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## ALGORITHM FOR DETERMINING THE FEATURES OF A PERSON'S PSYCHOEMOTIONAL AND FUNCTIONAL STATE UNDER STRESSFUL CONDITIONS

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**Introduction.** Long-term stress from negative emotions experienced as a result of psychotraumatic events leads to a disorder of adaptation mechanisms with a deterioration in the functional state and, subsequently, to psychosomatic diseases. Currently, the task of early detection of such stress-producing states is becoming particularly relevant.

**The purpose of the paper** is to develop an algorithm for determining the features of a person's psycho-emotional and functional state under stressful conditions.

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The tasks are to examine the contingent of scientific workers for functional and organic disorders of human body systems in relation with type of their constitution in terms of age and gender; to select the most effective methods of assessment of these states; to investigate the phenomenon of stress resistance in individuals with different constitutional types, psychotypes, features of the character, physical and psycho-emotional states; to conduct a quantitative assessment of the level of functional and physical state using the method of generalizing assessments.

**Methods.** To study the current psycho-emotional, physical and functional state of a person under stress, the software and hardware methodological complex "EXPRESSmed-OGLYAD" [12], described in detail in the previous work, was used. This complex was supplemented by a number of methods and scales for determining psycho-emotional and psychosocial characteristics, in particular the type of temperament (G. Eysenck test); determining the current psycho-emotional state – Eysenck Mental States Assessment Scales: Frustration Scale, Anxiety Scale, Aggression Scale and Rigidity Scale, determination of stress resistance and social adaptation by Holmes and Raghe, determination of stress resistance, positive mental health scale, determination the distressing "D" personality type with the DS 14 questionnaire "Standard Assessment of Negative Affectivity, Social Inhibition and Type D Personality", determination of susceptibility to PTSD, hospital anxiety and depression scale (HADS); as well as assessment of the individual's character traits according to the "TOHO" program. A medical examination and expert assessment of health status were performed on a 5-point scale – expert assessment of the doctor (EAD). All obtained primary parameters were used both for independent analysis and for calculating a number of indices and health assessments, in particular biological age, aging rate, level of physical condition according to Pirogova's method (1986). To assess the general functional state, the method of generalized assessments was used [12].

**Results.** A total of 63 scientists of different age and gender were tested. The age and gender distribution was comparable between all groups and had the following form: 18–45 years (women – 10 people, men – 10 people); 46–65 years (women – 12 people, men – 10 people); 66–75 years (women – 11 people, men – 10 people).

**It was revealed:** a decrease in the level of stress resistance, which was most clearly reflected in the scales of positive mental health, HADS, Eysenck's mental states, the DS 14 scale for determining the distressing "D" type; a decrease in adaptive potential; a decrease in the general level of health, which is determined by the indicators included in the general health assessment of the "GHA". When analyzing personal and family history data, it was found that the vast majority of respondents (about 90%) has psychosomatic diseases, in particular, arterial hypertension, ischemic heart disease, diseases of the digestive system, including gastric and duodenal ulcers, diabetes mellitus, vascular diseases of the extremities, bronchial asthma, and others. It has been shown that the basis of these diseases is hyper-sympathicotonia, an invariable companion of any stress. In the majority of the studied individuals, a low level of Baevsky's adaptive potential was found, which indicates unsatisfactory adaptation to stress and resource exhaustion, which invariably leads to somatic diseases of a psychogenic nature.

**Conclusions.** The conducted research has multifaceted importance, as it makes it possible the monitoring the functional state and identifying the dangerous for health and life conditions of employees, using simple screening tools, such as questionnaires and simple non-invasive methods and refer them to the medical institutions early and provide advice on life-style adjustments.

**Keywords:** long-term stress, functional state, adaptation mechanisms, stress resistance, constitutional type, type of temperament.

## Introduction

Stress is an indisputable companion of our lives. It can be caused by both positive and negative and have different durations. Short-term stress can be useful, activating the body's resources and making it worse the reaction

of the nervous system. In contrast, long-term stress from negative emotions experienced as a result of psycho-traumatic events, physical pain etc. leads to a disorder of adaptation mechanisms with a deterioration in the functional state and, subsequently, to psychosomatic diseases. Currently, the task of early detection of such stressful conditions is becoming particularly relevant.

