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SPORTIVE STRESS AND ITS IMPACT ON THE IMMUNE STATE OF ATHLETES DEALING WITH FREESTYLE WRESTLING

The article is dedicated to the study of the effect of physical loads on the maintenance and functional activity of lymphocytes in the peripheral blood system of freestyle wrestlers in the dynamics of the training macrocycle. Because of the impact from physical loads, a decrease occurs in the content of lymphocytes and their functional activity is reduced. Those changes depend on the intensity of physical loads; they become maximal at the end of the competition period and minimal in the transition period. It may be assumed that the immune system plays a significant role in the adaptation of the body to significant physical loads. The results of the conducted study show that the characteristics of cellular immunity are formed in wrestlers already at an early stage of sports training. It happens partly because of the presence of static pathology, associated with the reaction to physical loads within the framework of the training process. An enhanced immunological examination of wrestlers with an assessment of the mitochondrial activity of the lymphocyte population enables us to evaluate the individual threshold level of physical loads, the excess of which leads to a disturbance of the immune metabolism. Therefore, the inclusion of an additional transitional period in the training macrocycle helps to a more complete recovery of the studied indicators.

Key words: sport stress, physical load, adaptation, immunity, lymphocytes, functional activity, wrestlers.

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Спорттық стресс және оның еркін күреспен айналысатын спортшылардын иммундык куйі̆не әсері̆

Мақала жаттығу макроциклінің динамикасында еркін күресшілердің шеткі қан жүйесіндегі лимфоциттердің сақталуына және функционалдық белсенділігіне физикалық жүктемелердің әсерін зерттеуге арналған. Физикалық жүктемелердің әсерінен лимфоциттердің құрамы төмендейді және олардың функционалдық белсенділігі төмендейді. Ол өзгерістер физикалық жүктемелердің қарқындылығына байланысты; олар бәсекелестік кезеңінің соңында максималды, ал өтпелі кезеңде минималды болады. Иммундық жүйе дененің маңызды физикалық жүктемелерге бейімделуінде маңызды рөл атқарады деп болжауға болады. Жүргізілген зерттеу нәтижелері балуандарда жасушалық иммунитеттің ерекшеліктері спорттық жаттығулардың бастапқы кезеңінде қалыптасатынын көрсетті. Бұл ішінара жаттығу процесі аясында физикалық жүктемелерге реакциямен байланысты статикалық патологияның болуына байланысты болады. Лимфоциттер популяциясының митохондриялық белсенділігін бағалай отырып, балуандардың күшейтілген иммунологиялық сараптамасы физикалық жүктемелердің жеке шекті деңгейін бағалауға мүмкіндік береді, оның асып кетуі иммундық метаболизмнің бұзылуына әкеледі. Сондықтан оқу макроцикліне қосымша өтпелі кезеңді енгізу зерттелетін көрсеткіштерді толық қалпына келтіруге көмектеседі.

Түйінді сөздер: спорттық стресс, физикалық жүктеме, бейімделу, иммунитет, лимфоциттер, функционалдық белсенділік, балуандар.

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Спортивный стресс и его влияние на иммунное состояние спортсменов, занимающихся вольной борьбой

Статья посвящена изучению влияния физических нагрузок на содержание и функциональную активность лимфоцитов в системе периферической крови борцов вольного стиля в динамике тренировочного макроцикла. Из-за воздействия физических нагрузок происходит уменьшение содержания лимфоцитов и снижается их функциональная активность. Эти изменения зависят от интенсивности физических нагрузок; они становятся максимальными в конце соревновательного периода и минимальными в переходный период. Можно предположить, что иммунная система играет существенную роль в адаптации организма к значительным физическим нагрузкам. Результаты проведенного исследования показывают, что особенности клеточного иммунитета формируются у борцов уже на раннем этапе спортивной подготовки. Отчасти это происходит из-за наличия статической патологии, связанной с реакцией на физические нагрузки в рамках тренировочного процесса. Усиленное иммунологическое обследование борцов с оценкой митохондриальной активности популяции лимфоцитов позволяет оценить индивидуальный пороговый уровень физических нагрузок, превышение которых приводит к нарушению иммунного метаболизма. Поэтому включение дополнительного переходного периода в тренировочный макроцикл способствует более полному восстановлению изучаемых показателей.

Ключевые слова: спортивный стресс, физическая нагрузка, адаптация, иммунитет, лимфоциты, функциональная активность, борцы.

