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ORIGINAL ARTICLE

Observational Study

Undernutrition, risk of malnutrition and obesity in gastroenterological patients: A multicenter study

Massimiliano Rizzi, Silvia Mazzuoli, Nunzia Regano, Rosa Inguaggiato, Margherita Bianco, Gioacchino Leandro, Elisabetta Bugianesi, Donatella Noè, Nicoletta Orzes, Paolo Pallini, Maria Letizia Petroni, Gianni Testino, Francesco William Guglielmi

Massimiliano Rizzi, Silvia Mazzuoli, Nunzia Regano, Francesco William Guglielmi, Gastroenterology Unit, San Nicola Pellegrino Hospital, 76125 Trani, Italy

Donatella Noè, Nicoletta Orzes, Paolo Pallini, Maria Letizia Petroni, Gianni Testino, Francesco William Guglielmi, AIGO-Committee on Nutrition and Alcoholism, 20153 Milano, Italy

Rosa Inguaggiato, Margherita Bianco, Gioacchino Leandro, Gastroenterology Unit I, Saverio De Bellis IRCCS, 70013 Castellana Grotte, Italy

Gioacchino Leandro, UCL, Department of Liver and Digestive Health, London NW3 2PF, England

Elisabetta Bugianesi, Division of Gastro-Hepatogy, Department of Medical Sciences, University of Torino, 10126 Torino, Italy

Donatella Noè, Dietetics and Clinical Nutrition Unit, S. Carlo Borromeo Hospital, 20153 Milano, Italy

Nicoletta Orzes, Gastroenterology Unit, S. Giovanni di Dio Hospital, 34170 Gorizia, Italy

Paolo Pallini, Gastroenterology Unit, Umberto I Hospital, 30174 Mestre, Italy

Maria Letizia Petroni, Nutritional and Gastroenterological Unit, IRCCS, 28824 Piancavallo, Italy

Gianni Testino, Alcoholism and Related Conditions Unit, IRCCS-AOU S. Martino-IST, 16132 Genova, Italy

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Correspondence to: Francesco William Guglielmi, Professor, Gastroenterology Unit, Regional Centre of Home Artificial Nutrition, "San Nicola Pellegrino" Hospital, 76125 Trani, Italy. guglielmifw@libero.it
Telephone: +39-883-483209
Fax: +39-883-483342

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Abstract

AIM: To investigate the prevalence of undernutrition, risk of malnutrition and obesity in the Italian gastroenterological population.

METHODS: The Italian Hospital Gastroenterology Association conducted an observational, cross-sectional multicenter study. Weight, weight loss, and body mass index were evaluated. Undernutrition was defined as unintentional weight loss > 10% in the last three-six months. Values of Malnutrition Universal Screening Tool (MUST) > 2, NRS-2002 > 3, and Mini Nutritional Assessment (MNA) from 17 to 25 identified risk of malnutrition in outpatients, inpatients and elderly patients, respectively. A body mass index ⩾ 30 indicated obesity. Gastrointestinal pathologies were categorized into acute, chronic and neoplastic diseases.

RESULTS: A total of 513 patients participated in the study. The prevalence of undernutrition was 4.6% in outpatients and 19.6% in inpatients. Moreover, undernutrition was present in 4.3% of the gastrointestinal patients with chronic disease, 11.0% of those with acute disease, and 17.6% of those with cancer. The risk of malnutrition increased progressively and significantly in chronic, acute and neoplastic gastrointestinal diseases in inpatients and the elderly population. Logistical regression analysis confirmed that cancer was a risk factor for undernutrition (OR = 2.7; 95%CI: 1.2-6.44, P = 0.02). Obesity and overweight were more frequent in outpatients.

CONCLUSION: More than 63% of outpatients and 80% of inpatients in gastroenterological centers suffered from significant changes in body composition and required specific nutritional competence and treatment.

Key words: Obesity; Malnutrition; Risk of Malnutrition; NRS2002; Gastrointestinal disease

Core tip: The relevance of this study concerns the finding that in patients with gastroenterological disease, both prevalence of undernutrition and risk of malnutrition were higher in patients admitted to the hospital and in patients with cancer disease, while obesity and overweight were more frequently detected in outpatients. In conclusion, we can attest that two-thirds of gastroenterological patients suffered from abnormalities in body composition and required targeted nutritional treatments.

