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FUNCTIONAL STATE OF THE IMMUNE SYSTEM DURING SPORTS

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Abstract

In sports today, the increased incidence of illness among athletes and the development of secondary immunodeficiency states due to excessive physical and psycho-emotional stress are pressing issues. Among the numerous studies devoted to this issue, phenomenological studies of changes in the immune system during a single physical activity or a short adaptation period predominate, preventing a thorough understanding of the role and place of the immune system in the structure of adaptive changes in the body during the long-term training of highly qualified athletes. However, effective management of the training process, the safe use of preventive and rehabilitative measures, and immunocorrection agents are only possible based on a thorough, comprehensive understanding of the mechanisms of adaptation and the role of the immune system in this process. Current experimental data indicate the active involvement of the immune system in the development of adaptation syndrome, and that changes in it during physical training can significantly depend on the stage of adaptation. However, these areas of research, while having important theoretical and practical significance, remain underdeveloped. Changes in the immune system under the influence of physical exercise are currently considered primarily within the framework of the classical stress response. According to the tenets of adaptation theory, the stress response, as classically conceptualized, manifests itself only in the initial, imperfect, acute stage of adaptation, which, with repeated implementation, progresses to the next stage—perfect, long-term adaptation or training. Each of these stages accomplishes specific tasks through specific quantitative and qualitative changes in functional systems, among which the immune system occupies a significant place.

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The unfolding of the adaptation process is determined by the cause-and-effect relationships of two groups of factors: internal factors, such as the functioning of the body's regulatory and executive systems, and external factors, such as the influence of the athlete's training program. To develop fitness for a specific factor, the athlete's body must consistently undergo all stages of adaptive changes. The training program is planned based on the competition schedule, utilizing multidirectional physical loads in training sessions, micro-, meso-, and macrocycles. The relationship between the temporal structure of the training program and the body's own adaptive dynamics can be identified as an important research problem.

To study the dynamics of adaptive changes in the body, criteria for defining the stages of adaptation are necessary. It is known that the development of stress syndrome during the acute stage of adaptation induces free radical oxidation, one manifestation of which is lipid peroxidation (LPO). Therefore, its level can be used as a non-specific indicator reflecting the development of the acute stage of adaptation. Another non-specific sign of the acute stage of adaptation is the activation of protein catabolism, which can be manifested by an increase in blood urea levels. Since the state of an athlete's immune status during the training process depends on many factors (genetic characteristics, the functional state of the immune system, the athlete's level of training, the magnitude and bioenergetic focus of physical activity, etc.), experimental models on laboratory animals can reduce the number of these factors and control most of them. Analysis of the results obtained in such models will allow for a more definitive identification of the immune system's behavioral strategies during both the acute and long-term stages of adaptation to physical activity.

The aim of the work is to investigate the dynamics of changes in immune parameters during the process of adaptation to physical activity in an experimental model on laboratory animals and during training of swimmers.

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Research objectives:

To assess the intensity of lipid peroxidation and urea levels during adaptation to physical exercise in an experimental animal model. To investigate changes in immune parameters during adaptation to physical exercise in experimental animal models and to analyze their relationship with the dynamics of lipid peroxidation and urea.

Study results

For the first time, the use of free radical oxidation and urea levels in the blood as non-specific criteria for determining the stages of adaptation made it possible, within the framework of experimental animal models, to distinguish the urgent stage of adaptive restructuring and the stage of transition to long-term adaptation. Specific changes in immune parameters characteristic of each of these stages were discovered. The similarity of the dynamics of the studied parameters in experiments on two types of biological objects (mice and rats) indicates the commonality of the discovered patterns in the changes in immune parameters during the adaptation process in animals. During long-term observation of the adaptation process in athletes-swimmers, a dependence of changes in the population composition of athletes' leukocytes on the loads imposed as part of the training program was found. An increase in the volume of mixed energy supply work leads to a decrease in the proportion of segmented neutrophils and an increase in lymphocytes. An increase in anaerobic work causes a decrease in eosinophils, while aerobic work causes an increase in the proportion of basophils. Differences in the blood leukocyte ratio were identified between swimmers and individuals who do not regularly engage in sports. As a result of long-term training, swimmers had a reduced percentage of band neutrophils and an increased proportion of lymphocytes. This study expands our understanding of the immune system's role in adaptive changes that occur in the body during physical exercise under training conditions. Using an experimental training model, we found that under conditions of daily, identical-intensity physical exercise over the course of a month, the body sequentially undergoes stages of adaptive changes. The nature of changes in immune parameters varies at different

