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# PHYSIOLOGICAL AND PSYCHOLOGICAL ASPECTS OF STRESS RESISTANCE OF STUDENTS

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### *Abstract*

To provide for successful training of qualified staff that can ensure the state economic development, the government needs to improve health care, improving the performance of students. Therefore, the role of the university as a social institution is both to train specialists and also to help them to become socially active, responsible people with good physical and moral health and high stress resistance. Stress resistance is a common object of study of different scientific fields. Most studies deal with the psychological problems of adaptation, motivation and the ability of the individual to cope with different issues; the body's resistance to negative influences is maintained by systems organized in a certain way and subordinate to each other, their constant multilateral interaction leads to coordination of the levels of their functional activity, which is defined as a functional state (FS). The aim of the study is to analyze the psychophysiological and neuropsychological correlates of stress resistance and to develop approaches to the diagnosis and correction of stress resistance in students. The methods used in the study are: psychological tests, individual lateral profile determination, polyparametric method of body functional state determination. Statistical analysis proved the reliability of the ratio of stress resistance indicators only by the parameter of hemispheric asymmetry. Indicators of the anxiety scale are higher in all cases of insufficient stress resistance, but are not specific for determining the type of disorders and correction targets. Detection of dysfunction of the functional state of the body requires physical, psychological and neuropsychological correction.

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**Keywords:** Adaptive reactions, functional state of the body, students, stress resistance.



## 1. Introduction

Education as a part of the socio-cultural space has been deeply analyzed recently. Big transformations caused by the processes of globalization in the economic sphere and the formation of a new post - industrial economy require changes in the methods of training - a new post-industrial information society requires a new type of specialists who would be able to effectively apply their knowledge, using all of the available resources at their most (Kasatkin, 2017). Considering these needs, postmodernism still emphasizes the axiological aspect of education. Education is the only specialized subsystem of society, the objective function of which coincides with the purpose of the society - the education system "makes the person" – and this is its main function and goal (Umetov, 2018). At the same time, the analysis shows that the majority of modern concepts of education is utilitarian and technocratic, while the axiological aspect of education is either not taken into account or is not significant.

Successful training of qualified staff that can ensure the sustainability of the economic development of the state, is connected with the preservation of health and improvement of performance of students, but the growing requirements to the level of training of specialists due to the increase in volume of scientific information and implementation of innovative educational technologies lead to increasing emotional tensions of youth, depletion of adaptation reserves (Meermanova, Koygeldinova, & Ibraev, 2017; Shagina, 2010). Therefore the role of a university as of a social institution is not only to train specialists but also to help them to become a socially active and responsible person with good physical and mental health and high stress resistance.

Stress resistance is a complex quality of personality, which is characterized by the necessary adaptation to external and internal factors in the process of activity that helps to ensure successful achievement of the goals of this activity and is performed through the person's own behavior in emotional, motivational, cognitive and behavioral spheres of personality (Andreeva, 2008).

## 2. Problem Statement

The problem of stress resistance is studied by representatives of different scientific fields. Vardanyan (2008) defines stress resistance as a special interaction of all components of mental activity, including emotional ones. Khutor'naya (2009) defines stress resistance as an integrative part of the psychology of a person, which includes: personal component, that determines the development of cognitive, motivational, emotional and regulatory functions, and behavioral component, that includes the actualisation and application of anti-stress strategies.

Many researchers tend to think that stress resistance is the result of training, however, we should consider that each person has a certain set of traits of personality and physiological characteristics that determine personal resistance to stress. Stress sensitivity depends on external conditions and individual characteristics of a person – synthesis of reactions and individual-personal characteristics of a person, regulated by personal central nervous system and life experience. The stress resistance, coping resources, emotional burnout are also related to the approval from teachers (Davydova & Kozmina, 2014).

In the context of stress resistance, pedagogical psychology studying university pedagogics also studies the problem of specific relation of cognitive-behavioral and adaptation qualities of the individual to

the educational environment and new forms of educational activity. To be precise, it studies the determinations of such personality traits as tolerance, the ability to self-management, the activity of applying specific coping strategies and personality traits that make up the structure of adaptation (Liu & Petanova, 2016).