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INTRODUCTION

Malnutrition is defined as a structural and functional alteration of the body composition. Although the term malnutrition is commonly used in the sense of undernutrition, it encompasses both weight loss (undernutrition) and weight gain (overweight and obesity). The physiological basis of undernutrition and obesity is the deficit (undernutrition) or the excess (obesity) of calories that results in measurable adverse effects on clinical outcomes[1-5]. The equilibrium between the total energy requirements, nutrient intake and utilization is mediated by hormonal and cytokine stimuli that induce the activation of intracellular metabolic pathways.

Previous papers have found that the prevalence of hospital undernutrition varies between 27% to more than 50% depending on the identification criteria, the medical or surgical setting and the age of the patients[6-10].

It is important to identify and treat undernutrition because it has been associated with a higher likelihood of hospitalization, a prolonged (by 29%-65%) hospital stay[11-15] and an increase in costs of up to 68%[16,17]. Moreover, it must be emphasized that hospital undernutrition worsens if untreated[18]. Today, many health care workers do not recognize malnutrition and do not consider nutrition as one of the more relevant aspects of the clinical management of patients[19].

The risk of undernutrition can be identified using different validated nutritional screening tools, such as the NRS-2002, MUST, and the MNA[20-22].

Of note, the prevalence of overweight and obesity has been steadily growing in the general population and among inpatients and represent important risk factors of morbidity and mortality[23-27].

Currently few data are available in the literature about the prevalence of undernutrition and the risk of malnutrition among Italian inpatients and outpatients, particularly in the gastroenterological setting. The Italian multicenter HOMIS study identified undernutrition in 19.1% and obesity in 24.8% of its patients[28]. Another Italian multicenter study, PIMAI, reported a prevalence rate of undernutrition of 30.7%, a risk of malnutrition, evaluated by the NRS-2002, of 28.6% and a rate of obesity of 21%[29,30].

The nutritional state of Italian gastroenterological patients has been described in an Italian multicenter study[31] that involved twenty-seven gastroenterology units. The study highlighted a mean of 27% of undernourished patients with a wide range (4% to 55%), probably due to the lack of appropriate nutritional assessment.

Consistent data on the prevalence of malnutrition in gastroenterology units have been limited to a few subsets of patients such as those with cirrhosis[32-36] and Crohn's disease[37-39].

Similarly, the prevalence of obesity in Italian gastroenterology centers has not been adequately studied, although it is an important risk factor for many gastroenterological diseases[40-42], and it seems to affect approximately 12% of discharged patients[43].

The aim of this study is to measure the prevalence rate of undernutrition, risk of malnutrition and obesity in the Italian gastroenterological population suffering from acute, chronic and neoplastic disease.

MATERIALS AND METHODS

Study design

This was an observational, cross-sectional and prospective multicenter study that was urged and supported by the Italian Hospital Gastroenterology Association (AIGO).

Nineteen Italian Gastroenterological Units and Services participated in the study, as disclosed by the AIGO website.

Inclusion criteria

All inpatients and outpatients (day hospital and ambulatory) admitted between January 14 and 20, 2013 were consecutively enrolled in the study and submitted to nutritional assessment. As this was an observational study, the sample size was determined by the number of inpatients and outpatients who visited the various centers during the study week.

