; HDL-C, ± SEM, 1.8 ± 0.9 mg/dl, 95% CI 0.1 to 3.5 mg/dl; LDL-C, ± SEM, -4.4 ± 1.1 mg/dl, 95% CI -6.5 to -2.2 mg/dl; TG, ± SEM, -4.2 ± 2.1 mg/dl, 95% CI -8.4 to -0.1 mg/dl). Reductions of approximately 2%, 3%, and 5%, respectively, were observed for TC, LDL-C, and TG, whereas an increase of 3% was observed for HDL-C. They have concluded that aerobic exercise is efficacious for increasing HDL-C and decreasing TC, LDL-C, and TG in women.

Kelley GA, Kelley KS, and Tran ZV, et al., (2005) have also used the same meta-analysis approach to examine the effects of aerobic exercise on lipids and lipoproteins in overweight and obese adults. Computerized literature searches, cross-referencing from review and original articles, hand searching, and expert review of reference list were used. Studies selected for were 1) randomized controlled trials, (2) aerobic exercise > or =8 weeks, (3) adult humans > or =18 y of age, (4) all subjects overweight or obese (BMI > or =25 kg/m(2)), (5) studies published in journal, dissertation, or master’s thesis format, (6) studies published in the English-language, (7) studies published between 1 January 1955 and 1 January 2003, (8) assessment of one or more of the following lipid and/or lipoprotein variables: total cholesterol (TC), high-
density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), and triglycerides (TG). Dual-coding by the first two authors (inter-rater agreement=0.96). In total, 13 studies representing 31 groups (17 exercise, 14 control), 613 subjects (348 exercise, 265 control), and up to 17 outcomes were available for pooling. Across all categories, random-effects modeling resulted in statistically significant improvements for TC (X ± s.e.m., -3.4 ± 1.7 mg/dl, 95% CI, -6.7 to -0.2 mg/dl) and TG (X ± s.e.m., -16.1 ± 7.3 mg/dl, 95% CI, -30.2 to -2.1 mg/dl) but not HDL (X ± s.e.m., 1.6 ± 0.8 mg/dl, 95% CI, -0.02 to 3.2 mg/dl) or LDL (X ± s.e.m., -0.5 ± 1.3 mg/dl, 95% CI, -3.0 to 2.0 mg/dl). Changes were equivalent to improvements of 2% (TC), 11% (TG), 3% (HDL), and 0.3% (LDL). After conducting sensitivity analyses (each study deleted from the model once), only decreases in TG remained statistically significant. Increases in HDL were associated with increases in maximum oxygen consumption (VO$_2$max) in ml/kg/min, r=0.75, P=0.002) and decreases in body weight (r=0.77, P<0.001), while decreases in LDL were associated with decreases in body weight (r=0.75, P=0.009). They have concluded that aerobic exercise decreases TG in overweight and obese adults but suggested about the need for additional randomized controlled trials in various overweight and/or obese populations above and beyond those included in our analysis.

Hence, independently aerobic exercise irrespective of the intensity attached to the exercise would bring significant positive changes in lipid profiles of individuals. It may also valid for obese adults and hence aerobic exercise...
training can be used to bring positive changes in several cardio protective factors.

**Studies on the effect of anaerobic training on LDL, HDL and Triglyceride cholesterols**

Though both the resistance form of training and anaerobic running like sprinting are recognized as anaerobic form of training, the metabolic cascades may be different for both forms of exercise. Hence, both may be examined in the light of their effect on the LDL, HDL and triglyceride cholesterol of individuals. The improvements in the muscle protein or lean muscle also may cause for the increase in resting state metabolic rate. Hence, these metabolic cascades may lead to the significant changes in the resting lipid profiles of the individuals involving in regular strength training through resistance form of training.

