

Original Article**A 90 minute soccer match decreases triglyceride and low density lipoprotein but not high-density lipoprotein and cholesterol levels**

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Abstract

BACKGROUND: The association between the lipid profiles level and the incidence and severity of coronary heart disease (CHD) is very pronounced in epidemiological studies, and an inverse relation between physical fitness and the incidence of coronary heart disease has been observed in many studies. The aim of this study was to investigate the impact of a soccer match on lipid parameters of professional soccer players.

METHODS: Twenty two professional soccer players participated in the study. Blood (10ml) for determination of lipid profiles was obtained at rest and immediately after a 90 minute soccer match. Lipid parameters were measured using Boehringer Mannheim kits and Clinilab and BioMerieux analyser.

RESULTS: The results of this study showed that the triglyceride was significantly higher before the match than afterwards (159.09 ± 58.2 vs. 88.63 ± 34.1 mg/dl, $p < 0.001$), whereas the low-density lipoprotein (LDL) was lower before the match than after it (98.04 ± 28.9 vs. 112.31 ± 30.5 mg/dl). Moreover, there were no significant differences in cholesterol concentration (171.4 ± 30.28 mg/dl vs. 173.18 ± 32.75 mg/dl) and high-density lipoprotein (HDL) concentration (34.04 ± 5.58 mg/dl vs. 34.4 ± 4.6 mg/dl) between before and after the match.

CONCLUSIONS: Although the soccer competitive match has no favourable acute effect on lipid profiles, the lower rate of LDL, cholesterol and triglyceride as well as the higher level of HDL in players suggest a beneficial effect of regular soccer training on atherosclerosis and perhaps on CHD risk as well.

KEYWORDS: Coronary Heart Disease, Triglyceride, Cholesterol, Low-Density Lipoprotein, High-Density Lipoprotein, Soccer.

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Coronary heart disease (CHD) is the leading cause of mortality and disability in both men and women,¹ and the risk of developing CHD later in life is 50% for men at the age of 40.² Lipids are one of the most important risk factors for CHD, and epidemiological studies have shown a relationship between elevated cholesterol and CHD.³ It has been reported that increased physical activity is related to a reduced risk of cardiovascular disease, possibly because it leads to improvements in the lipoprotein profiles.⁴ In addition

to that an inverse relation between physical activity, physical fitness, and the incidence of coronary disease has been observed in many epidemiological studies. A low fitness level is associated with an increased risk for CHD,⁵⁻⁷ but a high fitness level leads to decreased risk CHD and less mortality.⁸

It is broadly accepted that aerobic physical activity is related to a less atherogenic lipid and lipoprotein profile leading to a reduced cardiovascular risk. Both cross-sectional studies and prospective-interventional trials

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show that the most frequent modification observed consists of a slight but significant increase in high-density lipoprotein cholesterol levels.⁹

Ruiz et al (2004) investigated fasting plasma levels of 28 swimmers, 17 volleyball players and 23 soccer players, and a control group. They reported that those who practice sports involving a high level of physical exertion (volleyball and soccer players) had a less favourable lipid profile compared to control subjects. In contrast, swimmers had a more favourable lipid profile.¹⁰

Recently the serum lipid concentrations of 12 soccer players and 12 nonathletes have been assessed. The soccer players had significantly higher HDL-cholesterol (by 18%) and significantly lower total cholesterol/HDL-cholesterol ratio (by 15%) than the nonathletes. There were no significant differences between groups in triglycerides, total cholesterol and LDL-cholesterol. The soccer players had significantly higher energy and fat intake, as well as significantly higher energy expenditure than the nonathletes.¹¹

More recently, effects of a soccer match on plasma lipid profile have been evaluated. Sotiropoulos et al (2008), reported that HDL level increased significantly after the match. Also, there was a significant decrease in TG and total Cholesterol. This data suggest that intermittent exercise of long duration, such as a soccer match, will result into an acute antiatherogenic modification of lipid profile, possibly due to the high aerobic energy expenditure.¹²

There has been much interest in the biology and the effects of soccer on physiological and biochemical factors, especially lipids profiles. Soccer is considered to be the most popular sporting event in the world.¹³ However, only limited research has studied the effects of a soccer match on serum lipid profiles in professional players,⁹⁻¹² and little is known about the effect of a competitive soccer on serum lipids. Therefore, the aim of this study is to investigate the impact of a soccer match on lipid profiles of professional players.

