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ABSTRACT

Coronary arteries are subjected daily in high shear stress and manifest atherosclerosis very early in life in comparison to other arteries in the human body. Some factors that are implicated in the evolution and progress of this process are the concentration of lipids and arachidonic acid metabolites, such prostacyclin and thromboxane. It has been reported that those who participate in aerobic activities such as walking, cycling, jogging or brisk walking might have normal values of the mentioned chemical substances. On the other hand, it is reported that the effects of anaerobic and strength activities has negative effects on the vascular endothelium, which is essential for the maintenance of hemostatic balance and the local regulation of vascular tone. Therefore, even although extensive research has been conducted in this field, there are crucial gaps in our knowledge. Consequently, the purpose of this brief review is to describe what is known about the effects of anaerobic activities in which the competitive athletes have participated on the following blood parameters: Total cholesterol, triglycerides, high density lipoprotein cholesterol (HDL-C), low density lipoproteins cholesterol (LDL-C), prostacyclin & thromboxane.

Key Words: Total cholesterol, triglycerides, high density lipoprotein cholesterol, low density lipoprotein cholesterol, prostacyclin, thromboxane, anaerobic trainings.
INTRODUCTION

Atherosclerosis is a multifactor disease which affects large and medium-sized arteries of the human in his/hers most productive years (1). Plasma lipids, lipoproteins and arachidonic acid metabolites, play an important role in the formation of atherosclerotic lesions (2). Lipoproteins serve as carriers of lipid compounds in the body and there are 3 groups: very low density lipoproteins (VLDL), low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Prostacyclin, the main product of arachidonic acid cascade is a vasodilator and a potent inhibitor of platelet aggregation, while its endogenous antagonist thromboxane is a vasoconstrictor and promotes platelet aggregation (3). Many epidemiological studies supported the view that there is a strong relationship between concentration of HDL-C, prostacyclin, thromboxane and coronary heart disease (4-12). High density lipoprotein cholesterol activates the enzyme prostacyclin synthetase with concomitant more prostacyclin production (13-15). Regular aerobic activities such as walking, jogging, swimming, cycling or similar activities have a positive effect on the lipid, lipoprotein and prostaglandin profile. However, anaerobic activities do not have similar effects. The purpose of this brief review is to refer to the adaptations of those participating in anaerobic activities and mainly those who are track and field athletes.

REVIEW OF LITERATURE

The following paragraphs describe in detail studies that were conducted in athletes who practiced in anaerobic or mixed activities and describe the mode, frequency, duration and intensity of the exercise.

Aellen et al (16), studied the effects of anaerobic and aerobic training on lipoprotein concentrations in sixty six healthy sedentary men. Thirty three subjects trained four times per week for nine weeks on a bicycle ergo-meter. Sixteen trained with intensity higher of the anaerobic threshold and seventeen exercised with intensity lower the anaerobic threshold. The results demonstrated that the training changed the lipid and lipoprotein profiles only after training below the anaerobic threshold. The authors concluded that physical training above the anaerobic threshold has no or even negative effects on blood lipoprotein profiles. Subsequently, in order to achieved beneficial adaptations in lipoprotein profile, the training should be performed below the anaerobic threshold.

Cardoso Saldaña et al (17), investigated the effects of long-term high level physical exertion on plasma lipids and lipoproteins in ninety-one young athletes, who practiced sports such as running, swimming, rowing, boxing and soccer and in 101 healthy subjects, who served as controls. The mean plas-
ma levels of high-density lipoprotein cholesterol (HDL-C) were significantly higher in male athletes than in controls. The prevalence of hypercholesterolemia, hypertriglyceridemia and low HDL-C levels, were lower in male and female athletes of the five sport disciplines than in sedentary controls; however, only hypercholesterolemia and the atherogenic index were statistically different. The results showed that low plasma levels of TG and high levels of HDL-C characterize the athletes who practice an aerobic physical activity. Moreover, male athletes who exercised in long-term training have lower LDL-C plasma levels. The authors concluded that athletes have a lipid profile that may be protective against the development of atherosclerosis.