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stages of adaptation and reflects its patterns, which must be taken into account when studying the impact of physical exercise on the immune system. Understanding the patterns of immune parameter dynamics during adaptation opens the possibility of more accurately defining the boundaries of physiological norms, expanded by adaptive processes. Training is a controlled process of adaptation with direct and feedback loops.

Conclusions

Analysis of immune parameters' dynamics demonstrates the influence of the structure and content of the training program, but these changes are not simply a consequence of changes in the quantitative and qualitative parameters of the physical activity performed. These circumstances complicate the training process monitoring system, but also allow for more precise immune correction if necessary. The study's results can be used in teaching physiology, sports medicine, physical education theory and methodology, and in training management.

References

1. Абзалов Р.А., Ситдиков Ф.Г. Развивающееся сердце и двигатетельный режим. Казань, 1998. - 96 с.
2. Абрамов В.В. Взаимозависимость функционирования иммунной и нервной систем//Успехи современной биологии. -1991.-Т. 111, вып. 6. С. 840-844.
3. Айрапетянц М.Г., Гуляева Н.В. Роль свободнорадикального окисления липидов в механизмах адаптации // Вестник АМН СССР. 1988. - № 11. - С. 47-50.
4. Abduraimovna, A.D., Turg'unboyevna, Y.N. and Rustamovna, Q.S., 2023. QIZLARNI OILA VA JAMIYATDA O 'ZO 'RNINI TOPISHDA PSIXOLOGIK KO 'NIKMA VA MA'NAVIY YETUKLIKNI SHAKLLANTIRISH. Scientific Impulse, 1(7), pp.310-313.
5. ERMATOV, N., KASSYMOVA, G., TAJIYEVA, K., KHASANOVA, M., ALIMUKHAMEDOVA, M., & AZIMOVA, S. (2020). Expression of tissue-

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

specific genes in mice with hepatocarcinogenesis. International Journal of Pharmaceutical Research (09752366), 12(3).

6. Ikramova, N. A., Jalolov, N. N., Mirsagatova, M. R., Kasimova, K. T., Sadirova, M. K., & Sultonov, E. Y. (2025, April). AMBIENT TEMPERATURE AND THE RISK OF THERMOREGULATORY DISORDERS AMONG TRAFFIC POLICE OFFICERS: AN EPIDEMIOLOGICAL ANALYSIS. International Conference on Advance Research in Humanities, Applied Sciences and Education.
7. Ikramova, N. A., Mirsagatova, M. R., Jalolov, N. N., Kasimova, K. T., Sultonov, E. Y., & Sadirova, M. K. (2025, April). THE EFFECT OF THERMAL LOAD ON THE BODY OF OUTDOOR WORKERS: ANALYSIS BASED ON MEDICAL AND HYGIENIC INDICATORS. International Conference on Advance Research in Humanities, Applied Sciences and Education.
8. Kamilova, D. N., Saydalikhujaeva, S. K., Abdashimov, Z. B., Rakhmatullaeva, D. M., & Tadjieva, X. S. (2021). Employment relations and responsibilities of medical institutions workers in a pandemic in Uzbekistan. Journal of Medicine and Innovations, 2(13-1).
9. Kamilova, D. N., Saydalikhujaeva, S. K., Rakhmatullaeva, D. M., Makhmudova, M. K., & Tadjieva, K. S. (2021). Professional image of a teacher and a doctor. British Medical Journal, 1(4), 4-14.
10. Masharipova, R. Y., & Khasanova, G. M. (2020). Improvement of motor fitness of dental students in the process of physical education classes. Bulletin of Science, 5(3), 101-104.
11. Masharipova, R., Togaynazarov, S., Pakhrudinova, N., Khasanova, G., & Abdurahimov, B. (2020). The main factors of formation and physical culture in society. Systematic Reviews in Pharmacy, 11(12).
12. Qosimova, X. T., Ikramova, N. A., Juraboyeva, D. N., & Mukhtorova, D. A. (2025, March). THE ADVERSE EFFECTS OF SMARTPHONES ON COGNITIVE ACTIVITY IN THE EDUCATIONAL PROCESS AND WAYS TO MITIGATE THEM. In The Conference Hub (pp. 76-79).

