Principles and Constants of the Golden Proportion as a Criterion in Donosological Diagnostics of the Functional States of The Body and in the Assessment of the Probability of their Changes

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Annotation

A functional state is a complex of properties of an organism that determines the   level of its vital activity. The construction of human functional structures is based on the laws of nature. The golden proportion is a universal natural law and the highest manifestation of the structural and functional perfection of the organism, and has properties and principles self-development, self-organization and self-regulation, balance and stability. It is found in the anatomical and physiological parameters of the human body, is a method for finding an extremum in solving problems of their optimization. Proceeding from the fact that the functional state of the cardiovascular system is an integral indicator of the general state of the body and its adaptation, as a process of searching for the optimal functional state, we studied this indicator in 43 young people. At the same time, it was found that the subjects under conditions of functional rest and in a satisfactory state of compensatory-adaptive capabilities, i.e. in prenosological conditions, their adaptive potential lies in the range of two values of the golden proportions (F = 1.618; F2 = 2.618). Thus, the golden proportions form the boundaries of the functional corridor, outside of which there is a change in the prenosological state of the body, namely, with an adaptive potential of less than 1.618, a physiological norm takes place, and with more than 2.618, premorbid states. In this regard, it is proposed a scale for assessing the functional state, as well as an index of the likelihood of developing a premorbid state in an individual's body, based on the principles and constants of the golden ratio. The discriminatory ability and sensitivity of the proposed scale to the functional states of the organism were assessed.

The Relevance of Research

International standards for the provision of medical care provide for the implementation of preventive measures aimed at preventing the occurrence of diseases already at the stage of their initial manifestations. At the same time, the existing system of

primary prevention is still devoid of the most important element - objectification of the assessment of the functional state of the body at the level of a pre-morbid state, when, as a result of the inconsistency of the body's capabilities, the prerequisites for the development of the pathological process arise. Such a gap in the system of primary prevention is intended to fill the methodology of prenosological diagnostics, according to which the development of clinical forms of diseases is preceded by quite definite disorders of the functional state (FS) of the body, in which the nonspecific component of the general adaptation syndrome manifests itself in the form of varying degrees of tension in the regulatory systems. FS is a systemic response of the body, ensuring its adequacy to the requirements of the activity. The assessment of the FS of a practically healthy person is an object of prenosological diagnostics, in which the main criterion of health is not the presence or absence of diseases, but the level of the organism's adaptive capabilities [1,2]. At the same time, two levels of degrees of tension of adaptation mechanisms are used as objective signs:

- Prenosological, characterized by the tension of regulation mechanisms

- Premorbid, where is decrease in the adaptive capabilities of the body.

At the same time, under the influence of negative factors that go beyond the functional and adaptive capabilities of the body, the presence of qualitative transitions in the state of physiological functions is also a regularity. They cause a number of changes in functional systems, change the regulatory and adaptive status of the body, determining the state of human health. Thus, the transition to each new gradation of adaptation is accompanied by qualitatively new changes in the FS.

In general biological terms, health can be defined as a harmonious unity of all kinds of metabolic processes in the body and manifested in the optimal functioning of its organs and systems [5]. The human body adapts to environmental conditions by changing the level of

functioning of individual systems and the corresponding tension of regulatory mechanisms. At the same time, the FS of the body is a complex and integral characteristic reflecting the level of adaptation of regulatory systems in the current conditions of existence. In essence, the principle of the mechanism of physiological adaptation is to ensure the harmony of opposites, as a result of which the optimization of the relationship of the organism with the environment and the efficiency of functioning is ensured.

Thus, the concepts of "functional state" and "regulatory-adaptive status of the organism" in modern physiology are considered as an integral part of individual health and as one of the important criteria of health.

Monitoring the health of healthy people, that is, prenosological control, is a practical step towards dynamically assessing the state of adaptation and regulatory systems, identifying the very initial manifestations of their overstrain and, through their prevention, ensuring the preservation of the health of healthy people.