Coutinho, (18) compared the different degrees of physical activity and the levels of blood lipids/lipoproteins. In his study participated one hundred fifty seven males, of average 21 years, who were divided in two groups: The experimental group comprises 88 athletes and the control group 69 non-athletes. After the results’ analysis the subjects of the experimental group showed lower levels of cholesterol, triglycerides, and the VLDL/cholesterol ratio, in comparison to the control group, as well as the risk rate 1 and 2, respectively the ratio of cholesterol/HDL cholesterol and LDL cholesterol/HDL cholesterol. There was no difference in both groups regarding the LDL and HDL cholesterol. The author concluded that the athletes had a more favorable lipid-lipoprotein level, which suggested a lower risk of developing ischemic heart disease.

Giada et al, (19), compared lipoprotein profile, body composition and diet in 20 soccer players (practicing mixed and anaerobic sports activities), in twenty body builders (anaerobic trained) and twenty sedentary subjects. They did not find significant differences in total serum cholesterol, triglycerides, HDL-C, LDL-C. Body builders had lower carbohydrate, and higher protein and cholesterol intakes, while soccer players had a lower polyunsaturated to saturated fat ratio. None of the apolipoproteins examined were correlated with any body composition of diet parameters. No correlations between lipid parameters and anthropometric or dietary variables were found by multivariate analysis when the subjects were considered as a whole. The authors suggested that in healthy lean normolipemic males, the lipoprotein profile is not modified by mixed or anaerobic sport activities.

Hübner-Woźniak et al (20) determined the effects of anaerobic activities on serum lipid profile. In their study a group of elite volleyball players participated, also, a group of wrestlers and untrained control subjects. The results showed a decrease in total cholesterol and LDL-cholesterol in both volleyball players and wrestlers. Also, a significant decrease was observed in TG and increase in HDL-cholesterol in volleyball players, while those changes amounted to only 11 and 8%, respectively, in wrestlers, and did not differ significantly from those in the control group. The authors concluded that competitive sport training had beneficial effect on serum lipid profile.
Imamoglu et al (21) compared plasma triglyceride and lipoprotein concentrations of male and female subjects of different training levels. In this study participated 20 male wrestlers, 44 male and 51 female physical education students and 40 sedentary females. The results showed no significant differences in lipid profile between control subjects and wrestlers with a 10-year experience. The authors concluded that wrestling training, consisting predominantly of anaerobic and strength exertions, was insufficient to stimulate a rise in HDL-cholesterol level.

Kishali et al (22), compared plasma lipid and lipoprotein concentrations in 20 male Wrestlers, in 44 male and 51 female students from physical education and sports department and 40 sedentary females. The results showed no significant differences in plasma TC and TG values between four groups. Also, no significant differences were found in HDL-C and LDL-C values between wrestlers and male students, and between female students and sedentary females. HDL-C values of female students and sedentary females were significantly higher when compared with the same values of wrestlers and male students and LDL-C values were found to be lower in females than males. The authors concluded that medium and high level of exercises did not cause significant differences in lipid and lipoprotein levels.

Kokkinos et al. (23) in another study investigated the effects of strength training lasting 20 weeks and reported that had no effect on either lipid component. It was assumed that beneficial changes in lipoproteins profile depend on the duration of training period rather than on training intensity. It seems that training consisting predominantly of anaerobic and strength exertions, was insufficient to stimulate a rise in HDL-cholesterol level.

Maso et al (24) investigated the metabolism of lipids in 21 high-level rugby players and men of the same age group who take part in no sporting activity. The authors reported that the concentration of HDL cholesterol was lower in rugby players than in control subjects, although TC and TG were decreased in the former group and LDL-cholesterol did not change.

Oyelola & Rufai, (25), determined plasma lipid, lipoprotein and apolipoprotein profiles in 14 healthy Nigerian male athletes and controls. The mean levels of total cholesterol and low-density lipoprotein cholesterol were significantly lower in the athletes than in the controls. There were no statistically significant differences between the mean values of the plasma triglycerides, high-density lipoprotein (HDL) & very low-density lipoprotein (VLDL) cholesterol respectively for the athletes and controls. The authors concluded that physical activity has salutary effects on the lipid and lipoprotein profile.

Tao, (26) investigated the anaerobic and aerobic activities training in 48 healthy untrained women and found that the training above the anaerobic threshold had negative effects on blood lipoprotein levels.

