УДК: 575/577.21/796:159.9

STUDYING PSYCHOLOGICAL AND GENETIC DETERMINANTS OF ATHLETIC SUCCESS WITHIN THE FRAMEWORK OF A NEUROPSYCHOBIOLOGICAL MODEL IN CERTAIN SPORTS

N.Sh. Usmonalieva, I.R. Mavlyanov.
Republican Scientific and Practical Center for Sports Medicine, Uzbekistan.

ИЗУЧЕНИЕ ПСИХОЛОГО-ГЕНЕТИЧЕСКИХ ДЕТЕРМИНАНТ СПОРТИВНОЙ УСПЕШНОСТИ В РАМКАХ НЕЙРОПСИХОБИОЛОГИЧЕСКОЙ МОДЕЛИ В НЕКОТОРЫХ ВИДАХ СПОРТА

Н.Ш.Усмоналиева, И.Р.Мавлянов.
Республиканский научно-практический центр спортивной медицины, Узбекистан.

БАЪЗИ СПОРТ ТУРЛАРИДА НЕЙРОПСИХОБИОЛОГИК МОДЕЛ ДОИРАСИДА СПОРТДАГИ МУВАФФАҚИЯТНИНГ ПСИХОЛОГИК-ГЕНЕТИК ДЕТЕРМИНАНТЛАРИНИ ЎРГАНИШ

Н.Ш.Усмоналиева, И.Р.Мавлянов.
Республика спорт тиббиёти илмий-амалий маркази, Ўзбекистон.

Abstract. *This article presents data from a study of the psychological and genetic determinants of athletic success in cyclic sports, genetic predictors of emotional stability, and genetically determined characteristics of neurotransmitter metabolism.*
Keywords: *genetic marker, genotype, allele, psychotype, sports psychogenetics*

Аннотация. *В данной статье приводятся данные изучения психолого-генетических детерминант спортивной успешности в циклических видах спорта, генетические предикторы эмоциональной устойчивости, а также генетически детерминированные особенности нейромедиаторного обмена.*
Ключевые слова: *генетический маркер, генотип, аллель, психотип, психогенетика спорта*

Изоҳ. *Ушбу мақолада циклик спорт турларида спорт муваффақиятининг психологик ва генетик детерминантларини, ҳиссий барқарорликнинг генетик предикторлари ва нейромедиаторлар метаболизмининг генетик жиҳатдан аниқланган хусусиятларини ўрганиш бўйича маълумотлари тақдим этилган.*
Калит сўзлар: *генетик маркер, генотип, аллел, психотип, спорт психогенетикаси.*

Relevance. The study of psychological determinants of athletic success in cyclic sports is based on the biopsychosocial model. The choice of C. Cloninger's Temperament and Character Inventory (TCI-125) is justified by its unique ability to differentiate: temperament: genetically determined biochemical systems of the brain (dopaminergic, serotonergic, noradrenergic) responsible for basic reactions. Character: conceptual systems of self-regulation formed under the influence of learning and conscious experience. In the context of sports medicine and genetics, this allows for the mapping of gene polymorphisms (e.g., dopamine and serotonin transport systems) onto specific scales of the questionnaire, providing a deeper understanding of the neurobiological basis of endurance.

Materials and Methods. The subject of the study was the psychogenetic profile of "elite" cyclic athletes, characterized by the following qualities:

• High Persistence (P): Biological readiness to continue work despite fatigue and the absence of immediate reinforcement.

• Low Novelty Seeking (NS): Tolerance for monotonous training loads.

• High Self-Directedness (SD): Volitional control and the ability to subordinate current actions to long-term athletic goals.

The Russian-language adaptation of C. Cloninger's questionnaire (adapted by N.A. Almaev) was utilized. Seven scales (4 temperament scales and 3character scales) were evaluated. Assessment was conducted under standard conditions during the preparatory period of the macrocycle. Genetic testing was also performed, followed by genotyping of polymorphic markers of candidate genes associated with psycho-emotional stability.

Results and Discussion. Genetic Determination of Psychological Traits: An analysis was conducted on polymorphic markers of genes responsible for neurotransmitter metabolism in the central nervous system. These markers were chosen due to their involvement in forming the biological foundation of temperament according to Cloninger's model:

• Dopamine System and the "Novelty Seeking" (NS) Scale

• DRD4 Gene (Dopamine Receptor D4): Polymorphism (variants with different numbers of repeats, 7R/4R) is associated with the intensity of seeking external stimuli. In cyclic athletes, a predominance of alleles contributing to low NS scores is expected, ensuring high tolerance for monotonous, repetitive loads (long-distance running, swimming).

• COMT Gene (Catechol-O-methyltransferase): Val158Met polymorphism. The Val/Val variant provides rapid dopamine breakdown in the prefrontal cortex, associated with high stress resistance ("warrior"), while the Met/Met variant ("worrier/explorer") correlates with higher NS scores and difficulties with monotonous tasks.