Therefore, the development of a non-invasive express method, criteria and scales for assessing the prenosological level of individual health and, on their basis, the creation of technology for remote prenosological diagnostics and monitoring of the health of a healthy contingent of the population is an urgent task of preventive medicine.

With this, we have previously developed and proposed a number of non-invasive methods and technologies for prenosological assessment of the levels of individual health of healthy people [16-18]. However, in this case, the criteria for assessing health levels were either the average statistical indicators of a large number of surveyed people [1,2], or various subjective factors. In these studies, the definition of the criteria for assessing the levels of the functional state of the body, we carried out on the basis of physiological optimization processes provided for by the natural technology of homeostasis.

As a justification of this approach, we note that

the level of formalization of knowledge in prenosological diagnostics is currently quite high, therefore it is possible to use rigorous mathematical procedures and statistical methods for recognizing states in it.

The level of formalization of knowledge in prenosological diagnostics is currentl y quite high, therefore it is possible to use strict mathematical procedures and statistical methods for recognizing states in it. However, the existing approaches to the synthesis of criteria and algorithms for prenosological diagnostics do not fully use the capabilities of modern methods of mathematical data analysis. When developing integral criteria for assessing FS (functional state), empirical approaches prevail, in which the criteria are built by arithmetic combinations of recorded indicators. Classes of states according to individual criteria are distinguished by an expert method, and there is still no unified methodology and criteria for a reliable assessment of the levels of functioning of the human body [3]. Therefore, they are highly specific to any one state of the organism, and the revealed information does not allow, in most cases, to integrally assess the state of the organism as a whole. These shortcomings are largely due to the lack of scientifically substantiated methodologies, criteria and decision-making algorithms in the prenosological assessment of human FS, taking into account the principles and mechanisms of their formation, optimization, stability and change. The solution to this problem requires taking into account that the functioning of multilevel systems, to which a person belongs, is faced with the tasks of not only optimizing the opposites of a particular parameter, but also their optimal coordination. The body is a self-organizing system, it chooses and maintains the values of a huge number of parameters, changes them depending on the needs, which allows it to ensure optimal functioning. Harmony is a criterion for the viability of a system, a way of functioning of any system, which consists in the rhythmic flow of opposites into each other [4]. Thanks to the active and continuous work of regulatory systems, the body optimizes its relationship with the factors affecting it. And, in the case of a decrease

in the adaptive reserves of the body, its unstable state is generated and the FS transition through the bifurcation point to a new level - to the corresponding maladaptive state. Thus, a living system is capable of restructuring, moving to a new homeostatic level, while activating some regulatory systems and inhibiting others. In other words, health can be considered as the severity of adaptive reactions. As you can see, in the issue under consideration, the influence of the principles and optimization factors is great. This is due to the fact that the essence of optimization, which underlies the development of the biological world [5], is the desire to obtain the maximum positive adaptive result with minimum energy and plastic costs. Maladaptive. Efficiency of functioning is the main feature of the adapted system, while the harmony of functional relationships is a universal fundamental principle that ensures the optimal functional state and maximum adaptive capabilities of the organism. In this regard, one of the most important tasks is to identify the criteria of harmony, in accordance with which individual "simple" systems are combined into stably functioning living systems. One of the manifestations of such a structural and functional balance is its compliance with the "Golden Section" rule [4]. Studies on the study of the morphological and functional balance of the body indicate that at various levels of organization of living systems, the specified golden proportion is revealed as an indicator of proportionality and harmony. It is believed that the principle of the "golden ratio" is the highest manifestation of structural and functional perfection in nature, including medicine. The mathematical principle of the proportion of the golden section, the unity of additivity and multiplicativity, fully corresponds to the law of harmony - the unity of form and content. To date, the laws of the golden ratio in many areas of medicine have been scientifically proven, in particular, it has been revealed [6,7,14] that the golden proportion is the criterion of optimality in the choice of the parameters of many morpho-functional indicators for the human body. For example, in anatomy, these are the vertical proportions of the body, the ratio of the linear dimensions

