Body composition as an indicator of the nutritional status in children with newly diagnosed ulcerative colitis and Crohn's disease – a prospective study

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Abstract

Introduction: The prevalence of nutritional status disorders in children with ulcerative colitis (UC) is much lower than in the case of Crohn's disease (CD). The largest variability in the components of body composition occurs at the time of a new diagnosis and in periods of disease exacerbation.

Aim: Assessment of body composition in children with UC and CD.

Material and methods: The preliminary study included 59 children with inflammatory bowel disease (IBD) (34 children with UC vs. 25 children with CD) aged 4–18 years. The final analysis included 26 newly diagnosed children (16 children with UC vs. 10 children with CD). The evaluation of body composition was conducted by means of BIA-101 bioimpedance analyser.

Results: Decreased values of lean mass were found in children with newly diagnosed IBD (UC: 41.13 kg vs. control group: 42.06 kg; CD: 35.50 kg vs. control group: 45.50 kg). After a year interval, an increase in fat (UC 1: 7.67 kg vs. UC 2: 10.33 kg; CD 1: 7.36 kg vs. CD 2: 9.47 kg) as well as lean body mass (UC 1: 35.22 kg vs. UC 2: 39.00 kg; CD 1: 35.99 kg vs. CD 2: 42.41 kg) was found in children.

Conclusions: Children with newly diagnosed IBD were highly vulnerable to nutritional status disturbances. The increase in fat and lean body mass in an annual interval may be due to the treatment regime and control of the children.

Introduction

Ulcerative colitis (UC) and Crohn's disease (CD), which are collectively referred to as inflammatory bowel disease (IBD), have their onset in childhood in nearly 25% of cases [1, 2]. Despite the development of various methods in IBD diagnosis, including the important role of biomarkers [3], still work is being conducted to find the most efficient way of diagnosis.

Disorders of fat absorption and acute malnutrition can occur in children with IBD [4]. Accordingly, an important aspect of monitoring of IBD patients is the assessment of nutritional status oriented at abnormalities in the body composition. The incidence of malnutrition in children with UC is much lower than in the case of CD; however, it may increase in exacerbation periods [5]. Malabsorption or protein loss in patients with CD in the active stage of the disease deteriorate the above condition [6]. Despite the improvement of nutritional status during remission, disturbances in the individual components of body composition still can be seen [7]. The most common consequences are weight loss, exhaustion of energy reserves [8], and a significant decrease in fat free body mass [9, 10], including the so-called "dry weight" [11]. Malnutrition in CD occurs in 32% of children at the time of diagnosis of the disease, and in 15% in subsequent years of its duration [12]. Bearing in mind the diagnosis of the disease at the level of 8.7% (persons under 16 years of age) in Poland, and the increase in the incidence of CD in recent years [13], careful analysis of body composition has become of particular significance. Some reports found overweight in 20–30% of children with

Table I. Demographic and clinical characteristics of 59 children with IBD

Parameter	Value
Age of respondents, mean ± SD [years]	13.5 ±3.41 (UC) vs. 13.8 ±3.12 (CD)
UC, *n*	34 (17 girls vs. 17 boys)
CD, *n*	25 (8 girls vs. 17 boys)
Disease activity (PUCAI/PCDAI):	
Lack	12 (UC) vs. 7 (CD)
Mild	8 (UC) vs. 5 (CD)
Moderate	10 (UC) vs. 9 (CD)
Severe	4 (UC) vs. 4 (CD)
Duration of the disease:	
New diagnosis	16 (UC) vs. 10 (CD)
Up to 1 year	4 (UC) vs. 3 (CD)
More than 1 year	14 (UC) vs. 12 (CD)
Location of UC lesions (the Paris classification):	
Pancolitis	27 (13 girls vs. 14 boys)
Left-sided	3 (2 girls vs. 1 boys)
Extensive	4 (2 girls vs. 2 boys)
Location of CD lesions (the Paris classification):	
1/3 of the distal section of ileum (L1)	1 child
The colon (L2)	2 children
The ileum and colon (L3)	3 children
The upper section distally to the ligament of Treitz and proximally to 1/3 of the distal section of ileum (L4b)	1 child
1/3 of the distal section of ileum and the upper section distally to the ligament of Treitz and proximally to 1/3 of the distal section of ileum (L1/L4b)	2 children
1/3 of the distal section of ileum and the upper section of the alimentary canal proximally to the ligament of Treitz (L1/L4a)	6 children
The ileum, colon, and the upper section of alimentary canal proximally to the ligament of Treitz (L3/L4a)	10 children

IBD – inflammatory bowel diseases, UC – ulcerative colitis, CD – Crohn's disease, PUCAI – Paediatric Ulcerative Colitis Activity Index, PCDAI – Paediatric Crohn's Disease Activity Index.