**Wooten JS, Phillips MD, Mitchell JB, et al., (2011)** conducted a study to quantify the effects of 12 weeks of resistance training, as well as a single session of resistance exercise on lipids and lipoproteins in obese, postmenopausal women. 21 obese, postmenopausal women, not on hormone replacement therapy (age=65.9±0.5 yr; BMI=32.7±0.8 kg/m (2)), were randomly assigned to control (n=12) and exercise (n=9) groups matched for age and BMI. For 12 weeks, 3 days/week, the exercise group performed 10 whole body resistance exercises (3 sets at 8-RM). Fasting (10 h) blood samples were collected immediately prior to and 24 h after the first and last exercise and
control session. Serum was assayed for concentrations of total cholesterol, triglycerides, LDL-C, HDL-C, HDL 2-C, HDL 3-C, non-HDL-C and TC:HDL and LDL:HDL ratios. The exercise group exhibited a significant (P<0.01) improvement in muscular strength, but no change in BMI, body mass or body composition post-training. Total cholesterol, LDL-C and non-HDL-C were significantly (P<0.05) lower in the exercise compared to the control group following the 12 weeks of resistance training. Hence, they have concluded that the whole body resistance training provides obese, postmenopausal women a non-pharmacological approach for the reduction of lipid and lipoprotein-cholesterol concentrations.

The resistance form of exercise when examined independently and not in comparison, may show significant positive results on cardiovascular risk factors. There have been several investigations using the different types of resistance form of exercises and with different intensities on these factors. The results of all the investigations may not be the same. But, still when there was no comparison with other forms of exercise the resistance form of strength training induced significantly positive changes on cardiovascular risk factors and markers.

**Leenders M, Verdijk LB, van der Hoeven L, et al., (2013)** investigated and compared the effects of 6 months resistance-type exercise training (three times per week) between healthy elderly women (n = 24; 71 ± 1 years) and men (n = 29; 70 ± 1 years). Muscle mass (dual-energy x-ray absorptiometry -
computed tomography), strength (one-repetition maximum), functional capacity (sit-to-stand time), muscle fiber characteristics (muscle biopsies), and metabolic profile (blood samples) were assessed. Leg lean mass (3% ± 1%) and quadriceps cross-sectional area (9% ± 1%) increased similarly in both groups. One-repetition maximum leg extension strength increased by 42% ± 3% (women) and 43% ± 3% (men). Following training, type II muscle fiber size had increased, and a type II muscle fiber specific increase in myonuclear and satellite cell content was observed with no differences between genders. Sit-to-stand time decreased similarly in both groups. Glycemic control and blood lipid profiles improved to a similar extent in both women and men. A generic resistance-type exercise training program can be applied for both women and men to effectively counteract the loss of muscle mass and strength with aging.

Elliott KJ, Sale C and Cable NT (2002) examined the effects of eight weeks of supervised, low intensity resistance training (80% of 10 repetition maximum (10RM)) and eight weeks of detraining on muscle strength and blood lipid profiles in healthy, sedentary postmenopausal women. Fifteen postmenopausal women, aged 49-62 years, took part in the study. Subjects were assigned to either a control (n = 7) or training (n = 8) group. The training regimen consisted of three sets of eight repetitions of leg press, bench press, knee extension, knee flexion, and lat pull-down, three days a week at 80% of 10RM. Dynamic leg strength, 10RM, and blood lipid profiles (total cholesterol (TC), low and high density lipoprotein cholesterol (LDL-C, HDL-C), triglycerides, and very low density lipoprotein cholesterol (VLDL-C)) were measured at
baseline, after eight weeks of training, and after a further eight weeks of detraining. They have observed that eight weeks of resistance training produced significant increases in knee extension (F(1,13) = 12.60; p<0.01), bench press (F(1,13) = 13.79; p<0.01), leg press (F(1,13) = 15.65; p<0.01), and lat pull-down (F(1,13) = 16.60; p<0.005) 10RM strength tests. Although 10RM strength decreased after eight weeks of detraining, the results remained significantly elevated from baseline measures. Eight weeks of training did not result in any significant alterations in blood lipid profiles, body composition, or dynamic isokinetic leg strength. There were no significant differences in any of the variables investigated over the 16 week period in the control group. They have concluded that this low intensity resistance training was not sufficient to bring significant changes in the lipid profiles of the individuals of the study though there was a significant increment in their strength aspect.