Methods

Twenty two professional soccer players participated in this study (mean \pm SD, age: 21.7 ± 1.3 ; height: 1.75 ± 0.05 ; body weight: 67.0 ± 6.3 ; body mass index: 21.7 ± 1.7). The subjects' anthropometrics characteristics were assessed at rest before the match by use of an 8-polar tactile-electrode impedance-meter, the body composition analyzer (InBody 3.0, Biospace, Seoul, Korea). This provides simultaneous measurements of body weight, lean body mass (or fat-free mass), total body water and, regional fat deposit. All the subjects had regular physical training (> 3 sessions per week for at least 3 years) before the present study. Ethical approval for the study was obtained from the University Ethic Committee, and informed consent forms were obtained from all players before the match. Blood samples (10 ml) for the determination of lipid profiles were obtained at rest and immediately after 90 minutes of soccer match. The blood then was centrifuged for 6 minutes at 4500 g for separating the blood serum. All of biochemical tests have been done with serum samples. Lipid parameters (Triglyceride; Cholesterol; Low-density lipoprotein; High-density lipoprotein) were measured using Boehringer Mannheim kits and Clinilab, bioMerieux analyser as used by Jastrzebska et al.¹⁴ The data were analysed using Student t tests. The level of significance for all tests was at $p < 0.05$.

Results

The data for body composition are shown in table 1. The results illustrate that the triglyceride is significantly higher before the match (159.09 ± 58.2 vs. 88.63 ± 34.1 mg/dl, $p < 0.001$) (Figure 1), and the low-density lipoprotein (LDL) is significantly lower before the match (98.04 ± 28.9 vs. 112.31 ± 30.5 mg/dl, $p < 0.001$) (Figure 2). There are no significant differences ($p > 0.05$) in cholesterol concentration (171.4 ± 30.28 mg/dl vs. 173.18 ± 32.75 mg/dl) and high-density lipoprotein concentration (HDL) (34.04 ± 5.58 mg/dl vs. 34.4 ± 4.6 mg/dl) between before and after the match (Figures 3 and 4, respectively).

Table 1. Body composition of soccer players (Mean \pm SD) (n = 22)

Weight (kg)	Intracellular Fluid (L)	Extracellular Fluid (L)	Protein Mass (kg)	Mineral Mass (kg)	Fat Mass (kg)	Total Body Water (L)	Soft Lean Mass (kg)	Lean Body Mass (kg)
67.03 \pm 6.33	29.45 \pm 2.64	13.73 \pm 1.35	11.78 \pm 1.05	3.72 \pm 0.28	8.33 \pm 2.29	43.19 \pm 3.95	4.55 \pm 5.38	58.70 \pm 5.29

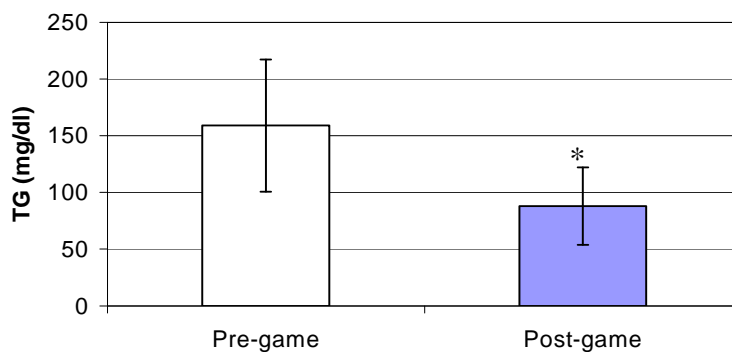


Figure 1. Concentration of triglyceride (TG) before and after the match
* p < 0.001