UC and in 10% of CD patients [14]. Growth disorders were seen in both conditions, but more frequently in CD patients [15].

The present study provides a thorough assessment of body composition in children with IBD when diagnosing autoimmune diseases, and allows an investigation into existing changes in the same population in the annual period of time.

Aim

The aim of the study was the assessment of body composition in children with UC and CD.

Material and methods

Sample selection

The study was conducted in the period from October 2012 to October 2013 in three stages. It was preceded by a month-long pilot study. The first stage of the research involved 59 children with non-specific IBD (34 children with UC, and 25 children with CD) aged 4–18 years hospitalised at the Clinical Department of Paediatrics with the Paediatric Neurology Unit of Regional Hospital No. 2 in Rzeszow. The study also included children continuing treatment under the supervision of Children's Specialised Clinic at Provincial Hospital No. 2 in Rzeszow. Demographic and clinical characteristics are presented in Table I.

The second phase of the study involved 26 children newly diagnosed with IBD (16 children with UC and 10 children with CD). This reduced the estimated error associated with the potential impact of the treatment on nutritional status and body composition, and gave a homogenous group of children. The control group of 26 children (age- and sex-matched control) were chosen from among the students of selected primary schools, junior high schools, and secondary schools in rural and urban areas of Podkarpacie.

The third stage concerned the research of the same group of children (9 children with UC and 9 children with CD) a year after the IBD diagnosis. Eight children (7 children with UC and 1 child with CD) were excluded from the final pool due to lack of parents' consent to participate in the repeated test.

The course of research

The tested children were measured for body mass and height (a personal scale with telescopic height – SECA 799). The measurement of body composition was performed by means of a BIA-101 impedance analyser made by AKERN (Italy).

The measurements were conducted in tetrapolar system in a contralateral mode (amplitude of mea-

sured current 800 μA, sinusoidal, 50 kHz), before noon (7:00–12:00), in supine position, with abducted upper (30°) and lower (45°) extremities, on an empty stomach, after 5 min of rest. To ensure high reliability of the results obtained, two measurement cycles were performed (one after another). Disposable electrodes were placed on the dorsal surface of the right upper (over the wrist) and right lower limb (the ankle). The measurement results were transferred to specialised software (Bodygram1_31 by AKERN).

Disease activity in cases of UC was assessed by means of the Paediatric Ulcerative Colitis Activity Index (PUCAI), whereas CD was assessed by the Paediatric Crohn's Disease Activity Index (PCDAI) modified by Ryżko and Woynarowski. The classification of Paris was adopted to assess the location of the lesions in the gastrointestinal tracts of all children.

Ethical approval

The study was approved by the Bioethical Commission of the Faculty of Medicine, University of Rzeszow in Rzeszow (No.5/02/2012). The study was conducted in accordance with the Declaration of Helsinki.

Statistical analysis

Parametric and non-parametric tests of significance were used for statistical analysis of the obtained data. Meeting the conditions for application of parametric tests allowed the use of *t*-test for independent samples, one-way analysis of variance (ANOVA), and Pearson's correlation. The level of significance was adopted at $p < 0.05$ for statistically significant relationship; $p < 0.01$ for a very statistically significant relationship; and $p < 0.001$ for a highly statistically significant relationship [16]. The calculations were conducted by means of IBM SPSS Statistics 20 software.

Results

The comparison of selected components of body composition in children newly diagnosed with UC to the control group showed lower values of fat-free mass (FFM) (UC: 12.95 ±41.13 kg vs. control group: 14.50 ±42.06 kg) and individual components of body cell mass (BCM) (UC: 21.19 ±8.78 kg vs. control group: 23.06 ±9.11 kg) and muscle mass (MM) (UC: 10.51 ±26.06 kg vs. control group: 10.99 ±28.19 kg). The differences were not at the level of statistical significance ($p > 0.05$). The fat mass (FM) and total body water (TBW) were comparable in both groups.

Comparative analysis of body composition in children newly diagnosed with CD showed significantly lower values of FFM than in the children from the control group (CD: 35.50 ±11.07 kg vs. control group: 45.50 ±9.95 kg; $p = 0.047$). Particularly significant differences were related to the values of BCM components (CD: 17.40 ±5.58 kg vs. control group: 25.30 ±5.79 kg; $p = 0.006$), MM (CD: 21.50 ±7.01 kg vs. control group: 31.00 ±7.13 kg; $p = 0.007$), and TBW (CD: 28.60 ±6.36 l vs. control group: 34.80 ±6.75 l; $p = 0.048$). Lower FM values were also observed, but in the absence of statistical significance.

