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## **DETERMINATION OF NUTRITIONAL STATUS IN PATIENTS WITH INFLAMMATORY BOWEL DISEASES USING BIOIMPEDANCE RESEARCH. ANALYSIS OF CLINICAL CASES.**

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### **Abstract**

**Actuality.** Inflammatory bowel diseases, which include ulcerative colitis and Crohn's disease, are often accompanied by nutritional imbalances. In these cases, in addition to calculating BMI and blood parameters, can be used bioimpedance analysis. Bioimpedance analysis is a noninvasive, inexpensive, and reliable method for assessing nutritional status in clinical and nonclinical settings. The article considers will examine the key aspects of the use of bioimpedance in patients with inflammatory bowel disease, highlighting the potential of this method in diagnosis, monitoring, and optimization of treatment for these patients.

**Aim:** To determine the characteristics of nutritional status in patients with IBD using bioimpedance analysis.

**Materials and methods:** A search was conducted in the Pubmed, Cyberlink, ScienceDirect databases. The included studies were cross-sectional, randomized and retrospective studies. A total of 13 articles that met the criteria were included. An analysis of criminal cases was also carried out on the basis of the Institute of Gastroenterology, Hepatology, and Metabolism in Almaty. The observational research method was used.

**Results:** Based on the data from the literature review and the examined clinical cases, we can conclude that all patients with IBD, even with normal BMI, against the background of a nutritious, balanced diet, and adequate physical activity, have a deficiency of muscle mass that is not detected by routine examinations. Thus, bioimpedance testing is recommended for all patients with IBD in order to determine the deficiency of muscle mass and the deficiency of consumed minerals and proteins caused by malabsorption syndrome.

**Conclusions:** The use of bioimpedance analysis is a valuable tool that can complement existing research methods that are initially used to monitor the nutritional status of patients with IBD. Also, assessment of the phase angle obtained using bioimpedance analysis should be recommended in clinical practice as a means of screening and monitoring the nutritional status of patients with IBD.

**Keywords:** *bioimpedance analysis, phase angle, ulcerative colitis, Crohn's disease, nutritional status, malabsorption.*

### **Резюме**

## **ОПРЕДЕЛЕНИЕ НУТРИТИВНОГО СТАТУСА У ПАЦИЕНТОВ С ВОСПАЛИТЕЛЬНЫМИ ЗАБОЛЕВАНИЯМИ КИШЕЧНИКА С ИСПОЛЬЗОВАНИЕМ БИОИМПЕДАНСНОГО ИССЛЕДОВАНИЯ. РАЗБОР КЛИНИЧЕСКИХ КЕЙСОВ.**

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**Актуальность.** Воспалительные заболевания кишечника, которые включают в себя язвенный колит и болезнь Крона, часто сопровождаются нарушениями нутритивного статуса. В этих случаях помимо подсчета ИМТ, показателей крови можно воспользоваться биоимпедансным анализом. Биоимпедансный анализ — это неинвазивный, недорогой и надежный метод оценки нутритивного статуса в клинических и доклинических условиях. В статье рассмотрены основные аспекты применения биоимпеданса у пациентов с воспалительными заболеваниями кишечника, выявляя потенциал этого метода в диагностике, мониторинге и оптимизации лечения данных пациентов.

**Цель исследования:** Определить характеристику нутритивного статуса у пациентов с ВЗК при использовании биоимпедансного анализа.

**Материалы и методы:** Был проведен поиск по базам Pubmed, Cyberlink, Sciencedirect. Включенные исследования были перекрестными, рандомизированными и ретроспективными исследованиями. Всего было включено 13 статей, которые соответствовали критериям включения. Так же был проведен разбор клинических случаев на базе института гастроэнтерологии, гепатологии и метаболизма города Алматы. Использован наблюдательный метод исследования.

**Результаты:** Основываясь на данных литературного обзора и рассмотренных клинических случаев, можно сделать вывод, что у всех пациентов с ВЗК, даже с нормальным ИМТ, на фоне полноценного, сбалансированного питания и адекватной физической активности, имеется дефицит мышечной массы, не выявляемый при рутинном обследовании. Таким образом, проведение биоимпедансометрии рекомендуется всем пациентам с ВЗК, с целью определения дефицита мышечной массы и дефицита потребляемых минералов и белков, обусловленных синдромом мальабсорбции.