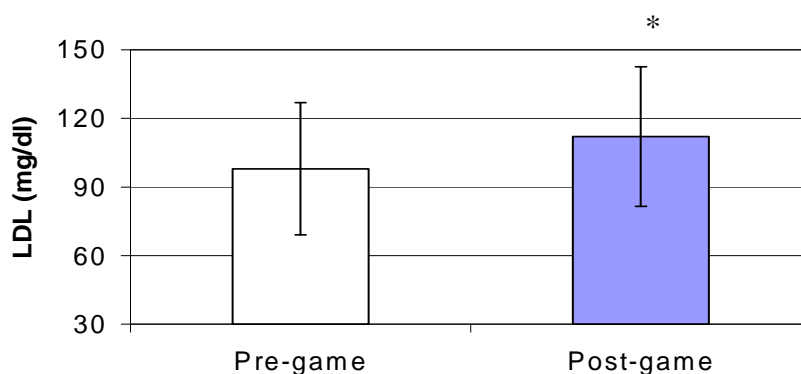


Figure 2. Concentration of low-density lipoprotein (LDL) before and after the match
* p < 0.001

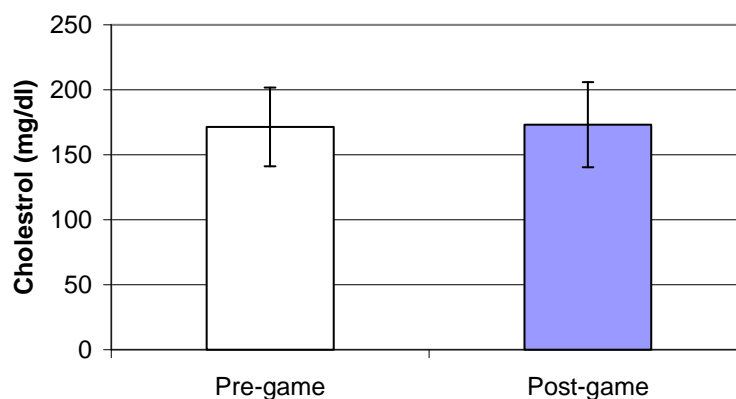


Figure 3. Concentration of cholesterol before and after the match

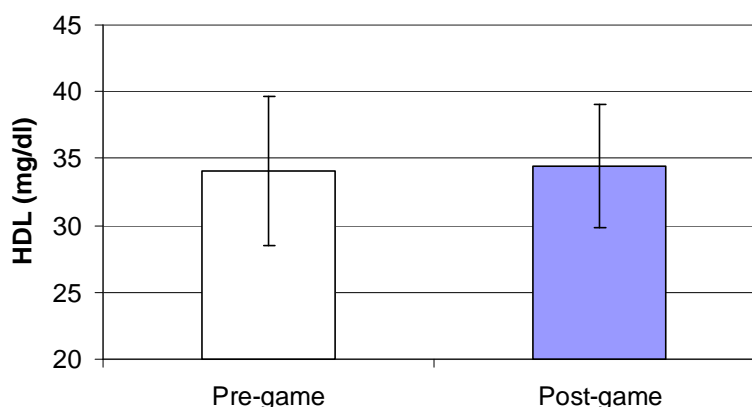


Figure 4. Concentration of high-density lipoprotein (HDL) before and after the match

Discussion

The purpose of this study was to investigate the effects of a competitive soccer game on lipid profiles. After the game, triglyceride concentration decreased significantly and, LDL increased significantly, however, cholesterol and HDL levels had no significant changes. Regardless of these results, the rate of LDL, cholesterol and triglyceride in the rest were lower and HDL was higher in our subjects compared to sedentary subjects of similar age which were reported in many previous studies.

The triglyceride concentration at rest for the subjects in this study was lower than the normal range. It has been reported that regular participation in endurance exercise and training is associated with lower serum triglyceride concentrations^{9,12,15} but such changes do not occur on those participating in anaerobic physical activities or resistance exercise.^{15,16} Triglyceride values after the soccer match in our study decreased (by about 44%) which is in agreement with researchers who reported a reduction in concentration of triglycerides following exercise training.^{12,15} Crouse et al also reported that a reduction in triglycerides occurred immediately after the exercise session.¹⁷ In many studies, decrease in triglyceride occurred without changes in high-density lipoprotein.¹⁸⁻²⁰ Exercise induced changes in

triglycerides may be mediated, at least in part, by an increase in lipoprotein lipase activity.²¹ The hydrolysis of triglycerides reduces the triglyceride content of the lipoprotein partial.¹ This suggests that skeletal muscle may be responsible for increased hydrolysis of plasma triglycerides during exercise and thus, may alter plasma lipoprotein metabolism after exercise training. This would induce a favourable lipid profile, with the low serum triglycerides and high serum HDL values that most often were observed in regular exercise.

