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INFLUENCE OF MODERATE PHYSICAL LOADS CAUSED BY PHYSICAL TRAINING ON HUMORAL COMPONENT OF SPECIFIC IMMUNITY INDICES

We have studied the humoral immunity changes of students under the influence of physical training. In the course of research we have discovered some adaptation reactions under the influence moderate physical loads. In particular there is a downward trend in serum immunoglobulin level (for all basic immunoglobulin classes: IgG, IgM and IgA). We also have analyzed the influence of moderate physical loads on the level of B-lymphocyte expressing antigen CD72. CD72 molecule is a IgM receptor and a ligand for CD5 molecule located on T-cell and it provides effective contact with T-helpers. Functionally mature B-lymphocyte is the precursor of antibody-forming plasma cells and correspondingly it is the cell factor of humoral specific immunity. The tendency is observed for a slight increase in percentage of cells with CD72+ phenotype in the absence of changes in their absolute number. Thus, we can prove the reference data that intensive physical loads inhibit mainly T-system of immunity and have almost no influence on B-cell link at the initial stage of adaptation process. Adaptation reaction of humoral component of specific immunity during moderate physical load is weak.

Keywords: *physical education, physical loads, humoral immunity, B-lymphocyte, immunoglobulin, adaptation.*

Problem definition. Recent studies and publications analysis. Analysis of medical examination results of students of Cherkasy National University showed that only one third of examined can be referred to the group of healthy or almost healthy, others turned to have various serious chronic diseases and need a complex of rehabilitative measures. So, the majority of students can't attend the main group of physical training lessons. At the same time major part of their life students have to live and work indoors, thus they have pronounced deficit of efferent activity [6, 8]. A vicious circle arises – young people studying in educational institutions could intensity their efferent activity on the lessons of physical training but attending these lessons is impossible for a big part of students because of their poor health. Lately more and more often a question ariseswhether physical loads really improve man's health?

Investigations of influence of physical loads on immune system indices demonstrate discordant data.

On the one hand there is no doubt that intensive and durable load of professional sportsmen especially in the competition period is a powerful immunosuppressant that causes depression of different elements of immune response [8]. Mechanism of suppressor effect of physical loads on natural resistance of human organism can be explained by their stress influence [1, 2]. Physical loads that reach the stress level influence main regulative systems of human organism causing development of adaptation syndrome, and if powerful and stable can cause homeostasis disorded and a number of pathologic conditions.

Immune system along with nervous and endocrine systems are main regulative systems that take part in adaptation syndrome development on all its stages. Pathophysiologic changes during adaptation breakdown are predetermined by changes of immune and endocrine homeostasis [4, 9].

On the other hand positive consequences of therapeutic physical training in diseases of various etiology are indisputable [1].

Thus, the question of physical load optimization in educational institutions is still open. Discussion as to "hypodynamia" concept and its correction continues [10]. Criteria of youth's adaptation for physical exercise are being analyzed [4].

A weighty criterion of adaptation process to physical load is immune system indices in dynamics [10]. According to reference data determination of humoral immunity components that provide homeostasis is of high practical importance for sport medicine as criterion of adaptation possibilities of humans during intensive physical loads is [1, 3]. This explains urgency of our investigation.

Investigations were executed as part of the project "Exploration of vitamins influence on immunedefensive organism functions and lipoid metabolism in normal physiological conditions and in the process of hypercholesterolemia development" (on order of Ministry of Education and Science of Ukraine).

Object of an article: to study the humoral immunity indices of students under the influence ofderate physical loads on the physical training lessons in educational institutions.

Methods

To attain the object we have definite *tasks*: estimating the humoral immunity indices of students of educational institutions before and after physical training lessons, information processing, formulation of conclusions.

Object of study and investigation methods: humoral immunity indices investigation was implemented in the group of second-year students aged 18-20 years who lived in the same climatic and geographical conditions for a long period of time. All students didn't have any acute or chronic diseases and attended the main group of physical training. The number of investigated – 40 people.

Immune system indices analysis was done in September before and after physical training lessons.

Educational-training process was held in the form of 90-minute health training process organized in traditional structure and contained exercises according to national educational program.

Blood samples were taken a day before physical training lessons. Second blood sampling was done just after the lesson.

Leukocyte level was calculated in Goryaev camera, lymphocyte level was determined using a blood smear (dyeing by Romanovskiy-Himse).

Expression of surface antigen CD72 with peripheral blood lymphocyte was determined with immunofluorescence method using monoclonal antibody to surface marker of immune system cells 3F3 and $F(ab)_2$ – fragments of ovine antibodies to IgG of a mouse, marked FITC ("Sorbent", Moscow).