**Выводы:** Использование биоимпедансного анализа является ценным инструментом, который может дополнить имеющиеся методы исследований, которые изначально используются для контроля нутритивного статуса пациентов с ВЗК. Так же оценка фазового угла, полученного с помощью биоимпедансного анализа, должна быть рекомендована в клинической практике как средство скрининга и мониторинга нутритивного статуса пациентов с ВЗК.

**Ключевые слова:** биоимпедансный анализ, фазовый угол, язвенный колит, болезнь Крона, нутритивный статус, мальабсорбция.

Түйіндеме

## **БИОИМПЕДАНСТЫҚ ЗЕРТТЕУЛЕРДІ ҚОЛДАНА ОТЫРЫП, ІШЕКТІҢ ҚАБЫНУ АУРУЛАРЫ БАР НАУҚАСТАРДЫҢ НУТРИТИВТІ АНЫҚТАУ. АНЫҚТАУ. КЛИНИКАЛЫҚ ЖАҒДАЙЛАРДЫ ТАЛДАУ.**

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**Кіріспе.** Ойық жаралы колит және Крон ауруын қамтитын ішектің қабыну аурулары көбінесе тамақтану жағдайының бұзылуымен бірге жүреді. Бұл жағдайларда ДСИ-ді, қан көрсеткіштерін есептеуден бөлек биоимпеданстық талдауды қолдануға болады. Биоимпеданстық талдау-клиникалық және клиникаға дейінгі жағдайларда нутритивті статусты бағалаудың инвазивті емес, арзан және сенімді әдісі.

**Зерттеудің мақсаты:** Биоимпеданстық талдауды қолдана отырып, ІҚА бар науқастардағы нутритивті статустың сипаттамасын анықтау.

**Материалдары мен әдістері:** PubMed, Cyberlink, ScienceDirect базалары бойынша әдеби шолу жүргізілді. Әдеби шолудағы мақалаларда қолданылған зерттеулер кросс, рандомизацияланған және ретроспективті зерттеулер болды. Критерийлерге сәйкес келетін барлығы 13 мақала енгізілді. Сонымен қатар Алматы қаласының гастроэнтерология, гепатология және метаболизм институт базасында клиникалық жағдайларға зерттеудің бақылау әдісі қолданыла отырып талдау жүргізілді.

**Нәтижелері:** Әдеби шолу деректері мен қарастырылған клиникалық жағдайларға сүйене отырып, ІҚА-мен ауыратын барлық науқастарда, ДСИ-нің қалыпты көрсеткіштерімен, толыққанды, рациональды тамақтану, ұтымды физикалық белсенділік болғанның өзінде бұлшықет массасының жетіспеушілігі байқалады. Бұл өзгерістер әдеттегі тексерулермен анықталмайды. Осылайша, бұлшықет массасының жетіспеушілігін және мальабсорбция синдромына байланысты тұтынылатын минералдар мен ақуыздардың жетіспеушілігін анықтау мақсатында ІҚА бар барлық науқастарға биоимпедансометрия жүргізу ұсынылады.

**Қорытынды:** Биоимпеданстық талдауды қолданубастапқыда ІҚА пациенттерінің нутритивті статусын бақылау үшін қолданылатын барлық зерттеу әдістерін толықтыра алатын құнды құрал болып табылады. Сондай-ақ, биоимпеданстық талдау арқылы алынған фазалық бұрышты бағалау клиникалық тәжірибеде ІҚА бар науқастардың нутритивті статусына скрининг және бақылау құралы ретінде ұсынылуы қажет.

**Түйінді сөздер:** биоимпеданстық талдау, фазалық бұрыш, ойық жаралы колит, Крон ауруы, нутритивті статус, мальабсорция.

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**Actuality**

Bioimpedance analysis is a modern, non-invasive research method that is widely used in medical diagnostics to assess nutritional status. Diseases such as Crohn's disease and ulcerative colitis pose significant challenges to the medical community due to their chronic nature and varied clinical manifestations. In recent years, bioimpedance has become widely accepted as a harmless and non-traumatic method that provides valuable data on body composition and changes. In the context of inflammatory bowel disease, where changes in body composition and fluid balance may play a key role, the application of bioimpedance becomes particularly relevant.

Inflammatory bowel diseases (IBD), which include ulcerative colitis (UC) and Crohn disease (CD), are often accompanied by nutritional status disorders. The European Association of Clinical Nutrition and Metabolism (ESPEN) defines nutritional status disorder, namely malnutrition, as a condition in which nutritional deficiency or insufficient intake leads to changes in body composition, in particular a decrease in the fat-free body mass index or lean mass, which in turn affects the physical, psychosomatic condition of patients with IBD, as well as the clinical outcome of diseases [3], [5], [1].