of bones and other formations. Also, many studies have been carried out to determine the "golden section" of the cardiovascular, sensory, respiratory and other systems. The meaning of the harmonious functioning of the body, according to V.D. Tsvetkov [7] is that the systems subordinate to him, act on the principle of system optimization in relation to the minimum energy consumption. In the process of adaptation of the organism to changed conditions and while ensuring homeostasis, that is, during the period of self-organization and functioning, it tries to minimize its energy expenditures, aimed at ensuring stable states or functions, and searches for an energy extremum. At the same time, the optimal search algorithm is the natural partition of the space on which the search takes place, in the golden proportion $(1 / F = 0.618)$. In the adaptation system, as in any "seeking", self-organizing natural system, a certain minimum number of search steps is "planned". To find extrema, he can use the Fibonacci number system depending on the numbers of the golden ratio. In work [8] it is shown that in the range from physiological rest, with characteristics of satisfactory adaptation, to the maximum allowable physical stress at the border of adaptation breakdown, the ratio of a number of functional indicators of the organism is in the range of two values of the "golden ratio". The revealed patterns give the author a reason to consider the golden proportions of the cardiorespiratory system as a universal tool for assessing the FS and the adaptive capabilities of the organism. Based on this, a fundamentally new idea of the boundaries of fluctuations of functional indicators, designated as a corridor reflecting the volume of the body's adaptive capabilities, was formulated:

Thus, the golden proportions of physiological indicators act as markers of transient states. The revealed phenomenon of golden proportions represents a new direction in assessing the adaptive capabilities of the human body. In the light of the above, it can be argued that the problem of reliably determining a specific place of the functional state of a certain person in the space between norm and pathology, i.e. establishing the belonging of a given person to a certain class of functional states is an urgent task of prenosological diagnostics.

When solving this problem, it becomes necessary to use a special scale, which is the most important tool for processing and fixing information about the object under study and designed to ensure its optimal processing. Thus, the main purpose of the scaling procedure is the ability to assess the processes under study. The above facts and provisions made it possible to formulate the following objectives of our research:

Goals and Objectives of the Study and their Practical Significance

Development, based on the principles and constants of the golden ratio, scales and criteria for assessing functional states and verification of prenosological levels of the body's health; -Based on the survey data of the most informative, morpho-functional indicators of a practically healthy contingent of young people, to assess the possibilities of the proposed criteria and scale; - To develop methods and criteria for assessing the index of functional stability of the organism and the likelihood of its qualitative change. For practical health care, prenosological diagnostics, in accordance with the proposed scale, allowing an early assessment of the level of health and risk factors, opens the way to increasing the effectiveness of health-improving measures and significantly complements the preventive principle in medicine.

Subject of research: In accordance with the goals, the subject of our research was the levels of the organism's adaptive potential as markers for assessing its functional state, as well as scales and criteria for their verification and interpretation.

Methods and Objects of Research.

In this work, we used statistical methods for quantitative and verbal assessment of examination results and methods for constructing medical rating scales.

As the most informative markers of the functional state of the organism, were used their adaptive potential, levels of somatic health and energy potential.

Among the entire spectrum of methods for analyzing the adaptive potential of a person, based on the assessment of various parameters of vital activity, the most informative are those that characterize the activity of the cardiovascular system (CVS) - the main indicator of all events occurring in the body. The formation of other systems largely depends on the state of this system, since, by participating in metabolic processes, the circulatory system determines the further viability of the entire organism as a whole.

In addition, this system plays a leading role in providing adaptation processes. We calculated AP, in arbitrary units - points, according to the formula of R. Baevsky [1], which uses data on pulse rate (HR), blood pressure (SBP - systolic, DBP - diastolic), age (A), height (H) and body weight (BW):

AP= 0,011 PR+0,014 SBP+0,008 DBP+0,014 A+0,009 BW-0,009 H-0,27.