Introduction

Several massive studies have shown that professional sports of the highest achievements have a depressing effect on the immune system. It has been determined that the frequency of acute and chronic diseases increases sharply in athletes at the peak of their sports form, which naturally reduces their athletic potential and the ability to achieve the best result. It was revealed that professional athletes, especially during periods of intense training, had an increased sensibility to infectious diseases such as upper respiratory tract infections. The main reason for this sensibility is considered the immunosuppression that is caused by physical loads. The final mechanism for the development of immunosuppression in professional athletes has not yet been elucidated, although it can be assumed that this is caused by the depletion of compensatory mechanisms and the disruption of the adaptation of the immune system (Aghayeva S, Alibekova S., 2015; Alibekova S, Aliyev S., 2017; Alibekova S., 2020a; Alibekova S., 2020b; Sterling Yu., 2007).

The changes occurred in the immune system under the impact of sports stress also has a contribution character, thus enabling to assume that immunological markers are more informative for studying physical loads of lower and moderate intensity (Alibekova S., 2020a; Gavrilin V., 2007; Courneya, K, et al., 2009).

It should be mentioned that before there existed a belief about the beneficial effects of physical culture and sports. It contributes to a decline in morbidity and an increase in life expectancy. Until modern circumstances, information has been accumulated on the ambiguous effect of physical loads during physical education and sports on immunity (Alibekova S., 2020a; Alibekova S., 2020b; Gavrilova E., 2009; Sterling Yu., et al, 2013). The carried-out studies entirely evidence the dependence of the parameters of the body’s immunological reactivity on the volume and intensity of loads. It has been shown that with a moderate amount of physical activity, immunity indicators increase, but the greater the intensity of physical loads, the lower the immunological reactivity of the body may be. At the same time, minimal physical loads in terms of energy consumption leave immunity indicators stable and contributes to a stimulating effect on the immune system. Considering adaptation from the standpoint of immunity, R.S. Suzdalnitsky and V.A. Levando (2003) distinguish four phases of immunological adaptation. In the first phase, called the mobilization phase, the immunological reserves of the body are mobilized in response to low-intensity (heart rate up to 16 bpm) training loads. As the intensity and volume of training loads increase, a compensation phase is noted, in which the physiological protection of the body remains almost at the same level as in the previous phase. According to the data from these authors, the third phase – the phase of decompensation, is observed, as a rule, in the competitive period against the background of high-intensity loads and is characterized by a severe decrease in immunity. After responsible competitions, acting as stress factors, the onset of functional paralysis of the immune system is possible. The fourth phase is observed after a significant reduction in training loads, when the indicators of the immunological and hormonal status are gradually restored (Gavrilova E., 2009; Gunina L., 2013; Khaydukov et al., 2009).

A comprehensive study of humoral factors of general and local immunity is sufficiently informative method for studying the immunological reactivity of a human body under stressful conditions. It is able to promptly identify the discrepancy between the loads presented and the functional capabilities of the immune system and signal a developing breakdown of adaptive mechanisms (Alibekova S., 2020b; Gavrilin V., 2007; Gavrilova E., 2009; Gunina L., 2013; Dichko E., 2013; Musin Z., 2007; Osadchaya O., et al., 2013).

As it is obvious, skeletal muscles have the unique ability to increase oxygen consumption essentially during contraction. These, of course, lead to the intensification of free radical oxidation, the initiation of adaptation and reparation, or, under certain conditions, to the development of inadaptation and functional deficiency. Since the role of free radical processes in the implementation of the influence of physical activity on the body was clarified, a period of intensive study began on the molecular mechanisms of damage to cellular and subcellular structures by free radicals, including reactive oxygen species. Up to nowadays, data have been collected on the significance of the free radical oxidation reaction within physiological processes during physical activity and the participation of the products of these reactions in the development of pathological conditions in athletes (Gavrilin V., 2007; Heint H., 2007).

