

IMMUNITY OF SWIMMERS IN THE CONDITIONS OF MODERN TRAINING

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ABSTRACT

Practical interest is the problem of tracing the stability of the detected changes in immunological reactivity during training cycles with different intensity and volume of loads.

Keywords: immunity, swimmers, load, conditions, training, stability.

INTRODUCTION

For successful management of the training process, the trainer must have the most complete volume of objective information about the functional state of the athlete's body. In recent years, the practice of sports medicine has begun to include methods for studying the immune system, which carries out one of the main functions in the body - providing homeostasis, which consists in maintaining the constancy of the cellular composition of the body. It is the disorders of the immune system that form the basis for the increase in morbidity observed in athletes during the period of important competitions (E. Jokl).

The body's immune system is a specialized system of cells, tissues and organs that performs the function of protecting the body, including against a number of pathogens. A cell specific to the immune system is a lymphocyte. There are two types of immunocompetent blood cells: T- and B-lymphocytes. T-lymphocytes carry out the processes of cellular immunity, B - humoral (they form antibodies that neutralize any foreign and atypical substances and cells that fall into their sphere of action). These two types of blood cells, interacting, play the role of guardians of the constancy of the internal environment. The most important function in immune responses belongs to T-lymphocytes. From beginning to end, they carry out a cellular immune response, are able to regulate the function of B-lymphocytes in the formation of antibodies, acting as assistants or as suppressors (cells that suppress the production of antibodies), regulating the strength of the response.

When studying the human immunity system, both quantitative and qualitative (functional) criteria should be used. The assessment of the immune status can be carried out both at the level of the organism (in vivo) and outside it - in a test tube (in

vitro). In the second case, biological fluids (blood serum, saliva, etc.) or blood lymphocytes are obtained from the subject, and the assessment is carried out outside the body. Immunological reactivity is determined by analyzing complex parameters of humoral (B-link) and cellular (T-link) immunity.

It is known that changes in the immunity of athletes are due to the specifics of their activities: a combination of great physical and emotional stress. Emotional tensions are most characteristic of competitive activity. In a number of special works, changes in the immunological reactivity of the organism of athletes under the influence of the loads of the competitive period have been shown (I.D.Surkina). The parameters of immunity and the mechanisms of its regulation were studied. In other works, significant inhibition of T-lymphocytes under the influence of a single large physical activity was found on the example of a marathon run (I. Eskola). It is characteristic that the ECGs recorded simultaneously with the indicators of immunity, as well as the acid-base balance (ACER) of capillary blood did not reflect any changes that would indicate a significant violation of the current functional state in connection with the previous training. Consequently, it takes more time to restore the indicators of immunological reactivity after a training load than to restore the indicators of energy supply and the functional state of organs and a number of physiological systems.

Of practical interest is the task of tracing the stability of the detected changes in immunological reactivity during training cycles with different intensity and volume of loads, since it is known that disorders of immune responses can gain a foothold with frequent repetition of stress loads and an insufficient recovery period (G.V. Polesya, A.A. . Gaevsky).

In the available literature, we could not find works that would talk about the state of the immune system in swimmers with different construction of the training process. High-class swimmers currently train 2 - 3 times a day, spending 5 - 7 hours daily in the aquatic environment. They also do a lot of work in the gym to develop strength, flexibility and other special qualities. It seems relevant to conduct a study of the immune status of swimmers, since they have a high percentage of exacerbation of chronic and acute inflammatory diseases of the ENT organs, as well as cases of repeated furunculosis. A possible cause of this pathology may be a violation of immunological reactivity.

METHODOLOGY

In connection with the above, we set the following tasks in our work:

to investigate the dependence of the indicators of the immunity system on the construction of the training process;

to find out the influence of large training loads on the immunological reactivity of the swimmers' organism and the nature of the recovery processes of immune reactions;

to determine the degree of influence of the competition on the immune status of the organism.

We examined 14 highly qualified swimmers (master of sports and master of sports of international class) at the age of 15-21. Their swimming experience is from 5 to 12 years. The subjects were specialized in swimming in different ways for different distances. A preliminary medical examination revealed that 5 athletes suffered from frequent recurrent diseases of the ENT organs, 2 others had pyoderma and recurrent furunculosis in the anamnesis, 6 people were found to have a state of hypertension, indicating an unfavorable course of recovery processes.

At the first stage of the study, the parameters of immunity were determined during the period of intense training at the end of the preparatory period (the volume of swimming reached 60 - 100 km per week) by the method of "double testing", that is, twice during the microcycle - after a day with a load close to the maximum ("Testing") and after a day of rest, completing the microcycle. This made it possible to determine the acute influence of the load, the range of reactions of the immune system, the possibility of its restoration in this period of training. In addition to the "testing" training, during the 6x200 m test (or 4x400 m for long distance runners), performance was assessed based on a number of physiological indicators: after each segment, the heart rate was determined, before and after the test, lactate and capillary blood acid baseline ratio were determined. This test was also carried out in the second phase of the research.