The problem of stress resistance is one of the most important in sociotics, where 4 groups of people are distinguished – non stress resistant, stress adaptable, stress reductive, stress resistant. It is stated that the optimal level of stress resistance should combine tolerance to stress, on the one hand, and the ability to empathize, on the other hand (Prokofjeva, 2009).

At the same time, "stress resistance" is one of the central concepts of neuropsychology, where it is determined according to the features of functional asymmetry – individual lateral profile. Individual lateral profile (profile of lateral organization) is an individual combination of functional asymmetry of hemispheres, motor and sensory asymmetry. The number of combinations of all of the signs of the asymmetries is extremely high (Bragina & Dobrokhotova, 1988; Dennison & Dennison, 1998; Khomskaya, 2010). This determines the diversity of lateral profiles and, consequently, the individuality and uniqueness of nerve connections, which, in turn, affects the way of organization of activities, including the regulation of the body functions, providing stress resistance (Dennison & Dennison, 1998; Sirotyuk, 2003).

The ability of the organism to adapt to different environmental conditions is connected with the health of a person in general, thus health can be viewed as the process of preservation and development of physiological, biological and mental functions, of optimal labour and social activity, of maximum duration of active creative life (Kaznacheev, 1975).

Most studies on students' stress tolerance relate to psychological problems of adaptation, motivation problems and coping resources of an individual. Various methods of determining resistance to stress include: a methodology for determining stress resistance and social adaptation by Holmes and Rago, a stress test by T.A. Nemchinova and J. Taylor (as cited in Dermanova, 2002), reactive and personal anxiety level scale by Ch.D. Spielberger, Yu.L. Khanin (as cited in Mikheeva, 2016), Manchester stress test (as cited in Shcherbatykh, 2008), Cohen stress test (as cited in Vorobeychik, 2004), a test for assessing the level of stress resistance by L.P. Ponomarenko, R.V. Belousov (as cited in Gorodetskaya, Konevalova, & Solodovnikova, 2013) and others.

### **3. Research Questions**

The terms "stress resistance" and "ability to adapt" are different in diagnostics, but the concept of "adaptation" is much wider – it is considered to be a product of all body functions, though some authors distinguish internal functions, others – external, others - both together; stress resistance is a special case of mental stability, manifested under stress factors, and their specificity is determined by a specific activity (Ababkov & Perret, 2004; Sudakov, 1998).

In general, the state of health and the body's resistance to negative environmental factors are provided by systems organized in a certain way and subordinated to each other. The result of multilateral constant interaction of biological structures is the coordination of levels of their functional activity, which is defined as a functional state (FS) (Danilova, 1992; Farkhutdinova & Farkhutdinov, 1999). Normal human

condition is characterized by optimal multiparametric ratio of homeostatic indicators of activity at the level of the whole body, individual systems and cellular and molecular levels.

If the mechanisms of regulation do not work properly, the coordination of reactions of a body at these levels can be broken. According to the system approach, we have developed a multiparametric method for diagnosing functional conditions, based on the assessment of the activity of the body at all these levels. We distinguished classes of FS characterized by specific for each of them complex of symptoms that can be found by means of the visualized graphic images of the analysis of multidimensional physiological data. In screening studies, study of the initial vegetative tone and microcirculation can be used as indicators significant for differentiation.

#### **4. Purpose of the Study**

Analysis of psychophysiological and neuropsychological correlates of stress resistance and development of approaches to the diagnosis and correction of stress resistance in students.

#### **5. Research Methods**

The study involved 30 freshmen of pedagogical university and 35 freshmen of medical university; of them 20 men and 45 women aged from 17 to 20.

In this study, we used self-assessment stress test by Kirsheva and Ryabchikova (1995) and test SAN "Health, activity, mood" (Barkanova, 2009). To identify neurotic conditions and subjective assessment of the activity of the ANS, we used the test of Yakhin and Mendelevich (2005). We analyzed several aspects such as: "Anxiety", "Neurotic depression", "Asthenia", "Hysterical type of reactions", "Obsessive-phobic disorders", "Vegetative disorders".

To determine the individual lateral profile we used sensorimotor and hemispheric asymmetry methods (Balashova & Kovyazina, 2009).

