Personality Traits and DRD4, DAT1, 5-HT2A Gene Polymorphisms in Risky and Non Risky Sports Participation

Riskli ve Risksiz Sporlara Katılımda Kişilik Özellikleri ile DRD4, DAT1, 5-HT2A Gen Polimorfizmleri

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ABSTRACT Objective: Relationships amongst Big Five personality traits and DRD4, DAT1 and 5-HT2A gene polymorphisms were investigated in 193 college students participating in risky and non-risky sports. **Material and Methods:** Personality traits were assessed by Five Factor Personality Inventory (FFPI) and gene polymorphisms were analyzed by polymerase chain reaction. **Results:** In order to examine whether signifant Big Five personality trait differences existed between DAT1 gene polimorphisms, independent sample t-test was used. Results showed that only Agreeableness dimension revealed significant difference indicating that individuals with non-10/10 genotype had higher agreeableness scores when compared to individuals with 10/10 genotype. ANOVA results showed that Big Five personality dimensions scores differed significantly amongst 5-HT2A genotypes. Individuals with CC genotype had lower emotional stability scores when compared to individuals with TC genotype, and CC genotype individuals had greater openness to experience scores when compared to TT genotype individuals. Openness to experience scores were also significantly different among DRD4 genotypes. Individuals with ll genotype had greater openness to experience scores when compared to individuals with ss genotype. No 5-HT2A and risky sport participation (RSP) interaction effect was found on emotional change score. **Conclusion:** DAT1 was not associated with RSP. It was concluded that DRD4 and 5-HT2A were not directly associated with RSP but may be used as indirect predictors of it.

Key Words: Polymorphism, genetic; personality

ÖZET Amaç: Bu araştırmada riskli ve risksiz sporlara katılımda kişilik özellikleri ile DRD4, DAT1, 5HT2A gen polimorfizmleri arasındaki ilişki, riskli ve risksiz sporlara katılan 193 üniversite öğrencisinde araştırılmıştır. **Gereç ve Yöntemler:** Kişilik özellikleri Beş Faktörlü Kişilik Envanteri ile ölçülmüş, gen polimorfizmleri polimeraz zincir reksiyonu ile tespit edilmiştir. **Bulgular:** Beş ana kişilik özelliğinin DAT1 gen polimorfizmleri arasında farklılık gösterip göstermediğini incelemek için bağımsız iki örnek t testi kullanılmış ve non-10/10 genotipe sahip bireylerin daha yüksek "yumuşakbaşlılık" skoru elde ettikleri bulunmuştur. 5-HT2A gen polimorfizmleri arasında kişilik farklılıklarını incelemek için yapılan varyans analizi sonucunda ise CC genotipine sahip bireylerin, TC genotipine sahip bireylerden daha düşük "nevrotizm" skoruna sahip olduğu; CC genotipe sahip bireylerin, TT genotipe sahip bireylerden daha yüksek "gelişime açıklık" skoruna sahip olduğu bulunmuştur. "Gelişime açıklık" özelliği açısından DRD4 gen polimorfizmleri arasında da anlamlı bir farklılık bulunmuştur. Buna göre: LL genotipe sahip bireyler, ss genotipe sahip bireylerden daha yüksek "gelişime açıklık" skoruna sahiptir. Çift yönlü varyans analizi sonuçlarına göre bir "nevrotizm" altgrubu olan duygusal değişim skorlarında 5-HT2A ile riskli spora katılım etkileşimi etkisi gözlenmemiştir. **Sonuç:** DAT1 riskli sporlara katılımla ilişkili bulunmamıştır. DRD4 ve 5-HT2A gen polimorfizmlerinin riskli sporlara katılımla doğrudan ilişkili olmadığını ancak indirekt olarak ilişkili olabileceği sonucuna varılmıştır.