The low-density lipoprotein level increased significantly after the game. It should be noted that it was still in the desirable zone (< 130 mg/dl). It is postulated that the increase of LDL after the match probably occurred because LDL is the primary transport carrier of cholesterol in the circulation. LDL delivers about 50-60% of cholesterol to the cells. A possible explanation for increasing level of LDL after the soccer match is that increased free radical production, associated with aerobic exercise, can influence the oxidative state of circulating LDL particles.^{8,22}

Regarding the lipid profiles in professional soccer players following match, our results which indicate a rise in LDL, suggest caution with respect to the supposed beneficial acute effects of soccer training on lipid metabolism. In contrast to our finding, Crouse et al²³ who recruited untrained adult men with known or

suspected elevated total cholesterol concentrations, reported that immediately after high-intensity exercise, LDL concentrations were significantly reduced from pre-exercise values but subsequently returned to baseline after 24 hours. We can only speculate why our findings differ from their study. Our subjects were professional soccer players with low body fat and ideal weight, these factors could influence post-exercise lipid metabolism and alter the LDL response.²³ There is little information about the biochemical mechanisms producing this change, and further studies are needed to elucidate plausibly mechanisms for them.

The lipoproteins (especially HDL and LDL) have been found to be strong predictors of coronary heart disease (CHD). Lipoprotein may affect atherosclerosis and thrombosis, mainly by binding to fibrin and attenuating the fibrin-enhanced plasminogen activation.²⁴

In the present study, the concentrations of total resting cholesterol and LDL were low in comparison with data from sedentary subjects.²⁵ Shephard claimed that prolonged distance running of soccer player during a competitive match had a favourable influence on their lipid profiles.¹³ The association between high serum cholesterol levels and the incidence and severity of coronary heart disease is very pronounced in epidemiological studies.²⁶ Manson et al²⁷ reported that a 1% reduction in a person's total serum cholesterol level led to a 2 to 3% reduction in the risk of coronary heart disease. There is a variety of environmental and personal factors that may influence a person's cholesterol composition such as age, gender, level of body fat, dietary intake of fat, cholesterol and carbohydrates, alcohol consumption, cigarette smoking, medication, menopausal status, and exercise. For example higher consumption of fast food has been associated with the risk of many chronic diseases and increasing the knowledge of people is very useful in this respect.^{28,29} Because of the complex interactions among these variables, it is difficult to assess how each

of these factors independently affects cholesterol levels and composition. It should be noted that the lowest value of resting cholesterol in soccer players may be due to the aerobic nature of the training they are doing. It seems that 90 minutes of intermittent activity has no acute effect on this factor as the cholesterol concentration did not change during the game in our study.

In the present study, HDL did not change after the soccer match. A high serum level of HDL has regularly been observed in endurance-trained persons^{5,30-34} but not in individuals involved primarily in anaerobic activities or resistance exercise.^{16,35-37} The serum lipid and lipoprotein levels of individuals are related to the type of training as well as the duration and intensity of exercise achieved by them.¹⁵ The distance covered during a competitive soccer match depends on the player's position in the field, an average of 8-12 km for outfield players has been measured,¹³ and this will contribute to aerobic fitness. The subjects participated in this present study were professional players (> 3 session of training per week for ore than 5 years) and probably for this reason they had a relative higher values of HDL at rest. As reported in previous studies, the regular endurance training for a long period of time can change HDL levels.¹² Since we did not find any significant change in HDL after a 90 minute match, it seems that the intensity and quantity of exercise involved in a soccer match does not lead to any change in HDL.

Conclusions

In conclusion, the lowest rate of LDL, cholesterol and triglyceride as well as the higher level of HDL in our subjects compared to data reported for sedentary subjects of similar age suggest a beneficial effect of regular soccer training on atherosclerosis and perhaps on coronary heart disease risk as well. Therefore, the well-known cardioprotective benefit of aerobic exercise could be based, at least in part, on a less atherogenic lipid and lipoprotein profile.

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Conflict of Interests

Authors have no conflict of interests regarding this paper.

Authors' Contributions

NR wrote the manuscript and is responsible for dealing with referees comments. AY and MM has collected the data. EB analyzed the data. All authors have read and approved the content of final manuscript.

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