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
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Website: usajournals.org

13. Sadullayeva, X. A., Salomova, F. I., & Sultonov, E. Y. (2023). Ochiq suv havzalari muhofazalash ob'ekti sifatida. In V международная научно-практическая конференция «Современные достижения и перспективы развития охраны здоровья населения.
14. Sadullayeva, X. A., Salomova, F. I., Mirsagatova, M. R., & Kobiljonova Sh, R. (2023). Problems of Pollution of Reservoirs in the Conditions of Uzbekistan.
15. Salomova, F. I., & Kosimova, H. T. (2017). RELEVANCE OF STUDYING INFLUENCE OF THE BONDS OF NITROGEN POLLUTING THE ENVIRONMENT ON HEALTH OF THE POPULATION SUFFERING CARDIOVASCULAR ILLNESSES (REPUBLIC OF UZBEKISTAN). In INTERNATIONAL SCIENTIFIC REVIEW OF THE PROBLEMS AND PROSPECTS OF MODERN SCIENCE AND EDUCATION (pp. 81-83).
16. Salomova, F. I., Ahmadalieva, N. O., Sadullaeva, K. A., & Sherkuzieva, G. F. (2022). Dust storm and atmosphere air pollution in Uzbekistan.
17. Saydalikhujaeva, S. K., & Rustamova, H. Y. (2022). Motivation and satisfaction with the professional activities of nurses anesthetists. MedUnion, (1), 163-169.
18. Saydalikhujayeva, S. K., Kosimova, K. T., Mamadzhanov, N. A., & Ibragimova, S. R. (2020). The role of modern pedagogical technologies in improving the system of higher medical education in the republic of Uzbekistan. New Day in Medicine, 1(29), 85.
19. Saydalikhujayeva, S. K., Kosimova, K. T., Mamadzhanov, N. A., & Ibragimova, S. R. (2020). The role of modern pedagogical technologies in improving the system of higher medical education in the republic of Uzbekistan. New Day in Medicine, 1(29), 85.
20. ShR, K., Mirrakhimova, M. H., & Sadullaeva, H. A. (2022). Prevalence and risk factors of bronchial asthma in children. Journal of Theoretical and Clinical Medicine, 2, 51-56.
21. Tadjieva, K. S. (2024). USING SITUATIONAL TASKS TO INCREASE THE EFFECTIVENESS OF TEACHING MEDICAL CHEMISTRY. Web of Teachers: Inderscience Research, 2(1), 64-68.