Patient population

In this study, we enrolled three different categories of patients with gastrointestinal disease: (1) subjects with a diagnosis of acute gastrointestinal disease: Dysphagia, dyspepsia, heartburn, other abdominal pains, acute diarrhea, exacerbation of chronic diarrhea, acute constipation, digestive hemorrhage, acute hepatitis, cholangitis, rectum hemorrhage, inflammatory bowel disease (IBD) exacerbation, or acute pancreatitis; (2) patients with chronic gastroenterological disease: Reflux disease, achalasia, chronic gastritis, chronic viral hepatitis, chronic alcoholic hepatitis, non-alcoholic fatty liver disease, other chronic hepatitis, cirrhosis, chronic pancreatitis, Crohn's disease and ulcerative proctocolitis, other chronic enteropathy, or chronic constipation; and (3) patients with gastrointestinal cancer: Esophagus, gastric, small bowel, colon, pancreatic, or biliary cancer and hepatocarcinoma. Patients were categorized as having (1) chronic disease, if the symptoms, signs and diagnosis had persisted for $\geqslant$ 6 mo; (2) acute disease, if the symptoms, signs and diagnosis had recently appeared, regardless of the presence of chronic disease; or (3) cancer, if affected by gastroenterological neoplastic disease, regardless of the presence of acute and/or chronic disease, as it was assumed that the presence of neoplastic disease itself was sufficient to determine further deterioration of a patient's nutritional status.

Nutritional parameters

Weight (kg) and height (centimeters) were measured in the morning in fasting patients dressed in their underwear and without shoes.

The body mass index (BMI) was calculated by dividing the weight in kg by the square of height in meters. Weight loss was calculated as the difference between the current weight and the weight in the last three-six months as reported by the patient. Patients were considered undernourished when they presented an unintentional (*i.e.,* without voluntary dietary restriction) weight loss > 10% in the last 3-6 mo. Obesity was defined as a BMI $\geqslant$ 30, and overweight a BMI between 25 and 29.9. Obese patients were considered undernourished when they lost more than 10% of their weight while receiving their usual diet. The risk of malnutrition was calculated using three different specific tools, as shown in Table 1.

Specifically, the calculation of the three methods are described in detail in the following text: (1) the Malnutrition Universal Screening Tool (MUST) was used for outpatients. This method was based on the BMI, the unintentional weight loss and the presence of acute disease that was able to significantly reduce nutrient intake in the following five days. The total score ranged from 0-6; a score of 0 indicated null or low risk of malnutrition, a score of 1 suggested a moderate risk of malnutrition, and a score $\geqslant$ 2 was indicative of a severe risk of malnutrition[44]. We considered a score $\geqslant$ 2 to identify patients at nutritional risk.

The Nutritional Risk Screening Score 2002 (NRS-2002) has been recommended by ESPEN to screen inpatients. This test evaluates the nutritional risk (score: 0-3) and the severity of disease (score: 0-3) with an additional point for patients $\geqslant$ 70 years old. The final score ranges from 1 to 7. The patient is considered at nutritional risk for scores higher than 3[45].

The Mini Nutritional Assessment (MNA) is a tool for elderly patients ($\geqslant$ 65 years). This tool has two parts. The first part consists of six items and results in a score between 0 and 14; a score lower than 12 is considered indicative of risk of undernutrition and leads to the patient answering the second part of the tool, which is composed of 12 items with a possible maximal score of 16. A total score < 17 is indicative of malnutrition, a score between 17 and 25 indicates risk of undernutrition, while scores > 25 are indicative of well-nourished patients[46-48].

We used the MUST and NRS-2002 to evaluate the risk of malnutrition in < 65-year-old patients and the MNA for those $\geqslant$ 65 years old.

Ethical considerations

This study was designed with the aim of obtaining epidemiological data and anthropometric measurements that did not compromise patient's safety. All data were anonymous. Patients were referred using the first two letters of their name and surname and with a consecutive number.

A written informed consent statement was obtained from each patient prior to study inclusion. The study was conducted with the consensus of the local ethical committees of each center and of all the patients.

Statistical analysis

The results were presented as the mean ± SD. Categorical data were described as frequencies. The nonparametric Mann-Whitney *U* test was used to compare continuous

Table 1 Subscores of the three nutritional risk screening tests used in the study

Test	Subscore				Nutritional risk score
MUST	BMI (score: 0-2)	Unintentional weight loss (score: 0-2)	Acute disease able to significantly reduce nutrient intake in the following 5 d (score: 2)		⩾ 2
NRS-2002	Pre-test: BMI < 2 0.5; weight loss, reduced caloric intake, acute disease	Nutritional risk: Weight loss, BMI, caloric intake (score: 0-3)	Severity of disease (score: 0-3)	Age ⩾ 70-yr-old (score: 1)	> 3
MNA	First part (six items: Caloric food intake, weight loss, motility, psychological stress, neuropsychological disease, BMI (score: 0-14)	If subscore ⩽ 11: Complete second part	Second part (12 items: Home and nutritional autonomy, drugs, bedsores, daily meals, brachial and calf circumference; (maximal score of 16)		17-25

MUST: Malnutrition Universal Screening Tool; NRS: Nutritional Risk Screening; MNA: Mini Nutritional Assessment.

variables, and χ^2 test was used to compare categorical data. Two-tailed *P* values less than 0.05 were considered statistically significant.