According to V.P. Bulakh [1], the consequences of stress is divided into physiological, subjective, behavioral, and cognitive. Among the physiological consequences of stress, the most studied group of the so-called "seven sacred cows" of psychosomatics is traditionally distinguished: diseases of the cardiovascular system (essential hypertension; ischemic heart disease (IHD) etc.); gastrointestinal tract (gastric and duodenal ulcer, non-specific ulcerative colitis); respiratory system (bronchial asthma (BA), chronic obstructive pulmonary disease (COPD); thyrotoxicosis (Graves' disease); rheumatoid arthritis; neurodermatitis). The subjective consequences of stress are a feeling of fatigue, guilt, anxiety, the world looks "gray", apathy, lack of meaning in life etc. Among behavioral disorders, there is a tendency to take out negative emotions on other people, inappropriate behavior with a decrease in the level of self-control is noted, excitability, reactivity, aggressive behavior may be increased; underestimation or overestimation of self-esteem of one's capabilities by the individual, there is an imbalance between intended and real plans, restlessness, incoherence of actions, inaccuracy and errors in work, work does not bring the same joy; this may be withdrawal into oneself and/or manifestations of negativism. As a result, cognitive disorders occur of imbalance in the processes of attention, memory, thinking, and volitional sphere. There is a deterioration in memory, difficulty in concentrating, inability to concentrate, frequent loss of the main line of conversation etc. [2, 3]. As a rule, the presence of a stressful state is diagnosed using test questionnaires, where a wide range of internal states is presented in the form of affirmative or negative questions.

An universal reaction of the body, reflecting all links of the regulatory system, is the variability of the heart rate, and it is the vegetative support that makes it possible to assess the adaptive reserves of the body and the functional state of a person. It was shown by numerous studies [4] the diagnostic value of determining the vegetative balance of the sympathetic and parasympathetic systems in relation with changes in the central nervous system that occur under the influence of chronic stress (PTSD, anxiety-depressive syndrome etc.), which are considered as predictors of psychosomatic cardiovascular diseases. According to Chaban O.S. et al., the search for possible early predictors of the PTSD and effective strategies for early interventions immediately after the action of mental trauma is one of the key aspects of modern psychiatry and medical psychology [5].

The studies of the phenomenon of individual stress resistance of a person, which, according to Kornatsky V.M., identifies people at high risk

of mental disorders and the development of psychosomatic diseases are drawn attention [6].

Depending on how much a person can withstand stressful situations and adapt to them, they talk about stress resistance, which means the ability of an individual to self-recover after the stressful events. It is believed that this is a genetically inherited, as well as formed in the process of life, the ability of the human body to resist the effects of negative factors. Stress resistance is an integral ontogenetically determined property of a holistic personality, interconnected with a multi-level system represented by a complex of cognitive, intellectual, emotional, and personal properties. The degree of expression of stress resistance has an individual differences and is determined by the qualitative and quantitative characteristics of the personality properties. Specific signs of lack of stress resistance are: low differentiation, reduced adaptive potential, preservation of the bipolar structure of the organization of factors etc. [7].

A number of researchers, considering the problem of individual characteristics of stress resistance, associate the level of development of this psychological phenomenon with a wide range of psychological characteristics of the personality, such as anxiety; aggressiveness; locus of subjective control; motivational orientation of the personality [8].

According to the psychoanalytic concept of Z. Freud, suppressed affect, mental trauma through conversions can manifest as a somatic symptom, while "somatic readiness" is necessary – a physical factor that is important for "organ selection". In this sense, the peculiarities of the human constitution and consequential genetic factors should be taken into account [9].

We believe that research into the phenomenon of both stress resistance and human constitution will help in the early diagnosis of human health threatening and in the selection of adequate corrective influences [10].