To study the functional state of the body, a polyparametric method was used (Farkhutdinova & Farkhutdinov, 1999), in which the most significant were the indicators of the autonomic nervous system (ANS) activity and of microcirculation. The ANS functional state was evaluated in terms of initial autonomic tone based on the evaluation of clinical signs (Wein, 2003), vegetative provision of activity based on indicators of clinic orthostatic sample. Microcirculation was studied through biomicroscopy of bulbar conjunctiva vessels. The degree of disfunction was assessed in points.

Statistical processing of results was performed using the software package "STATISTIKA" 13.3 for WindowsTIBCO Software, Inc. We carried out correlation, factor, variance analysis of the obtained results, a comparison of the absolute values of parameters of different classes according to the criterion  $\chi^2$  Pearson for small frequencies. The differences were considered significant at a level of  $p < 0.05$ .

#### **6. Findings**

A self-assessment test on the level of stress by Kirsheva and Ryabchikova (1995) consists of 18 questions, the answers to which allow to assess the level of stress in 9 gradations from very low to very high. The study showed that: 12.32% of the students got 38-41 points, that is estimated as average stress

level, 33,84% - 34-37 points – slightly above average, 33,84% - 30-33 points – above average, 20,0% - from 26 to 29 points – high. There were no extremes (very low and very high).

SAN test allows to assess the mental state of the psycho-emotional response to pressure, to identify the individual characteristics of psychophysiological functions. This test is based on the fact that the regulation of human activity at the level of the body depends not only on constitutional features, but also on its functional states - well-being, activity, mood, etc. At its core, these conditions are based on such a level of activation of the nervous system, in which certain behavioral acts that determine the effectiveness of any activity are implemented. The average score of the scale is 4. Estimates exceeding 4 points indicate a favorable state of the subject. Scores below 4 points indicate an unfavorable state of the subject. Normal assessment of the state lie in the range of 5-6 points.

SAN tests registered less than 4 points in several parts: 24.62% of students - on the scale of "well-being", 26.15% of students - on the scale of "activity", 7.69% of students - on the scale of "mood".

A significant number of students scored less than - 1.28, which indicated the bad nature of the detected disorders on one or another scale. The results of the analysis of the prevalence of neurotic disorders using clinical tests by Yakhin and Mendelevich (2005) showed a fairly high prevalence in students of various symptoms of neurotic register. It was found that 15.38% of students have some symptoms of neurotic depression; 24.62% - anxiety disorders, 13.85% - asthenic disorders. The most frequent are: obsessive-phobic disorders (38.46%), hysterical disorders (33.85%). It should be stated that autonomic disorders had 29.23% of the surveyed students.

Results of the study of sensorimotor and hemispheric asymmetries are stated in table 1.

**Table 01.** Parameters of sensory and interhemispheric asymmetry

Main organ	Frequency of cases (%)	
	Right side	Left side
Hemisphere	23,08%	76,92%
Hand	76,92%	23,08%
Leg	66,15%	33,85%
Eye	63,08%	36,92%
Ear	81,54%	18,46%

The dominating hemisphere in majority of students is left hemisphere (76.67%), the right hemisphere is dominant for 23.08% of students. They have different dominating parts of the body: 76,92% - right hand, 66, 15% - right leg; 23.08% - left hand, 33,85% - left leg. 63.08% - right eye, 36.92% - left eye. 81.54% - right ear, 18.46% - left ear.

9 students have cross individual lateral profile: two (3.08%) - right-sided, 7 students (10.77%) - left-sided; respectively, these students have 100% stress resistance. Two students (3.08%) have one-sided individual lateral profile (right-sided; stress resistance - 0%). 16.92% of students have mixed individual lateral profile with dominating right hemisphere, 66,15% have mixed individual lateral profile with dominating left hemisphere. 10,77% of the students have 25% stress resistance, 33,85% of students - 50% stress resistance, 38,46% of the students have 75% stress resistance.

The study of the functional state of the body. The results of the study of the initial vegetative tone (IVT) in the examined group of students are shown in table 2.