To assess the level of physical health, we used the express method of G LApanasenko [13]. To assess the level of health, measured at rest: vital capacity of the lungs (VC); heart rate (HR); blood pressure (BP); body mass; body length and hand dynamometry.

Then is performed a functional test (Martinet's test). The recovery time of the heart rate is taken into account within 3 minutes.

Based on the obtained data, the following indices are calculated:

1. Mass index: Body weight, kg / (Height, m2), in kg / m2

2. Life index: VC, ml / (body weight, kg), ml / kg

3. Strength index: Hand strength, kg / Body weight, kg, in%

4. Robinson's index: (HRreste , beats / min) * (АДsystol) / 100, in conventional units.

5.Functional test (Martinet test)

The results obtained for all of the above indicators are evaluated in points. Summing up the scores for all five indicators and comparing them with the scale proposed by the author, the individual level of physical health of the subject was determined (low, below average, average, above average, high).

The quantitative assessment of the body's energy potential was determined by the Robinson index (RI). Note that this indicator characterizes the level of metabolic and energy processes occurring in the body and the systolic work of the heart, and together with the adaptive potential is the most sensitive marker of the state of the CVS and the adaptive mechanisms of the human body. At the same time, the assessment of RI, according to the criteria proposed by the authors - excellent indicates a high; good - about the normal functional reserve of the CVS; a, average - insufficient, bad and very bad - different levels of dysregulation of the CVS. According to the methods described above, 43 (24 girls and 19 boys) practically healthy students of youth aged 17-25 were examined. During the work we used the methods of mathematical statistics and verbal marking of results of investigations and methods of creating medical marking scales.

Results of Investigations and their Discussions

When developing methods for quantitative assessment of the level of health, the correct assessment of the functional states of the body and systems that ensure the vital activity of the body as a whole is an important task. Since medicine deals with physiological processes, it operates, as necessary, with different numerical indicators, and connections between different characteristics. Currently, in medicine, many scales and criteria for assessments and classifications are used, for various conditions [9,10]. Back in the 10th century, Avicenna gave a comprehensive classification of health levels [11], considering six classes of the functional state of the body. This classification is consistent with the modern one, which is based on the degree of tension of regulatory mechanisms (normal, moderate, pronounced, pronounced and overstrain) [1,12]. If we take into account that the assessment of the prenosological status is aimed at objectifying the adaptive activity of the organism in the process of maintaining health and the formation of prenosological states, then the position of the theory of

adaptation can be used as the basis for predicting the development of health. Adaptation as a functional property of biological objects, along with homeostasis, is one of the basic concepts of biology. RM Baevsky and AP Bersenova proposed a classification of the FS of the body, according to the index of functional changes, based on ideas about homeostasis and adaptation [1,2], providing for the allocation of four levels of health and criteria for their assessment - the higher the conditional IFCh (index of functional changes) score, the higher the likelihood of developing pathological abnormalities. On their basis, they were the first to create a scale for prenosological assessment of functional states and the degree of tension of regulatory systems.

Note that measurement in its broadest sense can be defined as assigning numbers to objects or events according to some rules. These rules should establish a correspondence between the properties of the objects in question and the numbers. In the theory of measurements, it is customary to distinguish four main types of scales: names, order, interval and relations. In this case, measurements carried out using the first two scales are considered qualitative and nonparametric criteria are used for their processing, and measurements made on the last two scales are quantitative in this case, parametric criteria are applied. In each scale, the properties of numbers assigned to objects or phenomena are strictly defined. In this regard, we have chosen the interval scale as a model of the scale for assessing FS.

In mathematical statistics, interval estimation is the result of using a sample to calculate the interval of possible values of an unknown parameter, the estimate of which must be constructed. An interval scale is a scale that classifies according to the principle "more by a certain number of units - less by a certain number of units." The use of an interval scale is also possible in the case when, using a certain criterion (measurement standard), it is possible to determine the magnitude of the difference in features not only by the type of more or less, but also by how many units one object or phenomenon differs from another. A unit of measurement is set for this measurement. The scale of intervals is a fully ordered series with calibrated intervals between ranks, with the counting starting from an arbitrary value from the chosen value (there is no absolute zero). As a result, a conclusion on the state of health is formed.

