Chapter-II

REVIEW OF RELATED LITERATURE

Research scholar since beginning of his attempt for conceptualization of the study and till completion of the study reviewed extensively every literature related to this study, he could avail from various sources.

These efforts had helped to formulate the study as well as provided logical understanding about experimental programme designing their limitation, methodology and solution for implementation.

The literature that were of critical important to this study and sourced and reviewed from LNIPE library, D.A.V. Indore University, Internet and personal help, periodicals subscription were cited in abstract form in this chapter.

Mackinnon LT, Hubinger LM\textsuperscript{1}. Lipoprotein (a) [Lp(a)] is a unique lipoprotein complex in the blood. At high levels (> 30 mg/dl), Lp(a) is considered an independent risk factor for cardiovascular

diseases. Serum Lp(a) levels are largely genetically determined, remain relatively constant within a given individual, and do not appear to be altered by factors known to influence other lipoproteins (e.g. lipid-lowering drugs, dietary modification and change in body mass). Since regular exercise is associated with favourable changes in lipoproteins in the blood, recent attention has focused on whether serum Lp(a) levels are also influenced by physical activity. Population and cross-sectional studies consistently show a lack of association between serum Lp(a) levels and regular moderate physical activity. Moreover, exercise intervention studies extending from 12 weeks to 4 years indicate that serum Lp(a) levels do not change in response to moderate exercise training, despite improvements in fitness level and other lipoprotein levels in the blood. However, recent studies suggest the possibility that serum Lp(a) levels may increase in response to intense load-bearing exercise training, such as distance running or weight lifting, over several months to years. Cross-sectional studies have reported abnormally high serum Lp(a) levels in experienced distance runners and body builders who train for 2 to 3 hours each day. However, the possible confounding influence of racial or ethnic factors in these studies cannot be discounted. Recent intervention studies also suggest that 9 to 12 months of intense exercise training may elevate serum
Lp(a) levels. However, these changes are generally modest (10 to 15%) and, in most individuals, serum Lp(a) levels remain within the recommended range. It is unclear whether increased serum Lp(a) levels after intense exercise training are of clinical relevance, and whether certain Lp(a) isoforms are more sensitive to the effects of exercise training. Since elevation of both low density lipoprotein cholesterol (LDL-C) and Lp(a) levels in the blood exerts a synergistic effect on cardiovascular disease risk, attention should focus on changing lifestyle factors to decrease LDL-C (e.g. dietary intervention) and increase high density lipoprotein cholesterol (e.g. exercise) levels in the blood.

*LeMura LM* and et.al. The purpose of this study was 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-

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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 (VO2max) and HDL-C was 0.48 (P < 0.05), which explained 23% of the variation in HDL-C. The ATG increased VO2max 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 VO2max, or body composition during the training and detraining periods. The results of this study suggest that aerobic-type exercise improves lipoprotein-lipid profiles, cardiorespiratory fitness and body composition in healthy, young women, while resistance training significantly improved upper and lower body strength only.

Taralov Z. Physical activity has a beneficial effect on the serum lipid profile in adolescent and mature humans. The aim of the study was to compare the basic serum lipid parameters of pubescent athletes practicing different sports with those of untrained boys and girls and to investigate the relationship between the variations of the values of these variables and the respective type of sport practiced. 876 highly trained athletes (559 boys and 317 girls) were included in this study. Their mean (+/- SD) age, weight and duration of training were: 14.01 +/- 1.78 years; 56.24 +/- 15.39 kg, and 3.52 +/- 2.07 years. The

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control group consisted of 357 untrained subjects (171 boys and 186 girls) with mean (+/- SD) age and weight 14.58 +/- 1.70 years and 57.75 +/- 12.66 kg. The group of athletes was divided into seven subgroups according to the sport practiced: athletics (n = 105), swimming (n = 107), rowing (n = 233), wrestling, box and judo (n = 225), weight lifting (n = 47), various team sports (n = 92), and other sports (n = 67). Venous blood samples were drawn from the cubital vein and the concentrations of serum total cholesterol (CHOL), HDL-cholesterol (HDL-C), and triglycerides (TG) were measured. Statistical indices were computed for each group and for each variable, and analysis of variance factorial analysis was performed to evaluate the statistical significance of the differences detected. The CHOL in highly trained group was found lower than in the control group (3.93 +/- 0.89 vs. 4.31 +/- 0.76 mmol/l, p < 0.001), and in highly trained boys the CHOL was lower than in highly trained girls (3.88 +/- 0.71 vs. 4.02 +/- 0.89 mmol/l, p < 0.01). The HDL-C was lower in the trained group in comparison with the control one (1.43 +/- 0.59 vs. 1.60 +/- 0.57 mmol/l, p < 0.001). No differences were found in HDL-C between boys and girls in both trained and control group. Serum TG were higher in highly trained group than in controls (1.01 +/- 0.59 vs. 0.89 +/- 0.38 mmol/l, p < 0.001). The results of the study indicate that (a)
trained pubescents have lower serum total cholesterol than untrained boys and girls of the same age; (b) trained pubescent boys have lower serum total cholesterol than trained pubescent girls; (c) the level of serum TG is not relevant to the type of physical exercise in pubescence; (d) long-term sport practicing is not able to decrease serum HDL-C levels in both sexes; (e) sport affects serum total cholesterol to a greater degree than does sex in pubescence.

**Hislop MS,**

Although androgenic hormones decrease HDL-C concentration, no direct evidence has linked them to atherosclerosis. The present study was undertaken to extend our ability to assess risk associated with androgen induced lipoprotein(Lp) changes by simultaneously gathering information about postprandial triglyceridaemia (PPT), LDL particle size, HDL and Lp(a) in men either taking exogenous androgens or with suppressed endogenous androgen concentrations. The experimental groups comprised nine male bodybuilders who self-administered anabolic-androgenic steroids (AAS) for a mean period of 6.5 weeks, and 10 healthy men whose testosterone concentration had been reversibly suppressed for 5 weeks using the GnRH agonist triptorelin (Decapeptyl; D-Trp-6-LHRH). A

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separate group receiving no hormonal treatment provided analytical control (n=7). Lipoprotein size was assessed by gradient gel electrophoresis categorisation (GGE), lipoprotein concentrations by immuno and enzymatic assays and PPT by a standardised oral fat tolerance test (65g/m(2)). Testosterone concentration was significantly reduced on triptorelin from 7.32+/-1.92 to 1.15+/-0.57 ng/ml (P=0.002). High dose AAS use was confirmed by urinalysis. With AAS use, mean HDLC and Lp(a) concentrations and PPT decreased from 0.9+/-0.3 to 0.7+/-0.3 mmol/l (P=0.004), 125+/-128 to 69+/-73 U/l (P=0.008) and 11.6+/-10.0 mmol/l h to 7.5+/-5.4 mmol/l h (P=0.027) respectively. Mean total cholesterol and LDLC were unchanged. LDL size was unchanged in six AAS users, decreased in one but remaining in the normal size range, and increased in two from small LDL to the normal range. Size changes in the latter two subjects were associated with 42 and 58% reductions in PPT respectively. In the triptorelin group, mean total cholesterol, HDLC and Lp(a) were increased from 4.8+/-0.8 mmol/l to 5.2+/-1.0 mmol/l (P=0.039), 1.1+/-0.2 to 1.4+/-0.3 mmol/l (P=0.002) and 278+/-149 to 377+/-222 U/l (P=0.004) respectively. Mean LDLC concentration and PPT were unchanged. LDL particle size increased in four, decreased in two, and was unchanged in four subjects. LDL size decreased in two and
showed no change in the other five control subjects. Other lipid measures were unchanged in the control group. Thus, apart from lowering HDLC concentrations, no other potentially atherogenic effects of endogenous androgens or AAS were observed. A suppression of Lp(a) as well as a reduced PPT and increased LDL size in predisposed individuals may be antiatherogenic effects of AAS.

**Tolfrey K,**<sup>5</sup> PURPOSE: It is still unclear how habitual physical activity (HPA), peak VO₂, percent body fat (%BF), and dietary composition are related to the lipid-lipoprotein profile in children. The purpose of this study was to identify independent contributions from these selected predictor variables to prepubertal children's lipid-lipoprotein profile. METHODS: Peak VO₂, HPA from continuous heart rate monitoring, %BF, 7-d dietary analysis, total cholesterol (TC), total triacylglycerol (TG), high density lipoprotein (HDL) cholesterol (HDL-C), low density lipoprotein (LDL) cholesterol (LDL-C), TC/HDL-C, and LDL-C/HDL-C were determined in 33 prepubertal girls and 38 prepubertal boys (mean +/- SD age, 10.6 +/- 0.7 yr). RESULTS: Bivariate correlation analyses revealed that peak VO₂, %BF, and HPA were related to the lipid-lipoprotein profile in girls (P <

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0.05). For the boys, HPA was only related to TC/HDL-C (P < 0.05) and LDL-C/HDL-C (P < 0.05), whereas daily energy intake (kJ x d(-1)) was associated with TC and LDL-C (P < 0.05). Multiple linear regression analyses indicated that peak VO2, %BF and HPA were the main predictor variables for the girls. Peak VO2 accounted for 22.7%, 24.8%, 22.5%, and 24.2% of the unique variance (sr(i)2) in TG, HDL-C, LDL-C/HDL-C, and TC/HDL-C, respectively. For TC and LDL-C in girls, sr(i)2 were 18.0% and 22.6%, respectively, from HPA. In contrast, only daily energy intake had a significant unique contribution to the variance of TC (15.4%) and LDL-C (22.0%) for the boys.

SUMMARY: The main findings from this study were that the predictor variables are lipid-lipoprotein specific and depend on gender. These results would support the growing evidence that it is important to nurture an active lifestyle in children from an early age and that an awareness of fitness and body fatness is required.