In normal cases, any response of the body under the influence of stress-causing factors (including during physical loads) can be accompanied by a short-term increase in the number of reactive oxygen species and (Shephard R., 2010) there are two different types of natural oxygen species in the cell: the first are extremely active low molecular weight radicals with a relatively short period of existence – intermediate products of incomplete reduction of the oxygen molecule (superoxide anion radical, nitroxide, semi-ubiquinone), as well as oxygen molecules in the singlet state (nitric oxide, peroxynitrin, hypohalogenites, etc.). The second type includes less destructive and larger radicals, which are formed during the interaction of radicals of the first type with cell biomolecules and have a relatively long lifecycle (for example, hydroxyl radical, lipid radicals). Although the direct determination of the content of reactive oxygen species in living cells is very difficult, because they have a high reactivity and a short half-decay. During the past decade, direct evidence has been obtained regarding an increase in the content of active oxygen both in the mitochondria of the muscle tissue of a healthy untrained person after physical load, and in the blood of qualified athletes immediately after submaximal loads (Gavrilin V., 2007; Sugiura S., 2000).

Intense physical loads also negatively affect the immune resistance of athletes and increases the sickness rate (Alibekova S., 2020b; Walsh N., et al., 2011). Within the framework of sports immunology, the primary spheres of study are the effect of intense muscular activity on the immune system and the development of maintaining the functions of the immune system in athletes (Walsh N., et al., 2011). The study of immunological parameters in athletes at various stages of the annual training cycle undeniably indicates the regularity of the allocation of such a nosology as sports stress immunodeficiency, which belongs to the category of secondary immunodeficiencies (Alibekova S., 2020b). This type of immunodeficiency is fundamentally different from secondary immunodeficiency conditions considered in the clinical practice of internal diseases due to the peculiarities of pathogenesis and clinical and laboratory manifestations. It is characterized by a numerous recorded changes in all parts of the immune system, profound metabolic changes and a pronounced imbalance of the neuroendocrine system (Suzdalnitsky R., 2003). A high level of metabolic processes against the background of physical exertion leads to stress on the immune system in the process of removing a large amount of decay products resulting from redox reactions. The intensification of metabolism in the immunocompetent cells themselves leads to disruption of the formation and accelerated disintegration of directly immune structures, which leads to dysregulation of the immune system. At the same time, it is necessary to remember that there are certain genetic determinants that determine the individual threshold level of physical activity for the athlete's body, the excess of which leads to metabolic and immune disturbances (Alibekova S., 2020b; Dychko E., et al., 2012; Musin Z., 2007; Osadchaya O., et al., 2013). In other words, sports activity serves as the background, where the insolvency of the immune system is revealed, which is largely associated with genetic or acquired reduction in stress resistance.

The modern training process and competitive activity of athletes are associated with a high volume and level of physical loads that exceed the limit of functional capabilities of a body. In this regard, certain relevant and actual issues arise such as increasing the functional reserves of the body, contributing to an increase in the duration or intensity of physical loads, without exhausting these possibilities to the limit.

The objective of the study is to study the effect of sports stress on the immune status of athletes involved in freestyle wrestling.

Materials and methods

The work summarizes the results of an immunological examination of 16 wrestlers aged 19-20 years old (average age 19.5 years) with 1-2 mass categories. The training macrocycle included four periods: 1st – precompetitive, lasting 3 months, with a frequency of training 3 times a week for 2 hours. each; 2nd – competitive, lasting 2-3 days, with the number of sparring 2-6 for the entire duration of the competition; 3rd – transition period, lasting 10 days with light training 2 times a week, 4th – additional transitional period with light training 2 times a week. The control group consisted of 10 practically healthy untrained individuals aged 19-20 years. The study was performed in compliance with all the provisions of bioethics. Blood sampling for research was carried out at the beginning and at the end of each period (in the first hour after exercise). To accomplish the task, hematological methods were used: the determination of the absolute and relative number of lymphocytes in peripheral blood was determined on an automatic analyzer (MEK 8222, Japan), their quantitative and qualitative characteristics (microlymphotoxic method with monoclinal antibodies NPO Med-Bio-Spect, Moscow). Whole blood stabilized with EDTA (Ethylenediaminetetraacetic acid). Lymphocytes were isolated on a ficoll-verografin density gradient according to a modified Boyum method. The leukocyte formula was determined by direct counting of cellular elements in a thin smear stained according to the May-Grunwald-Romanovsky method. The cellular link of immunity was studied using flow cymoflumetry on a Facs Calibur analyzer (Becton Dickinson, USA). Determination of the main subpopulations of lymphocytes (CD3+ (mature T-lymphocytes), CD4+ (T-helpers / inducers), CD8+ (T-suppressors) (using a set of four-color direct monoclinal antibodies Multi Test IMK (Becton Dickinson, USA). Multiset program (Becton Dickinson, USA).

