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THE EXAMINATION OF THE EFFECTS OF PPAR-A (RS4253778) ON SERUM LIPIDS IN ELITE CROSS-COUNTRY SKIERS

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ABSTRACT

The purpose of this study was to examine the effects of PPAR-a (rs4253778) on serum lipids in elite cross-country skiers. This study included 34 cross-country skiers (23 males and 11 females who participated in the Turkish skiing national team camp). Genotyping for the PPAR-a gene rs4253778 G/C polymorphism was performed by PCR on Tercyk multicanal amplificator and restriction enzyme digestion. Statistical analysis was done by using the SPSS 22.0 package program. Genotypic frequency of the PPAR-a polymorphism was detected in cross-country skiers. PPAR-a GG, GC and CC genotypes were detected as 67.64%, 23.52% and 8.82%, respectively in 34 cross-country skiers while PPAR-a GG, GC and CC genotypes were detected as 47.05%, 16.64%, and 2.94%, respectively in elite males. PPAR-a GG, GC and CC genotypes were detected as 20.58 %, 5.88%, and 5.88%, respectively in females. PPAR-a G and C allele were detected as 49 and 19, respectively in 34 elite endurance athletes. In the present study, the GG genotypes were detected at higher frequencies in elite athletes (67.64% respectively) than GC and CC (23.52% and 8.82%, respectively). The difference between the PPAR-a G/C gene polymorphism of Turkish elite cross-country skiers and serum total cholesterol, HDL-cholesterol, LDL- cholesterol and TG levels was not statistically significant. Although there was not any statistically significant difference between the PPAR-a G/C gene polymorphism and lipid profiles of Turkish elite cross-country skiers, it is foreseen that PPAR-α genes have an important effect on endurance performance in sports requiring endurance such as cross-country skiing.

Keywords: Cross-Country athletes, lipids, PPAR-A gene polymorphism, sports.

ELİT KAYAKLI KOŞUCULARDA PPAR-A'NIN (RS4253778) SERUM LİPİTLERİ ÜZERİNDEKİ ETKİSİNİN İNCELENMESİ

ÖZET

Bu çalışmanın amacı, elit kayaklı koşucularda PPAR-a (rs4253778) serum lipidleri üzerindeki etkilerini incelemektir. Bu çalışmaya 34 kayaklı koşu sporcusu (Türkiye kayak milli takım kampına katılan 23 erkek ve 11 kadın) dahil edildi. PPAR-a geni rs4253778 G/C polimorfizmi için genotipleme, Tercyk multicanal amplifikatör ve restriksiyon enzim sindirimi üzerinde PCR ile gerçekleştirildi. İstatistiksel analiz SPSS 22.0 paket programı kullanılarak yapıldı. Kayaklı koşucularda PPAR-a polimorfizminin genotipik frekansı tespit edildi. 34 kayaklı koşucuda PPAR-a GG, GC ve CC genotipleri sırasıyla %67,64, %23,52 ve %8,82 tespit edildi. PPAR-a GG, GC ve CC genotipleri erkeklerde sırasıyla %47,05, %16,64 ve %2,94 olarak tespit edilirken kadınlarda PPAR-a GG, GC ve CC genotipleri sırasıyla %20,58, %5,88 ve %5,88 olarak tespit edildi. PPAR-a G ve C alleli 34 elit dayanıklılık sporcusunda sırasıyla 49 ve 19 olarak tespit edildi. Bu çalışmada, GG genotipleri elit sporcularda (sırasıyla %67,64) GC ve CC'den (sırasıyla %23,52 ve %8,82) daha yüksek frekanslarda olduğu tespit edildi. Türk elit kros kayakçılarının PPAR-a G/C gen polimorfizmi ile serum toplam kolesterol, HDL-kolesterol, LDL-kolesterol ve TG seviyeleri arasındaki istatistiksel olarak anlamlı bir fark tespit edilmedi. Türk elit kayaklı koşucuların PPAR-a G/C gen polimorfizmi ile lipid profilleri arasında istatistiksel olarak anlamlı bir fark olmamasına rağmen, PPAR-α geninin dayanıklılık gerektiren sporlarda dayanıklılık performansı üzerinde önemli bir etkiye sahip olduğu öngörülmektedir.

Anahtar Kelimeler: Kayaklı koşucular, lipitler, PPAR-A gen polimorfizmi, spor

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INTRODUCTION

Athletic ability certainly is one of the ways to succeed in sports. In a good number of research, it has been reported that athletic ability is influenced by genetic components such as ACTN3, PPAR and ACE (MacArthur and North, 2005; Rankinen et al, 2006)

However, phenotypes that are effective in determining athletic ability are highly polygenic, while it is still not obvious whether different genetic components play a role in the capacity of an athlete in sports (Amir, 2007). Relevant studies in the literature have detected that the basic motoric properties such as speed, strength, flexibility and nerve muscle coordination that determine the ability of an individual are related to genetic factors (Kaynar and Bilici, 2017). Furthermore, an individual's athletic ability is determined by the interaction between athletic ability, differences of the unique genetic structure and the environmental factors such as physiological adaptation to training, food habits, and sleeping pattern (Ulucan et al., 2015).Even more, nearly 70% of the athletic performance variance is explained with genetic factors(Corak et al., 2017). Peroxisome proliferator activated receptor alpha (PPAR-a) polymorphism (rs4253778) is also one of the genes that affect athletic performance (Rankinen et al., 2009). The PPAR-a is located on chromosome 22 (22q12-q13.1). PPARs are the members of the nuclear hormone receptor super family and PPAR-a codes for transcriptional factor named nuclear receptor protein (PPAR-a) (Van Raalte and Li, 2004).