Tolfrey K.6 This study examined the effect of exercise training on prepubertal children's (ET, N = 28) lipid-lipoprotein profile, relative to a maturity matched control group (CON, N = 20). Training for ET involved stationary cycling for 30 min, 3 times.wk-1 for 12 wk, at 79.3

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+/- 1.2% (mean +/- SD) peak heart rate (HR). Controls maintained their usual lifestyle pattern. Plasma concentrations of total triacylglycerol (TG), total cholesterol (TC), and high-density lipoprotein (HDL)-cholesterol (HDL-C) were determined pre- and post intervention. Low-density lipoprotein (LDL)-cholesterol (LDL-C) was subsequently estimated from these concentrations, and the ratios TC/HDL-C and LDL-C/HDL-C were also calculated. There were no pretest differences (P > 0.05) for any of these blood analytes between groups. The following, potentially, confounding variables were also measured: peak VO2, percent body fat (%BF), dietary composition, and habitual physical activity. These variables, with pretest HDL-C, were included as covariates in two-way split plot ANCOVA analyses. Dietary variables were not included as covariates as they were not related to any of the blood analyses. There were no differences over time or between groups for TG and TC (P > 0.05). LDL-C decreased in ET (-10.2%) but remained unchanged in CON (0.3%) over the intervention period (P < 0.05). HDL-C increased in ET (9.3%) but decreased in CON (-8.9%) (P < 0.01). A similar, but inverted, pattern of change (P < 0.01) was revealed for both ratios, TC/HDL-C (-11.6% vs 6.3%, ET and CON, respectively), and LDL-C/HDL-C (-17.2% vs 8.0%, ET and CON, respectively). The favorable alterations in the
lipid-lipoprotein profile for ET were independent of alterations in peak VO2 (group x time interaction, P < 0.05), %BF (main effect time, P < 0.01), and habitual physical activity (group x time interaction, P < 0.01). In conclusion, the favorable alterations in the lipoprotein profile seen in this study would suggest that it is possible to influence the prepubertal lipoprotein profile independent of alterations in confounding variables such as body composition, cardio respiratory fitness, and habitual physical activity.

Chu NF,7. To evaluate the association between anthropometric parameters and lipid levels among Taiwanese school children. Using a probability-proportional-to size sampling and multi-stages sampling procedure, we sampled 1500 school children from 10 schools in Taipei city. Anthropometric parameters including body weight, body height, waist circumference, hip circumference and skinfolds were measured. Serum total cholesterol (CHOL), triglycerides (TG), high density lipoprotein-cholesterol (HDL-C), apolipoprotein A1 and B (ApoA1 and ApoB) were measured by standard methods, low density lipoprotein-cholesterol (LDL-C) and CHOL/HDL-C ratio were calculated by formula. RESULTS: We included in our analyses 1366

children (681 boys and 685 girls) with a mean age of 13.3 y (from 12 to 16 y) and with valid anthropometric and biochemical parameters. The boys had higher body height (P < 0.001) and larger body weight (P < 0.05), waist circumference (P < 0.01) and waist/hip ratio (WHR, P < 0.001) than the girls. However, the girls had larger skinfolds than the boys. After adjusting for age, girls had higher total CHOL, TG, HDL-C, LDL-C, ApoA1 and ApoB concentrations than boys. In general, TG was positively associated with most anthropometric parameters (except body height); a similar negative association between HDL-C and anthropometric variables was noted. After controlling, for age, cigarette smoking, alcohol drinking and puberty development, shorter body height was the strongest predictor of total CHOL, LDL-C and ApoB concentrations among boys. Although body mass index (BMI) was a significant positive predictor (P < 0.01) of the CHOL/HDL-C ratio; skinfold measurements were the strongest anthropometric predictors of most lipid concentrations among boys. Among girls, we found WHR and BMI to be the strongest positive predictors of TG and ApoB level respectively (both P < 0.001), but skinfold measurements were best for predicting HDL-C, LDL-C, ApoA1 and the CHOL/HDL-C ratio. From this large study of school-age children from Taiwan, we found anthropometric parameters, such as body height, BMI or WHR,
are adequate predictors of blood lipid levels; however, skinfold measurements are generally more strongly associated with lipid levels in both genders.

Kishali NF, The aim of this study was to compare plasma lipid and lipoprotein concentrations of male and female subjects in different training levels and to examine the risks of cardiovascular diseases. For this purpose, 20 male athletes from the National Turkish Wrestling Team (age 23.5 +/- 1.25 years) and 44 male and 51 female students (ages 21.7 +/- 1.72 and 20.20 +/- 1.68 years, respectively) from physical education and sports department and 40 sedentary females (ages 21.14 +/- 1.72 years) participated in this study. Triglyceride (TG), total cholesterol (TC), HDL-C and LDL-C levels were determined by a Hitachi 717 Autoanalyser. Apo A-I, Apo B, and Lp(a) levels were determined by Behringer Nephelometer 100. Maximum Oxygen Consumption (VO(2) max) values were determined by 12-min run test and the anaerobic power values were measured by Jump Meter Instrument. Energy consumption of basal metabolic rates were for males 1 kcal for an hour and 0.9 kcal for females. There were no significant differences in plasma TC, TG, and small lipoprotein a

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(Lp(a)) values between four groups (p > .05). No significant differences were found in HDL-C, LDL-C, apolipoprotein Al (Apo-Al), and apolipoprotein B100 (Apo-B) values between wrestlers and male students, and between female students and sedentary females (p > .05). HDL-C values of female students and sedentary females were significantly higher when compared with the same values of wrestlers and male students (41.52 and 40.93 mg/100 ml versus 51.92 and 50.10 mg/100 ml). However, LDL-C values were found to be lower in females than males (121.83 and 101.10 mg/100 ml as opposed to 97.7 and 98.4 mg/100 ml) but only significantly lower than in wrestlers (p < .05). Although the wrestlers' training levels were always higher than male students, the lipid and lipoprotein values were not different. These variables were not different between female groups either. But the lipid and lipoprotein profile of female subjects was found to be better than that of males. These results showed that medium and high level of exercises did not cause significant differences in lipid and lipoprotein levels, but the sex differences were very pronounced. Lipid and lipoprotein values of the four groups have indicated that the individuals in these groups would not be exposed to danger of cardiovascular diseases.
Hsieh AT. Evidence suggests that there may be a metabolic syndrome characterized by hyperinsulinemia or insulin resistance associated with increased cardiovascular disease risk. The purpose of this study is to evaluate insulin, proinsulin or insulin resistance to determine which is the best parameter to predict lipid profiles among children in Taiwan. After multi-stage sampling, we randomly included 852 school children (415 boys and 437 girls) with a mean age of 13 yr in this study. We measured insulin and intact proinsulin levels by RIA (<0.2% cross-reactivity) and estimated insulin resistance index (IRI) using the homeostatic model assessment (HOMA) method. We used standard methods to measure atherosclerotic lipid profiles including total cholesterol (CHOL), triglyceride (TG), HDL-C, apolipoprotein A (ApoA), apolipoprotein B (ApoB), and lipoprotein[a] and calculated LDL-C and TCHR (total cholesterol to HDL-C ratio) levels. Girls had higher CHOL, LDL-C, ApoA and ApoB levels than boys (p < 0.001). There was no significant difference in insulin, proinsulin and IRI status between boys and girls. Among boys, insulin, proinsulin and IRI were positively correlated with TG, ApoB and TCHR and negatively related to HDL-C. Among girls, these associations were attenuated and

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became insignificantly for TCHR and HDL-C. After adjusting for potential confounders, IRI and insulin were still positively associated with TG and ApoB levels and negatively associated with HDL-C in boys. However, in girls, proinsulin and insulin were positively associated with TG only. Finally, in the stepwise regression analyses, IRI was a better predictor of TG, HDL-C, and ApoB than insulin or proinsulin in boys. However, in girls, proinsulin was a stronger predictor than insulin or IRI for TG and TCHR. From this study, we found that IRI (in boys) and proinsulin (in girls) levels are generally more significant and stronger parameters than insulin for predicting lipid profiles among children in Taiwan.

Tsopanakis C\textsuperscript{10}. The aim of this work was to obtain an insight into the influence exerted upon plasma lipid parameters by high quality physical training in different specialties of nine Olympic sports. We compared the concentrations of serum cholesterol (TC), total lipids (TL), triglycerides (TG), HDL, LDL, VLDL, and % distribution of HDL, LDL, and VLDL of elite athletes (n = 127, age = 22.0 ± 3.2 yrs) participating in regular training for over 3 years (2-4 h/day), separated into 11 groups of athletic specialties, with those obtained

from a group of selected sedentary controls (n = 26, age = 25.3 +/- 4.5 yrs). We also compared the lipoprotein ratio factor (RF) values TC/HDL and LDL/HDL. The athletic disciplines examined were football, basketball, volleyball, boxing, wrestling, judo, sailing, skiing (slalom), track (two groups), and throwing-jumping. Football, volleyball, judo, SD and LD running, and the total sum of athletes had significantly higher HDL than the controls. Football, basketball, volleyball and all the disciplines taken together showed significantly lower LDL. Boxing, judo, and LD running had significantly lower VLDL and volleyball, SD, and LD running significantly lower %VLDL. Volleyball had significantly lower TL, boxing and volleyball lower TC, while judo, boxing, SD and LD running had lower TG. Sailing had significantly lower %HDL and higher %LDL and TL than the controls; wrestling, skiing, and throwing-jumping did not differ. In all the athletes taken together, VO2 max or relative body weight, with respect to HDL and TC/HDL, were found to be slightly correlated (r = 0.30, P less than 0.01).