Results and their discussion

Based on the outcomes of conducted studies, it was established that the level of general health of the examined wrestlers was satisfactory. All subjects trained according to a single plan, however, the degree of adaptation to this load was different. It is worth to mention that all participants in the study at the time of the survey had a specialized sports experience of at least four years. The participants were divided into two groups: experimental (group I) and control (group II). These groups varied based on the extent of adaptation to physical loads. The average share of work in the second and third pulse zones was 11.3% in the experimental group with high adaptation and 23.1% in the control group with low adaptation, and the Maximum Oxygen Consumption (VO2 max) was 49.7 ml O_2/kg/min. and 45.4 ml O_2/kg/min., respectively. No statistically significant differences were found between the groups in terms of other morpho-physiological parameters (Table 1).

Table 1 – The effect of training process on morpho-functional characteristics of the wrestlers of the control and experimental groups (M±m)

Groups / Indicators	Control		Experimental	
	At the beginning of cycle	At the end of cycle	At the beginning of cycle	At the end of cycle
1	2	3	4	5
Age, years	18.5±3.4	19.0±1.3	18.5±2.4	19.4±3.0
Height, cm	178.5±1.8	180.5±2.0	181.2±1.7	183.1±2.2 *
Resting heart rate, bpm	70.6±1.2	74.4±1.2	68.0±1.4	75.0±1.1*

1	2	3	4	5
Heart rate Anaerobic threshold, bpm	172.0±0.7	180.0±0.9	174.0±0.7	180.0±0.6*
Heart rate max, bpm	182.0±0.50	200.3±0.52**	192.0±0.40	196.0±0.52*
Maximum oxygen consumption (VO_2 max), O_2/kg/min	44.5±0.8	46.8±0.85	47.0±0.82	58.0±0.79**
Blood oxygen level (saturation), %	98,0	99,0	98,5	99,5
Proportion of muscle tissue, %	51.6±3.1	52.7±2.40**	53.5±2.55	57.0±2.48**
Proportion of adipose tissue, %	12.3±2.7	19.6±2.75*	11.5±2.70	14.5±2.90*
Mass, kg	65.5±0.9	69.6±1.2	68.5±1.0	72.6±1.3*
Note: difference between the groups * – p<0,05, ** – p<0,001				

Based on anthropometric data, mass proportion of adipose tissue and muscle tissue was calculated. In experimental group, after intense training loads, the mass proportion of muscle tissue was significantly higher than in control group with lower resistance of training loads 52.15% (51.6-52.7) and 55.25% (53.5-57.0), respectively. The proportion of adipose tissue was to the certain extent higher in control group and constituted 15.90% (12.3-19.6), while this indicator was 13.0% (11.5-14.5) in experimental group. However, the given differences were not so essential from the statistical perspective.

The values for the main hematological indicators: the concentration of hemoglobin, the number of red blood cells, reticulocytes and platelets, as well as the level of hemotocrite practically did not varied in the group of athletes and persons of the control group who were not actively engaged in sport. There was no expression of those values both as a response to the training and for the duration of training cycle (Table 2).

Table 2 – The effect of training process on the main indicators in the blood (g/l) of wrestlers from control and experimental groups (M±m)

Groups / Indicators	Control		Experimental	
	At the beginning of cycle	At the end of cycle	At the beginning of cycle	At the end of cycle
Hemoglobin, g/l	154.6±0,6	165.0±0,05	152.0±0,07	164.2±0,08
RBC (red blood cells), 10^{12} cells/l	4.98±0,08	5.35±0,05	4.88±0,007	5.45±0,08
Reticulocytes, %	4.0±0,2	7.0±0,3	3.5±0,2	5.2±0,6
Thrombocytes (platelets), 10^9/l	245.0±0,02	333.0±0,03	235.0±0,07	318.0±0,04
Hemacotrites, %	46.0±0,09	48.3±0,013	44.8±0,018	48.9±0,025
Average hemoglobin concentration in 1 red blood cell, kg	31.4±0,03	32.7±0,0035	30.3±0,045	31.5±0,018

Immunological history (Anamnesis morbi) was obtained by the method of interviewing athletes. The frequency of cold diseases in experimented athletes ranged to 2-3 cases per year. There were no signs of colds observed for any of the athletes at the time of study. According to anamnesis data, the body temperature during colds ranged from 37 to 39°C (based on information from the experimented individuals). There were no statistically significant differences between groups on this basis.