It has also been found that PPAR gene is associated with variation on lipid metabolism and fatty acid oxidation (Yong et al., 2008; Berger and Moller, 2002).

PPAR gene has been a good candidate gene to study athletic ability because of its important roles in lipid metabolism tissue repair and transcriptional regulation of enzymes (Yessoufou and Wahli, 2010)

Cross-country skiing is a sports discipline that requires high effort and endurance, usually practised on mountainous regions, in cold weather and on long stretches of skiing (1.5 sprint, 15 and 50 km for men, 1.5 and 10 km for women). Therefore, in this sport branch, the energy need (lipid-carbohydrate metabolism) is intense.

Although skiing is popular in Turkey, it is known that the sportive success in skiing is not satisfactory. The fact that athletes with sporting talent in skiing are not detected before the beginning of the sport and the lack of scientific background are the important reasons for this failure.

The purpose of this study was to investigate whether there is an association between the PPAR-a G/C (rs4253778) polymorphism sportive performance and serum lipids in elite endurance skiers.

METHODS

Ethics Committee

The study was conducted in accordance with the Declaration of Helsinki (DoH). Written informed consent was obtained from all participants (athletes), and the study was approved by the Ethics Committees of (Ataturk University, Faculty of Medicine, Ethics Committee, with authorization number B.30.2.ATA.0.01.00/128).

Subjects

This study included 34 cross-country skiers (23 males and 11 females, 25.60 ± 6.8 years) who participated in the Turkish skiing national team camp. The criteria for being elite were determined as "a national championship in the last two years in the branch located at least the first 3, and to participate in the international tournament".

The approvals of all volunteers were taken orally and in writing. The blood samples of the athletes were taken to determine the PPAR-a polymorphism by experienced staff while the athletes were resting in sitting position in Erzincan and Ağrı State Hospitals. The samples taken for DNA analysis were kept under appropriate conditions until the test day.

Genotyping

Molecular genetic analysis was performed with DNA samples obtained from the epithelial mouth cells through alkaline extraction, or using a DNK-sorb-A sorbent kit according to the manufacturer's instruction (Central Research Institute of Epidemiology, Moscow, Russia), based on the method of sample collection (buccal swab or scrape). Genotyping for the PPAR-a gene rs4253778 G/C (intron 7) polymorphism was performed by PCR on Tercyk multicanal amplificator (DNA Technology, Moscow, Russia) and restriction enzyme digestion, as previously described (Flavell et al., 2002).

Statistical Analysis

Statistical data analysis was done by using the SPSS 22.0 package program (SPSS Inc., Chicago, IL, USA). Comparison of data was performed by using the Oneway ANOVA test. Differences between the groups were considered statistically significant ($p < 0.05$). Shapiro-Wilk normality test was applied to examine whether the data showed normal distribution. Kruskal-Wallis test, as a non-parametric test, was applied to 3 independent genotype groups since the data did not have a normal distribution. Mann-Whitney U test was used as a nonparametric test to determine intra-group variance.

RESULTS

Of the 34 elite cross-country athletes who participated in this study, 23 were males and 11 were females.

Table 1. Genotypic frequency of the PPAR-a polymorphism in Turkish elite cross-country athletes.

Groups (n)	Genotype Frequency [n(%)]			Allele Frequency (n)	
Cross-country skiers	**GG**	**GC**	**CC**	**G**	**C**
Male (n=23)	16 (47.05)	6 (16.64)	1 (2.94)		
Female (n=11)	7 (20.58)	2 (5.88)	2 (5.88)	49	19
Total (n=34)	23 (67.64)	8 (23.52)	3 (8.82)		

Genotypic frequency of the PPAR-a polymorphism was examined in Turkish elite cross-country skiers. PPAR-a GG, GC and CC genotypes were detected as 67.64%, 23.52% and 8.82%, respectively in 34 elite endurance athletes (23 males, 11 females). When Table 1 is examined, the GG genotypes were detected at higher frequencies in elite athletes (67.64% respectively) than GC and CC (23.52% and 8.82 %, respectively). PPAR-a GG, GC and CC genotypes were detected as 47.05%, 16.64%, and 2.94%, respectively in elite males. PPAR-a GG, GC and CC genotypes were detected as 20.58 %, 5.88%, and 5.88%, respectively in elite females (Table 1). PPAR-a G and C allele were detected as 49 and 19, respectively in 34 Turkish elite cross-country skiers (Table 1).

According to the comparison of the PPAR-a GG(67.64%) genotype and G(49) allele, PPAR-a GC(23.52%), CC (8.82 %) genotype and C(19) allele among Turkish elite cross-country skiers, it was found that PPAR-a GG genotype and G allele had a higher frequency.