**Table 02.** State of initial vegetative tone

Type of initial vegetative tone	Number of students (%)
Eutonia	55,38%
Sympathicotonia	10,77%
Vagotonia	9,23%
Mixed, predominant sympathicotonia	9,23%
Mixed, predominant vagotonia	15,38%

Normally in a body there should be no more than 6 vagotonic and no more than 2 sympathicotonic indicators. If the number of certain indicators increases, the person has vagotonic or sympathicotonic type of IVT. In the evaluation of initial vegetative tone only 55.38% of the students had eutonia, or normal IVT; 10.77% of students have sympathetic tone of the nervous system, 9.23% have parasympathetic tone of nervous system. 24.61% of students have mixed type with sympathicotonia predominance in 9.23%, with vagotonia predominance in 15.38% of students. These cases can be regarded as autonomic dysfunction.

On the basis of the clinooortostatic test (COT), the indicators were within the normal range in 28 patients (43.08%) – when standing up, blood pressure increased by no more than 20 mm Hg, heart rate – by no more than 30 in 1 minute. When moving to the horizontal position, the indicators returned to the initial parameters within 3 minutes. The rest of the patients have pathologies of COT: hypersympathicotonic - 9 (13,85%); tachycardic – in 13 patients (20%); asympathicotonic – 2 (3.08%); hyperdyastolic – in 13 (20,0%); sympathicotonia was not found. Thus, 28 patients have normal vegetative activity, 22 patients have excessive vegetative activity, 15 patients have insufficient vegetative activity.

The state of the vessels of the bulbar conjunctiva was normal in 42 patients (64.62%). The rest (35.38%) have microcirculation disorders of different severity. All of these students have vascular disorders, 7 of them have vascular disorders combined with extravascular in the form of perivascular edema, the lumen of blood vessels narrowed, arteriolo-venous ratio (AVR) of 0.45; the average number of points for microcirculation disorders –  $4,60 \pm 0,3$ . 9 students had only vascular disorders, mainly in the form of uneven caliber, apparent reticular structure of blood vessels, meandric tortuosity of capillaries, single or multiple arteriolo-venular anastomoses. AVR – 0,6. 7 students have intravascular dysfunction in the form of sludge-phenomenon, the uneven caliber of the vessels increase in caliber of venules, meandric tortuosity of venules, isolated glomeruli. AVR – 0,30. The ratio of diameter of arterioles and venules is 1:3, 1:4. Thus, the state of microcirculation was normal in 64.62% of the examined, the rest had microcirculation disorders of different degrees.

The study of microcirculation and autonomic nervous system with the help of visual graphic images helped to diagnose that 28 students have optimal functional state of the body. We have divided the students into 3 classes. Class 1 consists of 7 students (their state is characterized by vagotonia, normal neurophysiological parameters at rest, while medium physical activity causes signs indicating the predominance of inhibitory processes in the central nervous system); 23 students belong to the 2nd class of FS (characterized by sympathicotonia, predominance of excitation processes in the central nervous system, high rates of emotional stress, reduced immunological reactivity). 7 students were assigned to the third

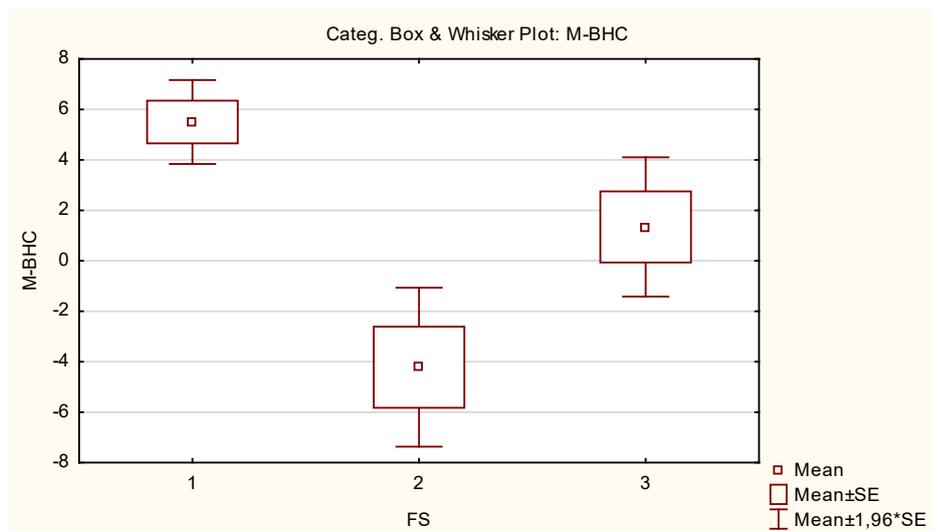
class of FS (characterized by severe dysfunction of both parts of the autonomic nervous system, disorganization of physiological rhythms of the EEG under functional stress, reduced mental stability when performing tasks).

