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Original Article

Changes in cellular immunity indicators in men who did not engage in exercising before the start of the study, and among basketball athletes of the level of higher sports achievements under the influence of systematic exercises in power fitness.

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Abstract:
Changes in the number and ratio of various subclasses of T-lymphocytes under the influence of moderate systematic physical activity were studied in people with different physical fitness. Participants in groups 1 and 2 who voluntarily participated in this study were randomized by age and gender. Volunteers included in groups 3 and 4 were selected for research among elite basketball athletes at the level of the highest sports achievements. Participants of groups 2 and 4 underwent training according to the proposed method of power fitness. An increase in the number of T-helpers in the blood of athletes was found, as well as an improvement in the calculated indicator - the immunoregulatory index under the influence of systematic moderate physical exertion.
Key words: immune resistance, T-lymphocytes, physical activity, immunoregulatory index.

Introduction.

Indicators of the immune resistance of athletes are fairly well researched and continue to be studied on the examples of various sports (Brown, Bigley,Ross,LaVoy, Simpson, & Galloway, 2015;Gałązka-Franta, Jura-Szołtys, Smółka,&Gawlik,2016). The modern scientific literature highlights the indicators of humoral and cellular immunity of athletes at rest and during training and competitive activities (Mackinnon, Chick, Van As &Tomasi,1987;Minuzzi, Rama, Bishop, Rosado, Martinho, Paiva, & Teixeira,2017). Less studied are the indicators of immune resistance of people who did not engage in exercising. Little attention is paid to young healthy men who are not involved in exercising, and changes in immunity in this category of people are not predicted if they increase the level of physical activity. And in what way indicators of immune resistance can change with a change in their physical activity. Questions remain open about whether it is possible to increase immune resistance in those people who have not been involved in sports before. At the same time, applying a load that is affordable for them.

It has not yet been established what level of load can be recommended to this large category of people. Of practical interest is also the question of how long it takes to train to achieve a positive result from immune resistance and how long this effect can persist (Morgado, Matias, Monteiro, Alves, Reis,Santos,Laires, 2017).

It is known that people who systematically engage in exercising have a more pronounced resistance to various infectious diseases (Khodaee, Grothe,Seyfert, &VanBaak, 2016).

So, in particular, athletes are less susceptible to the incidence of viral infections in the cold season, less likely to suffer from severe forms of respiratory viral infections and influenza. Sick athletes tolerate viral infectious diseases in a milder form and recover within fewer days (Gałązka-Franta,Jura-Szołtys, Smółka&Gawlik, 2016;Peake, Neubauer, Walsh, & Simpson, 2017).

The mechanisms of increasing immune resistance during systematic exercising are being intensively studied at present. It remains unknown whether it is possible to increase a person's immune resistance through physical exercise in a short time. For this, the content of various classes of T-lymphocytes was studied in athletes and people who, before the study, did not engage in exercising under the influence of physical activity.

In our study, an attempt was made to find out how the indicators of cellular immunity of blood change in people with different physical fitness as a result of systematic exercises in power fitness. To achieve the goal, the author's method of power fitness was used by O. Yu. Goncharenko, which allows both athletes and people who were not involved in exercising before the study to be adapted to physical activity (Goncharenko, 2018).

The aim of the study was to change the number of different classes of blood T-lymphocytes in people with different physical fitness as a result of regular training.

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Material and methods

Participants

Four groups of male volunteers aged 22 to 34 years participated in the study. Participants in groups 1 and 2 who voluntarily participated in this study were randomized by age and gender, but differed in changes in physical activity during the study period. So, the participants of group 1 did not train according to the proposed methodology, while the participants of group 2 regularly trained during the study period. Thus, the physical activity of group 1 volunteers (n = 30) remained unchanged during the study, and the physical activity of group 2 volunteers (n = 25) increased significantly.

Volunteers included in groups 3 and 4 were selected for research among elite basketball athletes at the level of the highest sports achievements. All participants of groups 3 and 4 were examined at the end of the training-competitive season before the holidays and after two months of vacation during which the participants of group 4 underwent training according to the proposed method of power fitness. That is, the participants in the first group made up the control group in relation to the second group, and the participants in group 3 - to the fourth group.

Procedure and test protocol

All subjects underwent blood tests to take into account the number of different subclasses of T-lymphocytes to assess the dynamics of the indicators as a result of training. All participants were examined before training, as well as after the completion of a two-month training course.

Results

As a result of the studies, it was found that before the start of training according to the proposed methodology, groups 1 and 2 as well as groups 3 and 4 did not differ significantly among all the studied indicators (table 1). This position confirms the uniformity of the indicators of immune resistance among the examined individuals, did not engage in exercising, as well as among athletes examined in standardized conditions before the start of power fitness.

Table 1. Indicators of blood lymphocyte subpopulations in athletes and volunteers were not engaged in exercising before the start of power training (%).