Anahtar Kelimeler: Çok biçimlilik, genetik; kişilik

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It has been suggested that engaging in high risk sports (e.g. parachuting) is associated with several personality traits especially with sensation seeking. In a review by Zuckerman it was reported that athletes participating in high risk sports had higher sensation seeking level than non-risk sports participants (non-RSP).[1] Further, Hughes et al. found that athlete participating Idita sport, a 200 miles cross country competition that takes place in the wild, and winter of Alaska, had higher experience seeking, extraversion and openness scores than norm groups.[2]

Recent evidences in behavioral genetics have been revealed that majority of personality traits may be linked with hereditary factors.[3] At the biological level, many personality traits are influenced by different neuronal systems that have a genetic basis. In many studies, dopamine receptor D4 (DRD4) and dopamine transporter (DAT1) genes in dopaminergic system and serotonin 2A receptor gene (5-HT2A). in serotonergic system shown to be correlated with several personality traits especially with novelty seeking.[4-9]

Therefore, it may be postulated that a genetic predisposition exists in high-risk sports participation. We aimed to study the interrelationship between personality traits of high-risk sports participants (RSP) and DRD4, DAT1 and 5-HT2A polymorphisms.

MATERIAL AND METHODS

PARTICIPANTS

The Study cohort was physically active (N= 193; 92 females and 101 males) university students (24.3 ± 6.1 years). The Cohort was separated two sub-groups as RSP (n= 60) and non-RSP (n= 133). Rock climbing, motor-cycle racing, paragliding, rafting, scuba diving, free diving and parachute athletes were considered as RSP and track and field athletes, gymnasts and team sports players as non-RSP. Informed consent was obtained from each participant and the study protocols reviewed and approved by Ege University Local Ethics Committee.

PERSONALITY ANALYSIS

Five Factor Personality Inventory (FFPI) developed by Somer, Korkmaz and Tatar is a 220-item personality inventory designed to assess the main five personality traits namely neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness and their 17 sub-dimensions.[10] Item responses are made using a five point-format. The inventory's manual provides evidence for reliability and validity of the measurement device.

GENETIC ANALYSIS

Genomic DNA was extracted from 200 µl of EDTA-anti-coagulated peripheral blood leucocytes using the Qiagen mini blood DNA purification kits (Qiagen, Ontaria Canada). PCR amplification was performed in a programmable thermal cycler GeneAmp PCR System 9700 (Applied Biosystems). The 48 bp-repeat polymorphism (varying from 2-8 and 10 repeats) in exon III of the DRD4 gene was assayed using the polymerase chain reaction (PCR) as previously described.[11] The primers used were 5´-GCGACTACGTGGTCTACTCG-3´ (forward) and 5´-AGGACCCTCATGGCCTTG-3´ (reverse). DNA was amplified for 40 cycles, each cycle comprising denaturation at 95 °C for 15 sec, annealing at 58 °C for 15 sec, extention at 72 °C for 20 sec with a final extention time of 10 minutes at 72 °C. The initial denaturation stage was carried out at 99 °C for 2 minutes. The 10-repeat allele of a VNTR in the 3' UTR region of DAT1 was assayed using PCR as previously described.[12] The primers used were 5'-TGTGGTGTAGGGAACGGCCTGAG-3' (forward) and 5'-CTTCCTGGAGGTCACGGCTCAAGG-3' (reverse). DNA was amplified for 20 cycles, each cycle comprising denaturation at 94 °C for 45 sec, annealing at 65 °C for 60 sec, extention at 72 °C for 90 sec with a final extention time of 1,5 minutes at 72 °C. The initial denaturation stage was carried out at 94 °C for 10 minutes. The size of PCR products was 328 bp for the 6R, 365 bp for the 7R, 444 bp for the 9R, 483 bp for the 10R and 521 bp for the 11R alleles, respectively. The 5-HT2A 102T/C polymorphism was analyzed using PCR as previously described.[13] The primers used were 5'-CAAGGTGAATGGTGAGCG-3' (forward) and 5-CAGAAGTGTTAGCTTCTCCA-3'(reverse). DNA was amplified for 40 cycles, each cycle com-

prising denaturation at 95 °C for 30 sec, annealing at 55 °C for 30 sec, extention at 72 °C for 30 sec with a final extention time of 1.5 minutes at 72 °C. The initial denaturation stage was carried out at 95 °C for 5 minutes. PCR products (342 bp) were digested with the restriction enzyme Hpa II at 37 °C for 4 hours. The size of PCR products was 342 bp for the TT, 216 bp +126 bp for the CC and 342 bp +216 bp +126 bp for the TC alleles, respectively. PCR-products were separated on ethidium bromide-stained agarose gels and visualized in digital gel image system (InGenius).

STATISTICAL ANALYSIS

The obtained data set was analyzed in SPSS 11.0 (SPSS Inc., Chicago, IL). Cross-tabulations, descriptive statistics, t test, One-way ANOVA and univariate analyzes were carried out to explore data. Confidence interval was set at $P<0.05$.