It may be necessary to identify here, that the intensity of the resistance training basing on the difficulty level, may show influence on the lipid profiles of the individuals. Low intensities of strength training may not be able to induce the required changes in the cardiovascular bio markers.

Prabhakaran B, Dowling EA, et al., (1999) examined the effect of a supervised, intensive (85% of one repetition maximum (1-RM)) 14 week resistance training programme on lipid profile and body fat percentage in healthy, sedentary, premenopausal women. Twenty four women (mean (SD) age 27 (7) years) were randomly assigned to either a non-exercising control group
or a resistance exercise training group. The resistance exercise training group took part in supervised 45-50 minute resistance training sessions (85% of 1-RM), three days a week on non-consecutive days for 14 weeks. The control group did not take part in any structured physical activity. Two way analysis of variance with repeated measures showed significant (p < 0.05) increases in strength (1-RM) in the exercising group. There were significant (p < 0.05) decreases in total cholesterol (mean (SE) 4.68 (0.31) v 4.26 (0.23) mmol/l (180 (12) v 164 (9) mg/dl)), low density lipoprotein (LDL) cholesterol (2.99 (0.29) v 2.57 (0.21) mmol/l (115 (11) v 99 (8) mg/dl), the total to high density lipoprotein (HDL) cholesterol ratio (4.2 (0.42) v 3.6 (0.42)), and body fat percentage (27.9 (2.09) v 26.5 (2.15)), as well as a strong trend towards a significant decrease in the LDL to HDL cholesterol ratio (p = 0.057) in the resistance exercise training group compared with their baseline values. No differences were seen in triglycerides and HDL cholesterol. No changes were found in any of the measured variables in the control group. Depending on these findings they suggested that resistance training has a favourable effect on lipid profile and body fat percentage in healthy, sedentary, premenopausal women.

Comparing the above two investigations done by two different teams on the effects of resistance training on the resting state lipid profiles it may be understood that longer duration of training like fourteen weeks may induce significant positive changes on cardiovascular risk factors. Though the LDL cholesterol may be seen decreasing significantly in many studies using the
resistance training, majority of the studies could not find significant changes in the HDL cholesterol levels.

**Studies on the effect of combined aerobic and anaerobic training on LDL, HDL and Triglyceride cholesterols**

The effect of combined exercise training of two or more different forms influences the metabolic cascades differently and may cause different changes in the components of blood and especially coagulator factors of blood. Keeping in view of the importance of the different forms of exercises to protect the health fitness of individuals it would be

**Pitsavos C, Panagiotakos DB, Tambalis KD, et al., (2009)** evaluated the effect of adding resistance exercise to aerobic activities on lipid-lipoprotein profile, in a representative sample of men and women from the province of Attica, Greece. They have randomly enrolled 1514 and 1528 healthy men and women, respectively, stratified by city, age and gender distribution. Participants were classified as inactive (INA), sufficiently active (SA) and highly active for either aerobic activities (HAA) alone or a combination of aerobic plus resistance exercise (HAC). The main outcome measures are lipid-lipoprotein profile [total, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides, apolipoprotein-A1, apolipoprotein-B] and anthropometric indices. From those participating in aerobic activities, 480 (31.7%) men and 502 (32.9%) women were classified as SA, 100 men (6.6%) and 93 women (6.1%) as HAA and 90 men (5.9%) and 49 women (3.2%) as HAC. After various adjustments were made, men from the HAC group had an
average of 23% lower plasma triacylglycerol concentration (P = 0.04) and 10% lower LDL-cholesterol (P = 0.01) when compared with the HAA group. Moreover, women from the HAC group had 13% lower LDL-cholesterol when compared with HAA group (P = 0.051). They have suggested that that combining aerobic and resistance-type activities may confer a better effect on lipoprotein profile in healthy individuals than aerobic activities alone.

Similar results have been found by many other authors confirming that combination of different forms of exercises than a single form of exercise may be better in enhancing the health status with regard to cardiovascular health.

