

Investigating the diagnostic criteria of abnormal body
composition and the efficacy of its treatment
in clinical practice

PhD thesis

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INTRODUCTION

The body composition of the patients is a prognostic factor for the outcome of the diseases. Abnormal body composition has an adverse effect on morbidity, mortality, conservative treatment efficacy, surgical complications, regeneration; increases length of stay and the cost of hospitalization; and impairs the quality of life. Progression of disease related malnutrition can be decelerated by applying regular body composition assessment and effective nutritional intervention; sarcopenia could also be treated more efficaciously. In the research I investigated various analysis methods and devices, and then conducted cross-sectional surveys and follow-up studies with IBD patients and elderly to evaluate their nutritional therapy.

OBJECTIVES

The main aim of the research was to develop a malnutrition and altered body composition screening method (according to the latest international guidelines) that measures the risk of nutrition disorders, provides sufficient data to follow and to evaluate the efficiency of nutrition therapy, and can be performed within the limited time-frames in outpatient care.

METHODS

In the prospective, cross-sectional and follow-up studies the results provided by the bioelectric impedance analysis (BIA) devices have been examined; in human researches the nutritional status and the changes in body composition of the patients have been the subject of the research.

Combined screening methods have been used to assess patients (with inflammatory bowel disease, IBD; or short-bowel syndrome, SBS) with MUST questionnaire and with InBody 720 body composition analyser. In case of the elderly muscle mass (with InBody 370 analyser), muscle strength (with Carmy EH101 hand dynamometer for measuring grip strength), and physical performance (Short Physical Performance Battery, SPPB) were assessed.

During the statistical analyses descriptive, variance (Analysis Of Variance, ANOVA) and correlation analysis (Sperman linear correlation coefficient determination) were applied using SAS and SPSS software packages. The diagnostic utility of BMI and fat-free mass index (FFMI) was determined by the Receiver Operating Characteristic (ROC) analysis. The categorical variables were analysed using Cohen's kappa calculation and Chi-square test.

RESULTS

Investigating BIA devices

After examining the BIA body composition analysing devices that are currently in use in Hungarian clinical practice, I have found that only professional devices are suitable for diagnosing the abnormal nutrition status of IBD patients. The characteristics of the professional BIA tools are the following:

- ✓ weigh body mass with at least one decimal accuracy
- ✓ have eight-point tactile electrodes
- ✓ apply measurements at various frequencies
- ✓ evaluate impedance measurements for the total body and for the five segments (trunk and four limbs)
- ✓ detect the severity of oedema in the five segments
- ✓ calculate several parameters (e.g., BMI, FFMI, FMI)
- ✓ do not use empirical correction factors
- ✓ are able to estimate the visceral fat area
- ✓ provide a “result sheet” indicating the normal ranges and the body composition history to monitor the changes at a glance
- ✓ include a data management software.

Results of the cross-sectional survey

In the cross-sectional surveys a professional BIA device was used for body composition analysis of patients with Crohn's disease, focusing on BMI and FFMI values, and comparing the results with those of the apparently healthy subjects. 21% of the patients were diagnosed with low BMI and 30% were diagnosed with low FFMI values. Significant differences were found between the BMI and the FFMI median values of the patients and the healthy subjects (BMI: 22.0 vs. 25.1 kg/m², p<0.0001; FFMI: 17.3 vs 18.4 kg/m²; p=0.0044). It is important to emphasize that the median BMI (17.8 kg/m²) and FFMI (14.4 kg/m²) of patients with intestinal strictures were below the cut-off points.

When studying the correlation between BMI and FFMI, a strong positive correlation was found in both male (r=0.861) and female (r=0.752) Crohn's patients. Conclusion: if they have low BMI, their FFMI value is also likely to be below the cut-off point.

The diagnostic utility of BMI and FFMI was determined by ROC analysis, and it revealed that neither is

efficient enough as a separate diagnostic factor, therefore they should be used in combination with other methods.

Several nutritional assessment tools are used in the clinical practice to identify patients requiring nutritional intervention. We have applied some of these tools to screen malnutrition and/or altered body composition among IBD patients. The distribution of malnourished patients varied as follows:

- ✓ 19% with low BMI ($<18.5 \text{ kg/m}^2$) *and* low FFMI (male $<17 \text{ kg/m}^2$, female $<15 \text{ kg/m}^2$)
- ✓ 21% with low BMI
- ✓ 25% below borderline BMI ($<20.0 \text{ kg/m}^2$)
- ✓ 30% with low FFMI
- ✓ 32% with low BMI and/or low FFMI
- ✓ 35% with medium or high risk of malnutrition validated by the MUST screening method
- ✓ 40% with risk of abnormal nutritional status assessed by combined MUST and BIA methods.

The MUST and the BIA validated methods do not substitute but complement each other with evaluating different parameters.