RESULTS

In order to examine the Big Five Personality dimensions' scores between RSP and non-RSP, independent sample t-test were employed. Results indicated that RSP individuals were more emotionally stable, more open and less conscientious than non-RSP individuals. As can be seen in Table 1, some of conscientiousness, emotional stability and openness to experience sub-dimensions were also significantly different between RSP and non-RSP (Table 1).

TABLE 1: Differences in Big Five and some sub-dimensions' scores between RSP and Non-RSP.

	RSP (n= 60)	non-RSP (n= 133)	t
Extraversion (E)	3.71 ± .44	3.66 ± .50	0.600
Agreeableness (A)	3.87 ± 3.9	3.78 ± .41	1.43
Conscientiousness (C)	3.55 ± .44	3.73 ± .46	-2.50*
Neuroticism (N)	2.04 ± .55	2.32 ± .67	-2.80*
Openness to experience (O)	4.25 ± .32	4.13 ± .34	2.40*
Differences in Sub-dimensions of Big Five Personality Trait Scores between RSP and non-RSP			
Adherence to rules (C)	3.60 ± .56	3.93 ± .54	-3.884*
Excitement seeking (C)	3.75 ± .59	3.30 ± .75	4.113*
Emotional variability (N)	2.23 ± .63	2.52 ± .70	-2.754*
Predisposition to anxiety (N)	2.06 ± .67	2.38 ± .82	-2.688*
Lack of Self confidence (N)	1.89 ± .49	2.11 ± .66	-2.347*
Analytical thinking (O)	4.38 ± .39	4.26 ± .40	2.031*
Novelty seeking (O)	4.32 ± .43	4.04 ± .47	3.862*

*p< 0.05; Independent Sample t-test.

Independent sample t-test was also employed to examine Big Five personality traits between DAT-1 genotypes. Only agreeableness dimension revealed significant difference indicating that individuals with non-10/10 genotype had higher agreeableness scores than individuals with 10/10 genotype.

A follow-up one way ANOVA with post-hoc LSD and Tukey to examine differences in the Big Five personality dimensions' score among 5-HT2A genotypes revealed that individuals with CC genotype had lower emotional stability scores when compared to individuals with TC genotype. Results of one way ANOVA also revealed that CC genotyped individuals had greater openness to experience scores than TT genotype individuals. As can be seen in Table 2, some of emotional stability and openness to experience sub-dimensions are significantly different among 5-HT2A genotypes.

Openness to experience scores were significantly different among DRD4 genotypes. One way ANOVA with post hoc Tukey indicated that individuals with ll genotype had greater openness to experience scores when compared to individuals with ss genotype (Tables 2, 3).

Univariate analyzes of variance was used in order to examine the presence of a significant 5-HT2A x RSP interaction for emotional change, a sub dimension of emotional stability score. Main effects for 5-HT2A [$F(1, 187)= 3.622$] and RSP [$(F(2, 184) = 6.433$] were found significant, although no 5-HT2A x RSP interaction was found in emotional change score ($F(2, 187)= .181$, $p> .835$) (Table 4).

DISCUSSION

To our knowledge, this is the first study investigating genetic associations with RSP. We found that RSP might be associated with conscientiousness,

TABLE 2: Differences in Big Five Personality Scores among DAT-1, DRD4 and 5-HT2A genotypes.