**Sillanpää E, Laaksonen DE, Häkkinen A, et al., (2009)** investigated the adaptations in body composition, physical fitness and metabolic health during 21 weeks of endurance and/or strength training in 39- to 64 year old healthy women. Subjects (n = 62) were randomized into endurance training (E), strength training (S), combined strength and endurance training (SE), or control groups (C). S and E trained 2 and SE 2 + 2 times in a week. Muscle strength and maximal oxygen uptake (VO$_2$max) were measured. Leg extension strength increased 9 ± 8% in S (P < 0.001), 12 ± 8% in SE (P < 0.001) and 3 ± 4% in E (P = 0.036), and isometric bench press 20% only in both S and SE (P < 0.001). VO(2)max increased 23 ± 18% in E and 16 ± 12% in SE (both P < 0.001). The changes in the total body fat (dual X-ray absorptiometry) did not differ between groups, but significant decreases were observed in E (-5.9%, P = 0.022) and SE (-4.8%, P = 0.005). Lean mass of the legs increased 2.2-2.9% (P = 0.004-0.010) in S, SE and E. There were no differences between the groups in
the changes in blood lipids, blood pressure or serum glucose and insulin. Total cholesterol and low-density lipoprotein cholesterol decreased and high-density lipoprotein cholesterol increased in E. Both S and SE showed small decreases in serum fasting insulin. Both endurance and strength training and their combination led to expected training-specific improvements in physical fitness, without interference in fitness or muscle mass development. All training methods led to increases in lean body mass, but decreases in body fat and modest improvements in metabolic risk factors were more evident with aerobic training than strength training.

Ghahramanloo E, Midgley AW and Bentley DJ (2009) have compared the effects of 3 different 8-wk training programs [endurance training (ET), strength training (ST) and concurrent training (CT)] on blood lipid profile and body composition in untrained young men. A total of 27 subjects were randomly allocated to an ET, ST or CT group which performed either progressive treadmill (ET), free weight (ST) or both the endurance and strength training requirements for 8 weeks. High-density lipoprotein and low-density lipoprotein profiles significantly improved in the ET and CT groups (P < .01) but not in the ST group. Triglyceride and total cholesterol profiles significantly improved in all 3 training groups. Total fat mass significantly decreased in the ET and CT groups (P < .001) but not in the ST group, whereas fat free mass significantly increased in the ST and CT groups (P < .01) but not in the ET group. Basing on their results they have indicated that CT can be used to
simultaneously improve both the serum lipid profile and body composition of previously untrained, apparently health young men.

Concurrent training with two or more forms of exercise training might results in better adaptations in physiological status of the individuals. Moreover, it is beneficial to monitor the health fitness components of an individual through different exercise programs as different exercise programs target different systems of the body and elevate the functional efficiency of these systems differently.

Zois CE, Tokmakidis SP, Volaklis KA, et al., (2009) have also obtained similar results with respect to the concurrent training of aerobic and resistance form of exercise. They studied the effects on blood lipids and physical fitness after a training program that combined strength and aerobic exercise in postmenopausal women with type 2 diabetes. Ten patients (55.0 ± 5.2 years) followed four exercise sessions per week, two strength and two aerobic, and ten (59.4 ± 3.2 years) served as a control group. Lipid profile, glycated hemoglobin (HbA(1c)), HOMA2 index, exercise stress and muscular testing were assessed at the beginning and after 16 weeks of training program. Exercise training increased significantly HDL-C (17.2%; \( P < 0.001 \)) and decreased triglycerides (18.9%), HbA(1c) (15.0%), fasting plasma glucose (5.4%), insulin resistance (HOMA2 25.2%) and resting blood pressure (\( P < 0.01 \)). After 16 weeks of training, exercise time (17.8%) and muscular strength increased significantly \( (P < 0.001) \). Basing on the results they have indicated that a combined strength and aerobic training program could induce positive
adaptations on lipid profile, glycemic control, insulin resistance, cardiovascular function, and physical fitness in post-menopausal women with type 2 diabetes.