• Serotonin System and the "Harm Avoidance" (HA) Scale

• 5-HTTLPR Gene (Serotonin Transporter): The short allele (S) is associated with increased anxiety and high HA scores. Elite cyclic athletes typically exhibit a predominance of the long allele (L), correlating with emotional stability, low pre-competition anxiety, and effective CNS recovery after grueling loads.

• Norepinephrine System and the "Persistence" (P) Scale

• DBH Gene (Dopamine Beta-Hydroxylase): Involved in the conversion of dopamine to norepinephrine. The activity of this enzyme modulates the level of persistence and volitional effort. High P scores in successful athletes are genetically supported by an optimal balance of noradrenergic

transmission, allowing them to ignore signals of pain and fatigue to achieve their goals.

Character scales (SD — Self-Directedness, C — Cooperativeness) show a less direct link to specific genes, as they reflect epigenetic influences—the result of upbringing, coaching, and the athlete's self-actualization. This aspect leads to a crucial conclusion: Genetics (temperament) determines the predisposition to a sport, while character (self-regulation) determines whether the individual becomes a champion.

Based on this, a conceptual framework of structural links was developed, consisting of:

• Genetic Level: DRD4, 5-HTTLPR, COMT polymorphisms.

• Neurotransmitter Level: Balance of dopamine, serotonin, and norepinephrine.

• Psychological Level: TCI profile (High P, Low NS).

• Behavioral Level: Resistance to hypoxia, monotony, and stress.

• Outcome: Achieving MS/MSMK (Master of Sports/ International Master of Sports) standards in cyclic sports.

It should be noted that while genetic markers define the biological limit and reactive tendencies (temperament), the Character scales (Self-Directedness) act as a mediator, allowing the athlete to compensate for undesirable genetic traits through conscious volitional regulation.

Comparative Analysis Findings:

• Dopamine System and Persistence (P): Carriers of the Val/Val genotype of the COMT gene showed statistically significantly higher scores on the "Persistence" (P) scale compared to Met allele carriers (28.4 \pm 3.2 vs 21.1 \pm 4.1 points, respectively; $p < 0.05$). The odds ratio (OR) for achieving high persistence with the Val/Val genotype was 2.4 (95\% \text{ CI}: 1.2–4.7).

• Genetic Predictors of Emotional Stability (HA): Analysis of the 5-HTTLPR polymorphism revealed that individuals with the homozygous LL genotype have significantly lower scores on the "Harm Avoidance" (HA) scale, characterized by low pre-competition anxiety and rapid recovery.

• Cognitive Control and Self-Directedness (SD): A synergy was found between the LL genotype (5-HTTLPR) and high SD scores, indicating that genetically determined emotional stability serves as a favorable background for the development of volitional personality traits.

Conclusion. The data verify the concept of a "psychogenetic core" in cyclic sports. Genetically determined neurotransmitter metabolism (primarily dopaminergic and serotonergic) sets the boundaries for temperament adaptability, while high Self-Directedness (SD) serves as the tool for realizing this potential. The psychological profile of high-ranking "cyclic" athletes is characterized by the "endurance triad": high Persistence (P), high Self-Directedness (SD), and low Novelty Seeking (NS).

Practical Recommendations: For Individualized Training: Athletes with high HA (S-allele carriers) should utilize ideomotor training and Biofeedback (BFB) to manage anxiety. Athletes with moderate NS scores require variety in training locations and methods to prevent psychological saturation. For Psychological Support: Since the SD scale is plastic, coaches should focus on developing the athlete's agency—involving them in planning and analyzing training logs to strengthen the psychological foundation for realizing their genetic potential.

References:

1. Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. Archives of General Psychiatry, 50(12), 975–990.
2. Almaev, N. A., & Ostrovskaya, I. S. (2005). Adaptation of Cloninger's Temperament and Character Inventory on a Russian-speaking sample. Psychological Journal, Vol. 26, No. 6, pp. 74–86.
3. Gillespie, N. A., et al. (2003). The genetics of Robert Cloninger's temperament and character dimensions: A meta-analysis of twin studies.
4. Cloninger, C. R. (1987). A systematic method for clinical description and classification of personality variants. A proposal. Archives of General Psychiatry, 44(6), 573–588.
5. Cloninger, C. R. (1994). The Temperament and Character Inventory (TCI): A Guide to Its Development and Use. St. Louis, MO: Center for Psychobiology of Personality, Washington University.
6. Enikolopov S. N., Erofeeva M. A. (2010). Testing of K. Cloninger's method for measuring temperament and character. Psychological Diagnostics, No. 4, pp. 5–22.
7. Comings, D. E., et al. (2000). The dopamine D2 receptor (DRD2) gene: a genetic risk factor in comparative psychopathology. Neuroscience & Biobehavioral Reviews.
8. Svrakic, D. M., et al. (1993). Differential diagnosis of personality disorders by the seven-factor model of temperament and character. Archives of General Psychiatry. Miettunen, J., & Raevuori, A. (2012). A meta-analysis of temperament and character inventory in patients with eating disorders. European Psychiatry.