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## **THE STUDY OF HEMATOLOGICAL AND FUNCTIONAL INDICATORS IN STUDENTS DURING THE EXAMINATION SESSION**

The article considers the changes in hematological and functional indicators in students during the examination session. To assess the possible occurrence of violations of students' health status, ascertaining the level of the price of adaptation when influencing the students' body of university loads, the most informative indicators are determined. In terms of leukocyte status, 45% of students who have leukocyte counts within the reference values of the norm have a successful adaptation reaction corresponding to their health. When comparing hematological indicators and health indicators, the most unfavorable values were found in the form of elevated glucose, increased systolic pressure, and an increase in lymphocyte count. An increase in the lymphocyte count is considered as one of the indicators of unfavorable adaptation to higher education. At 33%, the average level of stress was found, 67% showed a low level of stress, which indicates a state of psychological adaptation to workloads. Adaptation of students to study conditions in higher education is a complex multi-level physiological process. The development of disadaptation during the training period can have a negative impact on the functional state of the organism and lead to the development of pathological processes.

**Key words:** study load, students, lymphocyte, monocyte, adaptation.

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### **Емтихан сессиясы кезінде студенттердің гематологиялық және функционалдық көрсеткіштерін зерттеу**

Мақалада емтихан сессиясы кезінде студенттердің гематологиялық және функционалдық көрсеткіштерінің өзгеруі қарастырылады. Студенттердің денсаулығының бұзылуының мүмкін болуын бағалау, студенттердің университеттік жүктемелеріне ықпал ету кезінде бейімделу бағасының деңгейін анықтау үшін ең ақпараттылық көрсеткіштер анықталды. Лейкоциттер статусы бойынша лейкоциттердің нормаларының нормалық шектерінде саналған студенттердің 45%-ы олардың денсаулығына сай бейімделу реакциясын табады. Гематологиялық көрсеткіштер мен денсаулық көрсеткіштерін салыстыру кезінде ең қолайсыз мәндер жоғары глюкоза, систолалық қысымның жоғарлауы және лимфоциттер санының өсуі түрінде табылған. Лимфоциттер санының өсуі жоғары білімге қолайсыз бейімделу көрсеткіштерінің бірі ретінде қарастырылады. 33%-ында стрестің орташа деңгейі анықталды, 67% -ы стрестің төмен деңгейін көрсетті, бұл жұмыс жүктемесіне психологиялық бейімделу жағдайын білдіреді. Студенттерді жоғары білім берудегі жағдайды зерттеуге бейімдеу күрделі көп деңгейлі физиологиялық үдеріс болып табылады. Оқу кезеңінде бұзылудың дамуы ағзаның функционалдық күйіне теріс әсер етуі мүмкін және патологиялық процестердің дамуына әкелуі мүмкін.

**Түйін сөздер:** оқу жүктемесі, студенттер, лимфоцит, моноцит, бейімделу.

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### Изучение гематологических и функциональных показателей у студентов во время экзаменационной сессии

В статье рассматриваются изменения гематологических и функциональных показателей у студентов во время экзаменационной сессии. Для оценки возможности возникновения нарушений состояния здоровья студентов, выяснения уровня цены адаптации при влиянии на организм студентов вузовских нагрузок определены наиболее информативные показатели. По показателям лейкоцитарного статуса у 45% студентов, имеющих показатели лейкоцитов в пределах референтных значений нормы, наблюдается успешная реакция адаптации, соответствующая состоянию здоровья. При сопоставлении гематологических показателей и показателей состояния здоровья выявлены наиболее неблагоприятные значения в виде повышенного содержания глюкозы, повышение систолического давления, а также повышение содержания лимфоцитов. Повышение содержания лимфоцитов необходимо рассматривать как один из показателей неблагоприятной адаптации к обучению в вузе. У 33% обнаружен средний уровень стресса, у 67% выявлен низкий уровень стресса, что свидетельствует о состоянии психологической адаптированности к рабочим нагрузкам. Адаптация у студентов к условиям обучения в высшей школе представляет собой сложный многоуровневый физиологический процесс. Развитие процессов дезадаптации в период обучения может оказать негативное влияние на функциональное состояние организма и приводят к развитию патологических процессов.

**Ключевые слова:** учебная нагрузка, студенты, лимфоцит, моноцит, адаптация.

#### Introduction

The relevance of this research consists in a social significance of studying of systemic homeostatic, psychophysiological and hematological indexes for assessment of extent of violation of the state of health at students. The relevance decides on the one hand, the existing urgent need in successful adaptation of students of the first and second years to educational activity, and on another, by prophylaxis of a possible aggravation of symptoms of health during this adaptation [1].