**Tambalis K, Panagiotakos DB, et al., (2009)** have conducted a scientific review on the effectiveness of aerobic exercise training with different intensities (moderate and high) as well as the type of exercise (aerobic, resistance, and combined aerobic with resistance) in altering the blood lipids. They reviewed various trials via a systematic search of PubMed, published reviews, and references from original articles. They selected studies that involved aerobic and/or resistance and/or combined exercise training in healthy adults over a limit of 12 weeks and had examined the response of training to one or more of the following: triglycerides, total cholesterol, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol. They selected a total of 84 studies, 58 were randomized controlled trials. Comparisons between intensities of aerobic exercise programs resulted in favorable effects only for high intensity. The most frequently observed alteration was an increase in the high-density lipoprotein cholesterol, whereas reductions in triglycerides, total cholesterol, and low-density lipoprotein cholesterol appeared less often. Moreover, the evidence of the positive effect of resistance exercise marks out a trend mainly for the low-density lipoprotein cholesterol levels, whereas for combined exercise, results extracted from a short list of published studies show improvements in values of both the high-density lipoprotein cholesterol and the low-density lipoprotein cholesterol. High-intensity aerobic training results in improvement in high-density
lipoprotein cholesterol. For resistance and combined exercise, the results are inconsistent. The heterogeneity between the types of exercise did not allow reliable comparisons.

There have been several studies conducted on different forms of exercise and with different intensities but the studies on comparative basis selecting different combinations of exercises on the blood coagulator factors and lipid profiles. Hence, the present study investigated the effects of aerobic training, anaerobic training and yogasana on selected physiological variables viz. LDL, HDL and triglyceride cholesterol among young men.

**Studies on the effect yogasanas on LDL, HDL and triglyceride cholesterols**

*Dr.P.Leela, Dr.C.R.Mallikarjun, et al., (2013)* stated that coronary heart disease is one of the major causes of death and having a prevalence of 10% in Indian population. Dyslipidemia is one of the important modifiable risk factor. It initiates atherosclerotic plaque formation, finally resulting in degeneration of endothelial cell function, which enhances the coagulability of blood by activation of various factors for which apolipoproteins have been implicated. Various attempts such as physical exercises and dietary modifications have been performed to control the lipid content of blood. The aim of present study was to know the effects of pranayama and yoga on apolipoproteins, lipid profile and atherogenic index in healthy subjects. In this study a group of 30 healthy age and sex matched subjects were selected from
whom blood was drawn before and after pranayama and yoga for assay of apolipoproteins and lipid profile by immunoturbidimetric and enzymatic methods, respectively. There is a significant reduction in the levels of Total cholesterol, LDL-C, apolipoprotein B and ratio of ApoB/ApoA1, also significant increase in the level sof HDL-C and ratio of HDLC/T.Cholesterol after Yoga and pranayama.

**Dr. Maninder Bindra, Dr. Shema Nair, et al., (2013)** conducted a study on Type II diabetes mellitus is a highly prevalent chronic disease strongly associated with obesity and fat distribution. A number of behavioral interventions’ have been suggested for preventing and controlling type II D.M. including increased physical activity, diet modification and cessation of smoking. In order to regulate the stress psychology which is associated with insulin resistance, obesity and hypertension; mind body interventions have been suggested. The purpose of this investigation was to systematically analyze and synthesize yoga interventions designed to prevent and control type-II D.M. The study of conducted in the department of Biochemistry Gandhi Medical College in association with yoga Kendras Bhopal and Department of Pathology Gandhi Medical College. The study design was two groups of 50 subjects each. One group is taking only conventional medicines (group-I) and the other practicing yoga along with conventional medicines (group-II). Participants were type-II diabetics not taking insulin, recruited opportunistically by general practice staff with diabetic duration not more than 10 years. Patients with
rheumatoid arthritis, cancer, pulmonary TB, myocardial infarction and those who were not willing to perform yoga were excluded. First, (primary) outcome measure was HbA1C. Secondary outcome measures included lipid levels, blood glucose levels, quality of life related to diabetes. the lipid profile and other diabetic markers in type-II diabetes who were on conventional antidiabetic therapy and observed no statistical difference in mean values of lipid profile, fasting blood sugar and HbA1C, P>0.05 between two groups the group who were on yoga with conventional medicine shows greater control on diabetic markers than the group who was on conventional therapy alone. P > 0.01 except triglycerides (P> 0.05).

