

# Electronic Information Resources as Means of Diagnosis of the Status of Nutrition Persons of Younger Age

Natallia Bashun, Natallia Chuhai, Anastasiya Kuchar

**Abstract**— The objective of this paper is to find out the possibility of using electronic information resources as means of diagnosis of the status of nutrition persons of younger age. The analysis of anthropometrical and biophysical (bioimpedance) data of structure of a body and the metabolic status of student youth of University of Applied Sciences (Kaunas, Lithuania) and Yanka Kupala State University of Grodno (Grodno, Belarus) is carried out, recommendations about organization of a system of assessment of a nutritional status with development of a computer program, which based on complex of indicators are developed: personal data taking into account the level of physical activity, anthropometrical data, an assessment of nutritional status on the profile of nutrient consumption, frequency of consumption.

The regularity of the development of deviations from the physiological norm in the content and ratio of fatty and lean (fat-free) mass, the specific basic metabolism, extracellular and intracellular liquid of the body composition of youth with insufficient and excess body weight, depending on the level of their physical activity and nutritional status is determined. The established imbalance of the body composition indicators by the bioimpedance analysis method allows to assess the nutritional status in the youthful age for the purpose of detecting the violations of tissue hydration and lipid metabolism.

The developed information resource "Analysis of a condition of nutrition" allows you to identify deviations in the nutrition of student youth on a complex of indicators and to optimize solutions of these problems.

Scientific and practical recommendations on the organization of the system of assessment of the actual nutrition, including a group of indicators (somatometric: anthropometric, bioimpedance, functional, clinical) are developed.

The use of modern information technology, non-invasive procedures of a research on volunteers represents an optimal balance between traditional classical techniques and modern technologies that allow to maintain the proper quality of teaching. Active participation of students in studying of the actual nutrition and determination of parameters of a body lays the foundation for the formation of their representations and habits of proper nutrition and a healthy lifestyle.

**Index Terms**— analysis of a condition of nutrition, computer program, nutrition, health

## I. INTRODUCTION

Quantitative and qualitative value of nutrition defines extent of realization of genetic program of intellectual and

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physical development, including: cognitive ability, I.Q., working capacity, life expectancy, ability of an individual to reproduction, resistance to action of negative factors of environment, including stresses, weather climatic conditions, etc. [1] - [2].

At the same time researches of the actual nutrition of the population show great deviations of nature of nutrition from physiological standards. It plays an essential role in a wide dissemination in modern society of the so-called "diseases of civilization" (cardiovascular pathology, obesity, diabetes).

The functional activity and health status of young people in modern society causes serious concern and represents a socially important problem. The incompleteness of the development of the young organism, the impact of a complex of psychological and economic factors, a violation of the rules of a healthy lifestyle, including unbalanced nutrition, which generate a variety of risk factors of diseases, painful conditions and pathological processes in the student environment.

Unbalanced nutrition combined with a violation of body structure, a decrease in the adaptive capacity of an organism, a decrease in the nonspecific and immunological resistance of the young organism are risk factors for the health of students in many countries of the world. Modern researches of the status of nutrition among persons of youthful age are still insufficient and does not imply the use of a new methods for assessing the functional properties and potential of the young organism, the possibility of its correction by optimizing nutrition.

For the purposes of hygienic and nutritional monitoring, the research of anthropometric and biophysical (bioimpedance) data of composition of a body and the metabolic status of persons of a youthful age on the example of student youth of University of Applied Sciences (Kaunas, Lithuania) and Yanka Kupala State University of Grodno (Grodno, Belarus) with the development of a computer program for assessing the state of nutrition on a complex of indicators are attracted for the first time.

## II. METHODOLOGY OF RESEARCH

In total 30 students from University of Applied Sciences (Kaunas, Lithuania) and 70 students from Yanka Kupala State University of Grodno (Grodno, Belarus) took part in a research, the average age of the examinees was  $19.8 \pm 2$  years.