In order to study the ratio of indicators of different types of research and to identify the parameters that most precisely characterize the stress resistance we created a matrix of 20 aspects – indicators of the studies. Variable parameters were: indicators of ICT, microcirculation, individual lateral profile, stress resistance on the lateral organization, stress resistance tests of Kirsheva and Ryabchikova (1995), test SAN, all scales of the test of Yakhin and Mendelevich (2005).

The psychological tests of Yakhin and Mendelevich (2005), and Kirsheva and Ryabchikova (1995) showed more reliably significant correlations. Indicators correlating a priori (functional state to microcirculation, obsessive-phobic disorders to anxiety, etc.) were excluded. Other indicators were correlated as follows: the indicators of the functional status correlated with indicators of: hemispheric asymmetry ( $r=-0.3541$ , at  $P<0.05$ ), stress test of Kirsheva and Ryabchikova (1995) ( $r=-0.5385$ ), scales of autonomic disorders of the test of Yakhin and Mendelevich (2005) ( $r=+0.4282$ ). Indicators of stress resistance on the individual lateral profile correlated only with indicators of anxiety of the test of Yakhin and Mendelevich (2005) ( $r=-0.3869$ ). Correlations between indicators of autonomic nervous system and anxiety scale, self-assessment of stress resistance were reliably significant.

The relations of the studied parameters were studied by the method of analysis of variance. For this purpose, we identified the most significant features for this study and carried out factor analysis using the principal component method. For the initial 20 variables, representing indicators of the different studies, we obtained 4 orthogonal factors explaining the statistical properties of this set - the levels of indicators of stress resistance (in lateral profile), functional state of the body, the results of tests of Kirsheva and Ryabchikova (1995), and of Yakhin and Mendelevich (2005).

For the analysis of matrices of differences in averages, where the grouping variable were indicators of stress resistance and functional state, we ranked the indicators. The indicators of the functional state of the body were distributed into 4 groups: the first, second and third – statistically reliable groups with indicators of interhemispheric asymmetry, test of Kirsheva and Ryabchikova (1995) and indicators of autonomic disorders scale of the test by Yakhin and Mendelevich (2005) and initial autonomic tone (figure 1).



**Figure 01.** Influence of indicators of the scale of vegetative disorders test by K.K. Yakhin and D.M. Mendelevich on the indicators of the functional state of the body

The indicators of group 4 were related only to the indicators of microcirculation and initial vegetative tone. Indicators of stress resistance based on the individual lateral profile are statistically associated with indicators of variants of the lateral organization (a priori) and the parameters of the anxiety scale test of K.K. Yakhin and D.M. Mendelevich.

## 7. Conclusion

As a result of conducted analysis we can conclude that indicators of the functional state of the body are statistically more significant to determine the stress resistance, of which the most significant are the indicators of the scale of autonomic disorders test by Yakhin and Mendelevich (2005) and initial vegetative tonus, as well as indicators of the test of Kirsheva and Ryabchikova (1995). In the analysis of psychophysiological and neuropsychological correlates of stress resistance, we note that the statistical analysis showed the reliability of the ratio of stress resistance indicators only by the parameter of interhemispheric asymmetry. Indicators of the anxiety scale are increased in all cases of insufficient stress resistance, but are not specific for determining the type of disorders and correction targets, so we can recommend the use of this scale and the scale of autonomic disorders for the primary (selective) examination. To specify the type of disorders, the initial vegetative tone should be studied, which is available in an educational institution; if a severe autonomic dysfunction was found, the microcirculation study should be carried out. In addition, we recommend the use of the SAN test as a method that helps to assess the dynamics of the correction.