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

22. Tadjieva, K. S., Kosimova, K. T., & Niyazova, O. A. (2025). THE ROLE OF AIR POLLUTION IN THE DEVELOPMENT OF CARDIOVASCULAR DISEASES.
23. Tursunov, D., Sabiorva, R., Kasimova, X., Azizova, N., & Najmiddinova, N. (2016). Status of oxidant and antioxidant systems in alloxan diabetes and ways its correction. In Science and practice: a new level of integration in the modern world (pp. 188-190).
24. АБДУЛЛАЕВА, М., & ТАДЖИЕВА, Х. (2023). ИЗУЧЕНИЕ РАСТВОРИМОСТИ СИСТЕМ: КАЛИЕВАЯ СОЛЬ-ОДНОЗАМЕЩЕННЫЙ УКСУСНОКИСЛЫЙ МОНОЭТАНОЛАММОНИЙ-ВОДА. Международный центр научного партнерства «Новая Наука»(ИП Ивановская ИИ) КОНФЕРЕНЦИЯ: НАУЧНЫЙ ДЕБЮТ 2023 Петрозаводск, 03 декабря 2023 года Организаторы: Международный центр научного партнерства «Новая Наука»(ИП Ивановская ИИ).
25. Акромов, Д. А., & Касимова, Х. Т. (2017). Результаты изучения токсикологических свойств фунгицида" Вербактин". Молодой ученый, (1-2), 2-3.
26. Ахмадалиева, С. У., & Машарипова, Р. Ю. ОСНОВЫ ЗДОРОВОГО ОБРАЗА ЖИЗНИ СТУДЕНТА МЕДИКА. ББК: 51.1 л0я43 С-56 А-95, 228.
27. Балтабаев, У. А., Джураев, А. Д., & Таджиева, Х. С. (2008). Реакции фенилизотиоцианата с α-аминокислотами. Жур. Химия и химическая технология, 1, 39-42.
28. Денисова, У. Ж., & Ахмадалиева, С. У. (2019). МЕТОДЫ, ПОВЫШАЮЩИЕ ФИЗИЧЕСКОЕ ВОСПИТАНИЕ СТУДЕНТОВ В СОВРЕМЕННОЙ СИСТЕМЕ ОБРАЗОВАНИЯ. In ФУНДАМЕНТАЛЬНЫЕ ОСНОВЫ ИННОВАЦИОННОГО РАЗВИТИЯ НАУКИ И ОБРАЗОВАНИЯ (pp. 141-143).
29. Денисова, У. Ж., & Машарипова, Р. Ю. (2019). Изучение взаимосвязи между морфометрическими характеристиками телосложения

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Website: usajournals.org

баскетболисток 16-18 лет и показателями физической подготовленности. Вестник науки, 5(12), 17-22.

30. Денисова, У. Ж., & Машарипова, Р. Ю. (2022). ПОВЫШЕНИЕ ПОКАЗАТЕЛЕЙ ЭФФЕКТИВНОСТИ ОБМАННЫХ ДЕЙСТВИЙ В СОРЕВНОВАТЕЛЬНОЙ ДЕЯТЕЛЬНОСТИ СТУДЕНТОВ БАСКЕТБОЛИСТОВ 1-КУРСА НА ОСНОВЕ ПОДВИЖНЫХ ИГР. Вестник науки, 4(1 (46)), 18-24.
31. Камилова, Д., Сайдалихужаева, Ш., Абдашимов, З., Рахматуллаева, Д., & Таджиева, Х. (2021). Трудовые отношения и обязанности работников медицинских учреждений в условиях пандемии в узбекистане. Медицина и инновации, 1(2), 13-19.
32. КАМИЛОВА, Д., САЙДАЛИХУЖАЕВА, Ш., МАХМУДОВА, М., РАХМАТУЛЛАЕВА, Д., & ТАДЖИЕВА, Х. (2022). ИНСОН САЛОМАТЛИГИ ВА ТИББИЙ КЎРИКНИНГ АҲАМИЯТИ. Журнал" Медицина и инновации", (3), 143-162.
33. Каримов, В. В., & Машарипова, Р. Ю. (2021). Метод «Джит Кун До» в учебном процессе на занятиях по физической культуре для студентов-стоматологов. Вестник науки, 4(12 (45)), 32-36.
34. Машарипова РЮ, Рожкова АС. Использование нетрадиционных видов гимнастики для оптимизации занятий физической культурой в вузе. InСборник научных трудов I-Международная научно-практической онлайн-конференция «Актуальные вопросы медицинской науки в XXI веке». УДК 2019 (Vol. 6, pp. 613-615).
35. Машарипова, Р. Ю. (2020). Повышение специальной двигательной активности студентов-стоматологов. Наука, образование и культура, (8 (52)), 51-53.
36. Машарипова, Р. Ю. (2022). PhD, ассистент кафедры общественного здоровья, управления здравоохранением и физической культуры Ташкентский государственный стоматологический институт (г. Ташкент, Узбекистан). ВЕСТНИК НАУКИ.
37. Машарипова, Р. Ю. (2022). АНАЛИЗ ФИЗИЧЕСКОЙ ПОДГОТОВЛЕННОСТИ СПЕЦИАЛЬНЫХ АТЛЕТОВ-ГИМНАСТОВ.