Suter E. The relationship between risk factors for CHD such as physical activity, cardiovascular fitness, subcutaneous body fat,

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dietary intake characteristics, age, and sex with the blood lipid profile was examined in 39 boys and 58 girls aged 10-15 yr. In boys, a high level of physical activity was related to higher concentrations of HDL-C \( (r = 0.32, P < 0.05) \), as well as to lower concentrations of VLDL-C, total triglycerides (TG), and the ratio of total cholesterol (TC) to HDL-C \( (r = -0.42; -0.40, \text{ both } P < 0.01; \text{ and } -0.37, P < 0.05) \). A high sum of 10 skin folds (sigma 10SF) was related to a higher ratio of TC/HDL-C \( (r = 0.35; P < 0.05) \). In girls, physical activity was positively related to HDL-C \( (r = 0.29; P < 0.05) \). The sigma 10SF showed a negative association with Apo A-I and HDL-C \( (r = -0.26, -0.29, \text{ both } P < 0.05) \) and a positive association with apolipoprotein B (Apo B) \( (r = 0.28, P < 0.05) \). Cardiovascular fitness was not significantly related to any of the blood lipid concentrations, in either boys or girls. Intake of saturated fats and dietary cholesterol was positively related to TC levels in boys, but the associations failed to reach statistical significance \( (r = 0.34 \text{ and } r = 0.31, P > 0.05) \) due to the small sample size \( (N = 32) \).

**Zahavi I**, and et.al\(^{12}\). To determine age and ethnic patterns of blood lipid levels in childhood and adolescence and to extend previous adult and late adolescent Israeli data to prepubertal ages, the levels of

plasma total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were determined among 1,153 schoolchildren in the area of Petah-Tikva. Half of the children were born to immigrants from Yemen. Among boys, TC levels progressively decreased as age increased from 10-11 to 14-15 years (159 to 142 mg/dl). The age-specific TC and HDL-C means among boys are compatible with an initial swift fall with age, followed by a rise restricted to TC during puberty. Among girls, progressively lower means through ages 12-13 and increasingly higher ones for older age groups are also compatible with puberty-determined changes, previously observed in American cohorts. The differences in TC were only partly accounted for by lower HDL-C means at higher ages (52 mg/dl in the youngest and 45 mg/dl in the oldest age group, respectively, among boys, compared with 53 mg/dl for girls at both ages 9 and 16-17). TG levels in boys, but not in girls, showed age differences paralleling those found for HDL-C, but in an inverse direction. TC means were lower as age increased only among female offspring of European-born Jews (159 to 148 mg/dl, ages 9-12 compared with ages 13-17), a phenomenon that requires further study. Overall, TC and HDL-C were clearly higher among girls than boys beginning at ages 12-13, with little or no sex differences in TG. The
sex differences in TC, contrary to previous studies, were not fully accounted for by HDL-C sex differences. The ethnic variability paralleled previous findings in Israeli adults and adolescents, showing low TC levels among male offspring of Yemenite and other Asian-born fathers. The ethnic differences among girls were small. No specific pattern of age-related lipid changes was found in the group of Yemenite origin, who represented offspring of parents with notoriously low levels of coronary heart disease incidence.

Lippi G,13 There is consolidated evidence that physical activity exerts beneficial effects on several chronic conditions and longevity, on the basis of its proposed biological effects, especially on lipid profiles. However, debate continues regarding the intensity of activity required for good health, as vigorous physical activity might overwhelm advantageous changes. In addition, little is known so far on the effect of a vigorous and regular aerobic training regimen on emerging markers of cardiovascular risk, such as lipoprotein(a), total/high-density lipoprotein cholesterol ratio and the atherogenic index of plasma. To further investigate this topic, an extensive lipid profile, in accordance with the most recent guidelines issued by the

American Heart Association (AHA)/American College of Cardiology (ACC) and the National Cholesterol Education Program (NCEP), was evaluated in 60 healthy male sedentary controls and in a wide population of professional endurance athletes, including 40 male professional cross-country skiers and 102 male professional road cyclists. Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), triglycerides, TC low-density lipoprotein cholesterol (LDL-C) ratio and the atherogenic index of plasma were significantly lower in both categories of professional athletes, whereas the mean HDL-C concentration was significantly higher. The concentration of lipoprotein(a) did not differ significantly between the groups. When compared to current NCEP or AHA/ACC goals, the percentage of patients with undesirable values was statistically different for all parameters tested, apart from lipoprotein(a). According to multiple stepwise logistic regression analysis, lower TC/HDL-C ratio in professional skiers and lower TC/HDL-C ratio and TC in professional cyclists were significantly associated with increased aerobic physical activity. Results of this case-control study confirm that elevated aerobic energy expenditure might be associated with a highly favorable stabilization of most traditional and emerging cardiovascular risk predictors. Therefore, a substantial increase in aerobic physical activity
within the population might be recommended to reverse adverse lipid abnormalities, especially in subjects with a higher cardiovascular risk.

**Tsopanakis C.** The activity of lecithin: cholesterol acyltransferase (LCAT) and the plasma lipoprotein concentrations of elite athletes from 8 selected sports (volleyball, judo, sprinting, wrestling, throwing, cycling, water polo and tennis) were determined and compared with those of a sedentary control group. Plasma LCAT activity levels in the athletes were significantly 2.2-7.0 times higher than in the controls in most sports (p less than 0.01). Judo, sprinting, wrestling and throwing had comparable LCAT values while tennis, volleyball and cycling were considerably higher. HDL-C concentration was significantly higher than controls in the water polo (p less than 0.05), cycling and volleyball (p less than 0.01) groups. Percentage lipoprotein distribution in the athletes in all sports except tennis, throwing and wrestling were similar to the controls. The differences among groups in LCAT activity may be related to the effect of physical exercise and training adaptations to lipid metabolism. This may be of importance when judging the benefit of exercise for atherosclerosis protection.

Yataco AR,^15^ A number of studies demonstrate that highly conditioned older athletes are leaner than their sedentary counterparts, and have lipoprotein profiles similar to that of young individuals. It is not clear whether the high maximal aerobic capacity (VO2max) or lean body habitus is the major determinant of the favorable lipoprotein lipid profiles present in older athletes. The objective of this study was to determine whether body composition or VO2max was the major determinant of lipoprotein lipid profiles among 61 master (age 63 +/- 6 years, mean +/- SD) athletes (VO2max > 40 mL/kg/min), 39 age-matched lean (% body fat < 25%), and 51 obese (% body fat > 25%) sedentary men. Plasma high density lipoprotein cholesterol (HDL-C) concentrations were 25% higher in that athletes than in the lean sedentary men, and 42% higher than in the obese sedentary men. Triglyceride (TG) concentrations were 24% lower in the master athletes than in the lean sedentary men, and 51% lower than in the obese sedentary group. Plasma low density lipoprotein cholesterol (LDL-C) levels were 9% lower in the athletes than in the other groups of sedentary individuals. In stepwise multiple regression analysis the percent body fat was the major independent predictor of HDL-C and

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TG levels accounting for 29% and 41% of the variation in these levels, respectively. The VO2max accounted for an additional 6% of the variance in HDL-C levels and 2% of the variance in TG levels. These cross-sectional results suggest that the favorable lipoprotein profile of master athletes is largely due to their lean body habitus, with a small independent contribution from their higher levels of cardiovascular fitness. Thus, regular vigorous aerobic exercise and maintenance of low body fat may prevent the commonly observed age-associated deterioration in lipoprotein concentrations.

Tolfrey K.\textsuperscript{16} This study examined the effect of exercise training on prepubertal children's (ET, N = 28) lipid-lipoprotein profile, relative to a maturity matched control group (CON, N = 20). Training for ET involved stationary cycling for 30 min, 3 times.wk\(^{-1}\) for 12 wk, at 79.3 +/- 1.2\% (mean +/- SD) peak heart rate (HR). Controls maintained their usual lifestyle pattern. Plasma concentrations of total triacylglycerol (TG), total cholesterol (TC), and high-density lipoprotein (HDL)-cholesterol (HDL-C) were determined pre- and postintervention. Low-density lipoprotein (LDL)- cholesterol (LDL-C) was subsequently estimated from these concentrations, and the ratios

TC/HDL-C and LDL-C/HDL-C were also calculated. There were no pretest differences ($P > 0.05$) for any of these blood analytes between groups. The following, potentially, confounding variables were also measured: peak VO2, percent body fat ($\%$BF), dietary composition, and habitual physical activity. These variables, with pretest HDL-C, were included as covariates in two-way split plot ANCOVA analyses. Dietary variables were not included as covariates as they were not related to any of the blood analytes. There were no differences over time or between groups for TG and TC ($P > 0.05$). LDL-C decreased in ET (-10.2%) but remained unchanged in CON (0.3%) over the intervention period ($P < 0.05$). HDL-C increased in ET (9.3%) but decreased in CON (-8.9%) ($P < 0.01$). A similar, but inverted, pattern of change ($P < 0.01$) was revealed for both ratios, TC/HDL-C (-11.6% vs 6.3%, ET and CON, respectively), and LDL-C/HDL-C (-17.2% vs 8.0%, ET and CON, respectively). The favorable alterations in the lipid-lipoprotein profile for ET were independent of alterations in peak VO2 (group x time interaction, $P < 0.05$), $\%$BF (main effect time, $P < 0.01$), and habitual physical activity (group x time interaction, $P < 0.01$). In conclusion, the favorable alterations in the lipoprotein profile seen in this study would suggest that it is possible to influence the prepubertal lipoprotein profile independent of alterations in
confounding variables such as body composition, cardiorespiratory fitness, and habitual physical activity.

Oyelola OO, Rufai MA. The fasting plasma lipid, lipoprotein and apolipoprotein profiles were determined in 14 healthy Nigerian male athletes and controls matched for sex and anthropometric parameters. The mean levels of total cholesterol (P < 0.05), low-density lipoprotein (LDL) cholesterol, apolipoprotein (apo) AII and E were significantly lower (P < 0.01) in the athletes than in the controls. However, there were no statistically significant differences (P > 0.05) between the mean values of the plasma triglycerides, high-density lipoprotein (HDL), very low-density lipoprotein (VLDL) cholesterol, apo AI, B, Lp(a), LpA1 and CIII:NonB respectively for the athletes and controls. A priori, the potential effect on cardiovascular disease (CVD) risk was also compared using three predictor ratios - total cholesterol: HDL cholesterol (TC:HDL), LDL cholesterol: HDL cholesterol and apo B:AI. The mean of the three ratios was lower in the athletes than in the controls; however, the differences were not statistically significant (P > 0.05). Based on our data, exercise appears to decrease the TC:HDL ratio in the athletes by lowering LDL-

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cholesterol, while the HDL-cholesterol is unaffected. We conclude that physical activity has salutary effects on the lipid, lipoprotein and apolipoprotein profiles of healthy Nigerian men.