Below is one of the options for the scale, such a simplified interpretation of prenosological diagnoses.

As you can see, medical rating and prognostic scales have their own characteristics, principles and approaches to construction. From the existing scales of functional states, we have adopted an interval scale and

Standard rating scale	Simplified rating scale
Physiological state:	**Physiological state:**
1. Norms	High level of health;
2. Optimum	Optimum level of health;
3. Prenosological Good health with some condition - 1	Deviations that can be easily corrected;
4. Prenosological The level of health is mediocre,Yet condition - 2	Complete recovery of health is possible;
5. Premorbid Poor health with signs	Condition of diseases that are still compensated due to high voltage regulation systems
6. Pathological condition	The probable presence of pathology

built its following model, which follows from modern concepts and corresponds to the views of Avicenna:

Thus, the scale we recommend has 6 physiological states - "corridors" and 5 possible qualitative transitions.

Intervals of functional state	1	2	3	4	5	6
Modern Option [1,2]	Physiological norm	Physiological optimum	1-prenosology Condition stress	2-prenosology Condition Overvoltage	Premorbid fortunes	Pathology
Avicenna's version [11]	body is healthy to the limit	body is healthy, but not to the limit	the body is not healthy, but not sick	body easily accepting health	the body is sick but not to the limit	the body is sick to the limit

The next task is to determine the indicators characterizing these intervals, i.e. translate this verbal scale into a numerical one. It should be taken into account that the construction of a scale for assessing the functional state should be based on indicators acting on the principle of optimization and harmonization of the state of the body. Therefore, as an indicator of the scale of verification of the functional state of the organism, we have chosen the adaptive potential of its cardiovascular system that meets these requirements.

Since the functional state of the organism is subject to the hierarchical principle, i.e. Since a qualitative transition from one state to another is continuous, the upper boundary of each interval of the corridor is simultaneously the lower boundary of the next. Therefore, the scale proposed by us, with 6 intervals of states, is characterized by 12 boundaries, of which 5 are combined values. In accordance with the objectives of the study and taking into account the conclusions of [8], the numerical characteristics - the boundary indicators of the intervals of the proposed scale, we have determined based on the principles and constants of the golden ratio. In this case, we were guided by the fact that the n-step Fibonacci plan (Fn) is the optimal plan for finding the local minimum of the free energy consumption of the system in n-steps. Using this plan, biological systems receive the smallest errors in their work (in the search for and adaptation to the changed conditions of existence). This position explains the fact of the extraordinary frequency of finding in the structures and functions of biological systems of the "golden ratio" and the corresponding "golden" numbers. The number system for various structures and functions of a living organism cannot be determined by any one proportion, but it can use many different options, which are based on the golden ratio. Based on these provisions, in order to establish the values of the minimum and maximum boundaries of the functional corridors of the projected scale, on the basis of the constants of the golden ratio, we built two harmonic series of variability numbers, namely:

$$F^0, F^1, F^2, F^3, F^4, F^5 \quad (1)$$

$$F^2/2, F^3/2, F^4/2, F^5/2 \quad (2)$$

Taking into account the above principles of constructing the proposed scale, from the numbers of series (1) and (2), we have compiled the following boundaries of the projected 6 intervals of functional states:

$(F^0 \div F^2/2)$; $(F^2/2 \div F^1)$; $(F^1 \div F^3/2)$; $(F^3/2 \div F^2)$; $(F^2 \div F^4/2)$; $(F^4/2 \div F^3)$.