Univariate and multivariate analyses were used to identify potential predictors of malnutrition. A linear trend test was used to assess associations with severity of disease. A stepwise backward logistical regression analysis, adjusted for age and gender and considering acute, chronic and neoplastic disease independent of each other, was performed to identify significant independent predictors of malnutrition. Statistical analyses were performed using SPSS software version 12.0 (SPSS Inc., Chicago, IL, United States).

RESULTS

Five hundred and ninety-seven patients were enrolled. We excluded from the statistical analysis five patients for incomplete data and 79 cirrhotic patients because of the negative effects of ascites and peripheral edema on nutritional parameters.

In Table 2 we report the anthropometric and nutritional data of the 513 patients enrolled in the 19 gastroenterology units participating in the study: 51.4% were males and 48.6% females, and the average age was 59.8 ± 17.8 years without a significant difference between the centers.

In total, 39.8% of the patients required hospitalization, 12.1% were DH patients and 48.1% were ambulatory patients. Approximately 30.8% of the patients were urgently hospitalized, 21.2% of the cases had a planned admission, 22.2% needed a follow-up evaluation and 25.8% were at their first medical visit.

In Table 3 we report the age, gender, medical evaluation setting and disease category of patients according to their age category.

Gastrointestinal diseases were acute in 72.1% of the cases, chronic in 16.7% and neoplastic in 11.1%. In particular, chronic diseases were more frequent in younger participants (22.6% *vs* 9.0% in older patients, $P < 0.001$), while neoplastic diseases were more represented in the elderly patients (5.6% in younger patients *vs* 18.8%, $P < 0.001$).

Table 4 shows the prevalence of each pathology included in the three categories: Acute disease, chronic diseases and cancers according to age.

Undernutrition

The mean prevalence of undernutrition in our population was 12.1%:4.6% in the ambulatory and DH settings and 19.6% in patients requiring hospitalization.

The undernourished patients were affected by chronic, acute and neoplastic disease at rates of 8%, 74% and 18%, respectively.

In Table 5 we report the distribution of undernutrition, risk of malnutrition, obesity and overweight among in-patients and outpatients in both categories of age. In both categories of age, the rate of undernourished in-patients was significantly higher compared to that of outpatients.

As shown in Figure 1, the prevalence of undernutrition in chronic, acute and neoplastic gastrointestinal diseases was 4.3%, 11.0% and 17.6%, respectively, with a prevalence significantly higher in neoplastic patients than in those with chronic disease ($P = 0.03$). The linear trend test showed that the prevalence of undernutrition was significantly higher in hospital admitted patients ($P = 0.01$).

The logistical regression analysis corrected for age, gender and acute, chronic and neoplastic disease showed that gastrointestinal cancer was a risk factor for undernutrition with an odds ratio of 2.7 (95%CI: 1.2-6.4, $P = 0.02$).

Risk of malnutrition

The mean prevalence of risk of malnutrition in our population was 23.8%. In Table 5 we show the prevalence of risk of malnutrition among inpatients and outpatients, and in Table 6 we report the prevalence of risk of malnutrition according to the three screening tests and age group**.** Of the < 65-year-old patients, the 24.7% of inpatients were at risk of malnutrition; in the elderly participants, the MNA screening tool revealed a risk of malnutrition in inpatients that was higher than that of elderly outpatients (69.2% *vs* 40.6%, respectively, $P < 0.001$).