**Giada F**\(^{18}\). The influence of age on the response of plasma lipids, body composition, and cardiovascular performance to physical training and detraining was studied in 12 older and 12 young adult male cyclists. The athletes were first examined at the peak of their seasonal preparation and then again 2 months after its suspension. Sedentary males matched for age, weight, and height comprised the respective control groups. During training, body fat mass (BFM) was significantly lower and maximum oxygen consumption (VO2max) higher in both groups of cyclists as compared with controls. No differences in serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), apolipoprotein (apo) B, apo A-II, and fibrinogen were found. During the same phase, triglycerides (TG) and the LDL-C to high-density lipoprotein cholesterol (HDL-C) ratio were significantly lower and apo A-I, HDL-C, HDL3-C, and the apo A-I/apo B ratio were significantly higher in the athletes than in their corresponding sedentary controls. After physical deconditioning, BFM

increased and VO2max decreased significantly in both groups of athletes. TG, very-low-density lipoprotein cholesterol (VLDL-C), and fibrinogen increased in young athletes while the LDL-C/HDL-C ratio increased, and apo A-I, HDL-C, HDL2-C, and HDL3-C decreased significantly in both young and older athletes. Thus, an aerobic training program induced an antiatherogenic lipoprotein profile and beneficial modifications in body composition and aerobic power in both older and younger subjects; a 2-month interruption in the program changed these parameters unfavorably in both groups. Age does not seem to influence significantly the plasma lipid response to physical deconditioning.

**Azizi F.** Decreased serum high-density lipoprotein cholesterol (HDL-C) is one of the most common lipid disorders in patients with coronary artery disease (CAD). Existing evidence suggests that every 1 mg/dL decrease in serum HDL-C increases the risk of CAD by 2-3%. This study was performed in the year 2000 to study HDL-C determinants in a Tehran population. We studied 9514 subjects (3942 men and 5572 women) aged 20-69 years, who participated in the Tehran Lipid and Glucose Study (TLGS), completed a personal history

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questionnaire (especially concerning physical activity and cigarette smoking), and underwent a clinical examination including anthropometric and blood pressure measurements. Serum total cholesterol, triglyceride and HDL-C levels were measured, and OGTT was used to define diabetic patients according to WHO criteria. The women had a significantly higher mean HDL-C level than the mean (45 +/- 11 vs 38 +/- 9 mg/dL; p < 0.001); low HDL-C levels (< 35 mg/dL) were observed in 31% of the men and 13% of the women (p < 0.001). Obese subjects (BMI > or = 30 kg/m2) had a significantly lower HDL-C level than the normal subjects (42 +/- 11 vs 44 +/- 11 mg/dL; p < 0.001), and those with truncal obesity (WHR > or = 0.95 in men and > or = 0.8 in women) lower HDL-C levels than the normal subjects (37 +/- 9 vs 39 +/- 10 mg/dL in men and 44 +/- 11 vs 42 +/- 11 mg/dL in women; p < 0.001 for both). Smokers had a significantly lower HDL-C level than non-smokers (38 +/- 10 vs 43 +/- 11 mg/dL; p < 0.001) and a low HDL-C level was twice as common (36.4 vs 18.2%). Passive smokers also had lower HDL-C levels (42 +/- 11 vs 43 +/- 11 mg/dL; p < 0.001). Mean serum HDL-C was significantly lower in hypertriglyceridemic than those with normal triglycerides levels (men: 4 +/- 8 vs 40 +/- 9 mg/dL, p < 0.001; women: 40 +/- 10 vs 47 +/- 11 mg/dL, p < 0.01). Mean HDL-C levels were similar in subjects with
different degrees of physical activity, as well as between diabetics and non-diabetics and hypertensive and normotensive subjects. Multiple stepwise regression analysis showed that the determinants of serum HDL-C levels were, in order of entering the model: hypertriglyceridemia (OR 3.4, p < 0.001), male sex (OR 3.1, p < 0.001), cigarette smoking (OR 1.7, p < 0.001), obesity (OR 1.4, p < 0.01), age (OR 0.9, p < 0.05), high WHR (OR 1.2, p < 0.05), and passive smoking (OR 1.1, p < 0.05). Physical activity, hypertension, and diabetes mellitus did not enter the predictive model. Apart from age and sex which are constitutional, and unmodifiable variables, the determinants of HDL-C level (hypertriglyceridemia, obesity, truncal obesity, cigarette smoking, and passive smoking) can be used in community CAD prevention programmes.

Berg A, In 293 healthy, 18--30-year-old male adults (241 well trained athletes with different training types: (A) endurance, (B) mixed, and (C) power training; (D) 52 untrained students), serum total cholesterol and the cholesterol fractions (HDL-, VLDL-, LDL-cholesterol) were investigated. In comparison with the untrained students, lower LDL- and VLDL-cholesterol concentrations were

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found in group (A) (-0.23 mmol/l, p < 0.01; -0.08 mmol/l, p < 0.001), lower HDL-cholesterol concentrations were found in group (C) (-0.33 mmol/l, p < 0.001). Increased HDL-cholesterol values and decreased VLDL- and LDL-cholesterol values were found in athletes with a rising oxygen-uptake; a significant, age-related increase in HDL-cholesterol occurred only in endurance-trained persons. There was no significant correlation between relative body weight and the HDL-cholesterol in the subjects examined.

Kayatekin BM. Total cholesterol (TC), triglyceride (TG), high density lipoprotein-cholesterol (HDL-C), low density lipoprotein-cholesterol (LDL-C) and HDL-C/TC levels are important in determining the risk of coronary heart disease. The serum lipids and lipoprotein levels of regularly training sportspersons and non-sporting controls were determined and compared with each other to investigate the effects of exercise and sex on these factors. HDL-C levels of male and female training groups were higher than those of corresponding non-sporting groups (respectively P < 0.01, P < 0.001). The sportswomen's HDL-C levels were higher (P < 0.05); and TC, TG, and LDL-C levels were lower (P < 0.001) than those of sportmen's levels.

The non-sporting women's TC and TG levels were lower than those of non-sporting men's levels (P < 0.001). HDL-C/TC ratio of active females was higher than that of control females (P < 0.01). The corresponding difference in males was also significant. We conclude that physical activity and sex have effects on risk factors for cardiovascular disease.

**Seals DR.** To ascertain whether older (masters) athletes exhibit a more favorable plasma lipoprotein/lipid profile than sedentary men of similar age, 14 endurance-trained masters athletes (mean age 60 +/- 2 years [+/- standard error of the mean]), 12 older, untrained-not lean men (mean age 62 +/- 1 years), 9 older untrained-lean men (mean age 61 +/- 2 years), 15 young endurance-trained athletes (mean age 26 +/- 1 years) and 15 young untrained men (mean age 28 +/- 1 years) were studied. The athletes had higher values for maximal oxygen uptake and lower levels of body fatness compared with the untrained men, regardless of age (p less than 0.05). High-density lipoprotein (HDL) cholesterol was markedly higher in the masters athletes than in the other groups (66 vs 42 to 55 mg/dl, p less than 0.05). The total cholesterol (TC) and low-density lipoprotein cholesterol concentrations

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of the masters athletes generally were higher than those of the younger groups, similar to those of the older lean men, and lower than those of the older-not lean men (p less than 0.05). The TC/HDL cholesterol ratios were similarly low (2.8 to 3.4) for the athletes and the young untrained men compared with the older untrained men (4.0 to 5.6) (p less than 0.05). Thus, some older endurance athletes exhibit markedly higher HDL cholesterol levels and lower TC/HDL cholesterol ratios compared with their sedentary peers. This favorable plasma lipoprotein profile may indicate a reduced risk of developing coronary artery disease for older men who exercise regularly.

Sun Y.\textsuperscript{23} For determining the relationship between serum lipids and exercise, an investigation was carried out, 275 students (mean age, 16.33 years) acted as an exercise group from Anhui province physical training school and Hefei physical training middle school exercise classes, and 309 students (mean age, 16.96 years) as a control group from Hefei normal school and Hefei physical training middle school general classes. The variables were studied which included age, height, body weight, Quetlete index, energy expenditure, TC, TG, and HDL-C. The survey shows that exercise may lower serum TG, increase TC and

HDL-C levels. Energy expenditure, age, and height were identified as the most important predictors by the multiple linear regression analyses. These findings suggest that exercise may play significant role in primary prevention of the cardiovascular diseases.

Iscan A

In Turkish adults, the incidence of coronary artery disease (CAD) has been found to be high. However, no detailed lipid, or lipoprotein data of children are available from Turkey. The present study was designed to define the borderline lipid and lipoprotein levels of sera in 397 healthy children (aged 5-14 years; 206 boys and 191 girls). Mean levels of total cholesterol (TC), triglyceride (TG), high- and low-density lipoprotein cholesterol (HDL-C and LDL-C, respectively) were found to be 150, 79, 46.7, and 87.6 mg/dL, respectively, for boys, and 152, 77.5, 46.3 and 90.5 mg/dL, respectively, for girls. Lipids and lipoproteins did not show any significant correlation with age and body mass index (BMI), except for TG in boys in whom TG levels were positively correlated with age and BMI. There were no significant differences in lipid and lipoprotein levels between boys and girls. As in the Turkish adult population, serum HDL-C levels of Turkish children were profoundly low on

international comparison. Twenty-three (53%) of 43 children with low HDL-C level (< or = 35 mg/dL) had abnormal ratios of TC/HDL-C (> or = 5) and/or LDL-C/HDL-C (> or = 4.5), whereas only 13 (3.7%) of the remaining 354 children with a HDL-C level less than 35 mg/dL had abnormal ratios of TC/HDL-C (> or = 5) and/or LDL-C/HDL-C (> or = 4.5). The low levels of HDL-C in Turkish children may be associated with the high incidence of CAD in the Turkish adult population.

