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ADDICTION RELATED DRD2 RS1800497 POLYMORPHISM DISTRIBUTION IN VOLLEYBALL PLAYERS AND BODYBUILDERS

BAĞIMLILIKLA İLİŞKİLİ DRD2 RS1800497 POLİMORFİZMİNİN VOLEYBOLCULAR VE VÜCUT GELİŞTİRİCİLERDEKİ DAĞILIMLARI

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Abstract

Studies to date have shown the contribution of an athletes' genetic endowment in athletic performance. Although these studies revealed that cognitive abilities influence athletes' competitive performance, there are only a few studies trying to investigate the association between genetic polymorphisms, which is associated with cognitive ability, and athletic performance. In the present study, we aimed investigate the link between dopamine receptor-2 (DRD2) gene rs1800497 polymorphism, which is known to exert influences on brain dopaminergic system and athletic performance of volleyball players and bodybuilders. In this regard, we enrolled 9 female volleyball players and 15 active bodybuilders in the study. Real-time PCR methodology was used for genotyping. The respective numbers and percentages of A1A1, A1A2 and A2A2 genotypes in bodybuilders were 2 (13%), 1 (7%) and 12 (80%). All the volleyball players had A2A2 genotypes. The results have revealed that addiction related A1 allele is underrepresented in volleyball players and bodybuilders. These first findings indicate that the polygenic or multifactorial mechanism may explain effect of cognitive abilities in athletes' performance.

Keywords: sport genetics, athletic performance, addiction, genotype, polymorphism

Özet

Günümüze kadar yapılmış olan araştırmalar, sporcuların genetik yapılarının atletik performanslarına olan katkılarını göstermiştir. Bu çalışmalar ile bilişsel yeteneklerin sporcuların atletik performanslarına etkilediğini ortaya koymasına rağmen, bilişsel yetenekler ve atletik performans ilişkisini ortaya koyan yeteri kadar genetik çalışma bulunmamaktadır. Bu çalışmamızda, beyin dopaminerjik sistemine ve atletik performansı üzerinde etkili olduğu bilinen dopamin reseptörü 2 rs1800497 polimorfizmini voleybol ve vücut geliştiricilerdeki bağlantısını araştırmayı amaçladık. Bu bağlamda, araştırmaya 9 kadın voleybolcu ve 15 aktif vücut geliştiricisi katılmıştır. Genotipleme için gerçek zamanlı PCR metodolojisi kullanılmıştır. Vücut geliştiricilerde A1A1, A1A2 ve A2A2 genotip ve frekansları sırasıyla 2 (13%), 1 (7%) ve12 (80%) olarak bulunmuştur. Çalışma grubumuzda ki tüm voleybol oyuncuları A2A2 genotipinde bulunmuştur. Çalışma grubumuzda bağımlılık ile ilişkili A1 allelinin voleybolcular ve vücut geliştiricilerinde daha az bulunduğu gözlemlenmiştir. Elde ettiğimiz sonuçlar, bizlere bilişsel sistemin atletik performans üzerine etkisinin poligenik veya multifaktöryel mekanizma ile açıklanabileceğini göstermiştir.

Anahtar Kelimeler: *spor genetiği, atletik performans, bağımlılık, polimorfizm*

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1. Giriş

Athletic performance is an important component of the athletes and depend on both genetic factors and subsequent environmental factors (Corak et al., 2017). The latest research on athletic performance focuses on genetic variants that have effects on the performance of athletes. It is known that individual characteristics such as endurance, strength, muscle coordination and motivation have a genetic background (Ulucan et al., 2014). Sport genetic studies include a comprehensive investigation of the identification of genes that effect athletic performance. To achieve success, not only in individual sports, but also in team sports, organizing appropriate training and nutrition program depending on genetic endowment is gaining importance for the improved athletic performance (Ulucan, 2016).

