## Short Communication

# Analysis of fat and muscle mass in patients with inflammatory bowel disease during remission and active phase

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Inflammatory bowel disease (IBD) is often associated with malnutrition. The aim of this study was to compare the body composition of outpatients with IBD during remission and active phase. In order to evaluate disease activity we used Crohn's Disease Activity Index for Crohn's disease (CD) patients and Lichtiger's Index for ulcerative colitis (UC) patients. All patients underwent the analysis of BMI, arm muscle area (AMA) and triceps plus subscapula skinfold thickness (TST+SST) to identify total, muscle and fat mass, respectively. In total 102 patients were evaluated (CD, *n* 50; UC, *n* 52) and the majority was young women. Malnutrition according to BMI was found in 14·0 % of patients with CD and 5·7 % of UC patients. Muscle mass depletion was detected in more than half of the CD and UC patients. The BMI, TST+SST and AMA values were lower in the active phase only in CD patients ($P < 0.05$). Fat mass depletion was associated with active phase in both CD and UC patients. Body composition parameters obtained using BMI, TST+SST and AMA were not correlated with the presence of fistula in CD patients ($P > 0.05$). In conclusion, patients without signs of malnutrition had fat mass depletion especially in the active phase and muscle mass depletion occurred both in CD and UC patients.

**Inflammatory bowel disease: Body composition: Crohn's disease: Ulcerative colitis: Active disease**

Malnutrition is detected frequently among patients with inflammatory bowel disease (IBD) and its pathophysiology is complex and multifactorial. Several mechanisms that contribute to malnutrition in IBD patients may be caused by low dietary intake, changes in metabolism, increased intestinal protein loss and nutrient malabsorption[1,2].

In the active phase there is a decrease in the oral intake of nutrients because of abdominal pain and anorexia. The mucosal inflammation and associated diarrhoea lead to a loss of protein, blood, minerals, electrolytes and trace elements. Alterations in energy metabolism may result in increased resting energy expenditure and lipid oxidation in IBD patients[1,3].

Previous studies[4–6] that investigated hospitalized IBD patients or subjects with active disease showed an increased prevalence of malnutrition among those subjects; however, improvement of disease activity was associated with an increase in fat-free mass content in patients with active disease.

Recently the effect of the inflammatory cytokines in the metabolism of nutrients of patients with Crohn's disease (CD) has been subject to investigation. TNF, IL-1 and IL-6, which are pro-inflammatory, have demonstrated significant deleterious effects on protein metabolism. When TNF levels are increased the protein synthesis for nutrition purposes is affected by the deviation of amino acids for the synthesis of inflammatory proteins[7].

Although nutritional status changes have been reported in IBD patients, differences between CD and UC in active and remission phases have seldom been investigated and identified. The aim of the present study was to compare the body composition of patients with IBD in remission and active phases.

## Methods and materials

### Study population

The study protocol was approved by the Ethics Committee of the University Hospital Professor Edgard Santos and all subjects gave their informed consent to participate in the study.

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In total 102 outpatients diagnosed with IBD were selected from August 2005 to September 2006 at the Gastroenterology Clinic, Federal University of Bahia, Brazil.

### Patient evaluation

Disease activity was assessed according to the Crohn's Disease Activity Index (CDAI)[8] for CD and the Lichtiger's Index[9] for ulcerative colitis (UC), and patients were divided into two groups: those in the active phase (CDAI ≥ 150 or Lichtiger's Index > 10) and those in the remission phase (CDAI < 150 or Lichtiger's Index ≤ 10). All patients received medical treatment during the study.

Anthropometric measures included body height (in cm) measured using a scale-integrated stadiometer and body weight (in kg) measured in light clothing without shoes[10]. BMI was calculated from weight and height (kg/m$^2$)[11], and malnutrition was defined as BMI < 18·5 kg/m$^2$ in adults[11] and BMI ≤ 22·0 kg/m$^2$ in the elderly[12]. Skinfold thickness measurements were taken in duplicate from the non-dominant side of the body at two different sites (triceps and subscapula) using a skinfold caliper (Langer). Circumference measurement of the upper arm was measured with arm muscle area (AMA) and the sum of the skinfold thickness, calculated by standard equations. Patients were classified as having fat mass and muscle mass depletion when anthropometrical measures, triceps plus subscapula skinfold thickness (TST+SST) and AMA were below the 15th percentile of Frisancho's reference values, respectively[13].