Immunoglobulin level in blood plasma was defined with radial immunodiffusion method for Manchini using monospecific antiserums IgG(H), IgM(H), IgA(H).

Data were processed in Microsoft Excel.

Results and discussion

We have analyzed the influence of moderate physical loads on the level of main classes of blood serum immunoglobulin.

According to the reference data excessive physical loads cause accumulation of a great number of intermediate metabolic products in blood. As a result a significant shift of acid-base balance to acid side and essential temperature rise occurs. It causes activation of a group of ferments including protease that is able to destroy immunoglobulin molecule decreasing its level.

Along with pH change intensified secretion of immunotropic hormones takes place, they can be linked with albumin and globulins. This process is accompanied by further reduction of immunoglobulin level. The entire elimination of immunoglobulin from blood serum occurs in a process of their sorption (fixation) with numerous receptors including Fc on blood cells and many other cells [8].

Generally reduction of the level of all immunoglobulin classes is a common consequence of intensive physical loads [3]. In certain investigations there is information about possible increasing of IgA level against the background of decreasing of other immunoglobulin classes.

IgG is the main class of serum antibodies during the secondary immune response. It has the ability to penetrate through the placental barrier and that's why it is the main infection-defending factor for newborns in their first weeks of life. It is of great importance for bacterial toxins and microorganisms opsonization. IgG concentration is the highest among immunoglobulin in blood serum. Having high specificity, IgG is actively assisting immune response and regulating it and at the same time influencing activity of other immune response mechanisms – cell and humoral and defining the full scale of immune response [5].

IgA is present in blood serum in monomeric form. Dimeric form is found mostly in mucous membrane secretion and protects from infection penetration. Serum IgA is able to decontaminate microbes and toxins circulating in blood but its effect is weaker than secretory IgA [5].

IgM is the first barrier on infection path and evolutionary it appeared earlier than other immunoglobulin classes. On the membrane of B-lymphocyte it exists as a monomer and is a typical antigen-specific receptor of these cells.

After activation B-lymphocyte secretes pentameric IgM and then IgG and other immunoglobulin classes. As IgG synthesis and titer increase we can see sudden decrease of synthesis of slightly specific IgM that is regulated only with a level of appropriate specific IgG [5].

IgG synthesis is resistant to immunosuppressive agents and irradiation [5].

In our case after moderate physical loads we observed a tendency for a decrease in the level of all classes of immunoglobuline but discovered that changes were not statistically significant (Table 1).

Table 1

Humoral immunity and antibody-forming cell level before and after physical training lessons

Value	Before physical training	After physical training	p
IgG, mg/ml	9.59±0.173	9.44±0.201	p>0.05
IgM, mg/ml	1.58±0.114	1.51±0.071	p>0.05
IgA, mg/ml	1.79±0.082	1.72±0.082	p>0.05
CD72+, %	9.84±0.157	9.97±0.184	p>0.05
CD72+, $x10^9$/l	0.17±0.003	0.17±0.004	p>0.05

We have analyzed also the influence of moderate physical loads on the level of B-lymphocytes expressing antigen CD72. CD72 molecule is a receptor of IgM and a ligand for CD5 molecule located on T-cells, and it provides effective contact with T-helpers. Functionally mature B-lymphocyte is the precursor of antibody-forming plasma cells and correspondingly it is the cell factor of humoral specific immunity [5]. The tendency is observed for a slight increase of percentage of cells with CD72+ phenotype while their absolute number remains unchanged (Table 1).

Thus, we can prove the reference data that intensive physical loads inhibit mainly T-system of immunity and have almost no influence on B-cell link on the initial stage of adaptation process [7]. Adaptation reaction of humoral component of specific immunity on the moderate physical loading is weak.

Conclusions

In the course of research we have detected a weak adaptation reaction of humoral immunity component after moderate physical loads during physical training lessons.

In particular, after moderate physical loads a tendency for decrease of level of immunoglobulins of analyzed classes was observed and a slight increase of percentage of B-lymphocytes with CD72+ phenotype which didn't reach the level of statistical significance.

Further research in this sphere supposes evaluation of additional factors that can influence immune system indices change under the influence moderate physical loadings. These factors in particular are genetically determined control of immune status and role of psychoemotional load caused by educational process .