Volleyball, an advanced form of sporting games, needs a long-term low-intensity aerobic exercise. It requires special physical structure and motoristic features with variations of individual and team play. Volleyball players, like other athletes, require a high degree of physical and physiological parameters in order to achieve superior performance. Some of the properties that optimal players have are proper athletic performance, physical capacity, mental preparedness, technique, tactics, appropriate physical structure and game experience to face fast reaction, quick movements, durability and concentration (Koyomo et al., 1994). Therefore, those who are more genetically predisposed to instantaneous force characteristics are considered to have a chance of reaching the top level in volleyball.

Bodybuilding is a versatile sports branch that helps people to strengthen and develop various systems of muscles by doing scientific and programmatic work with specific weights, tools and machines. It is one of the most popular types of recreational physical activity in the world. However, athletic athletes prefer one-way training programs in favor of hypertrophic strength training, while neglecting cardiovascular studies that are important for a healthy life and performance increase (Erduğan et al., 2013). Depending on the training type, they are thought to have aerobic and anaerobic based training sections that is the underlying reason for the bodybuilders to benefit from different types of training programs.

Dopamine is one of the important key neurotransmitter of the dopaminergic system, and is considered to have crucial roles in daily life activities, and also in exercise. It is important for the regulation of brain function, and in the communication between nerve structures that provide the brain's morbidity. As psychological factors are known to influence the athletic performance (Ulucan et al., 2014), dopamine also has critical functions in determining athletic performance.

In the present study, we aimed to analyze the distribution of dopamine receptor 2 (DRD2) rs1800497 polymorphism in volleyball players and bodybuilders. This polymorphism is previously related with addiction, and therefore we hypothesized that sports willingness and athletic performance is related with addiction metabolism.

2. Materials - Methods:

2.1. Players

9 volleyball players and 15 bodybuilders were enrolled for the study. Volleyball players were all females (aged between 18-21) and were the members of Uskudar University Female Volleyball team. They had a 3 sessions of training sections per week, a total of 6 hours/week. Some of the players are still playing for local volleyball teams, and 2 were acting as a professional player. All bodybuilders were male (aged between 19-24), and had an average training of 5 days/week, a total of 7.5 hours/week. One builder was selected for the national team (2nd best builder in his class, 2017), and presented National team in 2017 European games. Üsküdar University Ethics Committee approved the study protocol, which was in accordance with the principles of the Declaration of Helsinki II. All subjects read, understood and confirmed the study by signing the informed consents explaining the study steps.

2.2. DNA sample collection and genotyping

Human peripheral leukocyte DNAs were isolated by using PureLink DNA isolation kit (Invitrogen, Van Allen Way Carlsbad, Calif., USA) by following manufacturers' instructions. DRD2 rs1800497 genotyping was carried out by Real- time PCR (Roche Light Cycler Nano, Germany) by using commercially provided Taqman Genotyping Assay (Applied Biosystems Foster City, CA, USA). C allele is considered the wild type, expressed as A2, whereas T allele is the polymorphic allele, and expressed as A1.

3. Results

All of the volleyball players had the A2A2 genotypes. A2 allele count was detected as 18 (Table 1). The respective numbers of A1A1, A1A2 and A2A2 genotypes in bodybuilders were 2 (13%), 1 (7%) and 12 (80%). A1 allele was counted as 5 (17%) and A2 was 25 (83%). Table 2 summarizes the genotype and allele numbers and frequencies in bodybuilders. When we consider all the athletes in our study, 2 had A1A1 genotype, only one had A1A2 genotype, and the rest had A2A2 genotype.

Table 1: Genotype and allele distributions of DRD2 rs1800497 polymorphism in volleyball players.

	Genotypes			Alleles	
	A_1A_1	A_1A_2	A_2A_2	A_1	A_2
Volleyball players (%)	-	-	9	-	18
	-	-	100 %	-	100 %

Table 2: Genotype and allele distributions of DRD2 rs1800497 polymorphism in bodybuilders.