Taking into account the values of the constant of the golden ratio F = 1.6180033, the following numerical indicators An of the boundaries of 6 intervals of the scale are established:

A₁ A₂ A₂ A₃ A₃ A₄ A₄ A₅ A₅ A₆ A₆ A₇

$A_1\ A_2$ $A_2\ A_3$ $A_3\ A_4$ $A_4\ A_5$ $A_5\ A_6$ $A_6\ A_7$

(1÷1,309); (1,309÷1,618); (1,618÷2,118); (2,118÷2,618); (2,618÷3,427); (3,427÷4,236)

Thus, the scale we propose has the following criteria for the indicators of assessing states (table 1.):

The values of the boundary indicators of the scale presented in Table 1, as well as the intervals of functional states generally correspond to the principles and constants of the golden ratio and the golden wurf [6-8], namely:

1. There is a constancy of the ratios of the values of the boundary indicators of each state of the scale, equal to the constant of the golden ratio - $A_n / A_{n-2} = 1.618 = F$, where n is 3,4,5,6,7;

2. The ratio of the values of the maximum and minimum boundaries of odd intervals correspond to the numbers of the golden wurf-1.309; and even intervals are 1.236, i.e. the ratio of the constant of the golden ratio to the golden wurf.

3. The width of the functional corridors of the scale also has its "golden" features, namely, the ratio of the width of the subsequent, even interval to the previous even interval and, similarly, the ratios of odd intervals correspond to the constant of the golden ratio - F = 1.618.

The most important characteristics of rating scales are their discriminatory ability and calibration, the first of which characterizes the ability of the scale to divide the subjects into groups, depending on any factor, and the second, the degree to which its indications correspond to the actual results, i.e. the reliability of the assessment. For these purposes, in accordance with the criteria of the developed scale, the individual indicators of the examined persons were analyzed - their adaptive potential, health levels according to Apanasenko and the state of the cardiovascular system (CVS) according to the Robinson index, assessed using the following methods.

The individual indicators of the surveyed, obtained by us, in terms of their adaptive potential, health levels and CVS state, were analyzed and verified based on the criteria of the proposed FS scale. The results of this analysis are presented in Table 2.

Personalized analysis of these data, in the light of existing ideas about the functional state and adaptation mechanisms, allow us to state the following:

Table 1.

function. intervals	1 interval	2 interval	3 interval	4 interval	5 interval	6 interval
Adaptation levels [13]	excellent	Good	Satisfactory	Tense	Unsatisfactory	breakdown adaptations
indicators the proposed scales in conditional units	$A_1\ A_2$ 1,0÷1,309	$A_2\ A_3$ 1,309÷1,618	$A_3\ A_4$ 1,618÷2,118	$A_4\ A_5$ 2,118÷2,618	$A_5\ A_6$ 2,618÷3,427	$A_6\ A_7$ 3,427÷4,236
functional corridor,	0,309	0,309	0,500	0,500	0,809	0,809

Table 2.

Functional corridor boundaries Min	max	Classification Functional Corridor	Levels Adaptive Potential	Quantities surveyed with indicators given corridor			Of them — Health levels according to Apanasenko					The state of the cardiovascular system according to Robinson				
				Bcero	Boys	Girls	Low	below the average.	average	above the average	high	Very bad	bad	average	good	Exellent
1,0	1,309	FN	optimal	-	-	-	-	-	-	-	-	-	-	-	-	-
1,309	1,618	FN	good	6	1	5	-	-	6	-	-	-	-	-	1	5
1,618	2,118	DS	Satisfactory	27	11	16	7	8	12	-	-	-	2	6	18	1
2,118	2,618	DS	tense	10	7	3	10	-	-	-	-	2	4	1	3	-
2,618	3,427	premorbital state	unsatisfactory	No	-	-	-	-	-	-	-	-	-	-	-	-
3,427	4,236	Pathological condition	Breakdown	No	-	-	-	-	-	-	-	-	-	-	-	-
Total				43	19	24	117	8	18	-	-	2	6	7	22	6

1. Of the 43 examined, only 6 (13.9%) individuals, the FS of the body corresponds, according to our scales, to the physiological norm with good adaptation and a normal level of regulatory mechanisms. At the same time, they all have an average level of physical health according to Apanasenko and high CVS reserves according to the Robinson index. Among the girls surveyed, 20.8% are in this state, and 5.3% of the boys..

