Baltic Journal of Health and Physical Activity

Volume 16 | Issue 1 Article 9

2024

Sprint performance following plyometric conditioning activity in elite sprinters

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Recommended Citation

Huminska-Lisowska K, Stronska-Pluta A, Suchanecka A, Massidda M, Trybek G, Calo CM, Rzeszutko A, Reclaw R, Grzywacz A. Association study of the Taq1D rs1800498 polymorphism of the DRD2 gene with personality traits in a group of athletes. Balt J Health Phys Act. 2024;16(1):Article9. https://doi.org/10.29359/BJHPA.16.1.09

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Abstract

Introduction: This study investigates an association between the human dopamine receptor 2 gene *DRD2* Taq1D rs1800498 polymorphism and personality traits among athletes, exploring the genetic underpinnings of sports performance and psychological characteristics. It aims to understand how genetic factors related to dopamine reception influence athletic predispositions and behaviors. Materials and Methods: An association study was conducted with 391 male participants, comparing 159 sports subjects with 232 non-trained controls. Personality traits were assessed using the NEO Five-Factor Inventory, while the *DRD2* Taq1D rs1800498 polymorphism was genotyped through real-time PCR. Results: Significant differences in the *DRD2* Taq1D rs1800498 genotype and allele frequencies were found between athletes and controls, with athletes displaying higher scores in extraversion and conscientiousness on the NEO-FFI scales. These findings suggest a genetic influence on certain personality traits relevant to sports performance. Conclusions: The study supports the notion that genetic factors, specifically the *DRD2* Taq1D rs1800498 polymorphism, are associated with personality traits that may influence athletic performance. This insight contributes to the field of psychogenetics in sports, offering a deeper understanding of how genetics and personality interact to shape athletic capabilities.

Keywords

DRD2 Taq1D polymorphism, personality traits, genetic predisposition, psychogenetics in sports, dopamine, NEO-FFI, extraversion, conscientiousness

Cover Page Footnote

Huminska-Lisowska K, Stronska-Pluta A, Suchanecka A, Massidda M, Trybek G, Calo CM, Rzeszutko-Belzowska A, Reclaw R, Grzywacz A. Association study of the Taq1D rs1800498 polymorphism of the DRD2 gene with personality traits in a group of athletes. Balt J Health Phys Act. 2024;16(1):Article9. https://doi.org/10.29359/BJHPA.16.1.09

Erratum

There was: Agata Rzeszutko There is: Agata Rzeszutko-Bełzowska

Authors

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Baltic Journal
of Health and Physical Activity
e-ISSN 2080-9999

Article

Association study of the Taq1D rs1800498 polymorphism of the *DRD2* gene with personality traits in a group of athletes

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Citation: Huminska-Lisowska K, Stronska-Pluta A, Suchanecka A, Massidda M, Trybek G, Calo CM, Rzeszutko-Belzowska A, Reclaw R, Grzywacz A. Association study of the Taq1D rs1800498 polymorphism of the *DRD2* gene with personality traits in a group of athletes. Balt J Health Phys Act. 2024;16(1):Article9. https://doi.org/10.29359/BJHPA.16.1.09

Academic Editor:
Agnieszka Maciejewska-Skrendo

Received: December 2023
Accepted: January 2024
Published: March 2024

Publisher's Note: BJHPA stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: Introduction: This study investigates an association between the human dopamine receptor 2 gene *DRD2* Taq1D rs1800498 polymorphism and personality traits among athletes, exploring the genetic underpinnings of sports performance and psychological characteristics. It aims to understand how genetic factors related to dopamine reception influence athletic predispositions and behaviors. Materials and Methods: An association study was conducted with 391 male participants, comparing 159 sports subjects with 232 non-trained controls. Personality traits were assessed using the NEO Five-Factor Inventory, while the *DRD2* Taq1D rs1800498 polymorphism was genotyped through real-time PCR. Results: Significant differences in the *DRD2* Taq1D rs1800498 genotype and allele frequencies were found between athletes and controls, with athletes displaying higher scores in extraversion and conscientiousness on the NEO-FFI scales. These findings suggest a genetic influence on certain personality traits relevant to sports performance. Conclusions: The study supports the notion that genetic factors, specifically the *DRD2* Taq1D rs1800498 polymorphism, are associated with personality traits that may influence athletic performance. This insight contributes to the field of psychogenetics in sports, offering a deeper understanding of how genetics and personality interact to shape athletic capabilities.