A large number of first-year students because of problems with adaptation to tutoring in higher education institution are annually deducted [2, 3]. Therefore researchers are faced by questions of selection of the most efficient methods and working methods which will provide selection and systems approach to process of adaptation of students of the first and second years. In the course of tutoring loads of the life-supporting systems of an organism of the student in general considerably raise. Against the background of, it in recent years, increase the number of the young men and girls having problems with health [4, 5, 6] is noted deterioration in physical health and emergence of diseases, the bound to violation of carbohydrate metabolism of glucose is observed. It is determined by existence of a large number of stresses which students in the course of tutoring, especially the first and second courses face.

In an organism of the students who entered to the university processes of adaptation to the new environment of tutoring are observed. Adaptation is a necessary link for transition just seeing educational activity to another. In this case process of transition from the pupil of school to the student of higher education institution means. Adapting to new conditions of tutoring: to the new system of requirements, new teachers and classmates etc to the student it is necessary to overcome the considerable difficulties. The lack of necessary skills for successful tutoring in higher education institution causes the strong emotional pressure in students that leads to deterioration in health of students. Process of overcoming such difficulties during the long-lived period of time can cause an overvoltage both on psychological and at the physiological level. There are various mechanisms of adaptation to educational activity in higher education institution which include biochemical changes in blood, both reorganization in bodies and fabrics. All this provokes an overload of systems of functions and leads to developing of stresses and as a result emergence of violations of health [7, 8].

Optimization of indexes of adaptation of first-year students and second-year students to tutoring conditions in higher education institution is impossible without adaptation process studying in general, psychophysiological changes which can lead to various violations of work of an organism including to violations of carbohydrate metabolism.

The purpose of researches was: a research of psychophysiological and hematological indexes of adaptation of students to educational activity and identification of dynamics of disorder of the state of health at the different levels.

**Material and methods of research:** observation, anthropometry, functionally physiological tests (measurement of arterial blood pressure, heart rate, biotic capacity of lungs, etc.), questioning by means of Spilbergera-Khanin and E. Howard's questionnaires, the comparative analysis of results, empirical kliniko-biochemical methods and methods of statistical data processing with use of reference computer programs. All researches were conducted according to rules of the ethical commission and the written consent of students to participation in inspection.

The research was carried out at department of biophysics and biomedicine of Al-Farabi Kazakh National University.

Results of inspections of 200 students during their training at the first and second courses in dynamics were the basis for work.

Examination was conducted for two years during the same period: at the beginning and the end of academic year.

The examined students had no expressed deviations in development (shortcomings of mental and physical development).

Within problems of the real research we estimated various aspects of activity of the blood circulatory system.

One of stages of studying of cell-like elements of blood is the morphological research. The painted dabs of peripheral blood are exposed to studying.

We investigated indexes of content in glucose blood. For identification of violations of carbohydrate metabolism of glucose, usually use glucose definition on an empty stomach (in 6-8 clocks after meal). Its level increases at a diabetes mellitus, at any stressful situations, plentiful reception with food of carbohydrates.

For data recording of physical health of surveyed the developed G.A. Aponasenko, R.G. Naumenko (1988) a method the health level assessment express on the clinic-physiological indexes having rather expressed correlative communications with the level of aerobic power supply of the person was used. As initial in this technique the following morpho-functional indicators are applied: growth, weight, force of the leading brush, biotic capacity of lungs, arterial blood pressure. The derivants received from them (the weight relation to body height, the relation of force of the leading brush to body weight, the relative biotic capacity mild, derivants of arterial

blood pressure and heart rate) are estimated on the formalized scale of points which sum determines the level of physical health.

For assessment of the generalized chronic mental or somatic tension which is shown in fatigue, irritability, impatience feeling of an internal restraint the scale of uneasiness of E. Howard was used (V.V. Grishin, P.V. Lushin, 1990; L.M. Sobchak, 1990).

For assessment of personal uneasiness Ch. Spilberger's scale was used. Assessment of an emotional condition of the student was defined by a formula:

$S + \text{How LPET} = \text{where } S - \text{assessment of level of personal uneasiness according to Ch. Spilberger, How} - \text{assessment of level of susceptibility to a stress, E. Howard, LPET} - \text{the level of psychoemotional tension.}$

Assessment was made on the scale established in psychophysiological practice: the first low level made lower than 25 points, the average level corresponded to indexes from 25 to 45 points, the high level is higher than 45 points.