### Statistical analysis

Results are expressed as means and standard deviations, percentage and absolute values. Differences in nutritional status between CD and UC patients were analysed by Student's t test. Categorical variables were compared with the $\chi^2$ test and Fisher exact test. The Statistical Package for the Social Science program version 9.0 (SPSS, Chicago, IL, USA) was used for these analyses.

## Results

In total 102 patients were evaluated: fifty with CD and fifty-two with UC; among them sixteen (32·0 %) and twelve (23·1 %), respectively, had active disease at the moment of the evaluation. The majority of patients were women (sixty-eight out of 102) and those with CD were younger than those with UC (mean age 37·4 (SD 13·4) and 45·0 (SD 12·1), respectively; $P < 0.05$).

Eighteen patients with CD had fistula and none had small-bowel resection. Disease duration and steroid requirement had no correlation with anthropometric parameters.

### Anthropometric parameters in Crohn's disease patients

According to BMI, seven (14·0 %) patients with CD had malnutrition. Eighteen (36·0 %) had fat mass depletion according to TST+SST and thirty-one (62·0 %) had muscle mass depletion according to AMA (Table 1).

Were observed a statistically significant association between malnutrition (BMI), fat mass (TST+SST) depletion and disease activity in patients with CD (Table 1). Also patients with active CD had BMI, TST+SST and AMA values significantly lower than those found during the remission phase (Table 2).

### Anthropometric parameters in ulcerative colitis patients

In patients with UC, TST+SST value was significantly lower in patients with active disease when compared with those in remission phase (Table 2) and fat mass (TST+SST) depletion was significantly associated with active phase disease (Table 1).

**Table 1.** Correlation between anthropometrical nutritional parameters in patients in the active and remission phases of inflammatory bowel disease‡

| | | Active disease | | Remission phase | | Total | |
|---|---|---|---|---|---|---|---|
| Disease | Interpretation | n | % | n | % | n | % |
| Crohn's disease (n 50) | | | | | | | |
| BMI* | Malnutrition | 6 | 12·0 | 1 | 2·0 | 7 | 14·0 |
| | No malnutrition | 8 | 16·0 | 35 | 70·0 | 43 | 86·0 |
| TST+SST† | ≤15th percentile | 10 | 20·0 | 8 | 16·0 | 18 | 36·0 |
| | >15th percentile | 4 | 8·0 | 28 | 56·0 | 32 | 64·0 |
| AMA | ≤15th percentile | 10 | 20·0 | 21 | 42·0 | 31 | 62·0 |
| | >15th percentile | 4 | 8·0 | 15 | 30·0 | 19 | 38·0 |
| Ulcerative colitis (n 52) | | | | | | | |
| BMI | Malnutrition | 2 | 3·8 | 1 | 1·9 | 3 | 5·7 |
| | No malnutrition | 24 | 46·2 | 25 | 48·1 | 49 | 94·3 |
| TST+SST† | ≤15th percentile | 14 | 26·9 | 5 | 9·6 | 19 | 36·5 |
| | >15th percentile | 13 | 25·0 | 20 | 38·5 | 33 | 63·5 |
| AMA | ≤15th percentile | 14 | 26·9 | 15 | 28·9 | 29 | 55·8 |
| | >15th percentile | 13 | 25·0 | 10 | 19·2 | 23 | 44·2 |

AMA, arm muscle area; TST+SST, triceps plus subscapula skinfold thickness.
Malnutrition (BMI) was significantly associated with the active phase (Fisher exact test): * $P < 0.01$.
Fat mass depletion (TST+SST) was significantly associated with the active phase (Fisher exact test): † $P < 0.05$.
‡ For details of subjects and procedures, see Methods and materials.

**Table 2.** Body composition of 102 patients with inflammatory bowel disease in active and remission phases‡

(Mean values and standard deviations)

| | Crohn's disease (*n* 50) | | | | Ulcerative colitis (*n* 52) | | | |
| | Active phase | | Remission phase | | Active phase | | Remission phase | |
| Measurements | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
|---|---|---|---|---|---|---|---|---|
| BMI (kg/m²) | 20·09* | 5·15 | 25·06 | 7·03 | 21·10 | 3·16 | 23·22 | 4·39 |
| TST+SST (mm) | 27·56* | 14·61 | 38·82 | 18·45 | 25·79* | 11·51 | 35·80 | 15·00 |
| AMA (cm²) | 25·15* | 11·06 | 34·14 | 11·49 | 29·65 | 8·26 | 30·57 | 8·20 |

AMA, arm muscle area; TST+SST, triceps plus subscapula skinfold thickness.
Mean values were significantly different from those of the remission phase (*t* test for independent samples): *P < 0·05.
‡ For details of subjects and procedures, see Methods and materials.