**Monge-Rojas R.** Adverse levels of serum lipids tend to persist over time into adolescence and young adulthood, underlying the progression of Coronary Artery Disease (CAD). Therefore, the lipid profile of Costa Rican adolescents and its relationship with dietary intake, physical activity and Body Mass Index (BMI) was evaluated in a total of 322 adolescents ages 13-18 years from urban and rural areas of San Jose, Costa Rica. Levels of Total Cholesterol (TC) and HDL-C (High-Density Lipoprotein Cholesterol) were significantly higher in urban adolescents than in rural youngsters. No differences were found between LDL-C (Low-Density Lipoprotein Cholesterol) and triglyceride levels among urban and rural adolescents. TC, HDL-C and LDL-C levels were higher in females than in males. The mean

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LDL/HDL ratio was 2.3 with no differences between gender and area. Over 20% of adolescents showed borderline TC levels (4.42-5.17 mmol/L) and 10% borderline LDL-C levels (2.86-3.35 mmol/L). The proportion of females with borderline TC and LDL-C was higher than the proportion of males. No differences were found between areas. Around 50% of adolescents showed borderline HDL-C levels (0.91-1.17 mmol/L) and over 55% presented borderline triglyceride level (1.02-1.46 mmol/L). The prevalence of borderline and high triglyceride levels (> or = 1.47 mmol/L) between urban and rural adolescents was similar. However the prevalence of high triglyceride levels was higher in females (22%) than in males (14%). An independent positive relationship was found between LDL-C, triglyceride, the cardiovascular fitness score and BMI. Likewise a negative relationship was found between cardiovascular fitness, BMI, gender and HDL-C. This study suggests that primary prevention programs are required to decrease the prevalence of cardiovascular risk factors among Costa Rican adolescents.

**Buyukyazi G.**26 Studies related with the role of intensive and moderate training on reducing coronary heart disease (CHD) risks have

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revealed conflicting Thus, the aim of this study was to clarify the association between long-term physical training with competitive and recreational purposes and blood lipids and apolipoproteins in the middle-aged master athletes, recreational athletes and sedentary controls. The association between long-term physical training and serum concentrations of lipids, lipoproteins, and apolipoproteins in the middle-aged men was investigated. Twelve male master athletes (MA), 12 male recreational athletes (RA) (>10 y), and 12 male sedentary controls (CG) participated in the study. Serum concentrations of lipids and lipoproteins were measured by enzymatic methods; apolipoproteins (ApoA1 and ApoB) and serum lipoprotein(a) Lp(a) were measured by immunoprecipitation assays. TC, LDL-C, ApoA1, Lp(a) levels and LDL-C/HDL-C ratio of the 3 groups did not show any significant differences. MA and RA had significantly higher levels of VO2max, HDL-C, ApoA1/ApoB ratio; and lower values of percent body fat, resting heart rate, systolic and diastolic blood pressures, TG, ApoB and TC/HDL-C ratio than CG. We did not find any significant differences between MA and RA in any variables except for BMI and TC/HDL-C ratio. Habitual physical training favorably altered serum lipid and apolipoprotein profiles. Although there was no statistical significance (except for BMI and TC/HDL-C) between MA and RA, a
tendency to reduce the CHD risks was observed almost in all variables in favor of MA.

Eisenmann JC. The purpose of this review is to describe the age- and gender-associated variation in blood lipids of young athletes and examine the association between training status, peak oxygen consumption (VO(2peak)), and body fatness with blood lipids in young athletes. Results from cross-sectional studies suggest similar levels of total cholesterol (TC), lower levels of triglycerides (TG) and low-density lipoprotein-cholesterol (LDL-C), and higher levels of high-density lipoprotein-cholesterol (HDL-C) in young athletes compared with controls. Longitudinal data show that the age- and gender-associated variation in blood lipids in young distance runners is similar to youth in the general population; TC and LDL-C remain stable, HDL-C declines during adolescence (especially in males), and TG increases with age. Considerable heterogeneity exists in the blood lipids of young athletes, including dyslipidaemic values. Age, sexual maturity status, training status, VO(2peak) and body fatness are determinants of blood lipids in young athletes. VO(2peak) is a significant predictor of HDL-C independent of body fatness. Further

research is warranted to examine: the prevalence rates of dyslipidaemia in various sport groups; and the complex interactions of genes, biological maturation, exercise training, dietary intake and composition, skeletal muscle and adipose tissue properties on lipoprotein metabolism in young athletes.

**Eisenmann JC, Womack CJ**. The purpose of this study was to examine the age-and sex-associated variation in blood lipids among young athletes. A mixed-longitudinal design was used to examine the development of blood lipids in competitive young distance runners followed from 1982 to 1985. Serial data included 99 annual measurements for 27 male subjects and 84 annual measurements for 27 female subjects aged 9-18 yr. Total cholesterol (TC), high-density lipoprotein (HDL-C), low-density lipoprotein (LDL-C), and triglycerides (TG) were determined by standard procedures. In general, cross-sectional age group means showed that TC and LDL-C remained stable and HDL-C declined with age, especially in male subjects. TG increased with age. Age-related trends were statistically significant for HDL-C and TG in boys only (P < 0.05). TC and LDL-C were slightly greater in boys at all ages except 11, 15, and 17 yr (P > 0.05). HDL-C

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was similar between the sexes until 13 yr when values became greater in girls (3.2-13.8 mg.dL(-1)) (P < 0.05 in 17+ yr). No clear pattern of sex differences emerged for TG. Compared with the general population, blood lipids of young distance runners showed the following trends: 1) TC was above reference medians, 2) LDL-C tended to approximate or to be slightly above reference medians, 3) TG fluctuated about the reference medians, and 4) HDL-C was higher in distance runners compared to the reference medians before age 14 yr, but in the older age groups, especially male subjects, HDL-C either approximated or fell slightly below the reference medians. There was considerable variability in blood lipid levels among the runners. In 21 male and 18 female subjects with serial data for 3-5 yr, HDL-C declined 22.4 and 18.3 mg.dL(-1) (P < 0.05), whereas TG increased 18.0 and 14.0 mg.dL(-1)(P < 0.05 in female subjects only) in male and female subjects, respectively. Tracking coefficients over intervals of 3-5 yr were moderate to high (0.48-0.90), except for TG in male subjects (0.08). The results indicate that the development of blood lipids in young distance runners is similar to youth in the general population. In contrast to observations in adult endurance athletes, young distance runners did not possess a superior blood lipid profile except for HDL-C in the younger age groups.
Cardoso GC. A one-point cross-sectional study of 20 sedentary individuals, 20 low-aerobic athletes (body-builders), and 20 high-aerobic athletes (long distance, endurance runners) was conducted in Mexico City, Mexico to determine the influence of these diverse life-styles on the plasma levels of Lp(a). Only non-obese male subjects, aged 23-33, who were nonsmokers, non-alcoholics, and had never used anabolic steroids were included in this study. Blood samples were drawn 24 h following the last period of physical activity, and after a 12-14-h fast-period and a 15-min sitting-rest. Plasma levels of Lp(a) and other parameters, including postheparin lipoprotein lipase (LPL) and hepatic lipase (HL) activities, triglycerides (TG), total cholesterol (TC), LDL cholesterol (LDL-C), and HDL cholesterol (HDL-C), as well as % body fat and muscle mass, and maximum aerobic capacity (VO2max) were measured to determine possible correlations with Lp(a) and to serve as convenient internal standards. Mean Lp(a) concentrations were significantly higher in the runners (52 +/- 19 mg/dl) than in the body-builders (40 +/- 6.4 mg/dl, P < 0.05) and the sedentary subjects (24 +/- 5 mg/dl, P < 0.001). Positive correlations between Lp(a) and VO2max (P < 0.001), HDL-C (P < 0.005) and

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HDL2-C subfraction (P < 0.005), and a negative correlation with TG were determined. Agglomerative cluster methods suggested three close-distance clusters and a fourth cluster which is composed of four runners who exhibited low LDL-C/HDL-C and high LPL/HL ratios, high mean Lp(a), HDL2-C, and Vo2max levels, but low TG levels. These data show that some individuals who maintain a life-style of very high level physical exertion may have remarkably elevated plasma Lp(a) concentrations. The highly increased concentrations of Lp(a) in high exercise athletes may represent a normal metabolic response to repeated small tissue injuries resulting from frequent and prolonged large muscle movement.

Gupta R. The prevalence of hyperlipidaemias has been inadequately studied in rural populations of developing countries. No significant data exist on the population levels of serum cholesterol, cholesterol subclasses or triglycerides in these countries. They studied fasting blood samples of 300 apparently healthy adults (202 men and 98 women, age range 20-73 years) randomly selected from a larger sample of 3148 individuals during a comprehensive cardiovascular risk-factor survey in Rajasthan, India. Levels of serum total

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cholesterol, its subfractions [low-density-lipoprotein (LDL) cholesterol, very-low-density-lipoprotein cholesterol and high-density-lipoprotein (HDL) cholesterol] and triglycerides were measured and correlated with age and anthropometric data. The mean +/- SD serum total-cholesterol levels were 4.39 +/- 1.0 mmol/l in men and 4.37 +/- 1.0 mmol/l in women, the mean LDL-cholesterol levels 2.51 +/- 1.0 mmol/l in men and 2.62 +/- 0.9 mmol/l in women, the mean HDL-cholesterol levels 1.15 +/- 0.4 mmol/l in both mean and women and the mean fasting serum triglyceride levels 1.63 +/- 0.6 mmol/l in men and 1.48 +/- 0.7 mmol/l in women. Age correlated positively with total-cholesterol, LDL-cholesterol, HDL-cholesterol and triglyceride levels in both men and women. Levels of the cholesterol subtypes did not differ between the sexes (P > 0.01), although triglyceride levels were significantly higher in men (P < 0.01). Lipoprotein lipids did not correlate significantly with height, weight, body-mass index or waist:hip ratio. When classified according to the recommendations of the US National Cholesterol Education Program for the determination of the prevalence of hyperlipidaemia, 43 individuals (14.3%; men 14.4% and women 14.3%) had borderline high cholesterol levels (5.20-6.18 mmol/l) and 24 (8%; men 7.9% and women 8.2%) had high cholesterol levels (> or = 6.21 mmol/l). Forty-five participants (15%)
had borderline high LDL-cholesterol levels (3.36-4.11 mmol/l) and 20 
(6.7%) had high LDL-cholesterol levels (> or = 4.14 mmol/l); low 
HDL-cholesterol levels (< 0.9 mmol/L) were found in 89 (29.7%). 
Eighteen participants (6%) had mild hypertriglyceridaemia (2.82-5.64 
mmol/l) and two (0.7%) had severe hypertriglyceridaemia (> 5.64 
mmol/l). Total-cholesterol and LDL-cholesterol levels are low in a 
rural Indian population, although an atherogenic lipid profile is present 
in a significant proportion.