The annual interval in children with UC showed an increase in fat as well as fat-free body mass. A particularly significant increase was observed among the components of the cell mass, muscle mass, and total body water (Table II). A follow-up after a year in children with CD showed statistically significant increase in FM and FFM. This trend was also visible in the components of the BCM, MM, and TBW (Table III).

Discussion

In the medical literature there are numerous reports that analyse the nutritional status of children with IBD using simple screening assessment indicators [12, 14,

Table II. The values of selected components of body composition in children with newly diagnosed UC in the annual time period

Components	UC1		UC2		*P*-value*
	N	Mean ± SD	*N*	Mean ± SD	
FM	9	7.67 ±3.08	9	10.33 ±3.74	0.285
FFM	9	35.22 ±14.85	9	39.00 ±13.87	0.007*
BCM	9	16.63 ±8.79	9	20.64 ±8.73	0.007*
MM	9	20.88 ±10.50	9	25.43 ±10.51	0.007*
TBW	9	26.90 ±10.92	9	29.52 ±9.73	0.007*

*FM – fat mass [kg], FFM – fat-free mass [kg], BCM – body cell mass [kg], MM – muscle mass [kg], TBW – total body water [l], UC1 – the first test (2012), UC2 – the second test (2013); *p < 0.05.*

Table III. The values of selected components of body composition in children with newly diagnosed CD in the annual time period

Components	CD1		CD2		*P*-value*
	N	Mean ± SD	*N*	Mean ± SD	
FM	9	7.36 ±1.96	9	9.47 ±2.96	0.020*
FFM	9	35.99 ±11.14	9	42.41 ±15.37	0.024*
BCM	9	17.50 ±5.30	9	21.41 ±7.20	0.024*
MM	9	21.82 ±6.66	9	26.37 ±8.79	0.028*
TBW	9	29.01 ±6.57	9	31.02 ±7.77	0.028*

*FM – fat mass [kg], FFM – fat-free mass [kg], BCM – body cell mass [kg], MM – muscle mass [kg], TBW – total body water [l], CD1 – the first test (2012), CD2 – the second test (2013); *p < 0.05.*

17–20]. Unfortunately, in many cases the results may not reflect an appropriate level of disturbance in the analysed group of children. The issue is confirmed by the long-term results of Sladek *et al.*, characterising the clinical picture of 146 newly diagnosed paediatric cases of CD. Despite the fact that patients reported weight loss (43.0%) or lack of its expected increase (48.0%), in most cases (64.8%) body mass index (BMI) values were in the range of the 5^{th}–85^{th} percentile [18]. In addition, the researchers pointed to a possible lack of precision in detecting loss in a FFM using only body weight or BMI [21, 22]. The answer to the presented issue is attempts of thorough analysis of nutritional status assessment, including the components of body composition in children with UC and CD [10, 19, 22].

Our study showed lower values of FFM and its individual components in children newly diagnosed with UC and CD. In children with CD, the results were characterised by high statistical significance ($p = 0.047$). These results were confirmed by previous observations regarding the lower values of FFM in children with inflammatory bowel disease [22–24] and in particular with CD [10, 11]. The reasons for this phenomenon should be seen in the exhaustion of energy reserves, due to high dynamics and the severity of the inflammation in the early stages of the disease.

The lack of statistically significant differences in fat mass in our study also proved the specificity of the course of nutritional status disorders in IBD, as described in the publication by Gerasimidis *et al.*, who pointed to weight loss and wasting that manifested in FFM disorders while FM remained stable [24].

Analysis of long-term changes in body composition in the present study showed a statistically significant increase in FM and FFM components. These results can be explained primarily by the influence of the recommended treatment, which in the long-term perspective caused remission in most cases. In the study by Sylvester *et al.*, analysing children with CD in a 2-year follow-up, no significant increase in FFM was demonstrated; however, in both studies, the values of body composition components were lower than the figures reported in the healthy children from the control group [25]. The differences may be the result of different duration of the disease and therefore, potentially more frequent changes in its activity. Valentini *et al.* also reported a decline of cell mass observed even in remission [26]. In conclusion, it should be emphasised that the chronically low figures in FFM in children with IBD (particularly muscle and cell mass) may result in a number of developmental disorders including disorders in skeleton growth and consequently osteoporosis or osteopaenia [27, 28]. Constant analysis of changes in the trend of body composition will allow a more accurate assessment of nutritional status in children at risk, including children with IBD.

Conclusions

Children with newly diagnosed IBD were highly vulnerable to nutritional status disturbances resulting in low levels of body composition. The increase in fat and lean body mass in an annual interval may be due to the treatment regime and control of the children.

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Conflict of interest

The authors declare no conflict of interest.

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