Indicator	Group 1	Group 2	Group 3	Group 4
T-lymphocytes	44,16±0,74	45,81±0,98	41,28±1,06	39,90±0,94*
T-helpers	27,02±1,89	26,22±2,09	**19,88±1,27**	**19,31±0,81**♯
T-suppressors	**20,44±0,86**	**19,59±1,15**	21,65±0,85	20,59±0,97
immunoregulatoryindex	1,32± 0,08	1,33 ± 0,13	**0,91± 0,18**	**0,93 ± 0,06**♯

Notes: ∗ - differences are significantin comparison with group 2, p≤0.05;♯ - the differences are significantcompared with group 2, p≤0.01.

However, a comparison of the lymphocyte counts and their individual subclasses in young healthy men who did not go in for sports before the start of the study with similar indicators in elite basketball athletes showed significant differences. For example, the total content of T-lymphocytes in the blood of elite athletes before starting training using the proposed power fitness method was significantly lower than that of young men who had not been involved in sports earlier by 14.8% (p <0.05). The content of helper T-lymphocytes in the blood was reduced in athletes in relation to a group of young people who did not engage in sports before the start of the study by 35.8% (p <0.01). Differences in the indicator of the immunoregulatory index in athletes relative to healthy young men who were not involved in sports were also revealed: this indicator turned out to be lower by 43% among athletes (p≤0.01). That is, athletes have more pronounced inhibition functions of cellular immunity, and in men with low physical activity - stimulation of cellular immunity (see Table 1).

Differences in the concentration of lymphocytes of various subclasses between healthy young people who did not go in for sports and athletes were noted by various research groups. So, for example, V.Dopsaj et al, as and D. T.Brunelli et al, argued that exhausting physical activity leads to inhibition of cellular immune responses and even contribute to the development of infectious and inflammatory diseases in athletes (Dopsaj, Martinovic, Dopsaj,Kasum,Kotur-Stevuljevic, &Koropanovski, 2013; Brunelli, Rodrigues, Lopes, Gáspari,Bonganha,Montagner&Cavaglieri,2014). The end of the training and competition season for basketball athletes at the level of the highest sports achievements, of course, can be considered as an exhausting and difficult period of sports activity. Research results are also known that show the traumatic effect of one-time heavy physical exertion on lymphocytic reactions (Minuzzi, Rama, Bishop, Rosado, Martinho, Paiva, & Teixeira,2017).

In our study, the lymphocyte counts, as well as the immunoregulatory index in young healthy men of groups 1 and 2 were quite normal.The content of blood lymphocytes in athletes at the end of the training-competitive period was slightly lower than the normative indicator. The immunoregulatory index in athletes of

groups 3 and 4 was also below normal. This may indicate a decrease in T-helpers more expressively than T-suppressors. However, the results of the examination of all participants in our study do not allow us to unambiguously judge the positive or negative effect of sports loads, as well as the lack of physical activity on cellular immunity. All study participants, both athletes and young men who did not engage in sports, remained clinically healthy at the time of the examination. That is, we can accept the obtained indicators as normal for these two different categories of subjects.

2 months after the start of systematic training according to the proposed method of power fitness, in which volunteers of groups 2 and 4 took part, all participants in the study were examined again. The indices of the content of various subclasses of T-lymphocytes changed during the two-month training period in all subjects (table 2). In group 1, young healthy men who did not go in for sports all the identified changes were of a trending nature and were not reliable compared to the initial indicators. In group 2, young men who trained, whose sports activity began during the study period and lasted 2 months, changes in various subclasses of T-lymphocytes also did not become significantly. Only trends were noted.

Table 2. Changes in the parameters of blood lymphocyte subpopulations in athletes and volunteers, who had not been involved in exercising before under the influence of power training(%).

Indicator		**Group 1**	**Group 2**	**Group 3**	**Group 4**
T-lymphocytes	Beforetraining	44,16±0,74	45,81±0,98	41,28±1,06	39,90±0,94 *
	Aftertraining	43,38±1,24	**47,00±1,04**	42,79±1,18	**44,18±1,02** ¥*
T-helpers	Beforetraining	27,02±1,89	26,22±2,09	**19,88±1,27**	19,31±0,81♯
	Aftertraining	28,43±1,66	**28,19±1,04**	20,81±0,86	**24,88±1,37** ¥*
T-suppressors	Beforetraining	20,44±0,86	19,59±1,15	21,65±0,85	20,59±0,97
	Aftertraining	21,18±1,25	**18,81±0,76**	19,60±0,92	**19,3 ±0,76**
Immunoregulatoryindex	Beforetraining	1,32± 0,08	**1,33 ± 0,13**	**0,91± 0,18**	**0,93 ± 0,06**♯
	Aftertraining	1,34± 0,15	**1,49 ± 0,12**	**1,06± 0,19**	**1,22 ± 0,19**¥

Notes:¥ - changes are significantin comparison with the indicator before the start of training, ≤ 0.05;∗ - the differences are significantcompared with group 2, p ≤ 0.05;♯ - the differences are significantcompared with group 2, p ≤ 0.01.

