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Methodological Problems of Biomedical Data Assessment

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***Abstract*—The results of a literature content analysis on methods for assessing biomedical data for constructing a model of human adaptive potential are presented. The software tools for collecting anthropometric data for children and youth from 0 to 19 years are determined. For adults, male and female, there are no universal means of assessing anthropometric data. In medical practice, the SCORE system is used to predict mortality from cardiovascular diseases, which does not take into account all health factors. According to many years of research, it was concluded that the success of the adaptation of the human body depends on two parameters: the functional state of the cardiovascular system (dynamic component) and the harmony of the ratio of anthropometric data (statics component). An ontology of human adaptive potential is proposed.**

Keywords—human adaptive potential, anthropometric data, ontology, system analysis.

I. INTRODUCTION

The problem of assessing biomedical data is determined by the complex hierarchical organization of a living system with fuzzy control loops. The theory of functional systems of P. K. Anokhin is the fundamental justification for the processes of adaptation and maintenance of homeostasis in the human body [1]. The creates of prognostic biomedical models based on regression analysis is widely used in anthropological research and risk assessment of cardiovascular disease [2]. Regression analysis is the main method of statistical processing of databases in the practice of biomedical research [3-5]. According to L. von Bertalanfi, it is necessary to accept the world as we find it, i.e. applying empirical methods of researching different systems to draw conclusions about observed patterns. Proposed by the author basic concepts and principles used to solve a wide variety of problems, such as the general definition of the system, to analyses growth types, systems, social engineering and engineering psychology [6]. The most controversial issue is the possibility of predicting the development of diseases in each person individually (a personalized approach) and in the structure of the incidence of the population as a whole (public health). Using system analysis, building neural networks and collecting big data, creating software and digitizing health care in national projects does not bring us closer to solving the problems of personalized medicine. The question of how many parameters need to be included to characterize the success of human adaptation to habitat factors remains an open question. Materials and methods of research: Content analysis of works of foreign and Russian researchers, construction of ontology.

II. RESULTS

Regression analysis is the main method of statistical processing of databases in the practice of biomedical research. The characteristics of a living system, unlike the cybernetic biological model: high morphological specificity of each organ and tissue system. Multidimensional relationships that develop at each point of time in a functional system end high-quality heterogeneity of the living biological system. The probabilistic nature of the reaction of the living biological system in response to the irritant of the same modality, a wide range of adaptive biosystem reactions to save homeostasis. The non-linear nature of interaction between elements of a living biological system. Experiments in natural living conditions are a priority area of research in biology and medicine. R. M. Bayevsky developed the concept of the possibility of using the circulatory system as an indicator of the adaptive reactions of the whole organism, which is presented in the form of a cybernetic system [7]. This system consists of managers: CNS, subcortical and vegetative centers. Controlled system: musculoskeletal and internal organs. Elements, the conciliation link between which is the circulatory apparatus. The simplest model of a living system is the Functional Changes Index: HR – heart rate, SBP – systolic blood pressure, DBP – diastolic blood pressure, BV – body weight, G – growth, A – age. Equation (1) is the Functional Changes Index (FCI):

$$\mathrm{FCI} = 0{,}011 \times (\mathrm{HR}) + 0{,}014 \times (\mathrm{SBP}) + 0{,}008 \times (\mathrm{DBP}) + 0{,}014 \times (\mathrm{A}) + 0{,}009 \times (\mathrm{BV}) + 0{,}009 \times (\mathrm{G}) - 0{,}27 \quad (1)$$

The index shows a link between myocardial-hemodynamic (heart rate, systolic blood pressure, diastolic blood pressure) and structural-metabolic (growth, body weight) by homeostasis. Quantitative data collected in the process of biomedical research are always associated with qualitative data (gender, occupation, social status) and are

subjected to statistical processing. Moreover, the result obtained is interpreted depending on subjective factors (commitment to a scientific school, social order and bioethical examination requirements). For an objective assessment of the tension of adaptation mechanisms, all research groups used indicators of the activity of the cardiovascular system and