Hortobagyi T. The purpose of this study was to determine the 
effects of short-term exercise cessation on lipid and lipoprotein profile 
and insulin sensitivity in highly trained runners (n = 12; mean age 19.9 
years) and power athletes (n = 12; mean age 24.4 years). Following 14 
days of exercise cessation, running time to exhaustion and maximal 
oxigen uptake decreased by 9.2% and 4.8% (P < 0.05) in the runners, 
while in the power athletes one repetition maximum squat and bench 
press did not change (P > 0.05). No changes occurred in body 
composition. Data from a 2-h oral glucose tolerance test revealed an 
impairment of the glycemic state in all athletes (P < 0.05). In contrast, 
exercise cessation did not significantly (P > 0.05) alter plasma levels of

31 Hortobagyi T, Houmard JA, Israel RG, Carpenter JW, Heath J, Barakat HA. Effects of exercise 
cessation on lipids and lipoproteins in distance runners and power athletes. Eur J Appl Physiol 
cholesterol, triglycerides, and low density (LDL) and high density lipoprotein (HDL). No changes were observed in HDL2, HDL2b, and HDL3 subfractions, LDL diameter, and qualitative LDL pattern (P > 0.05). These data thus suggest that despite a decrease in insulin sensitivity, short-term exercise cessation, independent of exercise mode, was insufficient to alter plasma lipid and lipoprotein profiles in well-trained athletes.

Sady SP\textsuperscript{32}. We compared the clearance rate (K2) of plasma triglycerides (TG) following the intravenous (IV) infusion of a fat emulsion in 13 male endurance athletes (age 33 +/- 5.6 years, mean +/- SD) and 12 sedentary men (33 +/- 5.6 years). The athletes had lower fasting triglycerides (TG) (75 +/- 30.4 mg/dL v 125 +/- 52.5 mg/dL) and higher high-density lipoprotein (HDL) cholesterol concentrations (64 +/- 16.2 mg/dL v 42 +/- 9.4 mg/dL) than the sedentary subjects (P less than .01 for all). The higher HDL concentrations were due to increases in both the HDL2 and HDL3 subfractions. K2 in the athletes was 92% higher than that in the sedentary men (4.8 +/- 2.3%/min v 2.5 +/- 0.7%/min, P less than .01), but there was no difference in postheparin lipoprotein lipase activity (LPLA) between the groups (P

greater than .05). K2 was positively correlated with LPLA (r = .51) and inversely related to fasting TG concentrations (r = -.73, P less than .01 for both). Furthermore, K2 was directly related to HDL (r = .75), HDL2 (r = .72), and HDL3 (r = .60) cholesterol concentrations (P less than .01 for all). These data suggest that the low TG levels in endurance athletes result at least in part from increased TG removal and that the elevated HDL concentrations of endurance athletes are related to enhanced fat clearance.

Ginsberg HN\textsuperscript{33}. Reduced plasma levels of high density lipoprotein (HDL) cholesterol are associated with increased risk for coronary heart disease. Although plasma HDL levels are, in general, inversely related to plasma triglyceride (TG) concentrations, a small proportion of individuals with low HDL cholesterol concentrations have normal plasma TG levels. We wished to determine whether subjects with low plasma levels of HDL cholesterol could be characterized by common abnormalities of lipoprotein metabolism independent of plasma TGs. Therefore, we studied the metabolism of low density lipoprotein (LDL) apolipoprotein B (apo B) and HDL apolipoprotein A-I (apo A-I) in subjects with low plasma HDL

cholesterol concentrations with or without hypertriglyceridemia. Nine subjects with low plasma HDL cholesterol levels and normal levels of plasma TGs and LDL cholesterol were studied. Autologous 131I-LDL and 125I-HDL were injected intravenously, and blood samples were collected for 2 weeks. LDL apo B and HDL apo A-I levels were measured by specific radioimmunoassays. Fractional catabolic rates (FCRs, pools per day) and production rates (PRs, milligrams/kilogram.day) for each apolipoprotein were determined. The results were compared with those obtained previously in nine subjects with low plasma HDL cholesterol levels and hypertriglyceridemia and in seven normal subjects. The normal subjects had an HDL apo A-I FCR (mean +/- SD) of 0.21 +/- 0.04. Despite large differences in plasma TG levels, the HDL apo A-I FCRs were similar in the low-HDL, normal-TG group (0.30 +/- 0.09) and the low-HDL, high-TG group (0.33 +/- 0.10), although only the latter value was significantly increased versus control subjects (p < 0.03). Increased apo A-I FCRs were associated with reduced HDL apo A-I levels in both groups of patients. Apo A-I PRs were similar in all groups. In contrast, LDL apo B PR was increased approximately 50% in the low-HDL, normal-TG group (19.3 +/- 6.6; p < 0.01) compared with normal subjects (12.5 +/- 2.6). There was a strong trend toward a
greater LDL apo B PR in the low-HDL, high-TG group (17.6 +/- 4.5; p = 0.06 versus normal subjects) as well. LDL apo B FCRs were similar in all three groups. LDL apo B concentrations were also increased in the group with low HDL cholesterol and normal TG levels. Both groups with low HDL cholesterol levels had cholesterol-depleted LDL and HDL particles.

Mackinnon LT\textsuperscript{34}. Lipoprotein(a) [Lp(a)] represents a class of lipoproteins with some structural similarity to low density lipoprotein (LDL), but containing a unique apoprotein, apoprotein(a). First reported in 1963, Lp(a) is now considered to have an independent role in the development of atherosclerotic lesions. The level of Lp(a) in the blood is under strong genetic influence and does not appear to be alterable by lifestyle factors known to influence other lipoproteins. Regular moderate exercise has been shown to favorably alter other lipoproteins, and recent attention has focused on whether Lp(a) level can be influenced by physical activity. Current data from cross-sectional and intervention studies show little effect of moderate exercise on serum Lp(a) concentration. One possible exception may be an elevation of serum Lp(a) concentration in adult endurance and

power athletes who exercise intensely on a daily basis. However, not all studies have taken into account possible racial or ethnic differences in Lp(a) concentrations and the skewed distribution observed within most populations. Standard dietary intervention such as a low fat diet recommended for weight loss and control of other blood lipids has little effect on serum Lp(a) level. At present, serum Lp(a) concentration does not appear to be significantly altered by realistic dietary changes and moderate physical activity as recommended for health. The synergistic effect on cardiovascular disease risk when both LDL-cholesterol and Lp(a) are elevated highlight the importance of attending to those risk factors that can be modified by exercise and other lifestyle changes.

Durstine JL. Dose-response relationships between exercise training volume and blood lipid changes suggest that exercise can favourably alter blood lipids at low training volumes, although the effects may not be observable until certain exercise thresholds are met. The thresholds established from cross-sectional literature occur at training volumes of 24 to 32 km (15 to 20 miles) per week of brisk walking or jogging and elicit between 1200 to 2200 kcal/wk. This

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range of weekly energy expenditure is associated with 2 to 3 mg/dl increases in high-density lipoprotein-cholesterol (HDL-C) and triglyceride (TG) reductions of 8 to 20 mg/dl. Evidence from cross-sectional studies indicates that greater changes in HDL-C levels can be expected with additional increases in exercise training volume. HDL-C and TG changes are often observed after training regimens requiring energy expenditures similar to those characterised from cross-sectional data. Training programmes that elicit 1200 to 2200 kcal/wk in exercise are often effective at elevating HDL-C levels from 2 to 8 mg/dl, and lowering TG levels by 5 to 38 mg/dl. Exercise training seldom alters total cholesterol (TC) and low-density lipoprotein-cholesterol (LDL-C). However, this range of weekly exercise energy expenditure is also associated with TC and LDL-C reductions when they are reported. The frequency and extent to which most of these lipid changes are reported are similar in both genders, with the exception of TG. Thus, for most individuals, the positive effects of regular exercise are exerted on blood lipids at low training volumes and accrue so that noticeable differences frequently occur with weekly energy expenditures of 1200 to 2200 kcal/wk. It appears that weekly exercise caloric expenditures that meet or exceed the higher end of this range are more likely to produce the desired lipid changes. This amount of physical activity, performed at
moderate intensities, is reasonable and attainable for most individuals and is within the American College of Sports Medicine's currently recommended range for healthy adults.

**Holme I**\(^{36}\). In the Oslo Diet and Exercise Study (ODES) 219 healthy middle-aged physically inactive persons with moderately deranged risk factor levels (increased bodyweight, diastolic blood pressure, serum cholesterol, triglycerides, decreased HDL-cholesterol) were randomized to 4 intervention groups: dietary intervention, exercise, diet + exercise and control. The purpose of the study was to test if these interventions maintained for a year, isolated or in combination, would change coronary risk factor levels as compared to control. One of the risk factors included was lipoprotein (a) (Lp(a)). The hypothesis to be tested was if physical exercise would be associated with increased levels of Lp(a) as a result of intervention. Those who exercised increased their Lp(a) levels with 15.4 (S.E. = 8.0) mg/l as compared to no exercise (P < 0.05). Also, dietary intervention tended to increase Lp(a), but the increase did not reach statistical significance. There was no detectable interaction on the effect on Lp(a) of the two intervention modalities. A dose-response relationship was

found between change in the exercise-specific variables heart rate and peak oxygen uptake, and Lp(a)-change and this dose-response was most pronounced in the exercise group. Change in Lp(a) was associated to change in several lifestyle related variables such as alcohol intake and waist circumference, pointing to the possibility that Lp(a), at least in some subpopulations, is more amenable to change through lifestyle alterations than reported so far.