Keywords: *DRD2* Taq1D polymorphism, personality traits, genetic predisposition, psychogenetics in sports, dopamine, NEO-FFI, extraversion, conscientiousness.

1. Introduction

Dopamine, as a neurotransmitter, is involved in many important functions of the central nervous system. These functions mainly concern motivation and the reward system. Other equally important factors include feeding, stress tolerance, sleep regulation, working memory, self-control and learning [1, 2]. In turn, in the periphery, dopamine has a physiological role. This is mainly the control of smell, cardiovascular functions, hormonal balance, retinal processes and regulation of the immune and sympathetic systems [2]. Researchers are also interested in dopamine and its impact on physical activity behaviors. More specifically, dopamine translates into the development of fatigue, which reduces the intensity of exercise or leads to its complete cessation. This happens by modulating circuits related to motor control, stress tolerance, the reward system and motivation [1, 3–5].

In analysis of the levels of physical activity, family determinants are observed [1–3, 6]. Therefore, physical activity is not only environmentally conditioned, but also generationally, i.e. genetically. It is a multifactorial and multigenic phenomenon. Not only a selected gene or its polymorphic variant is typed but several genetic variables distributed on various genes, not excluding epigenetics from this analysis. The dopamine D2 receptor gene is one of the candidate genes in these analyses, especially in connection with motivation, the reward system and movement control [7–10].

Animal studies support the neurobiological basis for this assumption. As proven in animal studies, reduced initiation of spontaneous movements occurred in mice with D2 receptor deficiency, and they also showed much more serious locomotor disorders such as akinesia, abnormal gait and posture [9, 11]. In the context of our research, we pay particular attention to exercise-induced pleasure, which is related to the physiology of neurotransmitters in the brain. Such a regularity has been observed in animals – namely, in rats, endurance training was associated with a change in the number of dopamine binding sites in the brain and its metabolism [12, 13]. In humans, similar results have been observed when examining plasma dopamine levels. Its increase was caused by short and long-term endurance training [14, 15]. There is no doubt that dopamine plays an important role in behavioral phenotypes, especially those related to the reward mechanism in the brain [16]. Such a rewarding effect may be psychoactive substances or compulsive overeating [17, 18], but physical exercise can also have a rewarding effect while exercising [19].

The topic is worthy of interest, mainly because physical activity is one of the most important elements of preventing lifestyle diseases. Of course, we must consider several factors influencing a personalized approach to physical activity, its intensity and frequency. Personality seems to be important in this context. Since then, the problem has started to be analyzed in this context – as sports psychogenetics. Many researchers emphasize that personality traits are also genetically determined factors, and that based on the analysis of personality traits, one can predict various behaviors, susceptibility to diseases (including somatic diseases), and attitudes towards physical activity [20–22]. However, several factors may influence an individual's approach to participating in physical activity, as well as an individual's achievements. A factor of great importance for shaping sportsmanship and achieving achievements is personality. Many publications emphasize that personality traits are a moderately heritable factor. On this basis, it is possible to predict various consequences throughout life, such as susceptibility to diseases or attitudes to physical activity [20–22].

This aspect seems to be even more interesting when professional sports are considered. When there is increased competition, several factors can determine success. Elite athletes often operate under pressure, which is influenced by personality and other psychological characteristics that may predispose them to success [23]. The main goal of a competitive athlete is success and, consequently, achieving maximum body adaptation to the effort. Training loads may cause an imbalance between training and regeneration, affecting the athlete's psyche. Researchers generally agree that sports development is based on the athlete's predispositions, the environment, practice and training [24]. At the same time, if sports talents are considered, one can observe an increased tendency to limit the focus on physiology and anthropometry to promote the psychological aspect as a critical element of talent development [24–26]. However, there are few publications on the genetic determinants of athletes' psychological traits despite significant progress towards under-standing the genetics of physical performance [27] and previous encouragement of psychological research [28, 29]. Therefore, in this study, the aspect of psychogenetics are presented in terms of the reward system.

This study focused on examining the relationship between personality traits and the *DRD2* Taq1D rs1800498 gene polymorphism in both groups of trained and non-trained individuals. The analyses considered the genetic factor and personality testing, which, as cited in the literature, is justified and necessary in this type of analysis concerning polygenic and multifactorial traits.