In the formation of the nature of the somatic response to a stressful situation, the human constitution plays a decisive role. The relationship between the types of constitution and the predisposition to certain somatic diseases, the development of which usually starts against the background of stressful events, is evidenced by numerous works of both domestic and foreign scientists from ancient times to the present day (Hippocrates, Krechmer, Sheldon, Seago, Bogomolets, Chernorutsky and others). In the previous work, we came to the conclusion that the most widely used and closest to medical practice are the ideas about the constitution that combine somatotype, body type and temperament [11].

**Purpose:** to develop an algorithm for determining the features of a person's psycho-emotional and functional state under stressful conditions.

**Tasks:** to examine the contingent of scientific workers for functional and organic disorders of human body systems in relation with type of their constitution in terms of age and gender; to select the most effective methods of assessment of these states; to investigate the phenomenon of stress resistance in individuals with different constitutional types, psycho-

types, features of the character, physical and psycho-emotional states; to conduct a quantitative assessment of the level of functional and physical state using the method of generalizing assessments.

## **Object and Methods of the Study**

To study the current psycho-emotional, physical and functional state of a person under stress, the software and hardware methodological complex "EXPRESS med OGLYAD" [12], described in detail in the previous work, was used. This complex was supplemented by a number of methods and scales for determining psycho-emotional and psychosocial characteristics, in particular the type of temperament (G. Eysenck test); determining the current psycho-emotional state - Eysenck Mental States Assessment Scales: Frustration Scale, Anxiety Scale, Aggression Scale and Rigidity Scale, determination of stress resistance and social adaptation by Holmes and Rague, determination of stress resistance, positive mental health scale, determination the distressing "D" personality type with the DS 14 questionnaire "Standard Assessment of Negative Affectivity, Social Inhibition and Type D Personality", determination of susceptibility to PTSD, hospital anxiety and depression scale (HADS); as well as assessment of the individual's character traits according to the "TOHO" program. A medical examination and expert assessment of health status were performed on a 5-point scale - expert assessment of the doctor (EAD). All obtained primary parameters were used both for independent analysis and for calculating a number of indices and health assessments, in particular biological age, aging rate, level of physical condition according to Pirogova's method (1986). To assess the general functional state, the method of generalized assessments was used [12].

The General Health Assessment (GHA) in our case has the following form:

$$GHA = (VI + BMI + AR + AP + PhL + FL + EAD) / 7$$
, we included the following assessments and indices: VI - Vega-Kerdo's index; Ketele's body mass index (BMI); Aging rate (AR); Baevsky's adaptive potential (AP); Physical condition level according to the Pirogova's method (PhL); Functional Level of the cardiovascular system (CVS) according to the Phaeography method (FL); Expert assessment of the doctor (EAD).

This diagnostic screening complex is aimed at identifying, and subsequently correcting, such conditions as PTSD, which are a risk factor for psychosomatic diseases, as well as identifying patterns of the impact of long-term stress on people of different temperaments and features of the character, in different gender and age groups.

For statistical processing, descriptive statistics and correlation analysis methods were used.

## **Analysis of the Received Data**

A total of 63 scientists of different age and gender were tested. Taking into account the phenomenon of age-related crisis periods, age groups were formed, because of peculiarities of development the neuroendocrine

system with a cardinal restructuring of physical and personal status. The age and gender distribution was comparable between all groups and had the following form: 18–45 years (women – 10 people, men – 10 people); 46–65 years (women – 12 people, men – 10 people); 66–75 years (women – 11 people, men – 10 people).

Regarding temperament, it was comparable between different types in different age and gender groups. In the general group, the advantage of phlegmatics (to a greater extent) and, to a lesser extent, melancholics of both sexes over choleric and sanguine people was noted.

When studying the relationship between constitutional types and temperament in the general group of both sexes, it was found that the majority of people (61.9%) belong to the normosthenic type of physique with a phlegmatic type of temperament (33.4%) and, to a lesser extent, melancholics (12.9%); phlegmatics also prevail in the group of asthenics, of which 25.4% (Table 1). But among hypersthenics, who are the least in the general group (12.7%), melancholics prevail. We believe that such a distribution is associated with the specifics of professional activity, which requires focus and concentration on the problem should be developed.

