The Relationship between Body Composition and Physical Activity in Patients with Crohn's Disease

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Abstract: Crohn's disease (CD) is a chronic inflammatory gastrointestinal disease associated with malnutrition, inadequate intake, increased energy expenditure, impaired digestion and absorption, leading to a reduction in skeletal muscle mass and adipose tissue. The purpose of this study was to evaluate body composition, phase angle (PhA) and muscular strength in a group of patients with CD. Forty-six male patients, participated in the study and were divided into two groups: 10 physically active patients (A-, age 29.1±8.9 years; weight 68.5±7.2 kg; height 172±4 cm; BMI 23.2±2.7 kg/m^2) and 36 sedentary (S-, age 28.9±7.4 years; weight 67.7±8.6 kg; height 174±6 cm; BMI 22.4±2.5 kg/m^2). Additionally, 20 healthy control subjects (CONTR, age 30.8±9.2 years; weight 71.4±5.6 kg; height 176±5 cm; BMI 23.1±2.1 kg/m^2) participated in the study. S- presented significantly lower FFM values compared to control subjects ($p<0.05$) but not than A-; whereas no differences were observed for fat mass values between groups. Whole-body PhA was higher in A- than other groups; while upper-limbs PhA was lower in S than other groups and lower-limbs PhA was higher in A- than S- but not compared to controls. Finally, muscular strength resulted statistically lower in S- than C- but not than A-.

1 INTRODUCTION

Crohn's disease (CD) is a chronic inflammatory intestinal disease associated with Protein-Energy Malnutrition (PEM) (Gassull, 1986; Krok, 2003). PEM is caused by inadequate intake, improved energy expenditure due to inflammation and impaired digestion and absorption (Triantafillidis, 2015). These conditions lead to decreases in skeletal muscle and adipose tissue mass. Altered body composition (BC), such as reduced fat-free mass (FFM), has been reported in patients with CD (Bryant, 2013; Molnàr, 2017). Additionally, decreased skeletal muscle mass has been observed in 60% of patients with CD in clinical remission (Schneider, 2008; Valentini, 2008). The relationship between decreased skeletal muscle mass and prognosis of patients with CD has yet to be clarified.

Skeletal muscle volume is reported to have a strong correlation with physical performance, such as gait speed, as well as with muscle strength, such as grip strength (Cruz-Jentoft, 2010). Premature and 'accelerated' decreases in muscle mass has been described in subjects affected by chronic inflammation, malnutrition and immobility, which are relevant in inflammatory bowel disease as CD (Sammarco, 2017; Harris-love, 2018; Beenakker, 2010; Beyer, 2012; Jo, 2012; Meng, 2010).

Bioelectrical Impedance Analysis (BIA) is a non-invasive, reliable and broadly applied method to evaluate BC and nutritional status in clinical and non-clinical setting. It is useful in clinical practice because it allows patients monitoring over time. Raw BIA parameters (resistance, reactance and phase angle), are commonly used to evaluate cellular function and hydration status. In particular, phase angle (PhA) can be considered an index of the integrity of the cell membrane. It identifies extra/intracellular water distribution: a low PhA being a common finding in severe malnutrition. Predictive equations can be useful to estimate BC from BIA parameters: FFM and fat mass (FM).

The purpose of this study was to evaluate BC, PhA and muscular strength in sedentary and physically active patients with CD compared with a control group.

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2 METHODS

Forty-six male patients with CD, attending the Clinical Nutritional Unit of the Department of Clinical Medicine and Surgery, Federico II University Hospital, Naples, participated in the study. Patients were divided into two groups according to leisure time activity: 10 physically active patients (A-group, age 29.1±8.9 years; weight 68.5±7.2 kg; height 172±4 cm; BMI 23.2±2.7 kg/m^2), who carried out physical activity from 3 to 5 hours a week since at least 1 year, and 36 sedentary patients (S- group, age 28.9±7.4 years; weight 67.7±8.6 kg; height 174±6 cm; BMI 22.4±2.5 kg/m^2). Additionally, 20 healthy control subjects with similar characteristics (CONTR group, age 30.8±9.2 years; weight 71.4±5.6 kg; height 176±5 cm; BMI 23.1±2.1 kg/m^2), who did not follow regular exercise regimes, participated in the study. Subjects were tested in fasting conditions early in the morning by the same operator, following standard procedures at Federico II University Hospital of Naples. Weight was measured to the nearest 0.1 kg using a platform beam scale and height to the nearest 0.5 cm using a stadiometer (Seca 709; Seca, Hamburg, Germany). BMI was then calculated as weight (kg) / height² (m²).

