Nutritional status of children in health and disease

The address of the IT system with evidence of the contribution of scientific activities and evidence of social impact

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The evaluated entity

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Nutritional status of children in health and disease

1. Contribution of scientific activities

In recent years, there have been numerous reports analyzing the nutritional status of children in health and disease. They indicate a cyclical increase in the trend of nutrition disorders, both overweight and obesity, and also malnutrition. Unfortunately, most reports are the result of simple anthropometric analyzes, such as: body weight, height or body mass index (BMI). The recommended BMI is based solely on body weight and height. Clinical experience indicates that BMI is insufficiently sensitive in a situation in which a patient with an asthenic type may have a seemingly low weight / height ratio, and thus a misinterpretation of malnutrition. On the other hand, a patient with an athletic (muscular) type of body build can present BMI values in the obesity cut-off. In addition, children have a problem with the interpretation of the data obtained, because the values of standards recommended by world scientific bodies are the resultant of measurements in various ethnic groups with other specific anthropometric parameters. The described situation gave rise to research analyzing the current state of knowledge, with a simultaneous attempt to search for a method that allows reliable assessment of the nutritional status of the healthy population and patients exposed to disorders of this condition, with particular emphasis on malnutrition.

The dynamics of body composition changes in individual periods of life is different. There are visible
differences of selected indicators and body composition components from childhood to old age. The use of advanced methods for assessing nutritional status and body composition allows you to objectively capture differences. In the 21st century, the diagnostic capabilities of the analysis of the composition of the human body have significantly developed. Technological progress has increased the chance of their application in screening, both healthy and sick people. In view of the increase in the global trend of nutritional disorders, the search for a relatively best method of its assessment seems to be a superior issue.

A relatively new method of assessing nutritional status is body composition analysis using bioelectrical impedance (BIA). Its evaluation allowed the use of additional assessment indicators resulting from the resistance (R) and reactance (XC) parameters. In the theoretical assumptions of the method, it was assumed that the human body is the resultant of 5 cylinders: 2 upper limbs, 2 lower limbs, trunk (the head does not participate in the analysis due to the longer current flow path in relation to the other segments). Each cylinder has a percentage of participation in overall body resistance. Practical application uses BIA single frequency (SF-BIA - most often 50 kHz). BIA is considered by many specialists to be a simple and safe method of assessing nutritional status and body composition. Mathematical equations for a given component validated on a homogeneous population play a significant role in the calculation of individual body composition components. Current research confirms the usefulness of the above mentioned method in assessing nutritional status, both nutrition and malnutrition.

In Poland, bioimpedance is still used only in selected medical entities or diet rooms. There are several reasons and are associated with the relatively high cost of the device itself, insufficient knowledge about the techniques of diagnosing nutritional disorders, and finally some limitations of the device itself. Bioelectrical impedance, apart from being used in healthy people's population studies, plays an important role in assessing the nutritional status of the sick persons. It is used to analyze selected components of the body composition, among others, in patients with liver cirrhosis, heart failure, non-specific inflammatory intestine disease, undergoing dialysis, oncological patients and many others.

Another valuable indicator of the nutritional status assessment is the phase angle (PA), calculated from the formula $PA = \arctan \left( \frac{XC}{R} \right) \times \left( \frac{180}{\pi} \right)$, where $\arctan$ - arctangent, $XC$ - reactance, $R$ - resistance, $\pi$ - 3.14. Its biological significance is not completely understood, but it can be interpreted as an indicator of cell membrane sensitivity and water distribution between intracellular and extracellular compartments. The phase angle correlates significantly with the functional state. It is proportional to the body cell mass, which results in sensitivity to the size of the potential of cell membranes that vary depending on the concomitant disease. It acts as a prognostic marker in various disease states and an indicator monitoring the effectiveness of nutritional intervention. The advantage of PA is not only a more reliable assessment of malnutrition, but also an indirect indication of what malnutrition we are potentially dealing with (marasmus, kwashiorkor), because PA is a resultant analysis of other body composition parameters (total body water, muscle mass, etc.), which should especially be taken into account in disease entities with a pronounced loss of lean mass. Studies examining the correlation of the phase angle with other tools or markers of potential malnutrition assessment showed a significant correlation between PA and the SGA (Subjective Global Assessment) scale, NRS-2002 (Nutritional Risk Score - 2002) and albumin level.

The last indicator for assessing nutritional status and body composition is the analysis of the bioelectrical impedance vector (BIVA). The method modeled on an electrocardiogram, allowed to interpret the results of resistance (R) and reactance (XC) normalized to body height ($R / H; XC / H$) in a different way. BIVA is considered by many researchers as an indicator of nutritional status. In addition, it allows you to determine the state of hydration and possible disorders in the total body water, occurring in various disease entities.
The length and angle of the vector, the range (centile) in which the single result is located (tolerance ellipses: 50%, 75% and 95% being percentile ranges) and the shape of the ellipse for the studied population are analyzed. The "y" axis represents the state of hydration (dehydration, overhydration) while the "x" axis represents body mass (cell, muscle, and lean mass). BIVA gives the opportunity to compare single vectors and tolerance ellipses for examined groups with different characteristics (different for age, sex, ethnic group, disease entities).

To sum up the rationale for the research topic, it should be clearly stated that in Poland no papers have been found to broadly analyze the components of the body composition of children in health and disease. There are only single studies, most often limited to body composition assessment using the BIA method. To the author's knowledge, no studies have been found so far on the Polish population of children assessing the phase angle parameter and bioelectrical impedance vector analysis.

2. Evidence of the contribution of scientific activities


3. Characteristics of social impact

The most important aspect of scientific and research work was the assessment of nutritional status among hospitalized and healthy children using new assessment methods: bioelectrical impedance (BIA, Bioelectrical Impedance Analysis), phase angle (PA, Phase Angle) and bioelectrical impedance vector analysis (BIVA, Bioelectrical Impedance Vector Analysis). For this purpose, research was undertaken in the group of healthy children (Journal of Public Health 2016; Pediatrics and Family Medicine 2017; Lipids in Health and Disease 2018, habilitation monograph WUR 2019). Research was also continued in children hospitalized for the diagnosis of non-specific inflammatory intestine disease (ulcerative colitis and Lesniowski-Crohn's disease) (Gastroenterological Review 2017; Nutrients 2018), type 1 diabetes (Journal of Clinical Medicine 2018), juvenile idiopathic arthritis (Pediatric Rheumatology 2018), celiac disease (Nutrients 2018) and cerebral palsy (Nutrients 2020).

4. Evidence of social impact

All publications are available on websites.

Bachelor's thesis, 3rd year, licentiate studies, Mateusz Chorążykiewicz, Utility of vector bioelectrical impedance analysis in assessing the nutritional status of patients with selected disease entities, 2018/2019 academic year.

Presentation at an international conference:


The use of acquired knowledge as part of the didactic classes in the subject Physical examination’ (Nursery, 1 year, II sem.).
The use of acquired knowledge as part of postgraduate education for nurses - specialized course ‘Physical examination’.

5. Justification of interdisciplinarity of scientific activity of crucial importance for the development of science

The presented project is a form of an interdisciplinary activity. The authors, in cooperation with specialists of various professions (doctors, nurses, nutritionists, physiotherapists) assessed the nutritional status of healthy and sick children, as well as pointed out specific implications for practice, presented in the published scientific papers.