Dysfunction of the functional state of the body determining the stress resistance requires correction, which should include both physical treatment of the microcirculation (physical exercises, breathing exercises, relaxation) and psychological effects (correction of anxiety, motivation analysis, behavioral therapy), and neuropsychological correction including the exercises for correction of basic sensorimotor (simultaneous and reciprocal) interactions, optimization and correction of hemispheric interactions.

This study allowed to find out more information about the concept of "stress resistance" in psychology and neuropsychology. Aleksandrovskij (2002) pointed out that the adapted mental activity is

determined not only the social and psychological mechanisms, but also by a number of others, which together provide vital activity of the human being (i.e. biophysical, including psychic and physiological adaptation).

From the point of view of psychology, stress resistance is a complex and capacious quality of personality; in general, the adaptivity of the body is the amount of its functional reserves that constantly help to maintain the balance between the body and the environment. The need to adapt to changing environmental conditions and maintain homeostasis requires to use certain regulatory mechanisms. Adaptation of the body to the effects of environmental factors occurs by mobilizing and spending functional reserves, ie, the body retains the necessary life homeostasis by reacting – the development of general adaptive reactions. Our studies showed that the majority of students-participants of the study - have a suboptimal physiological functional state. Another important result of the study was the diagnosing of increased anxiety in all cases of suboptimal functional state.

The role of emotions in the formation of psychophysiological relations (the system of interaction of mental and biological factors) is studied both in psychology and in physiology for many years. The role of emotions is determined by the fact that emotions, acting as a subjective experience of individually significant stimuli, include reactions from various physiological systems due to connections in the brain (Kitaev-Smyk, 2003). At the same time, the reaction of the autonomic nervous system is inevitable. The influence of emotional stress on somatic functions is realized due to the fact that emotional mechanisms, frustration and anxiety are related to the inclusion in the process of psychophysiological regulation the integrative cerebral systems.

Currently, the scientists have accumulated extensive electrophysiological data on various forms of involvement of the cortical-limbic-hypothalamic system in response to various forms of stress on the body. The special literature shows the importance of afferent-efferent connections of the hypothalamus, thalamus, amygdala, hippocampus and various parts of the cerebral cortex in stress resistance processes. The role of ANS is crucial in the regulation, coordination and adaptation of the activities of organs according to the needs of the body. ANS plays an important integrative role at the central level, allowing the body to adapt to new conditions and resume its work as a whole. The state of the ANS determines the power of the adaptive reserves of the body, the effectiveness and choice of adaptation strategies, efficiency and success of activities, as well as some personality traits. The activity of the ANS provides for adequate physiological support of free behavior and, at the same time, the maintenance of homeostasis (Stress: micro- and macro-levels, 2003; Theorell, 2003). In addition to vegetative-humoral and metabolic shifts, the described syndrome also includes an increase in muscle tone, diffuse or structured, which should be taken into account when planning corrective exercises (Medvedev, 2003).

Taking into account the undeniable postulate that the development of stress reactions is caused by emotional tension, we should consider that for developing an inadequate stress response the background condition of the body, including interhemispheric asymmetry, the state of the initial autonomic tone, microcirculation are significant. These indicators should be taken into account when diagnosing the functional state of students and taking measures for the development of stress resistance.

The conducted research shows that the concept of stress resistance, defined in neuropsychology on the basis of studies of individual lateral profile does not precisely reflect the stress resistance of the organism

as a complex of psycho-physical balance, but the most significant is hemispheric asymmetry, it should be studied in the researches of stress resistance, along with the study of the autonomic nervous system (on the basis of the initial vegetative tonus and vegetative response scale of the test of Yakhin and Mendelevich, 2005) and study of anxiety.

The specifics of the development of students' stress resistance is revealed in the works by Lozgageva (2014), Prokhorov and Yusupov (2015), Shcherbatykh (2010), Teplyakova (2018) and others. It should be noted that the problem of developing stress resistance in students in educational activities is not solved. This is also important because the body of a student, especially a freshman, is not yet fully formed, there is a final stage of ontogenesis, which will determine the psychophysiological and social development of the body, and hence the effectiveness of adaptive reactions, stress resistance, success in future professional and social interactions.

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