Next, the ranking of factors is performed, that is, their distribution, according to the accumulated points. As a result of ranking the indicators, the experts determined in the first place – the values and of total cholesterol. In second place is the body mass index. Third and fourth place was taken by a related indicator of left ventricular hypertrophy and

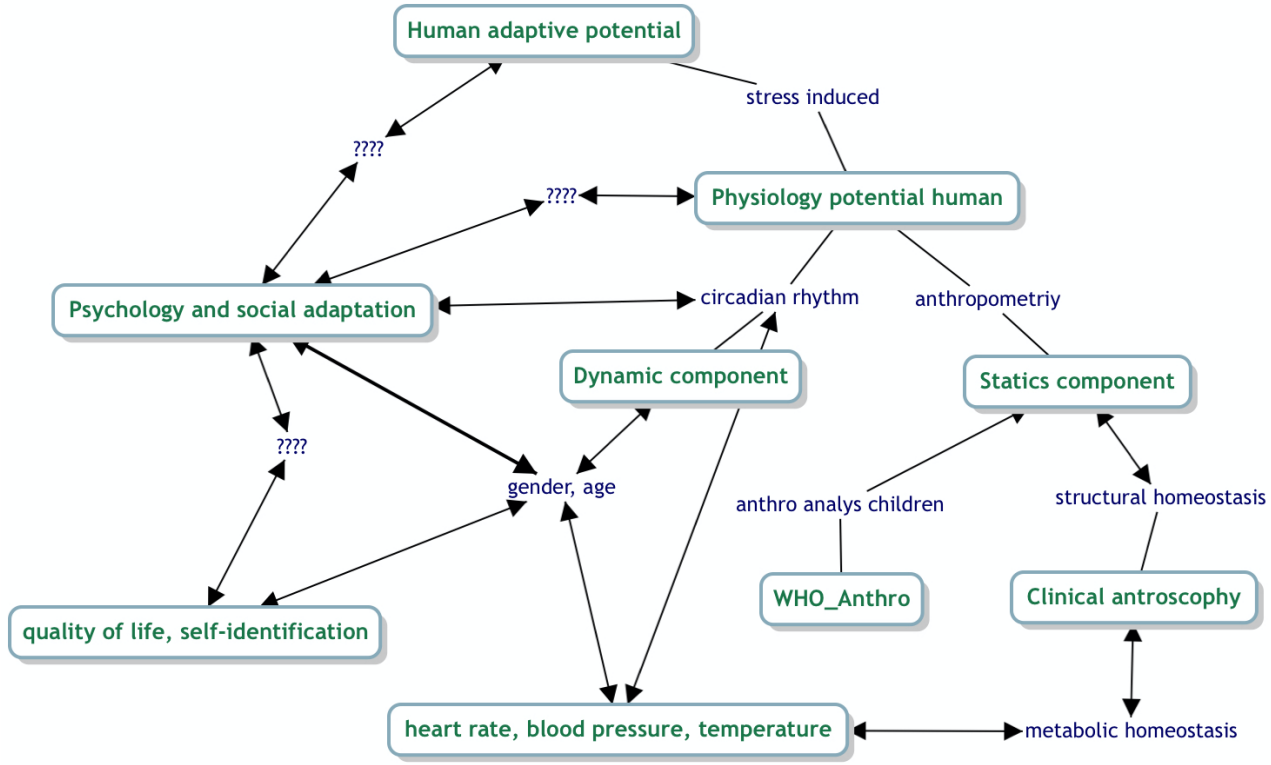

Fig.1. Ontology adaptive potential.

anthropometry. Fig. 1 shows a graphical model for assessing the human adaptive potential developed by us in the course of many years of research on compensatory – adaptive mechanisms of human environmental adaptation [8].

