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A review of reserve adaptive capabilities of the individual

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Abstract

Intenseness of the modern lifestyle imposes more stringent requirements not only to the professionalism of people performing their function but also to their health depending on a lifestyle. One needs an affordable, extremely simple, and efficient anticipatory self-test of the state for motivation to change the way of life. Medical practitioners need the same diagnostic methods. The authors have developed and published online the free-access program "Potential health capabilities: Assessment" on the website of the Rehabilitation Health Center "Health workshop of Ustinova" (<http://ustinova-zdorovie.ru/>).

Keywords: Physical health; self-assessment and the body's reserves; adaptive capacities; potential capacities of health.

Introduction

Intenseness of the modern lifestyle imposes more stringent requirements not only to the professionalism of people performing their function but also to their health. Therefore, the most important task in the field of public health is the development of methodologies for assessing functional reserves of the organism and identification of persons from the risk groups for the most prevalent diseases; monitoring health reserves by the most accessible and simple provision; detection of self-diagnostic methods and rating of the individual physical health; development of methods and techniques to prevent the development of pathological processes.

In terms of the approaches to the provision of professional medical care, we can single out three broad groups of people: (1) Professional athletes with a large number of physiological monitors created especially for them. Such monitors allow not only to monitor condition of the body but also to perfect technique and to make optimal training schedules without over-spending of adaptation possibilities. Scientists from many countries are currently involved in the developing of new diagnostic technologies in sports medicine [1-4]. (2) Sick people requiring professional medical care for the treatment of diseases. In order to provide them with skilled care, we use regulated, well-known, and newly

developed methods of diagnosis. (3) Practically, healthy people [5-11] require screening studies for organizing prevention measures. It is socially important for these people to stay in this group and not to move into the category of sick patients. Such patients have to be able to perform self-assessment of their health status to motivate a change in lifestyle, as WHO identified a lifestyle as the leading cause of aging [12]. Man needs to have an affordable, extremely simple, and efficient anticipatory self-test status for motivation to change his lifestyle. Medical practitioners also need to have such a diagnosis. The aim of our work is to find the most effective and simple methods of diagnosis and self-diagnosis in order to detect the presence or absence of reserves of adaptive capacities of the organism to adapt to a constantly changing environment. Such methods should be accessible for both medical practitioners and patients themselves.

Main Part

Currently, many researchers are working on developing comprehensive diagnostic methods and self-tests using information and learning software systems to assess the functional state, performance, and reserve capacities of the organism [13-18]. Such systems are important for the newly created health centers, but

they do not have mobility and suggest a variety of measurements, not specific to visit of the family doctor or a general practitioner. They are not available for the current self-assessment by the person in domestic conditions. A number of scientists investigate the issues of self-assessment of health in its connection with physical and social aspects of the personality [13,19-23]. We found an association of the self-assessment with the indicator of a subjective satisfaction with relationships to other people [20]. Moreover, self-assessment is a predictor of mortality [21,22]. Studies [13] show that the knowledge of their own condition as well as the inclusion of the person in the management of his health dramatically alter the motivation to work by strengthening it. In the test group of subjects undergoing a 3 yrs experiment where the participants received regular information about their health status, indicators of biological age improved by 43%, individual risk of cardiovascular diseases were mitigated by 54%, indicators of self-assessment of fatigue were improved by 40%, and indicators of AC were improved by 20%. During the same period the control group of virtually healthy subjects with no information about the level of capacities of the organism has reduced the same health indicators. Studies [13,21,22] show the importance to use anticipatory self-assessment of adaptive reserves of the body to promote health.

Many authors single out the following main indicators of the functional reserves of the body used both in the creation of the automated systems and proposed for self-assessment of their condition:

1. Anamnestic data – complaints, illnesses in past, characteristic of sleep, bad habits, living conditions, nature of work, work and rest mode, and others.

2. Measurement of anthropometric data – height and body weight, indicators of flexibility of the spine, measuring range of motion in major joints of the upper and lower extremities, dynamometry of hands, and others.

3. Measurement of heart rate (HR), systolic (SP) and diastolic (DP) pressure, and pulse pressure (PP).

4. Evaluation of the system of external respiration: vital lung capacity (VC); respiratory rate; tolerance to hypoxia in the Stange test – apnea on inspiration and Genchi test – apnea on expiration; vital index (VI): $VI = VC/M$, where VC is vital

lung capacity in ml, M is the weight in kg (VI: in men – 60 ml/kg, female – 50 ml/kg), etc.

5. Exercise tolerance testing – Ruf'e test, Martine test, bicycle exercises, stepergometric exercises, Cooper test, etc.

6. Integral methods – biological age, heart rate variability, AC, integrated indicator of health, and others.

7. Evaluation of glucose and total cholesterol concentration in the blood plasma.

8. Psychosomatic studies, including reactive anxiety test, short-term memory test, and mood test.

9. Integrated hardware-controlled methods – Nakatani test, Voll test, vegetative resonance test, pulse diagnosis, Y-syn, Kirlianography, iridodiagnosis, impedance diagnosis, and others [14-17, 24-31].