At this group of students (100 people) the research on the following indicators was conducted:

1. Anthropometrical data (height, weight, waist/hip index, body mass index);
2. Bioimpedance researches. The bioimpedance analysis of composition is the diagnostic contact method that allows you

on the basis of the measured values of electrical resistance of the human body and anthropometrical data to carry out assessment of a wide range of morphological and physiological parameters of an organism [3]. The physical entity of this method consists in measurement of two types of resistance of tissues of human body (resistive and reactive) by means of 2 pairs of in the arm-trunk-leg chain with use of a measuring (probing) sinusoidal current with constant frequency 50 kHz, a power not exceeding 500-800 μA (high frequency, low power) in the range of the measured values of an impedance of a biological object from 200 to 1000 Ohms [4].

The students of Yanka Kupala State University of Grodno (Belarus) carried out the given researches with the help of the bioimpedance analysis of the estimation of the balance of the water sectors of the organism with the software AVS-01 "Medass" (Russia) students of the University of Applied Sciences in Kaunas (Lithuania) with IOI 353 body composition analysis (Japan).

Testing of students using the developed information resource - the computer program "Analysis of a condition of nutrition" which give a comprehensive assessment of nutritional status on the profile of food consumption taking into account the frequency of their consumption.

Statistical analysis of the data were tabulated Microsoft Office Excel 2007 processor, statistics package Statistisa 6.0 and with a set of applications. Assessment of a parametrical data was carried out by Student's criterion, level p was taken for criterion of reliability of distinctions of average sizes less 0,05.

### III. RESULTS OF RESEARCH

Results of research, results of research, results of research, results of research, results of research, results of research, results of research, results of research, results of research, results of research.

In total 100 students took part in a research, the average age of the examinees was 19.8 ± 2 years, from them 33 young men (33%), 67 girls (67%).

The studied students were classified into groups according to the Body mass index (BMI) value: insufficient (Group 1: BMI <18.5) - 11 people (11%); normal (Group 2: BMI = 18.5-24.9) - 79 people (79%); excess (Group 3: BMI > 25) - 10 people (10%) body weight. In the studied groups, the anthropometric indicators of the students' body were measured (height, weight, waist circumference, hip circumference). In Table I is presented anthropometrical indicators of the studied groups of students.

Table I. Anthropometrical indicators of the studied groups of students (n=100)

Indicators	Group 1 BMI <18,5 (n=11)	Group 2 BMI 18,5–24,9 (n=79)	Group 3 BMI >25 (n=10)
Body mass index (BMI), kg/m <sup>2</sup>	17,5±0,8	21,2±1,7	27,1±1,7
Height, cm	170,3±9,3	174,8±8,8	171,2±10,2
Weight, Kg	51,0±6,4	65,1±9,2	79,9±12,1
Waist circumference, cm	67,1±6,2	75,4±7,9	86,0±9,5
Hip circumference, cm	89,0±4,1	99,3±42,0	107,5±7,3

Using bioimpedance meters ABC-01 "Medass" (Russia) and IOI 353 body composition analysis (Japan), the bioimpedance analysis of a body composition among students was performed in the following indicators: fatty weight, normalized by height, kg; lean (fat-free) weight, kg; total liquid, kg; index waist / hips (table 2). In Table II is presented indicators of assessment of a body composition of the studied groups of students (n=100) by method of the bioimpedance analysis.

Table II. Indicators of assessment of a body composition of the studied groups of students (n=100) by method of the bioimpedance analysis

Indicators	Group 1 BMI <18,5 (n=11)	Group 2 BMI 18,5–24,9 (n=79)	Group 3 BMI >25 (n=10)
Fatty weight, kg	8,6±2,8*	15,2±4,4	25,9±6,1*#
Lean (fat-free) weight, kg	42,4±7,3	49,9±9,0	54,0±11,0
Total liquid, kg	31,1±5,4	36,5±6,6	39,5±8,1
Index waist / hips	0,75±0,07	0,79±0,1	0,80±0,1
* p<0,05 – in comparison with group 2 # p<0,05 – in comparison with group 1			

The established imbalance of the body composition indicators by the bioimpedance analysis method allows to assess the nutritional status in the youthful age period for the purpose of detecting the violations of tissue hydration and lipid metabolism.

A computer program "Analysis of a condition of nutrition", (the method of the analysis of frequency of consumption of food, which describes the frequency of consumption of certain types of foods and dishes based on their volume or mass) is intended for the collection, storage and processing of a personal data for an assessment of the actual food. The program was developed by authors of the paper. The research of the consumption of products is conducted taking into account an anthropometric data (height, weight, waist/hip index, body mass index), a sex, age, the mode of work and rest.