Inflammatory bowel disease [IBD] causes significant changes in body composition [BC], including, but not limited to, osteopenia and osteoporosis, which are well documented [11].

Traditional nutritional measurements, like body mass index (BMI), correlate poorly with indices of FFM in patients with CD [4,9] resulting in a risk for under recognition and underestimation of the extent of nutrition depletion when relying only on weight-based indicators of nutritional status. The European Society of Enteral and Parental Nutrition (ESPEN) introduced body composition into its malnutrition definition, recognizing that nutritional depletion may be missed with weight-based indicators alone and that FFM depletion can occur in normal, overweight, and obese populations [5].

To our knowledge, there are few studies comparing different methods to determine which are sufficiently reliable and accurate for clinical use, and none have compared bedside methods with a reference method in either inpatient or outpatient settings. Bioimpedance (BIA) techniques, which are non-invasive and available in clinical settings, have not been adequately validated in outpatient populations with inflammatory bowel disease. Despite this, BIA appears in clinical studies of IBD as a method for determining body composition [9], [10], [5].

Bioimpedance analysis is a cost-effective and accurate way to measure body composition in both clinical and research environments without causing harm to the body. [8]. Bioimpedance analysis (BIA) is often used in medical settings to assess body composition in a practical way [4], making it helpful for determining Resting Energy Expenditure (REE) since fat-free mass is the primary factor influencing REE. The accuracy of BIA results relies heavily on the equations used to calculate fat-free mass. [7].

This assessment utilizes a small electrical current to measure different body characteristics by examining the resistance it encounters as it passes through the body. The method is based on the idea that muscles, which have high water content, will offer less resistance compared to fat tissues, which have lower water content. [2].

The human body consists of more than thirty measurable components. Direct measurement of body components in vivo is currently not possible; therefore, indirect methods and models have been developed for this purpose. Within the framework of this concept, the World Health Organization (WHO) defines "nutritional status" as a state of the body resulting from a balance of intake, absorption, and use of nutrients depending on individual physiological and pathological status [12].

This treatment, conducted among 139 Korean patients with inflammatory bowel disease (IBD) between November 2018 and November 2019, resulted in the following results. Of the total number of patients, 47 had ulcerative colitis,

and 92 had Crohn's disease. Classification of patients based on the Harvey-Bradshaw index and the partial Mayo index allows us to determine the presence of active or inactive IBD. BIA methods and blood biochemical markers were used to assess nutritional status. Blood protein density, albumin, hemoglobin, cholesterol, triglycerides and C-reactive protein (CRP), as well as erythrocyte sedimentation rate (ESR) were measured. The INBODY 770 was used to measure BMI, body fat percentage, skeletal muscle mass, body moisture, muscle mass, mineral content, and body fat. The study results showed that patients with inactive IBD had an increase in blood nutritional markers such as hemoglobin, albumin and total protein. In addition, active IBD has been associated with limited nutrient control and metabolism due to the inflammatory process, resulting in compromised mineral content, muscle mass, skeletal muscle mass, and BMI in patients with active disease [6].

This cross-sectional study assessed nutritional status in patients with Crohn's disease (CD) using BIA parameters such as phase angle (PhA) and muscle strength (HGS). Adult patients diagnosed with CD were recruited for the study according to the European Crohn's and Colitis Organization (ECCO) guidelines. They were recruited consecutively from July 2016 to March 2018 at the Department of Clinical Medicine and Surgery of the Federico II University Hospital in Naples, Italy. The total number of patients recruited was 140 with a mean age of  $38.8 \pm 13.9$  years and mean body weight of  $64.9 \pm 12$  kg, who were compared with the control group. The study results showed that all nutritional indicators, especially PhA and HGS, were lower in patients with CD compared to controls, and these indicators worsened significantly with increasing disease activity. Patients with active CD had lower body weight and fat mass than patients with inactive CD and controls. PhA was inversely correlated with age ( $r = -0.362$ ;  $p = 0.000$ ) and CDAI ( $r = -0.135$ ;  $p = 0.001$ ), but positively associated with fat-free mass (FFM) ( $r = 0.443$ ;  $p = 0.000$ ) and HGS ( $r = 0.539$ ;  $p = 0.000$ ). Similarly, serum protein levels were lower in patients with active CD compared to patients with inactive CD ( $p < 0.05$ ). Duration of illness and medications taken did not significantly influence nutritional status. Phase angle (PhA) is an effective tool for assessing nutritional status in patients with CD, as confirmed by nutritional biomarker analysis, and its values decrease with increasing disease activity. Therefore, assessment of the nutritional status of CD patients, especially using phase angle obtained by BIA, is recommended in clinical practice for screening and monitoring [4].