2. Materials and methods

2.1. Materials

The study group consisted of 391 male individuals who volunteered for the study. Within this group, 159 were identified as individuals actively involved in sporting activities (mean age = 29.38 years, standard deviation = 10.71; female = 48%, male = 52%; karate, n = 30; judo, n = 29; boxing, n = 24; wrestling, n = 25; ju-jitsu, n = 25; volleyball, n = 11, handball league, n = 15), and 232 were categorized non-trained controls (mean age = 26.91 years, standard deviation = 10.10; female = 80%, male = 20%). The study was conducted according to the guidelines of the Bioethical Committee at the District Medical Chamber in Szczecin (permit number: 13/KB/VI/2016) and the Regional Medical Council in Gdansk (permit number: KB-14/19). Written informed consent was obtained from all participants, and the research was conducted at the Independent Laboratory for Health Promotion. Recruitment and selection of sports and control group participants was conducted by a psychiatrist based on psychiatric assessment using the Mini International Neuropsychiatric Interview (MINI) and the NEO Five-Factor Inventory of Personality (NEO-FFI) questionnaires.

2.2. Methods

The NEO-FFI Five-Factor Personality Inventory assesses five key dimensions of personality, each with six main facets: Neuroticism includes traits such as anxiety, hostility, depression, self-consciousness, impulsivity and vulnerability to stress. Extraversion includes warmth, sociability, assertiveness, activity, emotion seeking and positive emotions. Openness to experience includes facets such as fantasy/imagination, aesthetics/artistic interest, feelings/emotionality, actions/adventurousness, ideas/intellectual interest and values/psychological liberalism. Agreeableness is measured by trust, straightforwardness, altruism, compliance, modesty and tendermindedness/sympathy. Conscientiousness assesses competence, order/organizing, sense of duty, striving for achievements, self-discipline, deliberation [20–22].

The NEO-FFI scores were presented using sten scores, a standardized metric. To translate the raw scores into the sten scale, the Polish norms for adults were followed. This scale interprets scores of 1–2 as indicating very low levels of the trait, 3–4 as low, 5–6 as average, 7–8 as high, and 9–10 as very high ones.

2.3. Genotyping

Genomic DNA was extracted from venous blood samples using established methods. Real-time polymerase chain reaction (PCR) was used for genotyping. Melting curves were generated for each sample by plotting the fluorescence signal against temperature. For the *DRD2* Taq1D rs1800498 polymorphism, melting peak temperatures were identified at 56.64°C for the C allele and 62.85°C for the T allele.

2.4. Statistical analysis

The Hardy-Weinberg equilibrium (HWE) fit of the genotype frequency distribution was assessed using the HWE software (https://wpcalc.com/en/equilibrium-hardy-weinberg/ from 5 April 2023). A multivariate factorial ANOVA analysis (including NEO-FFI dimensions × genetic variant × both groups × interaction between genetic variant and group membership) was used to examine the correlations between *DRD2* Taq1D rs1800498 polymorphisms in both sports participants and the control group with the NEO Five-Factor Inventory scores. The requirement for homogeneity of variance was met, as indicated by the Levene test ($p > 0.05$), despite the non-normal distribution of the examined variables. The NEO five-factor dimensions (Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness) were compared using the Mann-Whitney U test. Differences in *DRD2* Taq1D rs1800498 genotype frequencies between the control and exercise groups were assessed using the chi-squared test. All statistical analyses were performed using STATISTICA version 13 (Tibco Software Inc, Palo Alto, CA, USA) on a Windows platform (Microsoft Corporation, Redmond, WA, USA).

3. Results

These frequency distributions accorded with the HWE both in the sports subjects and control subjects (Table 1).

Table 1. Hardy-Weinberg's law for sports subjects and control subjects.

