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

ADAPTATION REACTIONS OF THE CIRCULAR SYSTEM IN RESPONSE TO THE IMPACT OF PHYSICAL ACTIVITIES AND THERMAL CONDITIONS OF THE EXTERNAL ENVIRONMENT

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Abstract

As is known, the human body, in addition to adapting to physical activity, continuously adapts to various factors and environmental conditions, such as psychogenic stress, changes in the nutritional composition of water and diet, high-altitude hypoxia, and weather and seasonal dynamics of environmental conditions. Therefore, studying the patterns of adaptation to several biotropic factors is relevant. The effect of the body's adaptation to physical activity largely depends on the functioning of the circulatory system and the immune system. However, adaptive changes in circulatory function during adaptation to physical activity during seasonal dynamics of environmental conditions have not been described in the available literature and require further study. On the other hand, it is known that the body's adaptation to stressful effects of various environmental factors is largely determined by the state of the blood and immune systems. In addition to maintaining the body's genetic homeostasis and protecting against infectious agents, immune system cells and humoral substances perform regulatory functions and modulate the activity of the autonomic nervous system. However, the mechanisms by which immune system cells and the humoral substances they synthesize contribute to the adaptation of the body and circulatory system to physical exertion under various seasonal environmental conditions remain largely hypothetical and require in-depth study. Thus, there is no doubt that the functional state of athletes depends not only on adaptation to physical exertion but is also determined by a combination of adaptive responses to environmental, technological, and social factors. Therefore, research into the

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

mechanisms of circulatory and immune system adaptation during athletes' adaptation to physical exertion and seasonal environmental changes is highly relevant.

The aim of the study was to identify the characteristics of adaptive changes in the activity of the circulatory and immune systems in athletes depending on seasonal environmental conditions during adaptation to aerobic physical activity.

Research objectives:
To compare the body composition characteristics of elite athletes with different adaptation rates to aerobic exercise and seasonal environmental conditions. To identify circulatory characteristics in athletes during adaptation to aerobic exercise in relation to seasonal environmental conditions. To compare the indicators of the state of the blood and immune systems in athletes with different dynamics of aerobic physical activity in the annual cycle.

Study Results
For the first time, differences in correlations between immune system parameters and circulatory parameters were identified in athletes with predominantly aerobic muscle energy supply, depending on seasonal environmental conditions during long-term adaptation to aerobic physical activity. It was found for the first time that in athletes with predominantly aerobic muscle energy supply, specific body weight, the value of which significantly determines the skill level of cross-country skiers and race walkers, is associated with the level of systemic circulation through correlations with blood vessel parameters, while in race walkers, it is associated with myocardial parameters. It was shown that, regardless of the characteristics of the dynamics of aerobic physical activity over the year, cross-country skiers and race walkers showed similar seasonal fluctuations in hemoglobin and ESR levels, lysosomal and NBT activity of neutrophils, circulating immune complexes, and complement activity. In addition, the specific body gravity of athletes in both groups was positively associated with the color index, ESR, and the level of the induced neutrophil NBT

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

test. The values of the cardiac index in athletes of both groups were positively associated with the blood level, the heart rate - with the IgM content, and the values of the systolic blood volume - with the eosinophil count. It was shown for the first time that the process of adaptation to aerobic physical activity in autumn and winter mediates a positive relationship between the cardiac index at rest and the content of CD25, CD34, and CD10-6a lymphocytes and a negative relationship with the level of band neutrophils, and during adaptation to such activity in spring and summer, the values of the heart rate in athletes were positively associated with the value of CD16 and CD5 lymphocytes. The state of the autonomic regulation of blood circulation in cross-country skiers was negatively associated with the content of monocytes in the peripheral blood, and in representatives of race walkers it was positively associated with the content of hemoglobin. Moreover, the dynamics of aerobic physical activity in the annual cycle exerted a modulating effect on the seasonal rhythm of hemoglobin content, the number of circulating platelets and monocytes in the blood, the level of phagocytic neutrophil count, the relative content of B-lymphocytes and the level of serum content. The identified features of the correlations between immune parameters and hemodynamic characteristics in athletes with different dynamics of aerobic physical activity in the annual cycle supplement the factual basis for determining the physiological patterns of the relationship between the immune system and the circulatory system when studying the mechanisms of their interaction under the influence of aerobic physical activity and seasonal environmental factors. The obtained data on the nature and parameters of the dynamics of the circulatory and immune system indicators in cross-country skiers and race walkers under the influence of physical activity and seasonal environmental conditions clarify the patterns of regulation of the seasonal rhythm of the functional state of the human body due to the dosing of the level of aerobic physical activity in the annual cycle. In a state of rest in athletes with predominantly aerobic energy supply of motor activity, the dynamics of blood circulation indicators in the year cycle largely depends on seasonal changes in environmental conditions during adaptation to physical activity.