References

1. Аронов Г.Е. Иммунологические методы в оценке состояния здоровья спортсменов / Г.Е. Аронов, Н.И. Иванова // Иммунология и аллергология. – 1984. – Вып. 18. – С. 96–98.
2. Аронов Г.Е. Иммунологическая реактивность в оценке состояния здоровья спортсменов / Г.Е. Аронов, Н.И. Иванова. – Киев: Здоровье, 1987. – 86 С.
3. Гелькин В.М. Состояние иммунного статуса организма при тренировочных нагрузках силовой направленности тяжелоатлетов / В.М. Гелькин // Олимпийский спорт. – 1993. – №7. – С. 12-13.
4. Двигательная активность и здоровье / [Н.А. Агаджанян, В.Г. Двоеносов, Н.В. Ермакова и др.] – Казань: Изд-во КГУ, 2005. – 216 с.
5. Дранник Г.Н. Клиническая иммунология и аллергология: учебное пособие. / Г.Н. Дранник. – Одесса: Астропринт, 1999. – 604 с.
6. Зміни вегетативних функцій у студентів початкових курсів / [В.Є. Антонік, Є.П. Антонік, А.П. Афонін та ін.] // Особливості формування та становлення психофізіологічних функцій в онтогенезі: симпозіум, 4-5 жовтня 1995 р.: тези доповідей – Київ–Черкаси, 1995. – С. 1.
7. Иванова Н.И. Влияние физических нагрузок на системы иммунитета / Н.И. Иванова, В.В. Талько // Теория и практика физической культуры. – 1981. – №1. – С. 82–83.
8. Суздальницкий Р.С. Новые подходы к пониманию спортивных стрессовых иммунодефицитов / Р.С. Суздальницкий, В.А. Левандо // Теория и практика физической культуры. – 2003. – №1. – С.26-31.
9. Хаитов Р.М. Иммунитет и стресс / Р.М. Хаитов, В.П. Лесков // Рос. Физиол. Ж. – 2001. – Т. 87, № 8. – С. 1060–1072.
10. Shirinsky I. Social stress disorders and immunity / I. Shirinsky, V. Shirinsky // Russ. J. Immunol. – 2001.– V. 6, № 2. – P. 207–214.

Анотація. Соколенко С.В. Вплив помірних фізичних навантажень, зумовлених заняттям фізичною культурою, на показники гуморальної ланки специфічного імунітету. *Вивчали зміни показників гуморального імунітету у студентів під впливом занять фізичною культурою. Проведені дослідження виявили певні адаптивні реакції показників на помірні фізичні навантаження, зокрема, тенденцію до зниження рівня основних сироваткових імуноглобулінів (усіх трьох класів: IgG, IgM та IgA). Проаналізовано також вплив помірних фізичних навантажень на рівень В-лімфоцитів, що експресують антиген CD72. Молекула CD72 є рецептором для IgM та лігандом для молекул CD5, розміщених на Т-клітинах, вона забезпечує ефективний контакт з хелперними Т-лімфоцитами. Функціонально зрілі В-лімфоцити є попередниками антитілопродукуючих плазматичних клітин, і, відповідно, клітинним фактором гуморального специфічного імунітету. Виявлено тенденцію до незначного підвищення відсотку клітин з фенотипом CD72+ та відсутність змін їх абсолютного числа. Таким чином, підтверджуються дані літератури, згідно яких фізичні навантаження високої інтенсивності пригнічують переважно Т-систему імунітету і практично не впливають (або навіть розгальмовують) В-клітинну ланку у початковій стадії адаптаційного процесу.*

Ключові слова: *фізичне виховання, фізичні навантаження, гуморальний імунітет, В-лімфоцити, імуноглобуліни, адаптація.*

Аннотация. Соколенко С.В. Влияние умеренных физических нагрузок, обусловленных занятиями физической культурой, на показатели гуморального звена специфического иммунитета. *Изучали изменения показателей гуморального иммунитета у студентов под воздействием занятий физической культурой. Проведенные исследования продемонстрировали определенные адаптивные реакции показателей на дозированные физические нагрузки, в частности, тенденцию к снижению уровня основных сывороточных иммуноглобулинов (всех трех классов: IgG, IgM и IgA). Проанализировано также влияние умеренных физических нагрузок на уровень В-лимфоцитов, экспрессирующих антиген CD72. Молекула CD72 является рецептором для IgM и лигандом для молекул CD5, размещенных на Т-клетках, она обеспечивает эффективный контакт с хелперными Т-лимфоцитами. Функционально зрелые В-лимфоциты – предшественники антителопродуцирующих плазматических клеток, и, соответственно, клеточные факторы гуморального специфического иммунитета. Обнаружены тенденция к незначительному повышению процента клеток с фенотипом CD72+ и отсутствие изменений их абсолютного числа. Таким образом, подтверждаются данные литературы, согласно которым физические нагрузки высокой интенсивности подавляют преимущественно Т-систему иммунитета и практически не влияют (или даже растормаживают) В-клеточное звено в начальной стадии адаптационного процесса.*

Ключевые слова: *физическое воспитание, физические нагрузки, гуморальный иммунитет, В-лимфоциты, иммуноглобулины, адаптация.*

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