Primary data for assessment of a condition of a vegetative homeostasis were obtained by means of the device of the Varikard 1.2 hardware and software which was counted by an integral indicator (index) of activity of regulatory systems and coefficient of a regulation between the heart rate and frequency of respiration. Record of cardiointervals was made within minutes. The following classification of states was offered: optimum tension – 1-2 points, moderate tension – 3-4 points, expressed – 5-6 points, an overvoltage – 7-8.

The index of adaptation to educational activity of students was counted on an index – the functional price of adaptation (FPA) which basis the formula of the physiological price of tutoring was (G.I. Paleev, 1996):

LFT – the level of the functional tension or level of a stress which was determined by a path of filing of the functional indexes of the Varikard 1.2 hardware and software, LPET – the level of psychoemotional tension, LPD – the level of physical development determined by G.L. Apanasenko's (1988) technique, SFF – subjective feeling of a fatigue, assessment was made on four to a mark scale by means of the questionnaire;

LRS – the level of the relation to study, assessment was made on ten to a mark scale by means of expressly developed card.

The received these estimates of the functional price of adaptation (FPA) allowed to allocate three of its levels: FPA 1,6 – a low index;

1,6 FPA 2,4 – an average value; FPA 2,4 – a high rate.

The presented complex of indexes of glucose, leukocytic formula, physical health, psychoemotional condition of students and tension of regulatory systems of an organism is adequate for problem solving of assessment of hematological and adaptation indexes of health of students.

Statistical data processing of observations errors of average ( $m$ ) and also criterion of reliability of Student ( $t$ ) of dependent selections who characterizes deviations of a difference of two arithmetic averages to errors of difference were carried out with use of the methods of mathematical statistics, with definition of mean values received during the researches of all indexes ( $M$ ). Data processing was made on PC IBM, using a package of the Microsoft Excel application programs and dialogue statistics of the Stadia system. Took changes for level at  $P < 0,05$ .

All students examined by us were distributed on four groups, on the basis of the theory of adaptation reactions of L.H. Garkavi.

The first group includes the following qualitative and quantitative characteristics: corresponds to reaction of a training; number of lymphocytes within the lower half of a zone of norm (21-25%); number of granulocytes within the top half of a zone of norm (65-72%); monocytes – within norm (up to 10%); leukocytes – within norm.

The second group includes the following qualitative and quantitative characteristics: corresponds to activation reaction; the number of lymphocytes within the top half of a zone of norm (28–33%) or are higher than norm (more than 33, up to 40-45% – are individual); the number of granulocytes within the lower half of a zone of norm or are lower than norm (less than 45%); monocytes – within norm (up to 10%); leukocytes –  $(4,0-9,0) \times 10^9/l$ .

The third group includes the following qualitative and quantitative characteristics: corresponds to reaction of acute stress; number of lymphocytes less than 20%; the number of granulocytes are higher than norm (more than 72%); monocytes – norm; leukocytes – it is raised.

The fourth group includes the following qualitative and quantitative characteristics: corresponds to reaction of a chronic stress; number of lymphocytes less than 20%; the number of granulocytes are higher than norm (more than 72%); monocytes – within an upper bound of norm above (more than 10%); leukocytes – more than  $8,0 \times 10^9/l$ .

**Results and discussion.** Most strongly under the influence of stressiruyushchy tutoring such components of a leukocytic formula as lymphocytes which are not so quickly restored change and therefore become the found indexes of an aggravation of symptoms of health of students.

**Table 1** – Of Indexes of a leukocytic formula of students of 1 and 2 courses

	Lymphocyte		Monocytes	
	1 course	2 course	1 course	2 course
1 group	7,69±0,98	26,19±1,07*	68,94±1,34	6,07±0,7
2group	7,9±0,91	29,87±1,61*	66,3±2,31	6±0,93*
3 group	9±1,22	19,5±0,5*	73,25±0,83	11±0,7*
4 group	11,5±0,5	20±0	70±1	12±1

\* Distinctions are reliable at  $P < 0,05$ .

We revealed reliable differences in indexes of leukocytes and lymphocytes the first and second groups of students at the end of the second year in comparison with a first year. It says about completion of process of adaptation to the end of the second year. At these reactions, especially at reaction of a training (the first group) and activations (the second group), activity of an organism it is harmonious and meets standard of young and healthy people, the

systems responsible for immune protection work. At these reactions, especially at reaction of a training and the increased activation – a stable state of health – students are most capable to cope with a stress (table 1).