Tsopanakis et al (27) investigated the effects of high quality physical training in different specialties of nine Olympic sports and compared the concen-
trations of serum lipids and lipoproteins with controls. Among the participating groups were track and throwing-jumping athletes. The total sum of athletes had significantly higher HDL than the controls. Throwing-jumping did not differ. Short- and long-distance running showed favorable HDL, indicating that these sports seem to be protective against atherogenesis with respect to lipid profiles. In strength sports such throwing-jumping, lipid values were found to be closer to normal values.

Witek (28) assessed the changes in serum lipid profile of 14 elite volleyball players aged 23-34 years, who were examined 3 times during the competition period lasting 10 weeks. After results analysis it was observed an increase in mean concentrations of TC, LDL, TC/HDL and LDL/HDL, while HDL-C gradually decreased as reflected by the significance of differences between consecutive examinations.

CONCLUSIONS

Male athletes who practice in sports, including anaerobic activities, generally have lower values of high density lipoprotein cholesterol (HDL), higher total cholesterol (TC), triglycerides (TG) and low density lipoprotein cholesterol (LDL) in comparison to athletes who practice sports that include aerobic activities.

Male athletes who practice in sports which include mixed activities (aerobic or anaerobic) generally have lower values of high density lipoprotein cholesterol (HLD), prostacyclin, higher total cholesterol (TC), triglycerides and low concentrations of low density lipoprotein cholesterol (LDL) and thromboxane in comparison to athletes who practice sports that include aerobic activities or male athletes who have been exercising with long-term training.

Male athletes who practice in sports which including anaerobic activities generally have higher values of high density lipoprotein cholesterol (HLD), and lower total cholesterol (TC), triglycerides and low density lipoprotein cholesterol (LDL) in comparison with sedentary individuals.

Male athletes who practicing in sports which include mixed activities, aerobic or anaerobic generally have lower values of high density lipoprotein cholesterol (HLD), and higher total cholesterol (TC), triglycerides and low density lipoprotein cholesterol (LDL) in comparison to athletes who practice sports that include aerobic activities.

The healthy lean normolipemic males, that practice sports which include mixed activities, aerobic or anaerobic have values of high density lipoprotein cholesterol (HLD), total cholesterol (TC), triglycerides and density lipoprotein cholesterol (LDL), that is not modified by this type of training.
Women who train with an intensity above the anaerobic threshold have lower values of high density lipoprotein cholesterol (HLD), higher total cholesterol (TC), triglycerides (TG) and low density lipoprotein cholesterol (LDL) in comparison to athletes who practice sports that include aerobic activities.

Generally, the participation of male athletes in the sports of wrestling, volleyball, rugby and some sports of track and other fields such as throwing, jumping and running 100 and 200, shows negative profile in lipids and lipoproteins.

**RECOMMENDATIONS FOR FURTHER RESEARCH**

As concluded from the literature review, there is a gap between aerobic and anaerobic activities in relationship to cardiovascular health, since the concentration of lipid and arachidonic acid metabolites are not modified by the second type of exercise. If the mentioned parameters are not altered by anaerobic training, the athletes of track and field may be at risk, if they practice only anaerobic, strength and power activities with no favorable lipidic-lipoprotein level, perhaps to develop ischemic heart disease.

It is important to study in detail whether anaerobic and strength exercise training in all sports of track and field can modify or not lipids and arachidonic acid metabolites. Ideally, a study would include the following:

The determination of high density lipoprotein cholesterol (HLD), total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL) and arachidonic acid metabolites in throwing male athletes who practice only anaerobic activities and comparison to the same category athletes who give emphasis in aerobic activities not as mixed but as proposed by American College of Sport medicine for health.

The determination of high density lipoprotein cholesterol (HLD), total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL) and arachidonic acid metabolites in throwing male athletes who practice moderate training intensities below anaerobic threshold.

The determination of high density lipoprotein cholesterol (HLD), total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL) and arachidonic acid metabolites in pault volt, jumping and running 100 and 200 meters woman athletes who practice only anaerobic activities and comparison to the same category athletes who give emphasis in aerobic activities not as mixed but as proposed by American College of Sport medicine for health.

The second area of research should focus on the effects anaerobic activities have on male or female athletes who already exhibit a low profile of HDL and prostacyclin and a high TC, TG, LDL and thromoboxane.
REFERENCES


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