What health indicators are regarded as the most reliable in the evaluation of health status? Primarily the height–weight ratio and overweight are of particular importance [14,17,19,23,24,26,30, 32-36]. The authors Lakoski *et al.* found that the most important risk factor for loss of health is precisely the body mass index (BMI) as obesity neutralizes an advantage of physical activities even in healthy individuals [35]. $BMI = W/H^2$ (m²), where W is the body weight in kg, H is the height squared in m². BMI ranges: less than 18.5 – underweight; from 18.5 to 24.9 – normal range; from 25 to 34.9 – grade I obesity; from 35 to 39.9 – grade II obesity; more than 40 – grade III obesity, severe, extremely high levels of disease. To determine the normal body weight (W, kg) taking into account the height ratio (H, cm) and calendar age (CA, yrs), the most accurate formula is as follows [32]:

$$W = 50 + 0.7 \cdot (H - 150) + \frac{CA - 20}{4}$$

Exploring the system of quantitative assessment of the health condition of human Stavitskiy *et al.* used indicators of peripheral blood as the main criteria. Multivariable analysis of a set of indicators (15-25 indicators) led to the conclusion that this method has high inaccuracy and low sensitivity [18]. The studies of the age dynamics of change of mathematical indicators of compensatory and adaptive reserves of the body of people living in extreme environmental conditions have shown that it is the cardiovascular system (CVS)

that is the *main indicator* of the quality of the body functions. It makes it possible to perform an effective preclinical evaluation of the health state [16]. The most informative noninvasive method of a complex assessment of CVS as well as functional and adaptive reserves of the body is the heart rate variability [14]. Such diagnosis is hardly applicable for self-assessment. The authors [15] conducted extensive studies exploring anticipatory diagnosis of the syndrome of chronic reduction of physical performance. It was revealed that the figures of a *resting heart rate* and results of a *Ruf'e* test are the most expressed criteria of the functional state of cardiovascular and nervous systems in the diagnosis of reduced physical performance. *Ruf'e* test in assessing the reserves of CVS is used by many authors [15,17,27,32,33,37]. It is simple, quick, and representative: the subject stands on his feet, investigator counts pulse (P_1) for 15 s; subject performs 30 squat challenge per 1 min; investigator counts his pulse in the first (P_2) and last (P_3) 15 s of the first minute of recovery. The *Ruf'e* index (RI) is calculated by the following formula [32,38]:

$$RI = \frac{4 \cdot (P_1 + P_2 + P_3) - 200}{10}$$

Functional completeness of the CVS is determined by the following indicators: RI less than 5 – “excellent” (for trained individuals and athletes); less than 10 – “good”; less than 15 – “satisfactory”; more than 15 – “bad”; more than 20 – “unacceptable”.

The level of physical health (PH) by the quality of the functioning of the circulatory system is defined by the authors [24,33] as follows:

$$PH = \frac{700 - 3 \cdot HR - 0.8333 \cdot SP - 1.6667 \cdot DP - 2.7 \cdot CA + 0.28 \cdot W}{350 - 2.6 \cdot CA + 0.21 \cdot H}$$

where PH is the level of physical health in points; HR, beats/min at rest; SP, mmHg; DP, mmHg; H, cm; W, kg; CA, full years. FZ: 0.375 or less – a low level; 0.376-0.525 – below average; 0.526-0.675 – average; 0.676-0.825 – above average; 0.826 or more – a high level of physical health.

AC (points) is calculated as follows:

$$AC = 0.0011 \cdot HR + 0.014 \cdot SP + 0.008 \cdot DP + 0.009 \cdot W - 0.009 \cdot H + 0.014 \cdot CA - 0.27$$

Group 1: AC below 2.5 – a high degree of adaptation. Group 2: AC 2.51-2.59 – satisfactory adaptation. Group 1 and Group 2 consist of people who can live a normal lifestyle. Group 3: AP 2.6-3.09 – stress of adaptation mechanisms. Group 4: AC 3.10-3.49 – overstress of adaptation mechanisms. These are people with a high probability of disease in the near future, it is necessary to perform preventive measures. Group 5: AC above 3.5 – failure (exhaustion) of adaptation mechanisms. These are people with hidden forms of diseases, chronic and unrevealed diseases who require a thorough medical examination [34,37,38].

Conclusion

In order to reveal potential health indicators for attending physician and for self-diagnostics, authors use the following indicators: BMI; normal body weight taking into account body height and calendar age; *Ruf'e* test; level of physical health and adaptive capacity summarized in one affordable program with the ability to use the software on any device (PC, any mobile device, etc.). The authors have developed and published online a free-access program “Potential health: An assessment” presented at the website of “Health workshop of Ustinova” (<http://ustinova-zdorovie.ru/>).

Summary

Here are the most important parameters for evaluation and self-assessment of capabilities of the body reserves:

1. BMI;
2. Normal body weight according to the ratio of growth and calendar age;
3. Heart rate at rest;
4. *Ruf'e* test;
5. Systolic and diastolic blood pressure;
6. Level of physical health, taking into account the above-mentioned indicators; and
7. Level of adaptive capacity.

Based on these figures, the authors developed software with the ability to use it on any device (PC, any mobile device, etc.). In this software it is possible to work as a doctor and to use it for self-assessment of reserves

of the organism's adaptive capacities by the patient. The program "Potential health capabilities: Assessment" was published online on the website of the Rehabilitation Health Center "Health workshop of Ustinova" (<http://ustinova-zdorovie.ru/>).

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