	non 10/10	10/10			
DAT 1 Genotype	**(n=104)**	**(n=89)**	**t**		
Extraversion	3.66±.49	3.69±..46	-.403		
Agreeableness	3.86±.41	3.74±.39	2.070*		
Conscientiousness	3.72±.43	3.61±.48	1.597		
Neuroticism	2.18±.65	2.30±.65	-1.264		
Openness to experience	4.15±.34	4.19±.34	-.854		
DRD4 Genotype	**s/s (n=133)**	**s/l (n=52)**	**l/l (n=8)**	**F**	**Sig.**
Extraversion	3.66±.49	3.67±.44	3.96±.42	1.474	.232
Agreeableness	3.82±.41	3.76±.39	3.86±.38	.430	.651
Conscientiousness	3.65±.46	3.68±.46	3.96±.41	1.777	.172
Neuroticism	2.23±.64	2.29±.66	1.96±.69	.929	.397
Openness to experience	4.15±.31	4.18±.39	4.44±.23	2.948*	.055
5-HT2A Genotype	**TT (n=65)**	**TC (n=85)**	**CC (n=43)**	**F**	**Sig.**
Extraversion	3.66±.51	3.67±.43	3.67±.54	.181	.834
Agreeableness	3.82±.39	3.77±.42	3.84±.41	.466	.628
Conscientiousness	3.65±.49	3.68±.46	3.68±.42	.069	.933
Neuroticism	2.20±.68	2.34±.62	2.06±.63	2.854*	.060
Openness to experience	4.11±.33	4.17±.32	4.27±.36	2.938*	.055
Differences in sub-dimensions of Big Five Personality Trait Scores amongst 5-HT2A genotypes					
5-HT2A Genotype	**TT (n=65)**	**TC(n=85)**	**CC(n=43)**	**F**	**Sig.**
Emotional variability (N)	2.36±.73	2.59±.67	2.22±.60	4.824*	.009
Predisposition to anxiety (N)	2.24±.83	2.41±.76	2.07±.73	2.872*	.059
Analytical thinking (O)	4.21±.46	4.28±.39	4.46±.40	5.185*	.006

*p< 0.05; Independent Sample T-test, ANOVA, Post-hoc Tukey and LSD tests.

emotional stability and openness to experience and some sub-dimensions of them while 5-HT2A polymorphism may be associated with emotional stability and openness to experience, and DRD4 polymorphism may be linked to openness to experience. On the other hand, these polymorphisms were not related with RSP. DAT1 showed a relation only with agreeableness, however it was not related to any personality traits that RSP was associated.

Studies using validated psychometric instruments have revealed that both participation in sports, and preference of RSP may be related with personality traits.[14,15] Athletes are generally less introverted and more emotionally stable than non-athlete counterparts[14] and these characteristics may not be related with sports participation, rather they are innate.[16] It may be assumed that the most probable personality trait candidate for RSP is novelty seeking.[15] This personality trait is categorized as a sub-dimension of openness to experience. We found that besides RSP, both DRD4 and 5-HT2A polymorphisms were associated with openness to experience. Former studies revealed conflicting results on DRD4 or 5-HT2A polymorphisms and novelty seeking. In some studies, novelty seeking was shown to be related with DRD4 polymorp-

TABLE 3: Univariate Analysis of Variance of Emotional Change in that 5-HT2A Genotype and RSP.

5-HT2A Genotype and Emotional Change	TT (n=65)	TC (n=85)	CC (n=43)	F	df
	2.32	2.52	2.17	3.622*	2
Predisposition to RSP and Emotional Change	RSP (n=60)	Non-RSP (n=133)		6.433*	1
	2.20	2.47			

TABLE 4: DRD4 and 5-HT2A Genotypes and RSP and Non-RSP Interactions.

DRD4 Genotype (N=193)	s/s (n=133)	s/l (n=52)	l/l (n=8)	cm	p
RSP	42 (31.6 %)	16 (30.8 %)	2 (25.0 %)	0.156	0.925
Non-RSP	91 (68.4 %)	36 (69.2 %)	6 (75.0 %)		
5-HT2A Genotype (N=193)	TT (n=65)	TC (n=85)	CC (n=43)	cm	p
RSP	21 (32.3%)	23 (27.1%)	16 (37.2%)	1.441	0.486
Non-RSP	44 (67.8%)	62 (72.9%)	27 (62.8%)		

hisms[4,17,18] while others failed to show it.[19-21] Several studies observed associations between 5-HT2A and novelty seeking.[22] In contrast, some studies revealed that 5-HT2A was negatively related with conscientiousness[23] and positively correlated with neuroticism (emotional stability).[24-26] In this study, similar to openness to experience, emotional stability was found to be associated with both 5-HT2A polymorphism and RSP. However, some studies revealed no association between personality traits and 5-HT2A variants.[27-29]

In conclusion, DRD4 and 5-HT2A polymorphisms were not directly associated with RSP but may be used as indirect predictors of it. In further investigations, RSP may be studied with distinct personality traits and genetic variants. Together with the change of the meaning attributed to sport and the athlete today, the sport psychology has gained importance[30] and this respect our study showed that behavioral genetic studies may contribute to the domain of sport psychology to further explain athletic behavior.

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