The anamnesis data is confirmed by laboratory information (Table 3). In the first group, the level of total Ig E in the blood serum of athletes ranged from 159.3 to 536.7 IU/ml. All experimented athletes from this group had an increased level of total Ig E. There were no such experimented athletes in the second group, and the level of Ig E ranged from 12.0 to 95.4 IU/ml. The group of athletes with varying resistance of training loads significantly differed in the level of Ig E (p=0.016). As a response to the training load, no changes in the level of Ig E in the blood serum of athletes were observed. During the observation period, no expressed dynamics of the Ig E level was recorded in any athlete.

Table 3 – The effect of training cycle on the immune system of wrestlers from control and experimental groups (M±m)

Groups / Indicators	Control		Experimental	
	Until loads, n=5	After loads, n=5	Until loads, n=6	After loads, n=6
General Ig G, g/l	8,70±2.1	13,50±2.4*	13,60±2.6	15,77±2.8*
General Ig A, g/l	1,72±0.70	2,13±0.6	2,53±0.7	3,64±0.62
General Ig M, g/l	0,94±0.54	2,80±0.50	1,09±0.01	1,51±0.70
General Ig E, IU/ml	12,35±6.4	72,97±6.00*	201,00±7.0	443,90±7.1*
C_3 component, g/l	0,49±0.11	1,84±0.13	0,62±0.10	1,69±0.18
C_4 component, g/l	0,19±0.08	0,33±0.07	0,22±0.04	0,30±0.13
Note: difference between the groups * – p<0,05, ** – p<0,001				

As it is obvious from the Table 3, under the impact of physical loads on the human immune system, the number of leukocytes increases, but their functional activity is tangibly reduced, the antigen – the presenting ability of macrophages is suppressed, depression of natural cells is observed, the number of T-lymphocytes decreases, the proliferative response of lymphocytes to T-mitogens is suppressed, and immunoglobulins disappear from blood or saliva during competition. The stress response during physical loads is realized through the sympatho-adrenal and hypothalamic-pituitary-adrenocortical system, which leads to an increase in the level of catecholamines and glucocorticoids. It is worth to mention that volume and intensive training have a powerful effect on the hormonal system. After such loads in the blood, there is a decrease in testosterone and other hormones involved in anabolic processes, and this is reflected in the immunological reactivity of especially young athletes. The physiological and biochemical processes that occur in the muscles during work should be necessarily tracked to understand the causes that affect the human immune system during physical loads.

Consequently, the study outcomes (Table 4) showed that the level of lymphocytes in the examined athletes before physical loads was 20.00±0.45%. After applying heavy loads, the content of peripheral blood lymphocytes was studied and this indicator increased by 24.05 ± 0.25%, which corresponds to the criteria for an adaptive training response.

General concentration of leukocytes in the blood of athletes was 19% lower ($p < 0,05$) than in control group (5,88±0,15 and 7,26±0,28, respectively). The content of lymphocytes and neutrophils in percentage is 11% higher ($p<0.05$); the increased content of monocytes in the blood of athletes makes us to pay attention on it: there are 43% ($p<0.01$) more of these cells with a nonspecific response. It was also fixed in the study that the immune system indicators do not change in athletes before performing heavy loads, and this is consistent with the data of some authors, indicating that in most cases the state of the immune system does not have any changes in athletes. Therefore, some authors consider that sports immunology is the immunology of a healthy person under conditions of essential sports loads (Yasko V, et al., 2012; Nieaman D., 2010).

Thus, the analysis of the obtained results shows that the assessment of the state of the immune system under the influence of physical activity should be carried out considering many factors, especially the type and direction of physical loads.

Table 4 – The dynamics of indicators for functional state of blood leukocytes in the wrestlers of control and experimental groups in the various periods of training process (M±m)

Indicators	Control group	Experimental group
1	2	3
	Preparatory period	
Leukocytes, g/l	6,20±0,15	7,26±0,28
Lymphocytes, g/l	1,54±0,08	1,21±0,30
Monocytes, g/l	0,30±0,07	0,42±0,25
Neutrophils, g/l	4,1±0,04	4,55±0,29
	Competition period	