Table 2 Characteristics of the patients in the 19 gastroenterological units participating in the study

Centers	*n*	M	F	Age (average ± DS)	Ambulatory	DH	Inpatients	MUST	NRS	MNA	Weight (kg)	Weight loss (%)	BMI
Bolzano	21	61.90%	38.10%	67.5 ± 17.2	0.00%	0.00%	100.00%	-	2.2 ± 1.5	16.8 ± 4.3	71.6 ± 16.4	-4.7 ± 6.2	24.8 ± 4.4
Fiemme del Cavalese	17	57.1%	42.9%	56.2 ± 25.1	57.1%	0.0%	42.9%	0.8 ± 1.3	1.7 ± 1.4	19.0 ± 9.9	66.9 ± 5.1	-2.5 ± 6.9	23.1 ± 2.4
Pordenone	14	25.0%	75.0%	48.7 ± 24.0	100.0%	0.0%	0.0%	1.0 ± 1.2	-	22.0 ± 0.0	58.3 ± 12.7	0.0 ± 0.0	21.3 ± 3.6
Udine	10	50.0%	50.0%	51.6 ± 8.7	70.0%	0.0%	30.0%	0.4 ± 0.7	-	13.0 ± 0.0	75.5 ± 16.0	-2.0 ± 5.7	25.9 ± 5.2
Como	12	72.2%	27.8%	65.3 ± 17.9	0.0	22.2%	77.8%	1.7 ± 2.1	2.3 ± 1.5	18.6 ± 5.4	73.5 ± 22.7	-7.6 ± 9.4	25.8 ± 6.7
Milano	17	64.0%	36.0%	64.9 ± 19.2	0.0	0.0%	100.0%	-	1.7 ± 1.4	9.5 ± 3.1	69.4 ± 15.7	-2.8 ± 7.4	25.2 ± 4.7
Torino	38	50.0%	50.0%	58.9 ± 16.1	0.0	55.3%	44.7%	1.6 ± 1.7	2.2 ± 2.2	15.8 ± 4.9	65.3 ± 16.6	-0.9 ± 9.1	23.9 ± 4.5
Alto Vicentino di Santorso	32	40.6%	59.4%	68.2 ± 12.7	97.3	0.0%	2.7%	0.2 ± 0.6	0.5 ± 0.7	15.4± 4.6	71.3 ± 12.8	-2.3 ± 4.9	25.0 ± 3.9
Bassano del Grappa	25	48.0%	52.0%	48.3 ± 17.9	60.0	0.0%	40.0%	0.5 ± 0.9	0.8 ± 1.4	17.6 ± 4.8	68.0 ± 14.5	0.1 ± 9.0	23.9 ± 4.3
Legnano	16	87.5%	12.5%	53.0 ± 16.1	0.0	0.0%	100.0%	-	1.1 ± 1.6	15.2 ± 4.6	66.1 ± 13.5	-4.2 ± 12.3	23.0 ± 2.7
Ravenna	66	41.5%	58.5%	57.4 ± 19.4	52.5	21.9	25.6%	0.8 ± 1.3	1.3 ± 1.4	19.6 ± 2.8	67.7 ± 17.4	-1.5 ± 7.2	24.3 ± 5.4
Ancona	33	39.4	60.6	58.9 ± 19	100.0	0.0	0.0	0.1 ± 0.3	-	13.5 ± 4.8	70.8 ± 13.5	0.5 ± 2.5	25.7 ± 4.8
Napoli	26	53.8	46.1	59.1 ± 15.8	7.7	30.8	61.5	0.5 ± 0.9	1.3 ± 1.2	12.2 ± 2.7	67.9 ± 14.9	-1.2 ± 3.8	24.7 ± 5.6
Foggia	33	39.4	60.6	57.7 ± 18.2	66.6	6,1	27.3	0.3 ± 0.9	0.4 ± 0.8	15.0 ± 3.3	76.5 ± 21.9	-1.5 ± 3.0	28.6 ± 7.6
Trani	53	58.5	41.5	55.5 ± 18.1	62.1	10.3	27.6	0.5 ± 0.9	0.7 ± 1.1	13.4 ± 3.2	71.6 ± 14.5	1.1 ± 5.5	27.1 ± 5.5
Cosenza	58	53.9	46.1	58.8 ± 18.4	38.1	15.9	46.0	1.3 ± 1.7	2.1 ± 1.1	15.3 ± 3.7	67.0 ± 15.9	-3.8 ± 7.9	24.5 ± 4.8
Palermo	15	64.7	35.3	64.2 ± 10.1	0.0	0.0	100.0	-	1.3 ± 0.6	13.0 ± 4.5	77.5 ± 21.3	-1.3 ± 1.6	27.6 ± 6.7
Marsala	17	41.2	58.8	70.4 ± 9.5	88.2	0.0	11.8	0.6 ± 0.8	2.6 ± 0.9	18.0 ± 5.4	72.2 ± 12.4	-2.2 ± 3.5	27.7 ± 3.7
Siracusa	10	60.0	40.0	67.9 ± 1.3	20.0	0.0	80.0	0.8 ± 1.2	2.6 ± 1.5	15.4 ± 4.6	61.8 ± 7.8	-1.6 ± 4.9	23.9 ± 2.6
Total	513	51.4	48.6	59.8 ± 17.8	48.1	12.1	39.8	0.7 ± 0.5	1.5 ± 0.8	15.8 ± 2.9	69.7 ± 16.0	-1.7 ± 6.9	25.3 ± 5.3