The phenomenon of stress resistance was studied on separate scales in relation to the types of constitution and temperament.

To assess the level of stress resistance, questionnaires that indicate the presence or absence of psycho-emotional signs of stress damage were used; the results on individual scales of the questionnaires according to a 3-level system were ranked: absence (optimum,  $\geq 3$  points), moderate (borderline) (satisfactory,  $2 \geq 3$  points) and expressed level of stressor signs (unsatisfactory,  $1 \geq 2$  points). Therefore, a conclusion about the level of stress resistance in individual groups was made. The total sum of points for each scale in individual groups (asthenics, normosthenics and hypersthenics) was calculated, and then summed up and the arithmetic mean score of stress resistance for each group was determined. Finally, the average level of stress resistance for the general array of researched individuals was determined.

In particular, when studying the relationship between stress resistance and body type, the following features were identified. In each of

**Table 1. The relationship between constitutional type and temperament in the general group of both sexes**

Constitutional type, %	Temperament type, %			
	Melancholic person	Choleric person	Phlegmatic person	Sanguine person
Asthenics – 16 people (25.4)	4 (25)	2 (12.5)	7 (43.75)	3 (18.75)
Normosthenics – 39 people (61.9)	8 (20.5)	4 (10.3)	21 (53.8)	6 (15.4)
Hypersthenics – 8 people (12.7)	4 (50)	1 (12.5)	1 (12.5)	2 (25)
Total	16 (25.4)	7 (11.1)	29 (46)	11 (17.5)

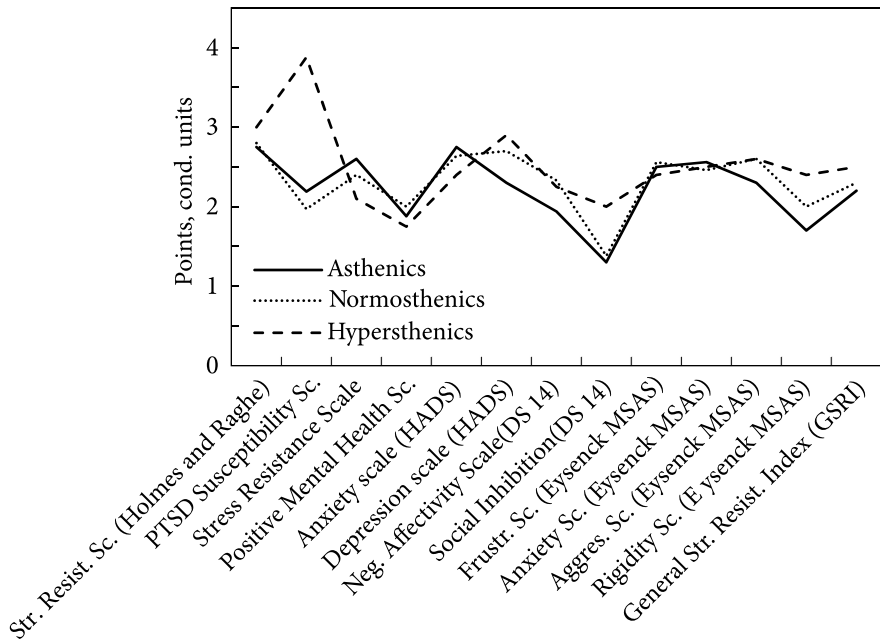


Fig. 1. The relationship between constitutional types and stress resistance for the general group

the three constitutional groups, the average level of stress vulnerability is noted in the general array, but there are differences between individual scales. Thus, according to the results of testing using the DS 14 questionnaire “Standard Assessment of Negative Affectivity, Social Inhibition and Tipe D Personality”, the presence of a distress D-type in the asthenics group, which indicates a predisposition to cardiovascular diseases and is a confirmation of their psychosomatic origin was revealed; a lower than average level of mental health and pronounced rigidity of the nervous system on the Eysenck scale are also noted. In normosthenics, who are the vast majority, the results are more equal, but there is a high level of social inhibition, and in hypersthenics – a somewhat lowered level of mental health with a simultaneously high level of stress resistance according to the Holmes and Raquet scale and a high tendency to PTSD.