Students of the second group initially had the increased percentage of lymphocytes (it testifies to their condition of activation), which number decreased by the end of the second year of tutoring

and approached an upper bound of norm that indicates improvement of the state of health and completion of process of adaptation. Increase in lymphocytes in the third group indicates existence of elements of intense adaptation, despite it process of adaptation happens. Initially the fourth group was characterized by low indicators of lymphocytes which number significantly did not change throughout the entire period of tutoring. Students of this group are least capable to cope with a stress that in turn leads to complication of process of adaptation to educational activity.

In general us data indicate receiving existence of a condition of a training and activations at the first and second group of students, both the first, and second year (82%) are more rare. At these reactions, a stable state of health – students are most capable to cope with a stress.

To a lesser extent at the examined students of the two first groups disharmonious reactions of a stress met minor change of indexes of lymphocytes and without sharp signs of strength.

Students of the third and fourth groups (18%) initially had weaker hematological indicators. In these groups by means of, leukogram researches we revealed a condition of tension though surveyed and had no particular chronic disease.

The condition of tension revealed by us complicated adaptation process which nevertheless came to the end in these groups by the end of the second year of tutoring. The approximation of all indexes of white blood to the lower bound of normal values demonstrates to it.

All above told can state on completion of process of adaptation to the end of the second year. Students of the first and second group are capable to cope with a stress better, than students of other groups.

Thus, the data obtained by us correspond to results of a research which was conducted by L.H. Garkavi. This hematological characteristic is vital since confirms existence or lack of development of pathology therefore we decided to continue and expand researches and to include indicators of glucose, a variation cardiography, a psychoemotional state for obtaining completeness of a picture.

Results of a research of indexes of physical health of students. Examination was conducted within two years, serious distinctions on the majority of indexes of physical health of students came to light [9].

In general, us data of the analysis of total of leukocytes and a leukocytic formula of students indicate receiving existence of a condition of reactions of a training and activations at the first and second group of students are more rare than both

the first, and second year (82%). At these reactions, especially trainings, are more rare at the increased activation – a stable state of health – students are most capable to cope with a stress.

To a lesser extent at the examined students of both the first, and second year disharmonious reactions of a stress met a slight lymphopenia and without sharp signs of strength. At these reactions the state physical and a mental discomfort, sometimes headaches and pains in heart, susceptibility to seasonal catarrhal diseases, the poor dream and appetite, etc. develops though surveyed and had no particular chronic disease or a serious deviation of mental and physical condition of health.

Higher and higher told, can indicate completion of process of adaptation, i.e. by the end of the second year process of adaptation of students came to the end. Students of the first and second group are capable to cope with a stress successfully.

As shows the analysis of separate indexes of physical development in the first group, the majority of indexes authentically did not change for the entire period of inspection and were in limits of mean values.

By the end 2 courses are observed decrease in body weight, decrease in biotic capacity mild in connection with minor change in body height at students, with increase in heart rate that it is bound at many to reloading, at the same time at all students and students of the third and fourth groups increase in arterial blood pressure is observed, and students of the first and second group on the contrary have a decrease. The dynamometry by the end 2 courses increases at students, and at students on the contrary decreases.

Mean values of anthropometric indexes of students from the second group practically same, as well as in the first group. Lower sizes of biotic capacity of lungs and a dynamometry by the end of training at the 2nd course at students, can be bound to a gipodinamomy, the characteristic of intensive educational activity in higher education institution. By the end 2 courses are observed increase in body weight at young men, in connection with minor change in body height at trainees.

The increase of size of arterial blood pressure at students in all groups can demonstrate adverse influence of an intensification of educational activity.

Change of mean values of common assessment of level of health in all groups was characterized by a tendency to increase by the end of each academic year. Though average values of the majority of components of physical health in all groups authentically did not change within each academic year.

Thus, it is possible to conclude that educational activity on the first and second year in all groups is followed by tendencies to increase in level of health, we connect this fact with growing of a young organism.

In general the analysis of the state of health and its separate indexes allows to draw a conclusion that in the first and second groups of students moderate reorganization of activity of the blood circulatory system reflecting various measure of expenditure of the functional reserves of the main systems of an organism is noted.

At a research of indexes of glucose in blood at students, both young men, and girls similar changes in the end of the first and second courses were revealed. The quantitative shifts are more noticeable in the third and fourth group of students of young men. The considerable changes towards increase in indexes of glucose up to an upper bound of norm were observed in the third and fourth groups.

Increase in indexes of glucose in blood at students of the third and fourth group can be an adverse prognostic indicator of health of these students.