BIA was performed at 50 kHz using Human Im Plus II (DS Medica-Milan) at room temperature (22–25 °C) after 20 min in the supine position; all subjects were in a fasted state (12 h) and voided prior to measurement.

Each subject was evaluated on the non-dominant side of the body using disposable electrodes. Two injecting electrodes were placed on the hand and foot (mid-dorsum of hand/foot just proximal to the metacarpal/metatarsal phalangeal joint line) and two sensing electrodes were placed on the wrist and ankle (mid-dorsum of wrist/ankle centred on a line joining the bony prominences of radius and ulna/the medial and lateral malleoli).

The measured BIA variables were R and PhA, which were determined at 50 kHz (Human Im Plus II, DS Medica S.r.l., Milan, Italy). For segmental BIA analysis, the length of each segment was measured, and the electrodes were properly positioned to measure PhA values of upper and lower limbs. This evaluation was conducted according to the Organ method (Organ, 1985). FFM and FM were estimated using the prediction equation developed by Kushner. Hand grip Strength (HGS), was measured at baseline with a hand dynamometer (Jamar Lafayette Hydraulic Hand Dynamometer, USA), always by the same operator (MM).

For each upper limb, three measurements were made at a distance of one minute from each other. The resulting value was then transcribed, with an approximation to 0.1 kg. For statistical analysis, the mean value (the arithmetic mean of the three recorded values) was considered for the non-dominant limb.

Statistical Analysis.

Results are expressed as mean ± standard deviation. The statistical analysis (SPSS. 19.0 vers., Chicago, USA) has been performed using one-way analysis of variance (ANOVA with post-hoc Tukey test). Simple linear correlation was used to assess the association between variables. Chi-square (χ^2) test was used for evaluation of prevalence in different groups. Statistical significance was pre-determined as $p<0.05$.

3 RESULTS

Age and anthropometric measurements did not show significant differences among the three groups (Table 1).

Table 1: Anthropometric characteristics, body composition and phase angle of participants.

		Active Crohn's Patients (n =10) Mean ± SD	**Sedentary Crohn's Patients** (n =36) Mean ± SD	**Control Group** (n =20) Mean ± SD
Age	years	29.1±8.96	28.9±7.37	30.8±9.18
Weight	kg	68.5±7.22	67.7±8.64	71.4±5.61
Height	cm	172±4	174±6	176±5
BMI	kg/m^2	23.2±2.7	22.4±2.5	23.1±2.1
FM	kg	12.3±5.9	12.7±6.4	12.5±3.2
FM	%	17.5±7.5	18.2±7.9	17.4±3.9
FFM	kg	56.2±4.1	55.0±6.2	58.9±4.7*
PhA W/B	degrees	8.03±0.72#	6.71±0.71	7.26±0.72
PhA U/L	degrees	6.32±0.75	5.11±0.59^	5.83±1.24
PhA L/L	degrees	9.31±0.76	7.94±1.14°	8.45±1.11
HGS	kg	39.2±4.9	35.0±6.8	39.2±2.9*

DS=standard deviation; BMI=body mass index;
FM=fat mass; FFM=fat-free mass;
NS=not significant; PhA=phase angle; W/B=whole-body;
U/L= upper-limbs; L/L=lower-limbs; HGS= hand grip strength;
*=C vs. S; #=A vs. all; ^=S vs. all; °=A vs. S;

Regarding BC, S- group presented significantly lower FFM values compared to controls ($p<0.05$) but not than A-. No statistically differences were obser-

ved for FM values between groups.

Whole-body PhA resulted higher in A- than other groups (Table 1). Upper-limbs PhA was significantly higher in both A- and controls than S- while, lower-limbs PhA was significantly higher in A- than S- but not compared to controls. HGS test resulted statistically lower in S- than controls but not than A-. Moreover, patients in clinical remission were about 80% for A-group and about 40% for S- group (test χ^2: p=0.001).

4 DISCUSSION

Our data shows that BC variables, like FFM and FM, were similar between A- and S- patients with CD. Conversely, PhA, as qualitative parameter, was higher in A- than S- and control subjects. In addition, muscular strength, evaluated with HGS, was higher in A- than S- but similar to control group. These results suggest that practising leisure time physical activity, as 3 to 5 hours per week, might be helpful in keeping and promoting health status of CD patients.

Finally, higher PhA, an index of integrity of the cell membrane, is associated with a more active lifestyle in patients with CD.

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