	Genotypes			Alleles	
	A_1A_1	A_1A_2	A_2A_2	A_1	A_2
Bodybuilders (%)	2	1	12	5	25
	13%	7 %	80 %	17%	83%

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4. Discussion

The interest in dopamine has been intensified since it has been recognized in the pathogenesis of some neuropsychiatric diseases, like Parkinson's disease and schizophrenia (Strange et al., 1992). Lower levels of dopamine in humans lead to Parkinson's disease and hyperactivity, whereas high levels are associated with mental disorders, due to abnormal brain function (Ndamanisha et al., 2009). It is also responsible for psychiatric and neurological disorders such as attention deficit and drug addiction. Dopamine is the primary endogenous ligand for dopamine receptors. There are five different types of dopamine receptors; DRD1, DRD2, DRD3, DRD4 and DRD5 (Gingrich et al., 1993). Not only the dopamine levels, but also abnormal dopamine receptor signaling and dopaminergic nerve function may cause various neuropsychiatric disorders, and effect daily life activities.

The DRD2, which codes for DRD2, have crucial functions in mediating brain reward metabolism. DRD2 is localized at 11q22-q23 and several polymorphisms have been identified within the gene (Turner et al., 1992). Taq1 polymorphism (rs1800497), a C-T substitution, is located in the 3 'flaking region of the gene and has been studied widely. C allele (A2) is accepted to be the wild type, whereas T allele (A1) is accepted as the polymorphic allele. Several studies have been conducted on DRD2 TaqA1 allele in Tourette syndrome, Attention Deficit and Hyperactivity Disorder (ADHD), impulsivity and substance abuse. The reason for this condition is based on the findings that A1 allele was associated with a decreased DRD2 receptor densities in neuron membranes. The number of receptor was reported to be highest in A2 homozygotes and lowest in A1 homozygotes (Grandy et al. 1989). Lack of DRD2 may cause individuals to have a high risk for multiple addictive, impulsive and compulsive behaviors (Noble et al., 2003).

Addiction, or having tendency to addiction, may effect athletic performance. In our cohort, we examined a total of 24 athletes; 9 volleyball players and 15 bodybuilders. None of the volleyball players carries A1 allele, which is considered the addiction allele, when compared to A2 allele. In bodybuilders, 3 of the athletes carry A1 allele; 2 of them had the homozygous (A1A1) and 1 had the heterozygous (A1A2) genotypes. 12 of the bodybuilders had the A2A2 genotype, as we expected. In our cohort, A2A2 genotype and A2 allele was found to be superior. Abe et al. (2017) examined the related SNPs (COMT, DRD2 and DRD3) that are considered to have influence on dopaminergic neural function in swimmers. In their cohort, like our results, A1A1 genotype frequency was lower than the other genotypes, but unlike our results, A1A2 genotype was higher than A2A2 genotype. They also concluded that SNPs of DRD2 and DRD3 were not associated with swimmer's competitive performance. Before, we analyzed DRD2 rs1800497polymorphism in 62 professional football players (unpublished data), the respective genotypes of the A2A2, A1A2 and A1A1 genotypes were found to be as 25 (%40.4), 34 (%54.8) and 3 (%4.8). These results were in agreement with our results, in the terms of A2 allele superiority. Unlike our results, A1A2 genotypes were higher in football players.

DRD2 A2 allele was found to be associated with addiction, and we hypothesized the same allele to be associated with sports addiction, and therefore related to sport success. In our cohort, the frequency of A2 allele was found to be lower than A1 allele. Although we expected A1 allele to be higher, low sample size may be the reason for our results. Also if success in sports is linked with sport addiction, we suggest that more than one genetic loci is related with the success phenotype.

Sports genomics is developing and genetic background of the successful players are gaining importance. By having information about the genetic endowment of the players, improved individual training strategies can be developed. In this regard, genotyping the related SNPs in successful players genome is important for sport scientists to find out the optimal alleles of the related genes. One of the limitation of the present study is the small sample size. According to the feedbacks for our manuscript, we are planning to replicate the study in different athletes. We could not find another study to compare our results; this is the second limitation of our discussion. We hope this preliminary study will guide further studies in the terms of psychological and genetic factors.

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