The following study was conducted at the Children's Republican Clinical Hospital of the Ministry of Health of the Republic of Tatarstan, Kazan. There were 63 children aged 5 to 18 years with CD: 23 children with CD, 40 children with UC. The average age of children with UC was 14 years  $\pm$  6 months, with CD - 3 years  $\pm$  7 months at different stages of the disease. All children were determined the component body composition using the device "Bioimpedance analyzer of metabolic processes and body composition AVS-01 "MEDASS" (Russia). We evaluated key indices reflecting body composition: active cell mass (ACM) (kg), body fat mass (BFM) (kg, %), skeletal muscle mass (SMM) (kg, %),

and phase angle (PA). Component body composition differed in children with CD depending on the disease. Children with CD were more likely to have fat mass deficiency than children with UC ( $p = 0.014$ ), and children with UC were more likely to have excess fat mass ( $p = 0.038$ ). Fat and active cell mass contents were lower in BC compared to ulcerative colitis. Lower fat mass values were determined in both the debut and remission periods of BC. Reduced phase angle was observed more frequently in children with CD during the disease exacerbation ( $p = 0.029$ ). One third of children with CD with normal physical development have abnormalities of body composition component indices according to the results of bioimpedanceometry. Thus, the frequency of nutritional status disorders was observed in 58% of children with ulcerative colitis and 74% of children with Crohn's disease. Malnutrition prevailed in the structure of nutritional disorders. Overweight is diagnosed only in patients with ulcerative colitis. The evidence that anthropometric indicators such as body weight and height of the child and body mass index do not always reflect the nutritional status of the child is the results of the analysis of the component composition of the body in children with UC with normal parameters of physical development. Thus, despite normal physical development according to anthropometry, children with UC have hidden disorders of nutritional status, in particular, excess and deficiency of LM, deficiency of TM and ACM [1].

**Aim:** to conduct a literature review on the topic of nutritional status in patients with IBD using bioimpedance analysis. Analysis of clinical situations on the topic at the Interna clinic in Almaty.

**Materials and methods.** A search was conducted in the Pubmed, Cyberlink, ScienceDirect databases. The included studies were cross-sectional, randomized, and retrospective studies. A total of 13 articles that met the criteria were included. An analysis of clinical cases was carried out at the Interna clinic in Almaty. An observational research method was used.

### Results

At the Interna clinic in Almaty, we selected several patients with IBD who underwent bioimpedance testing. For the purposes of the study, the INBODY770 device was used

#### Clinical Case №1.

Patient A., 51 years old, complained of general weakness, fatigue, sweating, chills, loose stools up to 3 times a day with an admixture of mucus, flatulence, bloating abdomen. The debut of the disease since September 2023, when for the first time against the background of complete health patient developed loose stools and decreased body weight by 12 kg over 6 months. From history life is known that the patient does not have bad habits, inheritance by IBD is not aggravated, of chronic diseases: Arterial hypertension grade 2, high risk of CVC. CHF with preserved EF by Simpson 65%, FC II by NYHA, stage B by ACC/ANA. The height of the patient is 178 cm, weight 67.9 kg. BMI 21.4 kg/m<sup>2</sup>. In January 2024 he received inpatient treatment. Further investigated. According to laboratory tests: mild anemia, accelerated ESR. According to the video colonoscopy: Erosion of the Bauginia shutter, Crohn's disease, minimal activity is not excluded. Internal

hemorrhoids, exacerbation. Diagnosis: Crohn's disease, terminal ileocolitis, with minimal activity (A3, B1, L3) CDAI 120 points. He was treated with Mesalazine 2 grams 2 times a day. According to the results of bioimpedansometry, despite of normal BMI, there are visible changes in the form of muscle deficiency. Noticeable changes in the form of muscle mass deficit, excessive fat deposition in the internal organs (76.4 cm). Internal organs (76.4 cm<sup>2</sup>). There is also insufficient protein intake - 10.2 kg, deficiency of minerals 3.62 kg, against the background of full nutrition of the patient, which indicates malabsorption syndrome characteristic of the patient's main disease.

Table 1.