For clarity, the relationship between stress resistance and body type is depicted in Figure 1.

Of interest are the results of the study of the relationship between temperament types and stress resistance, both on individual scales and on the generalized stress resistance index (GSRI). The generalized index was calculated on a 3-point system as the arithmetic mean of the sum of all 12 scales.

Assessment on a 3-level scale showed differences in the levels of stress resistance in the compared groups. The largest deviations on 8 scales out of 12 were found in melancholics, in particular: the greatest susceptibility to PTSD, the lowest level on the scale of positive mental health, the highest

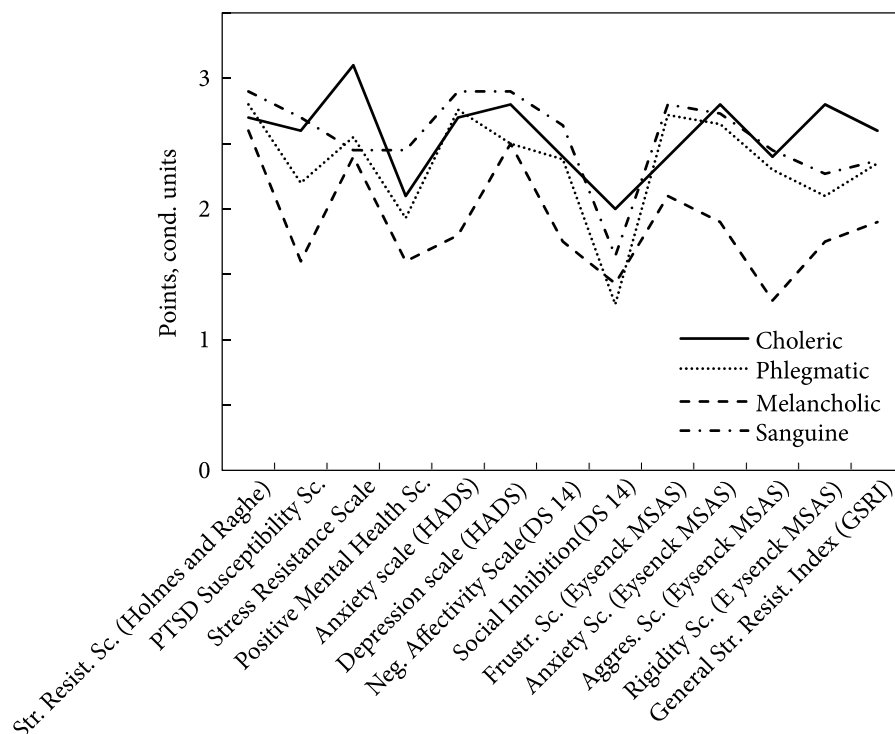


Fig. 2. The relationship between temperament types and stress resistance for the general group

level of anxiety on two scales: HADS and Eysenck’s mental states, a high level of social inhibition and negative affectivity (DS 14), as well as a high level of aggressiveness and rigidity (Eysenck). In general, the melancholics group showed the lowest stress resistance. The choleric group has an average level of stress resistance on all scales and a high level on the stress resistance scale. Phlegmatics also have an average level of stress resistance on all scales except the social depression scale (DS 14), where it is the lowest in the array, and also have a low level of positive mental health. Sanguines have an average level of stress vulnerability on all scales except the social inhibition scale (DS 14), where, as in other temperament types, there is a high level of social inhibition.

For clarity, the relationship between stress resistance and temperament types is depicted in Figure 2.

Therefore, in our opinion, the types of constitution and temperament are important coordinates that determine the characteristics of the response to a prolonged stressful situation, which is manifested by anxiety, a low level of positive mental health and a feeling of social inhibition in the studied individuals. This was most clearly reflected when using the following scales: positive mental health, HADS and Eysenck’s mental states, as well as the scale for determining the distress type DS 14. We believe that these scales are appropriate to choose for monitoring the current psycho-emotional state of employees and further screening studies.