Results of the follow-up study

We have evaluated the efficacy of a one year nutritional therapy in case of IBD and SBS patients. In the IBD patient group the nutritional indices improved: significant BMI ($18.5\pm 2.6 \rightarrow 19.8\pm 3.1 \text{ kg/m}^2$, $p=0.035$ s.) and non-significant FFMI ($15.4\pm 2.05 \rightarrow 15.9\pm 2.43 \text{ kg/m}^2$; $p=0.296$ n.s.) increases were observed. The 32% of the patients were moved from the risky to the non-risky group. In the SBS patient group the nutritional indices improved as well: significant FFMI ($15.7\pm 2.81 \rightarrow 17.2\pm 2.45 \text{ kg/m}^2$; $p=0.0031$ s.) and non-significant BMI increases ($19.9\pm 3.36 \rightarrow 20.6\pm 3.36 \text{ kg/m}^2$; $p=0.1524$ ns) were detected. We could reduce the number of patients to half who were diagnosed with low BMI *and* low FFMI values, and we could increase the number of patients with values within the normal range. A three-month combined (nutrition- and physiotherapy with progressive resistance training) intervention have also been studied in the elderly. Comparing the changes within the test and the control groups significant differences have been found both in muscle strength ($+1.6\pm 0.9 \text{ kg}$ vs. $-1.6\pm 0.9 \text{ kg}$; $p=0.038$) and in skeletal muscle mass ($+0.4\pm 0.3 \text{ kg}$ vs. $-1.0\pm 0.6 \text{ kg}$; $p=0.013$).

Four-parameter evaluation of the efficiency of nutritional therapy

In order to follow the efficiency of nutrition therapy a 4-parameter evaluation method has been developed, which considers two categorical and two continuous variables. The method is also suitable for individual and group evaluations. In case of the malnourished, the target values for nutrition therapy were: BMI=20 kg/m², FFMI=17 kg/m² (men) or FFMI=15 kg/m² (women). In case of both the BW and the FFM changes the target was a 6–10% increase over three months and a >10% increase by the end of the 6th month.

Gender-, age-, and BMI-adjusted percentile value tables of FFMI

Gender-, age- and BMI-adjusted FFMI percentiles tables have been determined using retrospective FFM-data from a previous survey involving 2952 subjects in Hungary. The BMI categories were classified based on the WHO and the ESPEN recommendations.

CONCLUSIONS

During my research I have examined the diagnostic criteria for malnutrition and abnormal body composition as well as the efficacy of nutrition therapy in the clinical practice. Based on the analysis of the collected data I have come to the following new scientific findings:

1. A wide range of body composition analysers are in use within the clinical practice, so it is necessary to set up proper criteria to select the professional medical devices suitable for assessing the patient population accurately. Firstly, I have set up the criteria determining whether a particular BIA device is suitable for the reliable measurements of outpatients with inflammatory bowel disease.
2. Using a professional BIA device I assessed the body composition of IBD patients and healthy subjects. I detected that the BMI and FFMI values were significantly lower of the IBD patients than those of the control subjects. Based on the BMI and the FFMI ROC analyses it is obvious that the observation of these values as an independent diagnostic tool is not sufficient

to evaluate the risk of nutritional disorder; therefore we recommend its combination with other methods.

3. When investigating the distributions of malnutrition and altered body composition of IBD patients, we have found that various screening methods result in significantly different groups with an indication of risk. Considering their sensitivity the combination of the MUST and the BIA methods proved to be the best, which complies with the latest guidelines regarding body composition assessment; therefore we recommend the combined usage of these methods. Their combination also provides relevant data for the analysis and the evaluation of the efficiency of nutrition therapy.
4. Regarding the efficacy of nutrition therapy, I have developed a 4-parameter evaluation method based on BMI, FFMI, Δ BW, and Δ FFM. After the efficacy analysis of nutrition therapy, I have concluded in the following results:
 - ✓ After a one-year nutrition therapy significant BMI and non-significant FFMI increases were registered in IBD patients. Significant BW gain was seen in

27% of the patients and significant FFM gain was seen in 21% of the patients.

- ✓ After a one-year nutrition therapy (with dietary counselling, oral nutritional supplement, parenteral nutrition formula, and intravenous feeding catheter) significant FFMI and non-significant BMI increases were achieved in SBS patients. Significant BW increase in 4 cases and significant FFM increase in 6 cases were recorded for our 15 patients. I was the first in Hungary who started to monitor with a professional body composition analyser the nutritional status of the SBS patients being managed in the home parenteral centre of St. Imre Hospital, Budapest.
- ✓ I have proven that a 3-month combined intervention (including special nutrition- and physiotherapy) can increase muscle strength and skeletal muscle mass even in the elderly. Comparing the alterations of the results between the test and the control groups significant differences have been found.

5. I have publicised an age-, gender-, and BMI-adjusted FFMI percentile table with the quantitative evaluation of Hungarian population's values.

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