Profile of the program is divided into 4 parts - the user information, the calculation of daily energy consumption, frequency of consumption of food and creation of own dish. The user profile is completed by the introduction of the personal data (name, gender, date of birth) and anthropometric data (height, weight, waist/hip index). Then, the program calculates the basal metabolic rate, BMI. The profile is completed on physical activity as follows: Exhibited amount of time, which the person spent on sleep, an educational and labor activity, driving in transport, hygienic procedures, eating, rest and sports. The time, which the person spent on training and work differentially for time spent for reading and study, performance of work of very easy, easy, average weight, heavy, very heavy. Thus, the estimates generated by the physical human activity throughout the day. Example of the profile with calculation daily energy consumption is shown in the Fig. I.

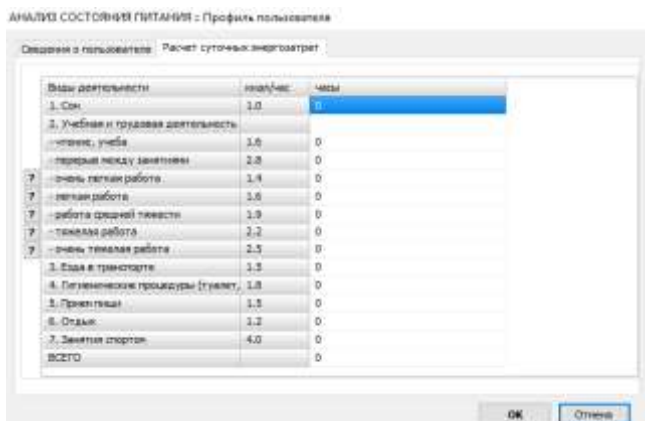


Fig. I. Example of the profile with calculation daily energy consumption

The profile is completed, considering the frequency and the number of consuming of the food per day. In the suggested program foodstuff is divided into the following functional groups: bean, nuts and seeds; auxiliary nutrients and flavor enhancers; fat products; grain and products of its processing; confectionery; milk and dairy products; meat and meat products; drinks; vegetables, mushrooms and products of its processing; fish, non-fish seafood and products of their processing; fruit, berries and products of their processing; eggs and egg products; «my dishes».

In each of the groups of products contains a large number of specific products. The program is presented wide enough for an objective assessment of range of the products. Example of the used photo is shown in the Fig. II.



Fig. I. Example of food photography (confectionery)

The user creates own dish, and the provided set of ingredients, choosing a necessary method of a thermal treatment (boiling, steaming, stewing, frying, baking) and weight of products. In the beginning user choose meal time: a

breakfast, a lunch (the second breakfast), a dinner, an afternoon snack, the first supper and the second supper.

Then user selects the group of products, for example, grain and products of its processing. This group contains 3 subgroups of products – grains, cereals and products and flour. In one of this subgroups for example cereals, nutrition assessment is conducted on their main types: buckwheat, corn, oat grain, oat-flakes, oat flour, millet cereal, rice, pearl-barley, barley, semolina, wheat cereals.

When the product is chosen from the list user expose the size of one regular portion in grams or ml. To facilitate the weight characteristics of the products in the process of entering data for each product displayed images on screen (all photos copyright) of these products in full size (for a 15-inch screen) with their weight. Example of food photography from "An album of photos of products and dishes" is shown in the Fig. III.



Fig. III. Example of food photography from "An album of photos of products and dishes"

Thus, the user enter data into the program by the frequency and weight of one portion by 558 types of products.

After introduction of all kinds of data, that takes an average of 45-90 minutes, including the time for measuring height, weight, waist, hips, creation of dishes, etc. the analysis of a condition of nutrition of the person is automatically made, according to the software.

Basic report is displayed:

- passport, anthropometrical data;
- coefficient of physical activity;
- Assessment of energy demand and its actual consumption;
- Assessment of nutritional status
- Assessment of nutrition on the profile of nutrient consumption (average value of the use of all products in gram/day).