Hardy-Weinberg equilibrium calculator, including analysis for ascertainment bias		**Observed (Expected)**	**allele freq**	**χ^2 (*p* value)**
DRD2 Tag1D rs1800498				
Sports subjects n = 159	T/T	90 (79.6)	p (T) = 0.71 q (C) = 0.29	15.890 (< 0.0001)
	C/C	24 (13.6)		
	C/T	45 (65.8)		
Control n = 232	T/T	69 (72.3)	p (T) = 0.56 q (C) = 0.44	0.765 (0.3818)
	C/C	42 (45.3)		
	C/T	121 (114.4)		

p–statistical significance χ^2 test

Statistical analyses revealed significant differences in *DRD2* Taq1D rs1800498 genotype frequencies between sports subjects and controls. For *DRD2* Taq1D rs1800498, the genotype distributions were T/T 0.57 versus 0.30, C/C 0.15 versus 0.18, and C/T 0.28 versus 0.52 in the control group, with a χ^2 of 29.890 and a *p*-value < 0.0001.

In addition, significant differences were observed in the allele frequencies of *DRD2* Taq1D rs1800498 between the sports subjects and controls, with the T allele at 0.71 versus 0.56 and the C allele at 0.29 versus 0.44, with a χ^2 of 17.850 and $p < 0.0001$ (Table 2).

Table 2. Frequency of genotypes of the *DRD2* Tag1D rs1800498 gene polymorphisms in the sports subjects and control subjects.

	DRD2 Tag1D rs1800498				
	Genotypes			Alleles	
	T/T n(%)	C/C n(%)	C/T n(%)	T n (%)	C n (%)
Sports subjects n = 159	90 (56.60%)	24 (15.09%)	45 (28.30%)	225 (70.75%)	93 (29.25%)
Control n = 232	69 (29.74%)	42 (18.10%)	121 (52.16%)	259 (55.82%)	205 (44.18%)
χ^2 (*p* value)		29.890 (< 0.0001)*		17.850 (< 0.0001)*	

n – number of subjects; * – significant statistical differences

Table 3 presents the means and standard deviations of the NEO-FFI scores for both the sports participants and the control group.

Table 3. STAI and NEO Five-Factor Inventory sten scores between healthy controls and sports subjects.

NEO Five-Factor Inventory/	Sports subjects (n= 159)	Control (n = 232)	Z	(p-Value)
Neuroticism/scale	4.81±2.22	4.61±1.90	0.627	0.5308
Extraversion/scale	6.79±1.90	6.37±1.99	2.020	0.0434*
Openness/scale	4.74±1.75	4.53±1.63	1.401	0.1612
Agreeability/scale	5.70±2.24	5.66±2.07	0.296	0.7675
Conscientiousness/scale	7.18±2.09	5.88±2.12	5.803	0.0000*

p, statistical significance with Mann–Whitney U-test; *n,* number of subjects; M ± SD, mean ± standard deviation; * statistically significant differences

The test sports subjects, compared to the control group, obtained higher scores in the assessment of the NEO-FFI Extraversion scale (6.79 vs. 6.37; Z = 2.020; $p = 0.0434$) and NEO-FFI Conscientiousness (7.18 vs. 5.88; Z = -5.803; $p \leq 0.000$).

Table 4 summarizes the results of the 2 × 3 factorial ANOVA, focusing on the sten scores derived from the NEO Five-Factor Personality Inventory (NEO-FFI).

Table 4. Differences in *DRD2* Tag1D rs1800498 and NEO Five-Factor Inventory scale between healthy control subjects and sports subjects.