Vaishali K, Vijaya Kumar K, et al., (2012) conducted a study on Yoga practice aids in management of Type 2 diabetes mellitus (DM 2). In this study, they aimed to see the effects of yoga-based program in modifying certain biochemical parameters for long duration Type DM2 elderly subjects. Sixty elderly with more than 15 years of DM 2 were randomly assigned into Control (Educational group) and Yoga group in a tertiary day care center. Educational group received advice and leaflets on general healthy lifestyle and exercise for every one month. The yoga group was offered individualized yoga asanas and Pranayama for 6 days a week over 12 weeks. Following 12 weeks of intervention, Pre and Post biochemical parameters were analyzed between the groups. Results showed Mean change in the primary outcome measure HbA1c in control group from 10.82% to 10.44% and in experimental group the mean
change of HbA1c was from 10.28% to 9.12% which is statistically significant at 95% confidence interval [CI]. Compared between groups the Yoga group had a statistically significant change for the entire outcome measures. With 95% CI Mean differences of outcome measures in the Yoga group are glycosylated hemoglobin level HbA1C 78% (64%–92%), fasting glucose level 28.43 mg/dl (18.37–38.94), TC 18.67 mg/dl (13.87–23.45), TG 22.05 mg/dl (14.35–29.61), HDL 5.2 mg/dl (4.54–5.86), LDL 6.81 mg/dl (1.21–13.42) respectively.

Lee JA, Kim JW and Kim DY (2012) stated that regular and continuous yoga exercise is one of the most important non pharmacological methods of improving serum lipid concentrations, adipose tissue, and metabolic syndrome factors. The purpose of this study was to analyze the effects of yoga exercise on serum adiponectin and metabolic syndrome factors in obese postmenopausal Korean women. For this study sixteen healthy postmenopausal women aged 54.50 ± 2.75 years with more than 36% body fat were randomly assigned to either a yoga exercise group (n = 8) or to a "no exercise" control group (n = 8). The variables of body composition, visceral fat, serum adiponectin, and metabolic syndrome factors were measured in all the participants before and after the 16-week study Body weight, percentage of body fat, lean body mass, body mass index, waist circumference, and visceral fat area had significantly decreased. High-density lipoprotein cholesterol and adiponectin had significantly increased, but total cholesterol, triglyceride, low-density lipoprotein cholesterol, blood pressure, insulin, glucose, and homoeostasis model
assessment-insulin resistance had significantly decreased. Serum adiponectin concentrations were significantly correlated with waist circumference, high-density lipoprotein cholesterol, diastolic blood pressure, and homoeostasis model assessment-insulin resistance in the postyoga exercise group. Our findings indicate that yoga exercise improves adiponectin level, serum lipids, and metabolic syndrome risk factors in obese postmenopausal women. Consequently, yoga exercise will be effective in preventing cardiovascular disease caused by obesity in obese postmenopausal Korean women.