K J Elliott\textsuperscript{37} To study 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. Subjects: 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))

\textsuperscript{37} K J Elliott, C Sale, N T Cable Effects of resistance training and detraining on muscle strength and blood lipid profiles in postmenopausal women \textit{Br J Sports Med} 2002;36:340–345
were measured at baseline, after eight weeks of training, and after a further eight weeks of detraining. Eight weeks of resistance training produced significant increases in knee extension (F1,13 = 12.60; p<0.01), bench press (F1,13 = 13.79; p<0.01), leg press (F1,13 = 15.65; p<0.01), and lat pulldown (F1,13 = 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. These data suggest that a short, low intensity resistance training programme produces substantial improvements in muscle strength. Training of this intensity and duration was not sufficient to produce significant alterations in blood lipid concentrations.

Crouse S. F.\textsuperscript{38} twenty-six hypercholesterolemic men (mean cholesterol, 258 mg/dl; age, 47 yr; weight, 81.9 kg) completed 24 wk of cycle ergometer training (3 days/wk, 350 kcal/session) at either high

\textsuperscript{38} Crouse S. F.; O'Brien B. C.; Grandjean P. W.; Lowe R. C.; Rohack J. J.; Green J. S.; Tolson H.; Training intensity, blood lipids, and apolipoproteins in men with high cholesterol Journal of applied physiology J. appl. physiol. ISSN 8750-7587 1997, vol. 82, n°1, pp. 270-77 (53 ref.)
(n = 12) or moderate (n = 14) intensity (80 and 50% maximal O[2]
uptake, respectively, randomly assigned) to test the influence of
training intensity on blood lipid and apolipoprotein (apo)
concentrations. All physiological, lipid, and apo measurements were
completed at 0, 8, 16, and 24 wk. Lipid data were analyzed via two X
four repeated-measures analysis of variance (α = 0.0031). Training
produced a significant decrease in body weight and increase in
maximal O[2]uptake. No interactions between intensity and weeks of
training were noted for any lipid or apo variable, and no between-
group differences were significant before or throughout training.
Therefore, intensity did not affect the training response. Regardless of
intensity, apo AI and apo B fell 9 and 13%, respectively, by week 16
and remained lower through week 24 (P < 0.0003). Total cholesterol
fell transiently (-5.5%) by week 16 (P < 0.0021) but returned to initial
levels by week 24. Triglyceride, low-density-lipoprotein cholesterol,
and high-density-lipoprotein (HDL) cholesterol did not change with
training. In contrast, HDL[2] cholesterol rose 79% above initial levels
by week 8 and 82% above initial levels by week 24 (P < 0.0018);
HDL[3] cholesterol fell 8 and 13% over the same training intervals (P <
0.0026). These data show that changes in blood lipid and apo
concentrations that accompany training in hypercholesterolemic men
are not influenced by exercise intensity when caloric expenditure is held constant.

Malina RM.\textsuperscript{39} To review the effects of resistance training programs on pre- and early-pubertal youth in the context of response, potential influence on growth and maturation, and occurrence of injury. Evidence-based review. Twenty-two reports dealing with experimental resistance training protocols, excluding isometric programs, in pre- and early-pubertal youth, were reviewed in the context of subject characteristics, training protocol, responses, and occurrence of injury. Experimental programs most often used isotonic machines and free weights, 2- and 3-day protocols, and 8- and 12-week durations, with significant improvements in muscular strength during childhood and early adolescence. Strength gains were lost during detraining. Experimental resistance training programs did not influence growth in height and weight of pre- and early-adolescent youth, and changes in estimates of body composition were variable and quite small. Only 10 studies systematically monitored injuries, and only three injuries were reported. Estimated injury rates were 0.176, 0.053, and 0.055 per 100 participant-hours in the respective programs. Experimental training

protocols with weights and resistance machines and with supervision and low instructor/participant ratios are relatively safe and do not negatively impact growth and maturation of pre- and early-pubertal youth.

**Ingle L.** Complex training, a combination of resistance training and plyometrics is growing in popularity, despite limited support for its efficacy. In pre- and early pubertal children, the study of complex training has been limited, and to our knowledge an examination of its effect on anaerobic performance characteristics of the upper and lower body has not been undertaken. Furthermore, the effect of detraining after complex training requires clarification. The physical characteristics (mean+/-s) of the 54 male participants in the present study were as follows: age 12.3 +/- 0.3 years, height 1.57 +/- 0.07 m, body mass 50.3 +/- 11.0 kg. Participants were randomly assigned to an experimental (n = 33) or control group (n = 21). The training, which was performed three times a week for 12 weeks, included a combination of dynamic constant external resistance and plyometrics. After training, participants completed 12 weeks of detraining. At baseline, after training and after detraining, peak and

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mean anaerobic power, dynamic strength and athletic performance were assessed. Twenty-six participants completed the training and none reported any training-related injury. Complex training was associated with small increases (< or =5.5%) in peak and mean power during training, followed by decreases of a similar magnitude (< or = -5.9%) during detraining (P < 0.05). No changes or minor, progressive increases (< or =1.5%) were evident in the control group (P > 0.05). In the experimental group, dynamic strength was increased by 24.3 -71.4% (dependent on muscle group; P < 0.01), whereas growth-related changes in the control group varied from 0 to 4.4% (P > 0.05). For 40-m sprint running, basketball chest pass and vertical jump test performance, the experimental group saw a small improvement (< or =4.0%) after training followed by a decline (< or = -4.4%) towards baseline during detraining (P < 0.05), whereas the control group experienced no change (P > 0.05). In conclusion, in pre- and early pubertal boys, upper and lower body complex training is a time-effective and safe training modality that confers small improvements in anaerobic power and jumping, throwing and sprinting performance, and marked improvements in dynamic strength. However, after detraining, the benefits of complex training are lost at similar rates to other training modalities.
Roemmich JN. To investigate the independent influence of alterations in fat mass, body fat distribution and hormone release on pubertal increases in fasting serum insulin concentrations and on insulin resistance assessed by the homeostasis model (HOMA). Cross-sectional investigation of pre- (n=11, n=8), mid- (n=10, n=11), and late-pubertal (n=10, n=11) boys and girls with normal body weight and growth velocity. Body composition (by a four-compartment model), abdominal fat distribution and mid-thigh interfascicular plus intermuscle (extramyocellular) fat (by magnetic resonance imaging), total body subcutaneous fat (by skinfolds), mean nocturnal growth hormone (GH) release and 06:00 h samples of serum insulin, sex steroids, leptin and insulin-like growth factor-I (IGF-I). Pubertal insulin resistance was suggested by greater (P<0.001) fasting serum insulin concentrations in the late-pubertal than pre- and mid-pubertal groups while serum glucose concentrations were unchanged and greater (P<0.001) HOMA values in late-pubertal than pre- and mid-pubertal youth. From univariate correlation fat mass was most related to HOMA (r=0.59, P<0.001). Two hierarchical regression models were developed to predict HOMA. In one approach, subject differences in

sex, pubertal maturation, height and weight were held constant by adding these variables as a block in the first step of the model ($r(2)=0.36$). Sequential addition of fat mass (FM) increased $r(2)$ ($r(2)((\text{inc})\text{remental})=0.08$, $r(2)=0.44$, $P<0.05$) as did the subsequent addition of a block of fat distribution variables (extramyocellular fat, abdominal visceral fat, and sum of skinfolds; $r(2)(\text{inc})=0.11$, $r(2)=0.55$, $P<0.05$). Sequential addition of a block of hormone variables (serum IGF-I and log((10)) leptin concentrations; $r(2)(\text{inc})=0.04$, $P>0.05$) did not reliably improve $r(2)$ beyond the physical characteristic and adiposity variables. In a second model, differences in sex and pubertal maturation were again held constant ($r(2)=0.25$), but body size differences were accounted for using percentage fat data. Sequential addition of percentage body fat ($r(2)((\text{inc})\text{remental})=0.11$, $r(2)=0.36$, $P<0.05$), then a block of fat distribution variables (percentage extramyocellular fat, percentage abdominal visceral fat, and percentage abdominal subcutaneous fat; $r(2)(\text{inc})=0.08$, $r(2)=0.44$, $P=0.058$), and then a block of serum IGF-I and log((10)) leptin concentrations ($r(2)(\text{inc})=0.07$, $r(2)=0.51$, $P<0.05$) increased $r(2)$. Mean nocturnal GH release was not related to HOMA ($r=-0.04$, $P=0.75$) and therefore was not included in the hierarchical regression models. Increases in insulin resistance at puberty were most related to FM. Accumulation of fat in
the abdominal visceral, subcutaneous and muscular compartments may increase insulin resistance at puberty beyond that due to total body fat. Serum concentrations of leptin and IGF-I may further modulate HOMA beyond the effects of adiposity and fat distribution. However, the results are limited by the cross-sectional design and the use of HOMA rather than a criterion measure of insulin resistance.

Faigenbaum AD. Previous research has shown that children can increase their muscular strength and muscular endurance as a result of regular participation in a progressive resistance training program. However, the most effective exercise prescription regarding the number of repetitions remains questionable. To compare the effects of a low repetition-heavy load resistance training program and a high repetition-moderate load resistance training program on the development of muscular strength and muscular endurance in children. Community-based youth fitness center. Eleven girls and 32 boys between the ages of 5.2 and 11.8 years. In twice-weekly sessions of resistance training for 8 weeks, children performed 1 set of 6 to 8 repetitions with a heavy load (n = 15) or 1 set of 13 to 15 repetitions with a moderate load (n = 16) on child-size exercise machines.