The second stage corresponded to the period of decreasing training loads, since the athletes participated in a series of competitions that ended with the winter championship. A repeated study of the effect of the "testing" training load on immunity, which was close to the first in structure, was carried out a week after the championship, in a microcycle, in which the volume of swimming decreased to 30 - 70 km. In this microcycle, the volume of training loads passed in the III, IV and V zones of intensity was almost the same as in the microcycle, during which the primary examination of the immune status took place. A decrease in the total volume of training loads was mainly achieved due to a decrease in the loads passed in the I and II zones of intensity (according to M.A.Vorobyeva).

Comparison of the parameters of immunity obtained at the first and second stages of the study helped to study the dependence of the immunological reactivity of the swimmers' organism on the construction of the training process. 7 swimmers were examined the day after the end of the national championship, which made it possible to determine the degree of influence of the competition on the immune status of the organism.

RESULTS AND DISCUSSION

The study of the immune system was carried out within the framework of a program developed by experts from the World Health Organization. The quantitative composition and functional activity of blood T and B lymphocytes were studied.

Metabolic indices were also studied - acid-base balance, urea and capillary blood lactate. They were determined immediately before and after exercise, as well as the next morning in order to assess the degree of restoration of metabolic processes.

At the first stage of the study, on the morning after a day with a “testing” training load close to the limit in terms of impact, there was a decrease below normal in the quantitative composition of T-lymphocytes ($61.4 \pm 10.9\%$ at a norm of $72.0 \pm 3,6\%$, according to ZS Orlova), and their functional activity (Table 1).

Table 1

The influence of training and competitive loads on the content and functional activity of peripheral blood T-lymphocytes in swimmers (average data)

Research stages	Research conditions	T cell content, % $M \pm \sigma$	Indicators of functional activity, imp / min, $M \pm \sigma$
First*	After loading	61,4±10,9	39950±7400
	After a day of rest	65,1±11,1	51850±14900
Second	After loading	61,6±11,4	69400±14950
	After the competition	37,7±14,4	—
Healthy non-sports individuals (at rest)		72,0±3,6	50,000 - 70,000 and above

Changes in acid-base balance, urea and lactate in capillary blood were assessed as moderate (Table 2).

Table 2

**Influence of training and competitive loads on metabolic indices in swimmers
 (average data)**

Research stage	Research conditions	Lactate ml mol / l $M \pm \sigma$	Urea, mg %, $M \pm \sigma$	BE, meq / l $M \pm \sigma$	pH $M \pm \sigma$	pCO ₂ , мм рт. ст. $M \pm \sigma$	pO ₂ , мм рт. ст. $M \pm \sigma$
First*	After loading	4,1±1,1	39,2±7,4	-6,1±3,9	7,27±0,03	44,1±8,3	69,0±14,5
	After a day of rest	2,5±0,7	30,1±3,7	-3,4±1,7	7,35±0,04	41,5±4,2	75,4±8,2
Second	After loading	2,1±0,4	38,4±5,0	-4,0±1,0	7,32±0,02	42,7±2,8	84,8±13,2
	After the competition	—	—	-4,2±1,8	7,32±0,03	43,1±4,3	92,3±6,5

At the end of this microcycle, after a day of rest, the majority of athletes experienced an almost complete restoration of metabolic processes according to the data of acid-base balance, lactate and urea. It was incomplete in only 6 people. This was evidenced by the state of hypertension found in these athletes.

At the same time, significant deviations were noted on the part of the parameters of the immune system. In almost all the examined subjects, the number of T-lymphocytes, although slightly increased (up to 65.1 ± 11.1), compared with the values obtained after a day with the “testing” load, was lower than normal. The functional activity of T-cells also increased (up to 51850 ± 14900 cpm), reaching only the lower limit of the norm.

Consequently, after a day of rest, completing the microcycle, there was no full recovery of the body. This was expressed to the greatest extent in changing the parameters of the immune system. It should be emphasized that both studies were conducted during periods of high training loads.

The parameters of the immunological status were characterized by a significant individualization of reactions. According to the state of the immune system against the background of intense training, it was possible to divide the subjects into 2 groups: I athletes with moderately severe disorders, mainly identified only after intense training; II - athletes with significant disorders of the immune status, identified both after a day with a large training load, and after a day of rest.

Over the next three weeks, the subjects participated in competitions. Analysis of the performance of swimmers in this series of competitions, which ended with the USSR - GDR match (after the end of the research), showed that out of 8 athletes assigned to group I (i.e., with less pronounced changes in immunity), 6 people improved in subsequent starts personal achievements, and 2 showed previous results. Out of 6 swimmers with more pronounced disorders of the immune status, 4

performed below their capabilities and only 1 set a personal record. This allowed us to assume that the parameters of the immune system are one of the indicators of the functional state of the body, which determines its performance.