**Results of the bioimpedance testing: analysis of the body composition of patient "A".**

Indicators	Results	Normal
Protein	10,2 kg	10,5-12,9
Minerals	3,62 kg	3,63-4,43
Body fat content	16 kg	8,4-16,7
Fat-free mass	51,9 kg	53,3-65,2
Bone mineral mass	3,01 kg	2,99-3,65

The patient's ideal weight according to bioimpedance is 69.7 kg, which indicates underweight.

The patient is recommended regular, long-term treatment. Dynamic monitoring of disease activity. Taking into account the deficit of muscle mass against the background of the main disease and adequate physical activity, it is recommended to increase in the diet protein products.

**Clinical case № 2.**

Patient B., 26 years old, complains of general weakness, decreased visual acuity, decreased appetite, stools up to 4 times a day with blood and mucus, abdominal bloating, weight loss of 9 kg for 4 months. The patient has had diarrheal syndrome for many years. He had not

previously sought medical help. Did not receive treatment. In December 2023 received inpatient treatment due to worsening of the condition. Further examined. According to videocolonoscopy: Endoscopic picture is more consistent with Crohn's disease, ileitis with minimal degree of activity, 5 points on SES-CD. Catarrhal typhlitis, proctitis. Laboratory results: lymphocytosis, ESR accelerated. Diagnosis: Crohn's disease (A2 B1 L3) ileocolitis, typhlitis, proctitis, with minimal activity. Received treatment in the form of Mesalazine 4 g (granules) and Mesalazine 1 g/day (rectal suppositories). From the life history it is known that the patient has no bad habits, heredity on IBD is not burdened, has no chronic diseases. The patient's height is 162 cm, weight 47.6 kg BMI 18.1 kg/m<sup>2</sup>.

According to the results of bioimpedansometry, despite normal BMI, in patient is deficient in muscle mass (6.2 kg). There is also an insufficiency of the consumed protein - 7.2 kg, a mineral deficiency of 2.4 kg, against the background of the patient's full nutrition, which indicates the malabsorption syndrome characteristic of the patient's main disease. The ideal weight of the patient according to bioimpedansometry is 55.1 kg, which indicates a lack of body weight. Given muscle deficiency weight against the background of the underlying disease and adequate physical activity, it is recommended to increase protein products in the diet.

Table 2.

**Results of the bioimpedance testing: analysis of the body composition of patient "B".**

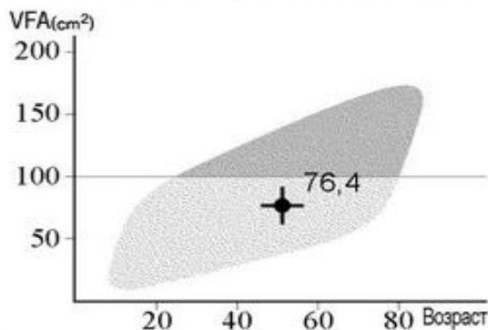
Indicators	Results	Normal
Protein	7,2 kg	7,6-9,2
Minerals	2,43 kg	2,60-3,18
Body fat content	11,4 kg	11,0-17,6
Fat-free mass	36,2 kg	38,2-46,7
Bone mineral mass	2,10 kg	2,14-2,62

**Оценка InBody**

67/100 Балл

\* Это общая оценка отражает состав тканей тела и телосложение. Человек с развитой мускулатурой может набрать более 100 баллов.

**Область жира внутренних органов**



**Контроль Веса**

Идеальный Вес 69,7 kg  
 Контроль Веса + 1,8 kg  
 Контроль Жира - 5,5 kg  
 Контроль Мышц + 7,3 kg

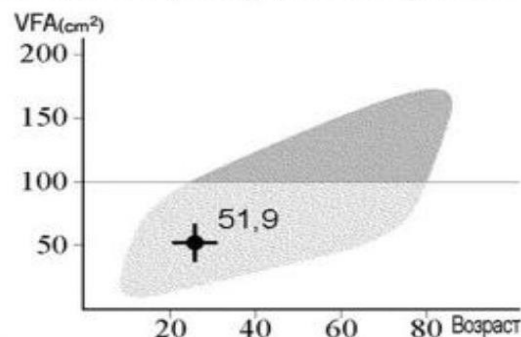
Figure 1. Results of bioimpedance study of patient "A".

**Оценка InBody**

72/100 Балл

\* Это общая оценка отражает состав тканей тела и телосложение. Человек с развитой мускулатурой может набрать более 100 баллов.