According to the results of the study of the current physical and functional state of employees using the above-described method ("EXPRESS med OGLYAD") [12], an array of actual indicators was obtained, on the basis of which a complex of calculated indicators and indices was formed. They have a high level of informativeness about the physical and functional state of the studied person, namely: VI – Vega Kerdo's index; Ketele's body mass index (BMI); Aging Rate (AR); Baevsky's Adaptive Potential (AP); Physical condition level according to the Pirogova's method (PhL); Functional Level of the cardiovascular system (CVS) according to the Phaseography method (FL); Expert Assessment of a Doctor (EOL).

The results of the study of the current physical and functional state and their analysis using the method of generalizing assessments on a 5-point scale showed that, divided into types of constitution, employees have average group health values at an average level, regardless on the type of constitution and age groups, with the exception of the age group 45–65 years and 66–75 years, where it is the lowest for hypersthenics – 2.8 and 2.9 points, respectively, due to the low Physical condition Index according to Pirogova, Ketele's Body Mass Index and low Adaptive Potential of Baevsky. In contrast, young hypersthenics showed an excellent result according to Pirogova's Physical condition Index and "good" according to the Vega Kerdo's Index, Functional Level of the cardiovascular system (FL), Expert Assessment of the Doctor and the General Health Assessment (GHA). At the same time, there is an average assessment according to the Baevsky Index, which indicates the tension of regulatory systems, but unsatisfactory adaptation occurs in middle-aged and mature age groups, regardless of the type of constitution. In addition, analysis of Heart Rate Variability data according to phaseography and Kerdo's Vega Index showed a tendency to sympathicotonia in the entire sample.

When analyzing personal and family history data, it was found that the vast majority of respondents (about 90%) have psychosomatic diseases, in particular, arterial hypertension, ischemic heart disease, diseases of the digestive system, including gastric and duodenal ulcers, diabetes mellitus, vascular diseases of the extremities, bronchial asthma and others. The basis of these diseases is hypersympathicotonia, an invariable companion of any stress. This was confirmed by a study of a contingent of scientists on the level of stress resistance according to scales, which showed an average and low level of this phenomenon in the majority of the studied individuals. Physiologically it manifests itself by a low level of Baevsky's adaptive potential, which indicates unsatisfactory adaptation to stress and exhaustion of resources, which invariably leads to somatic diseases of a psychogenic nature.

## **Conclusions**

The hypothesis of the stress-inducing effect of the current social situation on the functional, physical and psycho-emotional state was confirmed, as evidenced by a decrease in the level of stress resistance, adaptive po-

tential and general health, which is determined by the indicators included in the General Health Assessment (GHA).

The phenomenon of the constitution, including the type of temperament and the phenomenon of stress resistance are important information indicators of the development of psychosomatic diseases under the influence of negative psychogenic factors, which is most clearly reflected in the following scales: positive mental health, HADS and Eysenck's mental states, as well as the DS 14 scale for determining the distressing "D" type. We believe that these scales are appropriate for monitoring the current psycho-emotional state of employees as a control in further screening studies.

The conducted research has multifaceted importance, as it makes it possible the monitoring the functional state and identifying the dangerous for health and life conditions of employees, using simple screening tools, such as questionnaires and simple non-invasive methods and refer them to the medical institutions early and provide advice on lifestyle adjustments.

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#### АЛГОРИТМ ВИЗНАЧЕННЯ ОСОБЛИВОСТЕЙ ПСИХОЕМОЦІЙНОГО І ФУНКЦІЙНОГО СТАНУ ЛЮДИНИ ЗА СТРЕСОГЕННИХ УМОВ

**Вступ.** Тривалий стрес від негативних емоцій, що їх переживають внаслідок психотравмуючих подій, призводить до розладу адаптаційних механізмів з погіршенням функційного стану та, як наслідок, до психосоматичних захворювань. Наразі особливої актуальності набуває задача завчасного виявлення таких стресогенних станів.