In the analysis of change of degree of uneasiness within academic year it was established that by the end of tutoring almost in each group (with 1 on 2 courses) it accrues, with the greatest intensity it was characteristic of students of 1 courses.

Results of assessment of a psychoemotional state allow to say that the period of training at the 2nd course is the favorable for an emotional condition of students though at this time and the tendency to slight increase in level of uneasiness to the bound to intensive educational activity appears. By the end 2 courses are noted strengthening of psychoemotional tension at students in the third group coinciding with increase of level of the relation to study and increase in academic loads. Increase in level of uneasiness at students of both sexes in the fourth group in comparison with this index at the first year is observed [10].

The conducted research of level of tension of regulatory systems of students established that it is more girl, than young men are subject to tension of regulatory systems and psychoemotional stresses. It can be explained with the amplified loading and the collected fatigue.

By the end of each academic year increase in number of students with “the expressed tension” and “overvoltage” is noted. We connect a high level of a stress with emergence of signs of overwork that, eventually, leads to an overvoltage of regulatory systems.

Only in the fourth and third group at second-year students at the end of the academic year the functional price of adaptation authentically increases and approaches the top value of an average zone of strength in comparison with the beginning of the second year. Thus, the research of change of indexes of the functional price of adaptation showed that in different groups – students and students – these indicators increase. The functional price of adaptation to the end of study on the 2nd course increases in all four groups. It can be bound to increase in indexes of level of the functional tension that indicates the significant increase in tension of systems of adaptation though these indexes of increase in level of the functional tension of not exceeding critical level. The submitted analysis shows that this body height is caused by deterioration in physical health at 63% of students, increase of level of tension at 70% of students and also strengthening of psychoemotional tension at 44% of students and accumulation of a fatigue at 37%.

In general it is possible to tell that in all groups there is a body height of an index of the functional price of adaptation, but the largest growth is observed in the third and fourth group. It demonstrates to the intense nature of process of adaptation of the students who are engaged in intensive educational activity.

Proceeding from the above, one may say, that now the researches of the functional price of adaptation conducted by us indicate existence of a tendency to deterioration in health of students during their tutoring in higher education institution. At students both young men, and girls change of indexes of health in connection with presence of the functional and psychoemotional tension.

And as the received results testify, in the third and fourth groups more expressed deterioration in health influences all parameters of the main physiological systems of an organism that is shown in an aggravation of symptoms of health of students and can be an incitement for different developing of pathologies.

## Conclusions

With comprehensive research of indicators of adaptation of students to educational activity in the dynamics of indicators leukocyte status in 82% of the students that have the leukocyte count within the reference normal values, the observed positive responses of adaptation corresponding to the condition. 18% of students in the adaptive response

during two years of study was in the nature close to a state of chronic and acute stress. Comparison of hematological parameters and indicators of health status indicate that the most disadvantaged of them in the form of high glucose, bordering the upper normal values, and low estimates of the level of health and increased systolic blood pressure observed in students (boys 12% girls 6%), in which the percentage of lymphocytes exceeds 20%, which allows to distinguish this category of students at risk for health reasons, and bordering on the lower limit of the reference normal content of lymphocytes to consider, as one of the indicators of adverse adaptation to training in higher educational.

The majority of students (82%) have the process of adaptation to higher education in dynamics, the beginning of the first year and the end of the second, characterized by a significant decrease in the total leukocyte content, an increase in the percentage of lymphocytes, improve health, reduce anxiety and tension of regulatory systems. In the risk group of 18% of students, similar changes in hematological indicators are manifested as a trend, and the indicators of anxiety in girls indicate an increase in psychoemotional stress.

In the study of all complex parameters in the first year of study at the University, showed

that by the end of the year, there was a deviation of the hematological parameters, the imbalance of regulatory systems, an increase in functional tension, impaired carbohydrate metabolism, a decrease in the level of health in all studied groups. In the second year, students with low rates of health deviations in leukocyte status and energy exchange, a high level of anxiety. Tension of regulatory systems (18%) – the process of adaptation was completed by the end of the second year of training with high voltage, students with high health indicators (82%) – the process of adaptation was completed successfully without obvious deviations in health status. As well as the dynamics of indicators of functional adaptation price indicate that the majority of students (82%) functional adaptation price does not go beyond the level of low values, while in the risk group the functional adaptation price increases significantly, respectively, in boys 12% and girls 8% and reaches values estimated as high.

Thus, despite great stressful influence of academic loads and specifics of higher education institution, process of adaptation comes to the end at all students and students in all groups by the end of the second year, only with various strength of all systems and levels of an organism and the different price of adaptation.

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