M: Male; F: Females; DH: Day Hospital; MUST: Malnutrition Universal Screening Tool; NRS: Nutritional Risk Screening; MNA: Mini Nutritional Assessment; BMI: Body Mass Index.

Table 3 Clinical features of evaluated patients according to age group *n* (%)

	Total cohort (*n* = 513)	< 65 yr (*n* = 289)	≥ 65 yr (*n* = 218)	*P* value
Age (yr) (Mean ± SD)	59.8 ± 17.8	47.4 ± 12.8	76.1 ± 6.9	< 0.001[1]
Male gender,	260 (51.4)	138 (47.8)	122 (56.2)	0.06[2]
Setting				< 0.001[2]
Inpatient	204 (39.8)	93 (32.2)	110 (50.7)	
Outpatient	308 (60.2)	196 (67.8)	107 (49.3)	
Disease				< 0.001[2]
Acute	414 (72.1)	232 (71.8)	177 (72.2)	
Chronic	96 (16.7)	73 (22.6)	22 (9.0)	
Neoplastic	64 (11.1)	18 (5.6)	46 (18.8)	

P value: $P < 0.05$. [1]Wilcoxon rank-sum (Mann-Whitney) test; [2]χ^2 test. Significant standardized adjusted residual.

Of the outpatients at risk of malnutrition, acute and chronic gastrointestinal diseases had the same prevalence (50%); ten outpatients were affected by cancer, but none were at risk of malnutrition. In this population, only the 17.7% of patients with chronic gastrointestinal disease and 8.8% of those with acute gastrointestinal disease were at risk of malnutrition.

The inpatients at risk of malnutrition were affected by acute disease in 61.5% and by gastrointestinal cancer in 38.5% of the cases.

The elderly patients at risk of malnutrition presented chronic, acute and neoplastic disease in 5.2%, 67.0%, and 27.8% of the cases, respectively.

Figure 2 shows that the frequency of risk of malnutrition increased progressively with hospitalization, reaching statistical significance ($P < 0.007$) in the presence of neoplasm.

Overweight and obesity

The prevalence of overweight and obesity in our population was, respectively, 28.6% and 15.6%. In Table 5, we report the rate of overweight and obesity in outpatients (31.7% and 18.3%, respectively) and in inpatients (25.5% and 13.0%, respectively) according to age group. Moreover, the rate of overweight and obesity did not show a difference in age. The prevalence of overweight and obesity was, respectively, 28.7% and 19.1% in chronic, 29.1% and 15.7% in acute, and 26.4% and 11.3% in neoplastic disease.