1	2	3
Leukocytes, g/l	5,80±0,16	5,38±0,18
Lymphocytes, g/l	1,72±0,07	1,65±0,24
Monocytes, g/l	0,70±0,06	0,24±0,23
Neutrophils, g/l	4,60±0,05	4,25±0,30
	Transition period	
Leukocytes, g/l	6,10±0,18	5,80±0,24
Lymphocytes, g/l	1,40±0,09	1,30±0,26
Monocytes, g/l	0,25±0,07	0,16±0,26
Neutrophils, g/l	4,4±0,08	3,10±0,18
Note: difference between the groups * – p<0,05, ** – p<0,001		

While being directed towards the classification of development of sportive stressor immune-deficit proposed by R. Shefgard (2010), we may state that the study conducted at the basic stage of the training process corresponded to the phase of mobilization or the phase of compensation for the response of the immune system. As the literature data shows (Pershin B, et al., 2002), these phases are characterized by a dissociation syndrome, in which, against the background of regular physical loads of medium or high intensity, some immunological indicators increase against the background of a decrease in others, and in the compensation phase, the number of reduced indicators exceeds the number compensatory increases. It is worth to mention that changes in the cellular link of the immune system in different age groups are varying at all. For younger athletes, regardless of the presence of hotspots (foci) of chronic infection, a significant decrease in the number of cells in the population is typical. In the older age group, hotspots of chronic infection show a significant increase in the number of regulatory T-lymphocytes compared with clinically healthy peers. In athletes of the older age group, changes in the parameters of the immune system are more typical for highly qualified athletes at the basic stage of the training cycle and are accompanied by activation of the effector link of cellular immunity, especially at the site of chronic infection and functional impairment of the cardiovascular system in the form of a violation of myocardial repolarization processes. In adult athletes, an increase in mitochondrial cell activity witnesses their functional activation and may be a compensatory response of T-lymphocytes to regulatory T-lymphocytes. An increase in the mitochondrial activity of cells indicates their functional activation and may be a compensatory reaction of minor populations, which mainly carry out regulatory functions, in response to the syndrome of dissociation of the main lymphocytic populations. The evaluation of cumulative data obtained in the course of studies shows that, certain symptoms of latent immunodeficiency are developed in young athletes already in the early stages of professional sports training. They are in the form of inhibition of the effective link of cellular immunity with compensatory activation of a number of minor populations of lymphocytes in athletes with hotspots of chronic infection. In athletes of the older age group at the basic stage of the training cycle, changes in the parameters of the immune system are already more typical for highly qualified athletes and are accompanied by the activation of an effective link of cellular immunity, especially against the background of foci of chronic infection and functional disturbances of the cardiovascular system. Detailed changes occurred in the parameters of the immune system require closer attention from sports doctors, because they are a risk factor for the pathological transformation of the “sports heart” in young ages (Alibekova S., 2020b; Gavrilova E., 2009; Gunina L., 2013, Dychko E., et al., 2012; Heint H., 2007; West N., 2008).

Conclusion

We should highlight this fact as well, that an extended immunological examination of young athletes with an assessment of the mitochondrial activity of lymphocyte populations allows us to assess the individual threshold level of physical loads, the excess of which leads to metabolic and immune disorders. The indicators of the immune system can go beyond the physiological boundaries and be pathological, if they are under the impact of high intense physical loads; it may cause an increase in morbidity and a decrease in sports performance. However, although we have this information about immune changes, it can hardly be argued that their nature and significance have not been adequately studied.

Thus, it was established that when exposed to the effect of physical loads, the functional activity of peripheral blood lymphocytes of athletes becomes lesser, which is expressed in a decrease in sports secretion of IL-2, IL-6, IL-10, as well as in a decline in the cytotoxic activity of CD16+ cells. Changes in the secretory and cytotoxic activity of lymphocytes depend on the intensity of physical loads. They are moderate in the pre-competitive period, and the largest – in the competitive period; in the transitional period of the training process, the changes become decreasing. The inclusion of an additional transitional period in the training process contributes to the complete normalization of the functional activity of lymphocytes. It has been established that in the pre-competitive and competitive period of the training macrocycle, the absolute content of CD3+, CD4+, CD8+ lymphocytes in the peripheral blood of wrestlers decreases with the formation of a relative hypersuppressive variant of the immunodeficiency situation, under the effect of physical load. Immune disturbances are assessed as moderate in the pre-competitive period and as the greatest – in the competitive period. In the transitional period, there is no complete normalization of the parameters of the subpopulation composition of lymphocytes. The inclusion of an additional transitional period in the training macrocycle enables to make to a more complete recovery of the studied indicators.

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