NEO Five-Factor Inventory	Group	*DRD2* Tag1D rs1800498 T/T n = 159 M ± SD	C/C n = 66 M ± SD	C/T n = 166 M ± SD	ANOVA factor	F (p value)	η²	Power (alfa = 0,05)
Neuroticism scale	Sports subjects (SpS); n = 159	4.61 ± 2.12	4.42 ± 2.21	5.40 ± 2.36	intercept	$F_{1,385}$ = 1596.03 ($p < 0.0001$)	0.805	1.000
					SpS /control	$F_{1,385}$ = 0.64 ($p = 0.4247$)	0.002	0.125
	Control; n = 232	4.39 ± 1.99	4.81 ± 1.88	4.66 ± 1.86	rs1079597	$F_{2,385}$ = 2.52 ($p = 0.0813$)	0.013	0.505
					SpS /control × rs1079597	$F_{2,385}$ = 1.68 ($p = 0.1869$)	0.009	0.354
Extraversion scale	Sports subjects (SpS); n = 159	6.96 ± 1.98	6.83 ± 2.10	6.44 ± 1.60	intercept	$F_{1,385}$ = 3302.93 ($p < 0.0001$)	0.896	1.000
					SpS /control	$F_{1,385}$ = 2.82 ($p = 0.0938$)	0.007	0.388
	Control; n = 232	6.51 ± 2.04	6.24 ± 1.86	6.34 ± 2.03	rs1079597	$F_{2,385}$ = 1.08 ($p = 0.3407$)	0.006	0.239
					SpS /control × rs1079597	$F_{2,385}$ = 0.42 ($p = 0.6557$)	0.002	0.118
Openness scale	Sports subjects (SpS); n = 159	4.78 ± 1.94	4.92 ± 1.44	4.58 ± 1.51	intercept	$F_{1,385}$ = 2235.49 ($p < 0.0001$)	0.853	1.000
					SpS /control	$F_{1,385}$ = 1.56 ($p = 0.2122$)	0.004	0.238
	Control; n = 232	4.58 ± 1.61	4.43 ± 1.65	4.53 ± 1.64	rs1079597	$F_{2,385}$ = 0.22 ($p = 0.8025$)	0.001	0.084
					SpS /control × rs1079597	$F_{2,385}$ = 0.35 ($p = 0.7024$)	0.002	0.107
Agreeability scale	Sports subjects (SpS); n = 159	5.99 ± 2.48	5.25 ± 2.15	5.36 ± 1.65	intercept	$F_{1,385}$ = 2015.57 ($p < 0.0001$)	0.840	1.000
					SpS /control	$F_{1,385}$ = 0.25 ($p = 0.6170$)	0.001	0.079
	Control; n = 232	5.60 ± 2.16	5.69 ± 1.89	5.67 ± 2.10	rs1079597	$F_{2,385}$ = 0.85 ($p = 0.4281$)	0.004	0.196
					SpS /control × rs1079597	$F_{2,385}$ = 1.28 ($p = 0.2787$)	0.007	0.278
Conscientious-ness scale	Sports subjects (SpS); n = 159	7.39 ± 2.12	7.83 ± 1.46	6.42 ± 2.11	intercept	$F_{1,385}$ = 2884.21 ($p < 0.0001$)	0.882	1.000
					SpS /control	$F_{1,385}$ = 38.97 ($p < 0.0001$)*	0.092	0.999
	Control; n = 232	5.81 ± 2.28	5.14 ± 2.04	6.18 ± 2.00	rs1079597	$F_{2,385}$ = 0.74 ($p = 0.4765$)	0.004	0.176
					SpS /control × rs1079597	$F_{2,385}$ = 8.08 ($p = 0.0004$)*	0.040	0.957

*–significant result; SpS – Sports Subjects; M±SD – mean ± standard deviation

Conscientiousness scale

There was also a statistically significant effect of sports subjects or its control group on extraversion. The statistical analysis revealed a significant difference in the conscientiousness scale score among participants (F1,385 = 38.97 $p < 0.00001$) with an effect size $\eta^2 = 0.092$. The potency observed for this factor was over 99%, and approximately 9% was explained by sports subjects or lack thereof on the variance in the Conscientiousness scale score.

There was a statistically significant effect of *DRD2* Tag1D rs1800498 genotype interaction. *DRD2* Tag1D rs1800498 and sports subjects or control group on the Conscientiousness scale ($F_{2,385} = 8.08$ $p = 0.0004$; $\eta^2 = 0.040$; Figure 1). The potency observed for this factor was 96%, and approximately 4% was explained by the polymorphism of the *DRD2* Tag1D rs1800498 and sports subjects or lack thereof on trait Conscientiousness scale score variance. Table 5 shows the results of the post hoc test.