The BMI and AMA values were not significantly different between the two phases of the disease in UC patients (*P* > 0·05; Table 2).

Three (5·7 %) were malnourished, nineteen (36·5 %) had fat mass depletion and twenty-nine (55·8 %) had muscle mass depletion according to BMI, TST+SST and AMA, respectively (Table 1).

*Anthropometric parameters and presence of fistula in Crohn's disease patients*

In CD patients with fistula, five (10 %) were malnourished, six (12 %) had fat mass depletion and thirteen (26 %) had muscle mass depletion according to BMI, TST+SST and AMA, respectively. The presence of fistula in CD patients did not have a significant correlation with anthropometric parameters (*P* > 0·05).

**Discussion**

Nutrition plays a significant role in the management of IBD. This includes the prevention and correction of malnutrition. Patients with IBD are often found to have nutrient deficiencies at the time of diagnosis, whereas others develop features of malnutrition over the course of their illness. Employing nutrition support strategies complements the pharmacologic therapy of these patients[5,14].

In the present study the majority of the patients were women, although other studies showed that IBD affects equally both sexes. In previous studies from our group, Oliveira *et al.*[15] found that 73 % out of 100 UC patients were female and 61·5 % of sixty-five CD patients were female[16]. In the present study the mean age of patients with CD was lower than those with UC. Other authors have reported a greater frequency of CD diagnosis under the age of 40 years among Afro-descendent patients[17]. It seems that the increased frequency of CD in young female patients is associated with hormonal and race factors[16,18,19].

Malnutrition was more common among patients with CD than UC patients. The present finding is in agreement with the ones previously described by other authors[20,21] and probably occurs due to the small bowel involvement with impaired absorptive function and loss of nutrients by the fistulas. In CD there is a predominance of hypoalbuminaemia, protein intestinal loss and a negative nitrogenous balance, while in UC there is a greater prevalence of anaemia due to blood loss and the fact this is a disease limited to the colonic mucosa[1].

Of note, malnutrition according to BMI was not as frequent in the present study as in others. This could be explained by the presence of a greater number of patients in the remission phase. A low BMI may reflect poor nutritional status as well as poorly controlled disease. Filippi *et al.*[22], studying CD patients found similar data during the remission phase.

However, muscle mass depletion was found in the majority of CD and UC patients, also occurring in those in the remission phase. Other studies observed that the evaluation of the body composition allows one to identify IBD patients who are not malnourished but may be at nutritional risk, including subjects who are in the remission phase and in whom muscle mass depletion is found frequently[18,19,23–25]. Vaisman *et al.*[26] detected nutrient malabsorption in malnourished patients with CD during remission and Capristo *et al.*[27] showed that CD patients in clinical remission and without steroid therapy or nutrition support also had a lower fat mass than control subjects.

The anthropometric parameters BMI, TST+SST and AMA were significantly lower in patients with CD who had active disease. Reimund *et al.*[28] showed an inverse correlation between anthropometric measures and activity of the disease in patients with CD. BMI appears to be lower in CD patients when compared to controls[29].

In the present study the frequency of anthropometric alterations was not greater in CD patients with fistula. Several studies showed that nutritional therapy is important to close the fistula of malnourished IBD patients and the closure of the fistula is also important to improve the nutritional status[6,7].

Although muscle mass depletion was detected in UC patients, there was no correlation between AMA and the activity of the disease. Several studies have shown more evident anthropometric alterations in CD patients when compared with UC patients and controls[23,24,27,30,31].

The detailed evaluation of the nutritional status of patients with IBD even during the remission phase is very important to determine the correct nutritional management at the moment the disease becomes active and improve the depleted nutritional status. A good nutritional status represents a key factor in improving the quality of life of IBD patients.

In summary, malnutrition was more frequently detected among patients with CD than UC, however, muscle mass depletion was a common feature of both diseases during the active and remission phases. Fat mass depletion occurred

sharply in the active phase and partially recovered during the remission phase, however, depleted muscle mass remained in the remission phase indicating slow recovery of this body compartment or a greater sensitivity to IBD. The present results suggest that CD and UC during the remission and active phases seem to have some similarity from an anthropometric point of view. More studies are necessary to understand the pathophysiology and consequences of malnutrition in IBD patients.

## Acknowledgements

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