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

Regardless of the dynamics of aerobic physical activity throughout the year, cross-country skiers and race walkers exhibit seasonal fluctuations in indicators of the peripheral erythron system nonspecific resistance factors, and immunoreactivity. The process of adaptation of the athlete's body to aerobic physical activity largely depends on the state of the immune system's adaptive responses to seasonal changes in environmental conditions. The dynamics of physical activity throughout the year in cross-country skiers and race walkers significantly influence seasonal fluctuations in blood and immune system indicators. Studies are currently regularly appearing on the morphofunctional changes in the athlete's body. This is entirely natural, as the adaptive changes that occur in athletes during systematic training are the physiological basis for improving their performance. Body composition indicators vary significantly among athletes in different sports depending on the specific nature of their motor activity. Furthermore, the levels of many somatometric indicators in athletes are subject to change due to the dynamics of physical and mental stress, as well as the impact of environmental conditions on the body. Recent studies to elucidate the mechanisms of athlete adaptation to physical stress demonstrate that morphofunctional changes during long-term adaptation are necessarily accompanied by changes in the relationships between regulatory mechanisms; the mobilization and utilization of the body's physiological reserves; and the formation of a functional system for adaptation to a specific type of motor activity. During the process of adaptive responses to physical stress, morphological changes occur at various levels of the structural organization of skeletal muscles: organ, cellular, and subcellular. These changes can result in metabolic restructuring in myocytes and, under certain conditions, changes in the plastic properties of their energy-producing and contractile structures. Following activation of the number and functional activity of mitochondria, protein synthesis increases and myofibril mass expands. The dynamics of publications indicate a rapidly growing interest in the study of body composition. Body composition is significantly correlated with a person's level of physical performance and the effectiveness of their adaptation to the environment. This relationship is particularly pronounced during extreme professional and sports

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

activities. To study body composition, it is necessary to examine the absolute and relative content of its main components, such as body weight, muscle, fat, bone, internal organ content, and water. An increase in muscle mass typically leads to increased physical performance, which is accompanied by an increase in adenosine triphosphate (ATP) levels and/or increased aerobic resynthesis. Macroergs. Conversely, increased fat mass worsens health and, as a rule, contributes to a decrease in physical performance. Athletes of different specializations differ not only in the thickness of the subcutaneous fat layer but also in the nature of its distribution on the body surface. Fat and lean (active) body mass are determined by various methods: biochemical, hydrometric, hydrostatic, isotopic, ultrasound, radiographic, etc. However, anthropometric methods are the most accessible and widely used in practice. It is believed that body composition allows for more effective morphological monitoring of training status, achieving the optimal ratio of body components in athletes of a given specialization. Athletes of different specializations exhibit significant differences in the circumference sizes of the middle and lower chest. According to V.I. Kozlov, and Gladysheva AA, the average perimeter of the middle chest in skiers and track and field athletes is 91.4±0.30 cm, which is significantly higher than that of non-athletes - 89.9±0.40 cm. At the same time, according to the same authors, the perimeter of the middle and lower chest in swimmers is significantly higher than that of skiers and track and field athletes (92.8±0.38 cm and 83.3±0.37 cm, respectively). In contrast to the data presented above, the results of a study conducted in 2007 by Matveeva AM (2007) indicated higher chest perimeter values in skiers living in the North, amounting to 93.21 ± 4.80 cm. At the same time, height indicators did not differ significantly (173.04 ± 11.17 cm), and body weight and the Quetelet index were significantly lower (61.00 ± 8.23 and 352 conventional units). It is quite possible that such differences in the data are due to the influence of the climatic and geographical conditions of the region on the somatometric characteristics of the developing organism. The chest excursion in skiers living in the North was 6.54 cm [Matveeva AM, 2007], which is significantly lower than the value of this indicator in skiers according to Kozlov V.I., Gladysheva AA (1977) - 9.4 ± 0.12 cm. According to the results of the latter

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study, the excursion of the lower chest in skiers was 9.7 ± 0.11 cm, which is significantly greater than that of non-athletes - 8.9 ± 0.19 cm. The value of chest excursion in track and field athletes occupies an intermediate position and is 9.14 ± 0.12 cm for the middle chest and 9.3 ± 0.12 cm for the lower chest. At the same time, the authors note that in track and field athletes, the increase in chest excursion is achieved mainly due to inhalation, and in skiers due to exhalation.

Conclusions

Thus, according to most researchers, the somatometry parameters of endurance athletes, unlike gymnasts, are characterized by a higher muscle and fat content of body mass and a lower lean body mass. Unlike non-athletes, skiers have larger chest girths, higher muscle and lean body mass, and a lower fat content. The perimeter of the upper, middle, and lower chest sections is almost identical in skiers and track and field athletes; however, the chest excursion is slightly greater in skiers than in track and field athletes. Furthermore, a greater proportion of the chest excursion is achieved through exhalation in skiers, while in track and field athletes, it is achieved through inhalation.

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