**Мета.** Розробити алгоритм визначення особливостей психоемоційного і функційного стану людини за стресогенних умов.

Дослідити контингент наукових працівників у віковому та гендерному аспекті на наявність функційних та органічних розладів органів та систем у взаємозв'язку з типом їх конституції; відібрати найефективніші методики оцінювання цих станів; дослідити феномен стресостійкості в осіб з різним конституційним типом, психотипом, особливостями характеру, фізичним та психоемоційним станом; провести кількісне оцінювання рівня функційного та фізичного стану за методом узагальнювальних оцінок.

**Об'єкт і методи дослідження.** Для дослідження поточного психоемоційного, фізичного та функційного стану людини в умовах стресу було використано програмно-апаратний методичний комплекс «ЕКСПРЕСмедОГЛЯД» [12], доповнений рядом методик та шкал на визначення психоемоційних та психосоціальних характеристик, зокрема: типу темпераменту (тест Г. Айзенка); визначення поточного психоемоційного стану — оцінювання психічних станів за Г. Айзенком (шкала фрустрації, шкала тривожності, шкала агресивності, шкала ригідності), визначення стресостійкості та соціальної адаптації за шкалою Холмса і Раге, визначення стійкості до стресу, шкала позитивного ментального здоров'я, визначення належності до дистресорного «Д» типу особистості, визначення схильності до ПТСР, госпітальною шкалою тривоги та депресії (HADS); а також оцінюванням особливостей характеру індивіда за програмою «ТОХО». Лікарі проводили огляд та експертне оцінювання стану здоров'я за 5-ти бальною шкалою — експертне оцінювання лікарем (ЕОЛ). Всі отримані первинні параметри використовувались і для самостійного аналізу, і для обчислення ряду індексів та оцінок здоров'я, зокрема біологічного віку, темпу старіння, рівня фізичного стану за Пироговою (1986). Для оцінювання загального функційного стану використали метод узагальнювальних оцінок [12].

**Отримані результати та їх аналіз.** Всього було протестовано 63 науковця різного віку і статі. Віковий та гендерний розподіл, порівнюваний між усіма групами, був таким: 18–45 років (жінок — 10 осіб, чоловіків — 10 осіб); 46–65 років (жінок — 12 осіб, чоловіків — 10 осіб); 66–75 років (жінок — 11 осіб, чоловіків — 10 осіб).

Було виявлено зниження рівня стресостійкості, що найвиразніше відобразилось за шкалами позитивного ментального здоров'я, HADS, психічних станів Айзенка, шкалі DS 14 на визначення дистресорного «Д» типу; зниження адаптаційного потенціалу; зниження загального рівня здоров'я, що визначається за показниками, які увійшли до узагальнювальної оцінки здоров'я «УОЗ». При аналізі даних персонального і сімейного анамнезу було виявлено, що у переважній більшості респондентів (близько 90 %) є захворювання психосоматичного характеру, зокрема артеріальна гіпертензія, ішемічна хвороба серця, захворювання травної системи, у тому числі виразкова хвороба шлунку і 12-палої кишки, цукровий діабет, судинні захворювання кінцівок, бронхіальна астма тощо. Було показано, що в основі цих захворювань — гіперсимпатикотонія, незмінна супутниця будь-якого стресу. У переважній кількості досліджуваних осіб було виявлено низький рівень адаптаційного потенціалу Баєвського, що свідчить про незадовільну адаптацію до стресу та виснаження ресурсів, яке незмінно веде до соматичних захворювань психогенного характеру.

**Висновки.** Проведене дослідження має багатоаспектне значення, оскільки дає можливість простими скринінговими засобами, якими є опитувальники та нескладні неінвазивні методи, проводити моніторинг функційного стану працівників та виявляти небезпечні для здоров'я і життя стани, щоб завчасно скеровувати людей до медичних установ та надавати поради щодо коригування способу життя.

**Ключові слова:** тривалий стрес, функційний стан, адаптаційні механізми, стресостійкість, тип конституції.