Table 2. The association analysis between PPAR-α rs4253778 genotypes and lipid profiles in Turkish elite cross-country skiers.

Variables	Genotypes	n	Mean ± SD	P
Cholesterol	CC	3	141.00 ±4.36	0.719
	GC	8	155.13 ±40.41	
	GG	23	150.22 ±22.83	
	Total	34	150.56 ±26.62	
HDL- cholesterol	CC	3	50.33 ±1.53	0.764
	GC	8	52.00 ±13.35	
	GG	23	48.61 ±10.87	
	Total	34	49.56 ±10.90	
LDL- cholesterol	CC	3	81.33 ±2.10	0.653
	GC	8	89.93 ±22.02	
	GG	23	93.63 ±35.86	
	Total	34	91.67 ±31.20	
Triglycerides	CC	3	46.67 ±10.02	0.073
	GC	8	109.40 ±67.61	
	GG	23	122.29 ±82.90	
	Total	34	112.58 ±77.59	

N, number of genotypes with serum lipids levels measurement; SD, standard deviation.

There was no statistically significant difference between the PPAR-a G/C gene polymorphism of Turkish elite cross-country skiers and their serum total cholesterol, HDL-cholesterol, LDL- cholesterol and TG levels ($p>0.05$) (Table 2).

DISCUSSION

Sports scientists have long been investigating the relationship between the PPAR-A gene polymorphisms and aerobic performance in sports that require endurance. Recently, many researchers have reported that the PPAR GG genotype offers an advantage for athletes engaged in endurance sports (Lucia et al., 2005; Ahmetov II et al., 2006; Krämer et al., 2006).

It has been reported that the PPARA rs4253778 GG genotype and G allele frequency was statistically higher in five researches, including a group of 77 elite male Czech ice hockey players (Petr et al., 2015), 760 endurance athletes and 1792 controls (Lopez-Leon et al., 2016), elite Polish rowers and combat athletes (Maciejewska et al., 2011) and Russian athletes engaged in endurance sports (Ahmetov II et al., 2006) as compared with sedentary control group and/or sprinters.

It has been shown that PPAR-a GG genotype is associated with high oxygen pulse (Ahmetov II et al., 2013). For this reason, this genotype is one of the important genetic markers of intense aerobic exercise such as endurance phenotype (Ahmetov II et al., 2006). Furthermore, in the study conducted by Eynon et al. (2010), 240 non-athletic Israeli healthy individuals and 74 long distance runners, whose main event was the 10000 m run or the marathon, were found to be associated with increased endurance performance of the PPAR-α GG genotype.

Our results showed that when the PPAR-a GG (67.64%) genotype and G (49) allele were compared to GC (23.52%), CC (8.82%) genotype and C allele, GG genotype and G allele have a higher frequency in Turkish elite cross-country skiers. It is understood that the results of the present study are similar to the studies in the literature. It is reported that exercise has an effect on blood lipid levels in the literature. This effect causes different results on blood lipid levels in endurance exercises, such as various training time or training intensities (Wang and Xu, 2017; Silva et al., 2019).

As an example, most studies have reported endurance exercises, decreased or not altered triglyceride levels, decreased or sometimes unchanged total cholesterol, increased HDL cholesterol, decreased LDL and total cholesterol levels (Saritas, 2012; Kaynar et al., 2016).

The relationship between PPARα G/C polymorphism and blood lipids was shown in many studies. It is known that PPAR-a plays an important role as in the control of fatty acid oxidation during endurance training and in the regulation or alterations in lipid metabolism, especially in endurance training (Liang and Ward 2006; Sung et al., 2017).

Furthermore, the G allele of the PPAR-a G/C polymorphism was found to be higher in Type 1 slow twitch than in Type 2 fast twitch muscle fibers (Ahmetov II et al., 2006) and is thought to be associated with higher lipid levels (Yong, 2008). According to the data obtained from the heritage family study of Hautala et al. (2007), the variation in the DNA sequence of the PPAR gene has been shown to cause changes in cardiorespiratory fitness and plasma HDL-C in response to regular exercise in healthy individuals. Most researchers have reported that the PPAR-a C allele increases total cholesterol and LDL cholesterol (Lucia et al., 2005). While the PPAR C allele was associated with higher HDL-cholesterol and lower TG and VLDL levels in the São Paulo population, the result that the same allele was associated with dyslipidaemia in the Cuiaba population (Mazzotti et al., 2011) hypothesizes that the discrepancy might be explained by the different social stratification in the results of these two studies.

In the present study, which examined the relationship between the PPAR-α gene rs4253778 polymorphism and lipids of blood, it was detected that the PPAR-a G / C gene polymorphism and serum total cholesterol, HDL-cholesterol, LDL-cholesterol and TG levels were not statistically significant in Turkish elite cross-country skiers.

Although there was no statistically significant difference between PPAR-a G/C gene polymorphism and lipid profiles of Turkish elite cross-country skiers, it is foreseen that the PPAR-α genes have an important effect on endurance performance in sports such as cross-country skiing.

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