2. Of the surveyed, 27 (girls-16, boys-11) are in a prenosological state, with sufficient functional capabilities and satisfactory adaptation. However, the levels of their physical health have certain variations with the prevalence of the average level. Corresponding variations are observed in the states of CVS, where 67% of these individuals have normal values;

3. Of the surveyed 10 persons (girls-3, boys-7), have a prenosological level of functional state, but with a tense adaptation mechanism and significant mobilization of functional reserves to maintain homeostasis of the body. All of them have low levels of physical health and variations in the Robinson index, with the prevalence of the level of bad and very bad.

At the same time, for the criterion of such an analysis, we propose the functional state stability index (**FSSI**), and inversely proportional to it, the probability of a qualitative change in the functional state, the probability of a qualitative change in the functional state (**PQFS**), the value of which, in% can be calculated by the formulas:

$$\text{FSSI} = \{(A_{max,i} - AP_{k,o}) / (A_{max,i} - A_{min,i})\} \times 100 \quad (3);$$

$$\text{PQFS} = (100 - \text{FSSI}) \quad (4),$$

$A_{max,i}$, $A_{min,i}$ values of the maximum and minimum boundaries of the **i**-th functional interval, where the adaptive potential of the $AP_{k,0}$ is fixed, about **k**-examined. Note that quite often, when conducting expert assessments, it becomes necessary to use a special type of ordinal scales - *verbal-numerical scales*. Such scales include a verbal description of the selected gradations and the corresponding numerical values. The most famous and widely used in practice is the Harrington scale [15], which has universal application. So for example, adapted by us for any, separately taken, one functional interval, for the assessment of **FSSI** and **PQFS**, it has the following form.

In accordance with these approaches, first of all, the individual indicators of the FSSI were assessed, which showed that 8 persons (girls-4 and boys-4), out of all surveyed, have very high; 1 (girl) - tall; 22 (girls-15 and boys-7) -medium; 1-low and 11 (girls-4, boys-8) - very low levels of functional stability of the body. Using the individ-

№	value of FSSI (in%)	indicators FSSI	value PQFS	indicators PQFS
1	80–100	Very high	20-0	Very low
2	64–80	High	37-20	Low
3	37-64	The average	64-37	The average
4	20-37	Low	80-64	High
5	0-20	Very low	100-80	Very high

Table 3.

meaning VIFS on formula 4 v, %	Indicators VIFS on Harrington	Total of surveyed with data VIFS	Of these, the likelihood of quality transition have:			
			from FN in D-1	from D-1 in D-2	from D-2 to premorbid. condition	From premorbid to pathology
80-100	Very high	11	2	8	1	-
64-80	High	1	-	-	1	-
37-64	The average	22	-	-	-	-
20-37	Low	1	-	-	-	-
0-20	Very low	8	-	-	-	-

ual FSSI values obtained for each subject according to formula 3, the PQFS were estimated, which are presented in table. 3.

Note that the integral indicators of the FS, such as the levels of its reserve, stability and the probability of change are interrelated, namely - the more the reserve of the FS, the higher the levels of its stability and the less the probability of change (deterioration); and vice versa.

Based on these provisions, we analyzed the results of prenosological assessment of the FS of the surveyed presented in Table 3 and found that 12 (27.9%) of the surveyed individuals have high levels of probability of qualitative changes in functional states, namely: 2 of them transition from physiological norm in the D-1 state; 8- from D-1 to D-2 state; and in 2 surveyed there is a risk of developing pre-morbid conditions, that is, a transition to a premorbid state. At the same time, 31 (72.1%) persons from the surveyed contingent, having below the threshold levels of the probability of a change in FS, do not have a risk of deteriorating their health.

Conclusions

Thus, the developed scale and its criteria, and algorithms for assessing the indicators of the adaptive potential of the CVS, allow us to classify practically healthy individuals, according to the levels of the functional state. Its sufficient sensitivity and discriminatory properties are confirmed by the presence of a correlation between the scaling results and the indicators of those examined by the level of health and functional reserve of CVS.