In group 4, the athletes of basketball players of the level of the highest sports achievements, the following results were obtained. The total number of T-lymphocytes increased from 39.9 to 44.18, which amounted to 10.7% (p ≤ 0.05). The difference of this indicator from the same in group 2 acquired significantly and amounted to 6.4% (p ≤ 0.05). Thus, the increase in T-lymphocytes in the group of people who did not involve in exercising earlier showed a higher level of stress at the beginning of changes in physical activity than in the group of athletes for whom the load was less than their usual work (see Table 2).

The population of T-helpers increased over a two-month period in group 4 from 19.31 to 24.88, which amounted to a significantly difference of 28.8% (p ≤ 0.05). In group 3, athletes who did not engage in power fitness during the summer holidays, this indicator showed an upward trend, but did not have significant differences from the original value. Thanks to the comparison, we can observe unidirectional changes in the groups of athletes 3 and 4, but are more pronounced in group 4. That is, as a result of training using the method of power fitness, the number of T-lymphocytes increased, which increases the intensity of the immune response most significantly in the group of athletes No. 4 (see table 2.).

The content of T-suppressors tended to decrease in all examined groups. It can be assumed that the cell population, which inhibits the intensity of the immune response as a whole, decreased in all subjects, regardless of training and initial level of physical fitness. Significantchanges in this indicator were not registered in 4 groups of volunteers. Perhaps the same type of changes were associated with the summer season during which this study was conducted (Cury-Boaventura, Gorjão, Moura, Santos, Bortolon, Murata, Hatanaka, 2018).

Significantchanges in this indicator increase in the immunoregulatory index as a result of training using the method of power fitness was registered only in the group of athletes No. 4, they took a training course during the summer off-season holidays. So, the initial indicator of 0.93, which was below the age norm for this group of

patients, reached a value of 1.22, which is normal. The difference from the initial value was 31% ($p \leq 0.05$). The increase in the calculated indicator of the immunoregulatory index was due to an increase in the number of T-helpers, which generally shows an increase in cellular immune reactivity (Cury-Boaventura, Gorjão,Moura, Santos, Bortolon, Murata, Hatanaka,2018).

Dicussion

Studies of many research teams have shown earlier that in the blood of elite athletes there is an increased content of anti-inflammatory markers and T-lymphocytes of various subclasses during the period of professional sports activities (Prieto-Hinojosa,Knight, Compton, Gleeson& Travers,2014;Peake, Neubauer, Walsh & Simpson,2017). These changes can persist for a long time and be restored during training activities throughout life (Mackinnon, Chick, Van As &Tomasi,1987; Morgado, Matias, Monteiro, Alves, Reis,Santos&Laires, 2017). However, the cessation of training, including temporary, during the off-season holidays leads to an increase in the frequency of acute respiratory diseases, according to the athletes and coaches themselves (Khodaee, Grothe, Seyfert, &VanBaak, 2016;Peake, Neubauer, Walsh, & Simpson2017). Thus, it can be argued that moderate physical activity in highly qualified athletes contributed to improving the quality of the cellular immune response.

In our study, the quantitative indicators of T-lymphocytes in athletes at the end of the training-competitive season showed the norms of the total number of T-lymphocytes which closest to the upper boundary, the normal number of T-suppressors with a reduced number of T-helpers. This ratio may indicate a relative inhibition of cellular immunity, as indicated by the magnitude of the immunoregulatory index (Peake, Neubauer, Walsh, & Simpson2017). The results obtained regarding basketball athletes correspond to the idea of over-training at the end of the training-competitive season, which corresponds to the research of V.Dopsaj and L. G.Minuzzi (Dopsaj,Martinovic,Dopsaj, Kasum, Kotur-Stevuljevic, &Koropanovski,2013; Minuzzi, Rama, Bishop, Rosado, Martinho, Paiva, & Teixeira,2017).

At the same time, in relation to a group of young people who did not go in for exercising before and began to train only during the study period, it should be noted that an increase in the rates of specific cellular immunity demonstrated a strain of cellular immunity. It can be assumed that the oxidative stress characteristic of the participants in the training process at the beginning of training did not lead to a sufficient level of adaptation within a 2-month period. A similar effect of oxidative stress on the number of T-lymphocytes is reported by Petrovic J. at all (Petrović, Stanić, Dmitrašinović,Plećaš-Solarović,Ignjatović, Batinić&Pešić, 2016) and Mackinnon L.T. at all (Mackinnon, Chick, Van As &Tomasi,1987). Obviously, for people who have not involved in exercisingbefore, a longer training period is required to achieve a sufficient level of adaptation.

Conclusion

Highly qualified athletes had positive changes in the subpopulation of T-lymphocytes as a result of the proposed physical activity. So, classes according to the proposed methodology during the off-season were more profitable than passive rest. The proposed method of power fitness had a positive effect on the immunity indicators of people who have not been involved in exercisingbefore. For this vast category, a longer period of continuous exercisingcan be recommended.

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