**Область жира внутренних органов**



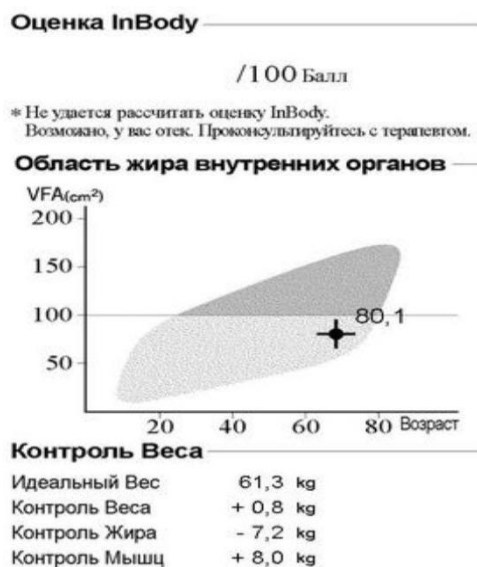
**Контроль Веса**

Идеальный Вес 55,1 kg  
 Контроль Веса + 7,5 kg  
 Контроль Жира + 1,3 kg  
 Контроль Мышц + 6,2 kg

Figure 2. Results of bioimpedance study of patient "B".

**Clinical case №3.**

Patient C., 55 years old, complaining of pain in the right abdomen, weight loss of 8 kg within 2 months. In September 2019, in connection with the appearance of colitic syndrome, he was examined at his residence: conducted an VCS and irrigation. According to videolonoscopy: Moderate activity is not excluded. According to irrigoscopy: Signs of non-specific ulcerative colitis. Large intestine diverticulum. Bauginium flap deficiency. Treatment prescribed: Mesalazine 2 gr/day, Rifaximin 200 mg 3 times a day. He received hospital treatment several times. From the anamnesis of life it is known that the patient against the background of UC has cirrhosis of the liver (METAVIR A2F4, Ludwig4 histologically), CTP B8 MELD-Na11, in the outcome of primary sclerosing cholangitis combined with sero-negative autoimmune hepatitis, with weak biochemical activity (1 AST VGN). Lack of response to immunosuppressive therapy of Prednisolone and Azathioprin (2018-2022), re-induced therapy of Prednisolone (01-04 2023), independently canceled by the patient without recommended combination with Mofetylamycophenolote. Does not have harmful habits, heredity is not aggravated by the IBD. The patient's height is 167 cm, weight 60.5 kg, BMI 21.7 kg/m<sup>2</sup>.



**Figure 3. Results of bioimpedance study of patient "C".**

According to the results of bioimpedanceometry, despite a normal BMI, the patient has a deficit of muscle mass (8 kg), excessive fat deposition on internal organs. There is also insufficiency of protein intake - 8.5 kg, deficiency of minerals 2.3 kg, against the background of full nutrition of the patient, which indicates malabsorption syndrome, characteristic for the main disease. The ideal weight of the patient according to bioimpedanceometry is 61.3 kg, which indicates a deficiency of body weight. Taking into account the deficit of muscle mass against the background of the underlying disease and adequate physical activity, it is recommended to increase protein products in the diet.

Based on the data of the above-mentioned clinical cases, we can draw conclusions, that in all patients with IBD, even with normal BMI, against the background of full-fledged, rational nutrition, adequate physical activity, are noted deficit of muscle mass, undetectable by routine

examinations. Thus, bioimpedanceometry is recommended for all patients with IBD in order to determine the deficit of muscle mass and the deficit of consumed minerals and proteins, due to malabsorption syndrome.

Table 3.

**Results of the bioimpedance testing: analysis of the body composition of patient "C".**

Indicators	Results	Normal
Protein	8,5 kg	9,3-11,3
Minerals	2,93 kg	3,19-3,90
Body fat content	16,4 kg	7,4-14,7
Fat-free mass	44,1 kg	46,9-57,4
Bone mineral mass	2,41 kg	2,63-3,21

**Conclusions.** In conclusion of our work, we would like to emphasize that performing bioimpedanceometry can be more useful as it can be used to assess nutritional status and IBD activity. This method can also complement other traditional assessment methods, including blood tests and questionnaires. The use of bioimpedance analysis is a valuable tool that can complement existing nutritional methods that are initially used to monitor the nutritional status of patients with IBD. nutritional status of patients with IBS. Also, the evaluation of the phase angle obtained with the bioimpedance analysis should be recommended in clinical practice for screening and monitoring of the nutritional status of patients with IBD.

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