A repeated study of the immunological reactivity of the organism in swimmers after the "testing" training load was carried out a week after the end of the USSR Championship - in the period of a significant decrease in training loads. The reaction of the body in athletes to the repeated test of 6x200 m (or 4x400 m for long distance runners) in terms of metabolism was more economical than during the initial examination (with a similar average speed of swimming of the segments). The degree of recovery of metabolic parameters the next morning after repeated near-limiting training load was also higher than after the first test (Table 2).

Parameters of immunological reactivity also correlated with metabolic parameters. Repeated training with a near-limit load had a significantly less depressing effect on the body's immune system compared to the effect of the first, which was mainly expressed in an increase in the proliferative capacity of T-lymphocytes (see Table 1). For the majority of the surveyed, its values reached the average values for healthy individuals who do not go in for sports.

Of particular interest was the task of determining the direct effect of competition on the indices of immunological reactivity. We examined 7 swimmers the morning after the end of the championship.

All subjects for 5 days of competition started 5 - 8 times in individual heats and relay races. Despite the fact that the energy cost of competitive stresses was significantly lower than with 2 - 3 daily trainings, the inhibition of immunological reactivity under the influence of competition was most pronounced. This was noted even when comparing with the data obtained after the "testing" training load against the background of significant physical exertion (Table 1). The emotional factor played an undoubted role here, since all athletes attached great importance to the results of their performance in these competitions.

All the changes in the immune status described above at different stages of the examination were related to the T-system of immunity. As for the parameters of the B-system of immunity, we did not find significant differences in either the quantitative composition of B-lymphocytes, or their functional activity.

It is known from the literature that changes in immunity are based on overstrain of regulatory mechanisms under stress. According to G. Selye's definition, a stressor is any strong stimulus, the effect of which is accompanied by a certain complex of neuro-humoral hormonal reactions. According to modern concepts,

reactions of this type contribute to an increase in the body's resistance, its adaptability to the effects of adverse environmental factors. However, if the intensity of the stress impact exceeds the adaptive capabilities of the organism, the regulation processes are disrupted and adaptation is disrupted. Excessively frequent and intense psychoemotional and physical loads, which are of the nature of extreme influences, in conditions of irrational training planning and insufficient recovery, also lead to similar disorders. One of their manifestations is changes in immunological reactivity.

The data we obtained on the suppression of the T-system of immunity under the influence of high physical activity and incomplete restoration of the immune status after a day of rest suggest that the construction of the training process at the final stage of the preparatory period did not correspond to the functional capabilities of the organism of the athletes we examined: the loads exceeded them, and the restitution period was insufficient. This is confirmed by the data obtained at the second stage of the survey, when the same "testing" training, but carried out in the period of relative decrease in training loads, did not cause such a significant impairment of immunity. Metabolism indices studied in parallel testified to a more favorable functional state of the organism at this stage. Apparently, under these conditions, the "testing" training was adequate to the functional capabilities of the athletes.

Consequently, to maintain the normal immunological reactivity of the body of athletes, not only the intensity of the impact of a single training load is important, but also the construction of the training process as a whole.

When comparing the indicators of metabolism and parameters of immunity, determined the next morning after a day with a near-limit load, it was found that it took more time to restore immune responses compared to metabolic processes.

Even more pronounced changes in the immune status were found the next day after the end of the competition, which is apparently due to the combined effect of physical and emotional stress on the T-system of the immune system. The state of the sympatho-adrenal system plays a special role in this. Shifts from this system serve as one of the most informative criteria for emotional stress accompanying the performance of athletes in competitions (S.A. Razumov).

The accumulation of stressful effects of large physical exertion, their aggravation when combined with emotional stress are accompanied by the emergence of a complex of changes in immune reactivity, which leads to a decrease in the body's resistance to pathogenic factors and, ultimately, to diseases.

CONCLUSIONS

Based on the foregoing, the following conclusions can be drawn:

1. Changes in immunological reactivity are the cornerstone of morbidity observed in highly qualified swimmers.
2. Physical activity of large volume and intensity causes a decrease in functional activity and the total number of T-lymphocytes in peripheral blood. Indicators of the B-system of immunity at the same time remain within normal limits.
3. Immune reactions are restored later than the processes of energy metabolism. This must be taken into account when planning training loads.
4. The combination of physical and emotional stress during the competition causes the most significant violations of immunological reactivity, which requires special measures to restore it.
5. The methodology of building the training process is one of the main factors on which the immune status of the body of athletes depends. This is manifested both in the response of the immune system to a single near-limiting load, and in the restoration of immunity parameters.
6. Correct planning of training sessions in a one-year cycle with the use of loads adequate to the individual functional capabilities of athletes, and optimization of recovery processes will prevent immunity disorders and thereby reduce morbidity in athletes. The control of the immune status of the body of swimmers at various stages of training can be used as an informative method in controlling the training process.

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