The proposed scale, its criteria and methods of analysis, also make it possible to assess the levels of FS stability, within certain functional intervals and the likelihood of their qualitative changes in the direction of deterioration. As a result, it becomes possible to quantitatively assess functional states, their reserves and predict the occurrence of premorbid conditions, that is, to carry out prenosological monitoring of the health of healthy people and to determine the contingent of persons at risk of deteriorating health.

References

1. Baevsky R. M., Berseneva A. P. Introduction to prenosological diagnostics. M .: Firma "Slovo", 2008.-220 p.

2. Agadzhanyan N.A. , Baevsky RM, Berseneva AP .. The problem of adaptation and the doctrine of health - M .: Publishing house of RUDN, 2006. – 284p.

3. Chuyan E.N., Biryukova E.A., Ravaeva M.Yu. An integrated approach to assessing the functional state

of the body of students. Scientific notes of the Tavrichesky National University named after V.I. Vernadsky. Series "Biology, Chemistry". Volume 21 (60) .2008. No. 1. S. 123139.

4. Marutaev M.A. Harmony as a law of nature. // Golden ratio. Three views on the nature of harmony. - M .: Stroyizdat, 1990. P. 130-233.

5. Rosen P. The principle of optimality in biology: Per.from English M.: Mir,1969.216 p.

6. Saturday A.G. "Golden section" ("Sectio aurea") in medicine. 2nd edition. St. Petersburg: firm "Stroylespechat", 1996. 168 p.

7. Tsvetkov V.D."Golden harmony and hearts", Pushchino, NGO "Foton-century", 2008.202 p.

8. Horst V.R., Bykov I.A., Polunin I.N., Gorst N.A. Gold proportions of the adaptive potential of the cardiovascular system. International Journal of Applied and Basic Research.- No. 5,2018.p.380-384.

9. Alexandrovich Yu.S., Gordeev V.I. Assessment and prognostic scales in critical care medicine. Publishing house "Sotis". - 2007.-140 p.

10. Razinkin SM, Gladkova SN, Klenkov RR, Tolokonin AO, Panasenko SL, methodological aspects of the formation of a scale for assessing the psychophysical level of health. Bulletin of Neurology, Psychiatry and Neurosurgery. 2012.03. p.23-26.

11. Abu Ali Ibn Sina. Canon of Medicine. Selected Sections. Part 1. Moscow - Tashkent, 1994 .-- 400 p.

12. Sevryukova G.A., Konovalova G.M. Functional state and regulatory and adaptive capabilities of the human body. Volgograd: Volg GTU, 2015.104 p.

13. Apanasenko G.L. Diagnostics of individual health. Problems of restorative medicine. - 2011. - No. 8. - P. 15–20.

14. Malov Yu.S., Kuchmin A.N., Borisov I.M., Malova A.M. Golden symmetry is an indicator of the norm and pathology of the human heart. Bulletin of the Russian Military Medical Academy. CM. Kirov. Volume 70, No. 2 (2020) P. 189-194

15. Akhnazarova SL, Gordeev LS Using the Harrington desirability function in solving optimization problems of chemical technology: textbook. allowance. - M .: RKhTU im. D. I. Mendeleeva, 2003 .- 76 p.

16. Karabaev M.K, Botirov M.T and Gasanova N.M. The subjective health index as a criterion for assessing the level of the prenosological state of the body.; Asian journal of advances in medical science. -2020. -2(4): P. 9-15.

17. Karabaev M., Gasanova N.M., Botirov M.T. Morphological Indicators of Dehydrated Saliva Microcrystals as an Indicator of One's Prenosological Level. Journal of Preventive Medicine.-2020.vol.5. No.6:68.

18. Karabaev M., Abdumananov A., Aliyev R. Remote, automated and personalized monitoring of donosological population health level. Prenosology and healthy. Lifestyle Scientific journal.- 2020 - № 1 (26).- P.20-27.