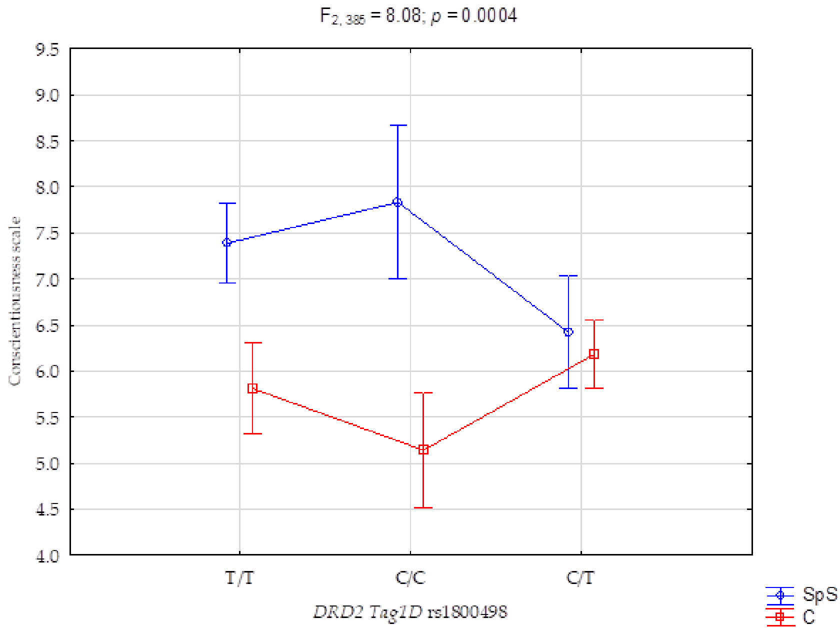

Figure 1. Interaction between the with Sports subjects (SpS) / control (C) and *DRD2* Tag1D rs1800498 and Conscientiousness scale.

Table 5. Post hoc test (Least Significant Difference) analysis of interactions between the Sports subjects /Control and *rs1079597* and Conscientiousness scale.

rs1079597 and Conscientiousness scale						
	(1) **M = 7.39**	**(2)** **M = 7.83**	**(3)** **M = 6.42**	**(4)** **M = 5.81**	**(5)** **M = 5.14**	**(6)** **M = 6.18**
Sports subjects T/T (1)		0.3508	0.0111	0.0000	0.0000	0.0000
Sports subjects C/C (2)			0.0073	0.0000	0.0000	0.0004
Sports subjects C/T (3)				0.1247	0.0042	0.5066
Control T/T (4)					0.0998	0.2368
Control C/C (5)						0.0053
Control C/T (6)						

*– significant statistical differences, M–mean.

4. Discussion

From a neurobiological point of view, endurance training increases the number of dopamine binding sites and dopamine metabolism in rats [12]. Just 1 hour of exercise increased extracellular dopamine levels in the striatum in both trained and untrained rats [13]. In humans, endurance training also leads to behavioral and physiological changes, as there is evidence that intense physical exercise increases the level of sulfoconjugated dopamine in the subjects' plasma. The measurement concerned well- and poorly-trained men [30].

Statistically significant differences were found in the frequency of *DRD2* Tag1D rs1800498 genotypes and alleles in the tested sports subjects compared to the control group [31]. Interestingly, the distributions of genotypes and haplotypes of *DRD2* gene polymorphisms were examined in the context of their impact on the effectiveness of the training program. Five polymorphic sites were selected and analyzed in a group of Caucasian women. The surveyed women took part in a 12-week training program. Polymorphic variants and biochemical parameters were examined. Most important biochemical parameters changed over time, but no static significance was found for *DRD2* gene polymorphisms [31].

A similar result was obtained by Michałowska-Sawczyn et al. 2021 [32], where no significant differences in the genotype distributions in the rs1800498 polymorphism of the *DRD2* gene were noted between the group of examined martial arts athletes and the control group.

In addition to environmental and psychosocial factors, innate biological mechanisms influence sports predispositions [9, 11, 33]. Participation in sports activities was examined in the context of biological factors influencing this process. Twin studies and family resemblance models have reported that behavioral tendencies are transmitted genetically [34–36]. Genetic factors explain over 80% of male students' sports participation, while environmental influences account for greater variation in sports participation among female students than genetic factors [11]. Interestingly, differences in this aspect also concern gender. One study showed that *DRD2* had a significant statistical impact on sports participation only in males [37] and untrained rats [13].

Simonen et al. examined the association between the dopamine D2 receptor gene (*DRD2*) and physical activity among black and white adults. *DRD2* TT homozygotes were significantly less likely to participate in sports and physical activity than *DRD2* CT heterozygotes and CC homozygotes in white women [38]. Lee et al. also found that the more females had the *DRD2* A1 allele, the greater the likelihood they would not participate in sports throughout adolescence and young adulthood [39]. Similarly, Flack et al. showed that carrying the A1 allele of the *DRD2* gene is associated with lower exercise RRV (relative reinforcement value of exercise) among 178 adults (127 women) [40]. It should be emphasized, however, that the dopaminergic system does not always contribute to positive behaviors related to reward in the brain. Carriers of these alleles may engage in addictive behaviors to satisfy their needs rather than practicing sports; it has been shown that the A1 alleles and T alleles of the *DRD2* gene are associated with several addictive behaviors [41–45].