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ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

Central Asian Research Journal for Interdisciplinary Studies (CARJIS), 2(5), 730-737.

38. Машарипова, Р. Ю., & Хасанова, Г. М. (2020). Повышение двигательной подготовленности студентов-стоматологов в процессе учебных занятий физической культурой. Вестник науки, 5(3 (24)), 101-104.
39. Машарипова, Р. Ю., Тангиров, А. Л., & Мирзарахимова, К. Р. (2022). Пути повышения эффективности решения социальных проблем детей с ограниченными возможностями в условиях первичного медико-санитарной помощи. Scientific approach to the modern education system, 1(10), 124-127.
40. Пахрудинова, Н. Ю., Хасанова, Г. М., & Машарипова, Р. Ю. Хореография и здоровый образ жизни. ББК: 51.1 л0я43 С-56 А-95, 278.
41. Рустамова, Х. Е., Нурмаматова, К. Ч., & Машарипова, Р. Некоторые аспекты состояния здоровья населения Узбекистана. ББК, 51, 118.
42. Сайдалихужаева, Ш. Х. (2020). Professional risks in the activities of nurses. on the example of 3rd clinics Tashkent medical academy. Молодойученый.–2020, 52(342), 60-62.
43. Сайдалихужаева, Ш. Х., Косимова, Х. Т., Мамаджанов, Н. А., & Ибрагимова, Ш. Р. РОЛЬ СОВРЕМЕННЫХ ПЕДАГОГИЧЕСКИХ ТЕХНОЛОГИЙ В ДАЛЬНЕЙШЕМ СОВЕРШЕНСТВОВАНИИ СИСТЕМЫ ВЫСШЕГО МЕДИЦИНСКОГО ОБРАЗОВАНИЯ В РЕСПУБЛИКЕ УЗБЕКИСТАН.
44. Сайдалихужаева, Ш., & Рустамова, Х. (2021). Синдром эмоционального выгорания у медицинских сестер-анестезистов. Медицина и инновации, 1(2), 9-12.
45. Таджиева, Х. С. (2022). ИСПОЛЬЗОВАНИЕ МЕТОДА ПРОБЛЕМНЫХ СИТУАЦИЙ НА ЗАНЯТИЯХ МЕДИЦИНСКОЙ ХИМИИ. In Kimyo va tibbiyot: nazariyadan amaliyotgacha (pp. 205-208).
46. Таджиева, Х. С. (2023). МОДЕЛИРОВАНИЕ ПРОБЛЕМНОГО ОБУЧЕНИЯ В МЕДИЦИНСКОМ ВУЗЕ. West Kazakhstan Medical Journal, (3 (65)), 170-175.

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

47. Таджиева, Х., & Юсупходжаева, Х. (2023). Особенности преподавания медицинской химии в современных условиях на лечебном и педиатрическом факультетах медицинских вузов. Современные аспекты развития фундаментальных наук и вопросы их преподавания, 1(1), 119-124.
48. Хасанова, Г. М., & Машарипова, Р. Ю. (2021). ХОРЕОГРАФИЧЕСКАЯ И АКРОБАТИЧЕСКАЯ ПОДГОТОВКА НА НАЧАЛЬНОМ ЭТАПЕ ПОДГОТОВКИ В ТРАМПОЛИНЕ. Academic research in edu