In the development of a mathematical model for assessing the significance of the components of adaptive potential, mathematicians-experts twice analyzed and processed information on the questionnaire, randomly selected data in 151 men. To develop methods for obtaining, analyzing and processing information, the experts responded to the questionnaire twice. They were asked to indicate the importance of the factors presented, which affect complications of hypertension, i.e. the degree of their effect on the effectiveness of ranking parameters. Assessing the factor, the specialist assigns them a certain rank. Men with separate criteria above the norm were selected from the statistics. Factors, depending on their significance, are assigned a value within the range of "1 ÷ 7" points, that is, "1 point - more significant ÷ 7 points - less significant". If a specialist equally evaluates the influence of several factors, then all of them are assigned the same score. Equation (2) is the total score for all rows (i) must match the sum for columns (j):

$$\sum_{j=1}^{m} \sum_{i=1}^{k} Xij = \sum_{i=1}^{k} \sum_{j=1}^{m} Xij \qquad (2)$$

interventricular septum. Fifth and sixth places were occupied by blood pressure values. The last place is given to hypertrophy of the posterior wall of the left ventricle. Behavioral risk factors for the development of diseases of the cardiovascular system: smoking, changes in eating behavior, social status of the respondents, and the level of stress load, experts ignored [9]. Clinical significance is attached to the level of systolic blood pressure and overweight. Morphological changes in the left ventricle are a complication of arterial hypertension and cannot be considered independently as a risk factor.

III. Discussion

This is anthropometric data that characterizes body length (g. Growth reflects the state of plastic processes in the body. Weight expresses total body weight (development of bone-muscle apparatus, fat fiber, internal organs). As a result of the Multicenter Study on the Development of Reference Growth Indicators (MGRS), a large data processing software was created that takes into account the reference indicators of the growth achieved by the new standards for body mass index (BMI) by age.

The WHO Anthro tool is designed to monitor the growth and development of motor skills in individual children and in the general population of children under 5 years of age. The program is designed to analyze the results of the study of baby

food and consists of 3 modules: an anthropometric calculator, individual assessment and examination of nutritional status. The standard of the regulatory growth model is the indicator of breastfeeding. WHO AntroPlus allows you to evaluate anthropometric indicators in children and adolescents aged 5 to 19 years according to centile tables [10].

The standardized indicators of the dependence of body weight on age, body length on age, head circumference on age, shoulder circumference on age, skin folds of age and the scale of development of motor skills should be used when conducting studies evaluating the physical development of children and adolescents, regardless of place of residence. Growth studies should provide detailed descriptions of anthropometric standardization and reliability of measurements. For adults, there is no standardized anthropometric study procedure [11-13]. The variability of the heart rhythm is another indicator that is easily subject to mathematical analysis. According to a number of researchers, the characteristics obtained by spectral methods of heart rhythm analysis only make sense when meeting the strict requirements for the sequence of R-R intervals, called in the language of mathematics "stationary process". Such "stationaryness" can be achieved on the site of an electrocardiogram lasting 5-6 minutes.

When studying the rhythm of the heart for many hours in a row, the "stationary process" cannot be visually recorded. This fact is not a problem of clinical or electrophysiological interpretation of data but reflects the imperfection of the attached software of outpatient electrocardiography [14,15]. The importance of secondary risk factors for cardiovascular disease (smoking, high cholesterol, blood pressure, male sex) and prediction of death are presented in the model V. Dzau. With the SCORE tables, it is easy to extrapolate the overall and relative cardiovascular risk by the age of 60. According to the recommendations of the European Society of Cardiology, patients with high risk include patients with clinical manifestations of cardiovascular disease, regardless of the profile of risk factors and patients without symptoms of cardiovascular disease diseases with a combination of risk factors (smoking, male sex, high levels of systolic blood pressure, hypercholesterolemia), in which the 10-year risk reaches 5% at present or at the forecast age of 60 years. With age, all men and women with AG are more likely to die from cardiovascular disease due to an unfavorable risk factor profile [16,17].

IV. Conclusion

The software tools for collecting anthropometric data for children and youth from 0 to 19 years are determined. For adults, male and female, there are no universal means of assessing anthropometric data. The SCORE system is used to predict mortality from cardiovascular diseases, which does not take into account all health factors. According to many years of research, it was concluded that the success of the adaptation of the human body depends on two parameters: the functional state of the cardiovascular system (dynamic component) and the harmony of the ratio of anthropometric data (statics component). An ontology of human adaptive potential is proposed.

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