For the majority of the surveyed students was typical of a normal nutritional status - 82%, superfluous occurred at 10%, insufficient at 8%. The optimal nutritional status is not detected in this group. In Table III is presented nutritional status of students. The data are preliminary and require further investigation by increasing the number of students surveyed.

Table III. Nutritional status of students

Assessment of nutritional status	Students of Yanka Kupala State University of Grodno and University of Applied Sciences in Kaunas
Normal	82% (82 students)
Optimal	–
Superfluous	10% (10 students)
Insufficient	8 % (8 students)

It should be noted that the most of the students have normal nutrition nutritional status (TABLE 3 HERE). However this program allowed to reveal by what types of nutritional nutrients students experience malnutrition or, conversely, redundancy. It gives the opportunity to correct a diet by an exception (bakery) or increases (dairy products, vegetables, fruits) in consumption of a certain food products depending on the nutritional status of the student which was defined within educational process on a laboratory lessons by the computer program.

This computer program allows you to reliably analyze a condition of nutrition, to identify compliance energy expenses of an organism, its own metabolism and energy supplied with food, to identify the adequacy of balance of food in numerical values, in percentage terms, the possibility of correction both by types of food, and the list of basic nutrients, identify the risk of possible diseases. Assessment of nutritional status students on the profile of nutrient consumption showed that along with the general tendencies of nutrition (for example, a lack in the diet alimentary fibers, vitamin A), excess of the total fat and saturated fatty acids.

IV. CONCLUSIONS

The regularity of the development of deviations from the physiological norm in the content and ratio of fatty and lean (fat-free) mass, the specific basic metabolism, extracellular and intracellular liquid of the body composition of youth with insufficient and excess body weight, depending on the level of their physical activity and nutritional status is determined. The established imbalance of the body composition indicators by the bioimpedance analysis method allows to assess the nutritional status in the youthful age for the purpose of detecting the violations of tissue hydration and lipid metabolism.

The developed information resource a computer program for an assessment of the actual food "Analysis of a condition of nutrition", which based on a complex of indicators: anthropometrical data (height, weight, waist/hip index, body mass index); assessment of energy demand (general energy expenses of an organism, the energy value of a daily diet, the level of the basal metabolism, index of physical activity, working increase); assessment of nutritional status on the profile of food consumption (grain and products of its processing, beans, nuts, milk, dairy products, fat products with a fat content of more than 50%,vegetables, fruit, berries and products of their processing, meat, meat products, fish, non-fish seafood, drinks, confectionery

and etc.); frequency of consumption; assessment of nutritional status on the profile of nutrient consumption (the main macronutrients: proteins, fats, carbohydrates and micronutrients: vitamins, bio-elements, etc.) which allows you to identify deviations in the diet and to optimize solutions of these problems.

Thus, assessment of nutritional status based on a complex of indicators: anthropometrical (BMI, height, weight, constitution type, a waist/hip index) and the questioning of students to assess the nutritional status students on the profile of nutrient consumption and frequency of consumption, a profile of consumption of products.

The use of modern information technology, non-invasive procedures of a research on volunteers represents an optimal balance between traditional classical techniques and modern technologies that allow to maintain the proper quality of teaching. Active participation of students in studying of the actual nutrition and determination of parameters of a body lays the foundation for the formation of their representations and habits of proper nutrition and a healthy lifestyle.

REFERENCES

- [1] Ashwell M. (2001). Functional Foods: A Simple Scheme for Establishing the Scientific Basis for all Claims. Public Health Nutrition. CABI Publishing, Oxford, UK, 4, (3), pp. 859-862.
- [2] Diplock A. T., Aggett P. J., Ashwell M., Bornet F., Fern E. B., Roberfroid M. B. (1999). Scientific Concepts of Functional Foods in Europe: Consensus Document. British Journal of Nutrition, 81, pp. 1-27.
- [3] Kyle U.G., Bosaeus I., De Lorenzo A.D. Bioelectrical impedance analysis. I. Review of principles and methods // Clin. Nutr. 2004. Vol.23. P.1226–1243.
- [4] Kyle U.G., Genton L., Karsgaard L. Single prediction equation for bioelectrical impedance analysis in adults aged 20–94 years // Nutrition. 2001. Vol.17. P.248–253.



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