Sensation seeking, not self-control, was the key factor influencing the relationship between dopamine functioning and aggression. This model suggests that a genetic predisposition to greater reward-seeking not only leads individuals to seek risky experiences, such as the use of illicit drugs [46], but sometimes achieves this goal in the form of violent arguments. Carriers of the T allele of Taq1D rs1800498 SNP (located at position 112796798) show greater features of antisocial personality disorder [47] and aggression in childhood [48]. Five SNPs of the *DRD2* gene were identified for their association with aggressive tendencies: rs1800497, rs1800498, rs1799978, rs12364283 and rs4581480. Moreover, these results support the conceptualization of aggression as a gratifying behavior. Aggression interventions may greatly benefit from this putative role of positive affect and reward as motivational factors. Although some treatments acknowledge the reinforcing properties of aggressive responses and behaviors [49], few directly address the role of positive emotions in their onset. Behavioral and pharmacological therapies typically used to reinforce behaviors such as substance abuse may be useful to incorporate into interpersonal violence interventions and perhaps even tailored to individuals whose genotypes place them at such risk.

The tested sports subjects, compared to the control group, obtained higher scores in the assessment of NEO-FFI Extraversion and Conscientiousness scales. Additionally, there was a statistically significant effect of *DRD2* Tag1D rs1800498 and sports subjects or control group on the Conscientiousness scale.

The study of athletes' personalities in the context of their successes has been widely described and researched. Beckmann and Kazen [50] observed that controlled athletes with high energy regulation requirements (long-distance runners and rowers) are predisposed to failure orientation or lack of motivation. Egloff and Gruhn [51] suggested that in the case of endurance athletes, extraversion and sociability strongly influence the choice of sport. Extraversion is characterized by sociability, controlled impulsivity and optimism

[52]. Morgan [53] found that male long-distance runners reported lower levels of stress, depression, anger and fatigue compared to the average person. Backmand et al. [54] emphasized that endurance athletes have lower neuroticism scores than other athletes.

5. Conclusions

In conclusion, this study reinforces the hypothesis that genetic factors, specifically the *DRD2* Taq1D rs1800498 polymorphism, significantly influence personality traits as-sociated with athletic performance. Our findings provide a robust link between the genetic makeup of individuals and their predispositions towards sports, highlighting the role of dopamine receptor genes in shaping key personality traits like extraversion and conscientiousness. These results underscore the importance of considering genetic aspects when evaluating athletes' psychological profiles and their potential impact on performance.

Further research is recommended to explore additional genetic markers and their interaction with environmental factors in sports. This could lead to a more nuanced understanding of the psychogenetic determinants of athletic ability, potentially guiding training and talent identification processes in sports. Recommendations for future studies include a longitudinal approach to assess how these genetic traits influence athletic performance over time and the exploration of gene-environment interactions in different sports disciplines.

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Author Contributions: Study Design, KH-L; Data Collection, KH-L, AG; Statistical Analysis, KH-L, AS-P, AS, AG; Data Interpretation, KH-L, AG; Manuscript Preparation, KH-L, AS-P, AS, MM, GT, CMC, AR, RR, and AG; Literature Search, KH-L, AS-P, AS, MM, GT, CMC, AR, RR, and AG. All authors have read and agreed to the published version of the manuscript.

Funding: The research obtained no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Bioethical Committee at the District Medical Chamber in Szczecin (permit number: 13/KB/VI/2016) and the Regional Medical Council in Gdansk (permit number: KB-14/19).

Informed Consent Statement: Written informed consent was obtained from all participants, and the research was conducted at the Independent Laboratory for Health Promotion. Recruitment and selection of sports and control group participants was conducted by a psychiatrist based on psychiatric assessment using the Mini International Neuropsychiatric Interview (MINI) and the NEO Five-Factor Inventory of Personality (NEO-FFI) questionnaires.

Data Availability Statement: Data available from the corresponding author on request.

Conflicts of Interest: The authors declare no conflict of interest.