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Children in the control group (n = 12) did not resistance train. One repetition maximum (RM) strength and muscular endurance (repetitions performed posttraining with the pretraining 1-RM load) were determined on the leg extension and chest press exercises. One RM leg extension strength significantly increased in both exercise groups compared with that in the control subjects. Increases of 31.0% and 40.9%, respectively, for the low repetition-heavy load and high repetition-moderate load groups were observed. Leg extension muscular endurance significantly increased in both exercise groups compared with that in the control subjects, although gains resulting from high repetition-moderate load training (13.1 +/- 6.2 repetitions) were significantly greater than those resulting from low repetition-heavy load training (8.7 +/- 2.9 repetitions). On the chest press exercise, only the high repetition-moderate load exercise group made gains in 1-RM strength (16.3%) and muscular endurance (5.2 +/- 3.6 repetitions) that were significantly greater than gains in the control subjects. These findings support the concept that muscular strength and muscular endurance can be improved during the childhood years and favor the prescription of higher repetition-moderate load resistance training programs during the initial adaptation period.
Tsolakis CK. Nineteen untrained preadolescent males (11-13 years old) were randomly placed into an experimental trained group (STG, n = 9) and a control group (n = 10). Informed consent was obtained from the children and their parents. The STG was submitted to a 2-month resistance-training program (6 exercises, 3 x 10 repetitions maximum [RM], 3 times per week), followed by a 2-month detraining program. The effectiveness of the resistance program was determined by measuring pre- and posttraining and detraining differences in isometric and isotonic (10RM) strength and hormonal responses in testosterone (T), sex hormone binding globulin, and free androgen index (FAI). Their maturation stage was evaluated according to Tanner. Significant posttraining isometric strength gains (17.5%) and mean T and FAI value increases (p < 0.05-0.001) were observed in STG. Detraining resulted in a significant loss (9.5%, p < 0.001) of isometric strength whereas the hormonal parameters of STG remained practically unaltered. The relative (delta%) postdetraining hormonal responses correlated significantly with the respective isometric strength changes. In conclusion, the resistance training induced strength changes independent of the changes in the anabolic and androgenic

activity in preadolescent males. Further research is needed to fully clarify the physiological mechanisms underlying the strength training and detraining process.

Mazzetti SA. 44 The purpose of this study was to compare changes in maximal strength, power, and muscular endurance after 12 wk of periodized heavy-resistance training directly supervised by a personal trainer (SUP) versus unsupervised training (UNSUP). Twenty moderately trained men aged 24.6 +/- 1.0 yr (mean +/- SE) were randomly assigned to either the SUP group (N = 10) or the UNSUP group (N = 8). Both groups performed identical linear periodized resistance training programs consisting of preparatory (10-12 repetitions maximum (RM)), hypertrophy (8 to 10-RM), strength (5 to 8-RM), and peaking phases (3 to 6-RM) using free-weight and variable-resistance machine exercises. Subjects were tested for maximal squat and bench press strength (1-RM), squat jump power output, bench press muscular endurance, and body composition at week 0 and after 12 wk of training. Mean training loads (kg per set) per week were significantly (P < 0.05) greater in the SUP group than the UNSUP group at weeks 7 through 11 for the squat, and weeks 3 and 7

through 12 for the bench press exercises. The rates of increase (slope) of squat and bench press kg per set were significantly greater in the SUP group. Maximal squat and bench press strength were significantly greater at week 12 in the SUP group. Squat and bench press 1-RM, and mean and peak power output increased significantly after training in both groups. Relative local muscular endurance (80% of 1-RM) was not compromised in either group despite significantly greater loads utilized in bench press muscular endurance testing after training. Body mass, fat mass, and fat-free mass increased significantly after training in the SUP group. Directly supervised, heavy-resistance training in moderately trained men resulted in a greater rate of training load increase and magnitude which resulted in greater maximal strength gains compared with unsupervised training.

Lafortuna CL.\textsuperscript{45} The purpose of the present study was to compare aerobic, anaerobic and strength performance changes induced by two short-term (3-week) body mass reduction programs based on the same low-calory diet (1200-1500 kcal/day), nutritional education and psychological counseling, but entailing different exercise training

protocols. An individualized, low-volume and moderate-intensity exercise training (IET) was contrasted with a non-specific, high-volume, low-intensity exercise training (NET). Thirty obese in-patients (12 males, 18 females; mean age +/- SD: 33.9 +/- 9.4 yr, range: 19-51yr; mean BMI: 40.5 +/- 3.8 kg/m2, range: 35.3-51.4 kg/m2) were randomly divided in two gender-matched groups of 15 subjects each undergoing a different exercise training protocol. Maximum oxygen uptake (VO2max) determined with a submaximal indirect test on a bicycle ergometer, lower limb maximum power output (W(max)) determined with the jumping method, global motor capabilities determined by analysis of locomotor pattern during a short (8 m) running, maximum strength (1-RM) of upper and lower limb muscle groups determined with isotonic machines were tested before and after the program. Adherence to an individual exercise activity and maintenance of body weight (bw) loss were evaluated with a telephonic interview 6 months after the completion of the program. In both groups a significant (p < 0.001) and comparable weight loss was observed (IET: -4.27%; NET: -4.17%). In both groups VO2max and W(max) increased significantly (p < 0.05-0.001) when expressed relatively to body mass, while in absolute terms they were significantly (p < 0.001) improved only in IET group. 1-RM in all tested muscle
groups was significantly increased in both IET and NET subjects (p < 0.001-0.01), but improvements were significantly greater in IET as compared with NET (p < 0.05-0.001). The analysis of locomotor pattern during the short running indicated that IET subjects significantly improved their global motor capabilities (p < 0.05-0.001), while no change was observed in NET group. After 6 months, IET subjects reported a level of spontaneously chosen physical activity significantly higher (p < 0.05) than NET subjects, displaying a trend of further decrease in bw. It was concluded that, although no difference in bw loss was appreciated between the two studied groups and significant improvements were found also in subjects performing NET protocol, the IET protocol offers better overall results in terms of muscle performance and physical fitness, with a possibly stronger motivation to subsequent exercise activity.

**Seynnes O**46 The purpose of this efficacy study was to measure the dose-response effect of a free weight-based resistance training program by comparing the effects of two training intensities (low-moderate and high) of the knee extensor (KE) muscles on muscle function, functional limitations, and self-reported disability. The

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authors conducted a single-blinded, randomized, placebo-controlled trial. Twenty-two institutionalized elders (mean age, 81.5 years) were assigned to either high-intensity strength training (HI; n = 8), low-moderate intensity strength training (LI; n = 6), or weight-free placebo-control training (PC; n = 8). The HI group trained at 80% of their 1-repetition maximum and the LI group trained at 40%. All groups performed 3 sets of 8 repetitions, 3 times per week for 10 weeks. Outcome measures included KE maximal strength, KE endurance, and functional performance as assessed by 6-minute walking, chair-rising, and stair-climbing tests, and by self-reported disability. KE strength and endurance, stair-climbing power, and chair-rising time improved significantly in the HI and LI groups compared with the PC group. Six-minute walking distance improved significantly in the HI group but not in the LI group compared with the PC group. Changes observed in HI were significantly different from those observed in the LI group for KE strength and endurance and the 6-minute walking test, with a trend in the same direction for chair-rising and stair-climbing. Changes in strength were significantly related to changes in functional outcomes, explaining 37% to 61% of the variance. These results show strong dose-response relationships between resistance training intensity and strength gains, and between strength gains and functional
improvements after resistance training. Low-moderate intensity resistance training of the KE muscles may not be sufficiently robust from a physiologic perspective to achieve optimal improvement of functional performance. Supervised HI, free weight-based training for frail elders appears to be as safe as lower intensity training but is more effective physiologically and functionally.

Lafortuna CL\textsuperscript{47}. The purpose of the present study was to compare aerobic, anaerobic and strength performance changes induced by two short-term (3-week) body mass reduction programs based on the same low-calory diet (1200-1500 kcal/day), nutritional education and psychological counseling, but entailing different exercise training protocols. An individualized, low-volume and moderate-intensity exercise training (IET) was contrasted with a non-specific, high-volume, low-intensity exercise training (NET). Thirty obese in-patients (12 males, 18 females; mean age +/- SD: 33.9 +/- 9.4 yr, range: 19-51yr; mean BMI: 40.5 +/- 3.8 kg/m2, range: 35.3-51.4 kg/m2) were randomly divided in two gender-matched groups of 15 subjects each undergoing a different exercise training protocol. Maximum oxygen

uptake (VO2max) determined with a sub maximal indirect test on a bicycle ergometer, lower limb maximum power output (W(max)) determined with the jumping method, global motor capabilities determined by analysis of loco motor pattern during a short (8 m) running, maximum strength (1-RM) of upper and lower limb muscle groups determined with isotonic machines were tested before and after the program. Adherence to an individual exercise activity and maintenance of body weight (bw) loss were evaluated with a telephonic interview 6 months after the completion of the program. In both groups a significant (p < 0.001) and comparable weight loss was observed (IET: -4.27%; NET: -4.17%). In both groups VO2max and W(max) increased significantly (p < 0.05-0.001) when expressed relatively to body mass, while in absolute terms they were significantly (p < 0.001) improved only in IET group. 1-RM in all tested muscle groups was significantly increased in both IET and NET subjects (p < 0.001-0.01), but improvements were significantly greater in IET as compared with NET (p < 0.05-0.001). The analysis of loco motor pattern during the short running indicated that IET subjects significantly improved their global motor capabilities (p < 0.05-0.001), while no change was observed in NET group. After 6 months, IET subjects reported a level of spontaneously chosen physical activity
significantly higher (p < 0.05) than NET subjects, displaying a trend of further decrease in bw. It was concluded that, although no difference in bw loss was appreciated between the two studied groups and significant improvements were found also in subjects performing NET protocol, the IET protocol offers better overall results in terms of muscle performance and physical fitness, with a possibly stronger motivation to subsequent exercise activity.