Ramos-Jimenez A, Hernandez-Torres RP, et al., (2011) reviewed that Hatha Yoga (HY) is an alternative exercise system for improving health in adults and older people with low physical capacity. Although the HY benefits on cardiovascular health have been demonstrated, its physical determinants haven’t been demonstrated. Therefore, this study evaluates the effect of an HY intervention on cardiovascular risk factors, in physically active adult women. For this study sixteen healthy and physically active adult women (56.31±10.47 years) were enrolled into an 11-week HY program (55 sessions/ 90 min each session). The program adherence, asana performance and work intensity were assessed along the intervention. Anthropometry and biochemical analysis were evaluated before, and after HY intervention. Cardiovascular fitness and dietary parameters were evaluated before and after HY intervention. After the completion of study we can find A decreased of ~1.5 kg of body fat and ~17 mm of skinfold thickness (p<0.05) was detected in women. Total serum cholesterol, HDL-C, LDL-C, glucose and lactate increased 27 mg/dl, 11 mg/dl, 19 mg/dl,
11 mg/dl and 5 mM, respectively (p<0.05). The maximum oxygen uptake (VO₂ peak) increased ~3 ml/kg/min. Systolic and diastolic blood pressure decreased 6 mmHg and 3 mmHg respectively (p<0.05). Heart rate (56 ± 8 beats/min) during HY determined changes in the Σ skin folds and systolic blood pressure (78 and 58% of the variance, respectively). Likewise Asana performance skills determined changes in HDL-C, glucose and maximal lactate (79, 42 and 89% of the variance, respectively). Finally, the program adherence, measured as % session attendance”, determined changes in diastolic blood pressure (55% of the variance).

Hence the proposed HY intervention improves physical fitness and reduces CVD risk factors in physically active adult women. In addition, heart rate during HY exercise, asana performance skills and percentage assistance to the intervention program, determined about 42-89% of the changes in cardiovascular health in senior physically active women.

BK Acharya, AK Upadhyay, et al., (2010) examined many styles of Pranayama (Voluntary Regulated Breathing) and Yogasana (Yoga Postures) that range from very dynamic, active movements that go from one posture to another (and result in a thorough aerobic workout) to more slow-paced practices that hold postures for several minutes and form an intense strength training and balanced workout. Twenty male junior footballers younger than 15 years of age, belonging to the Mohun Bagan Athletic Club, Kolkata, were selected for the study at Haridwar. They had to play in a Football Cup
organized in UK and they were here to practice yoga sequences taught by Swami Ramdevji. They were of age 14.65 ± 0.58 years and none of them had a history of lipid metabolism disorders. All the footballers were healthy with no history of smoking or alcohol consumption. The scope and objectives of the present study were explained to the subjects and their written consent was obtained for participation in the study. The institutional ethical committee had approved the study protocol and design. The subjects were asked to follow their routine diet and exercise pattern during the period of study. None of the subjects were exposed to yogic practices before this yoga training session. There was a significant reduction in the levels of serum cholesterol, Low-density lipoprotein (LDL) cholesterol, serum triglycerides, and very-low-density lipoprotein (VLDL)-cholesterol at the end of the yoga session. The results indicated that the fasting blood sugar (FBS) level was positively elevated in junior footballers. This demonstrated that pranayama and yogasana were helpful in regulating sugar levels. The present study demonstrates the efficacy of SRY (Swami Ramdev Yoga) pranayama and yogasana sequences on blood lipid profiles in normal healthy footballers. pranayama and yogasana can be used as supportive therapy in patients with lipid disorders, heart diseases, hypoglycemia, and so on. There is a need for conducting the experiments on a larger number of participants, to explore the results and mode of action.

**Prasad KVV, Sunitha M, Raju, et al., (2006)** Conducted a study on impact of pranayama and yoga on lipid profiles in normal healthy volunteers.
41 men and 23 women were selected as subjects to evaluate the impact of pranayama and yoga asanas on blood lipid profiles in two stages in stage – I pranayama was taught for thirty days and in stage two, yogic practices were added to the pranayama for another sixty days. A significant reduction was observed in triglycerides and VLDL cholesterol in men and free fatty acids alone were reduced in women at the end of stage – I. A significant elevation of HDL-cholesterol was seen only in the men at the end of stage – I. At the end of stage-II, free fatty acids increased in both men and women, and women demonstrated a significant fall in serum cholesterol, triglycerides and LDL and VLDL-cholesterol. The results indicated that HDL-cholesterol was elevated in women with pranayama, while triglycerides and LDL-cholesterol decreased in women after yogasanas. The results of the present study indicate that pranayama and yogasanas can be helpful in patients with lipid metabolism disorders such as coronary artery disease, diabetes mellitus and dyslipidemia.