In our population, we found that no obese outpatients presented a weight loss > 10% in the last 3-6 mo, while the prevalence of risk of malnutrition was 15% higher

Table 4 Prevalence and number of patients with chronic disease, acute disease and cancer according to age group

Chronic disease	%	< 65 yr	⩾ 65 yr	*P* value	Acute disease	%	< 65 yr	⩾ 65 yr	*P* value	Cancer	%	< 65 yr	⩾ 65 yr	*P* value
GERD	8.90	35	18	0.123	Dysphagia	2.7	7	9	0.199	Esophagus	0.7	0	4	0.033
Achalasia	0.20	1	0	0.577	Dyspepsia	9.3	25	30	0.046	Stomach	1.3	3	5	0.219
Chronic gastropathy	5.90	17	18	0.174	Epigastralgia	12.6	44	31	0.44	Small-large intestine	3	5	13	0.01
Chronic viral hepatitis	4.20	17	8	0.194	Other abdominalgia	17.7	53	52	0.78	Pancreas	0.5	1	2	0.394
Chronic alcoholic hepatitis	3.20	14	5	0.113	Acute diarrhea	2.5	8	6	0.602	Liver	3.4	7	13	0.036
NAFLD	4.50	13	14	0.206	Acute constipation	1.5	7	2	0.18	Biliary tree	2	3	9	0.024
Other chronic hepatitis	1.30	3	5	0.211	Digestive bleeding	5.6	13	20	0.027					
Compensated cirrhosis	14.70	49	38	0.441	Acute hepatitis	3.4	13	7	0.315					
Chronic pancreatitis	1.20	4	3	0.632	Cirrhosis complicated	11.5	39	29	0.478					
Non-IBD chronic diarrhea	3.50	11	10	0.391	Hematochezia	3.5	7	14	0.022					
Crohn's disease	6.60	33	6	0.0002	IBD exacerbation	6.1	33	3	0.0000033					
Ulcerative colitis	4.5	24	3	0.00036	Acute pancreatitis	4.9	17	12	0.515					
Chronic constipation	5.2	13	18	0.053										
Celiac disease	1.7	10	0	0.004										

GERD: Gastricesophagitis reflux diseas; NAFLD: Non-alcoholic fatty liver disease; IBD: Inflammatory bowel disease.

Table 5 Patients with nutritional abnormalities in the 19 gastroenterological centers participating in the study *n* (%)

	Outpatients		Inpatients		*P* value
	< 65 yr	> 65 yr	<65 yr	> 65 yr	
Undernutrition	8 (4.2)	6 (5.7)	24 (23.9)[1]	15 (15.6)[2]	[1]*P* < 0.001 [2]*P*
Risk of Malnutrition	24 (12.2)	43 (40.6)	21 (24.7)	64 (69.2)[3]	[3]*P*
Obesity	34 (18.3)	19 (17.5)	15 (17.2)	10 (10.5)	NS
Overweight	52 (26.5)	46 (42.5)	18 (20.7)	27 (28.4)	NS

[1]*P* < 0.001 out- *vs* inpatient < 65; [2]*P* = 0.02 out- *vs* inpatient ⩾ 65; [3]*P* < 0.001 out- *vs* inpatient > 65.

Table 6 Prevalence of risk of malnutrition according to age group

Nutritional risk test	Total cohort (*n* = 513)	< 65 yr (*n* = 289)	⩾ 65 yr (*n* = 218)	*P* value
MUST				0.45
< 2 (%)	274 (89.0)	172 (87.8)	97 (90.7)	
⩾ 2 (%)	34 (11.0)	24 (12.2)	10 (9.3)	
NRS 2002				0.002
< 3 (%)	112 (63.3)	61 (75.3)	51 (53.1)	
⩾ 3 (%)	65 (36.7)	20 (24.7)	45 (46.9)	
MNA 17%-25%	115 (54.2)	-	115 (54.5)	

MUST: Malnutrition Universal Screening Tool; NRS: Nutritional Risk Screening; MNA: Mini Nutritional Assessment.

in elderly subjects (36.8%). The rate of undernutrition was 12% in the hospitalized obese patients, and the prevalence of risk of malnutrition was 13.3% in young obese inpatients and increased up to 80% in those > 65 years old.

Of the overweight outpatients, the rate of undernutrition was 2%, while it was 8.9% in overweight inpatients. The rate of overweight outpatients at risk of malnutrition was

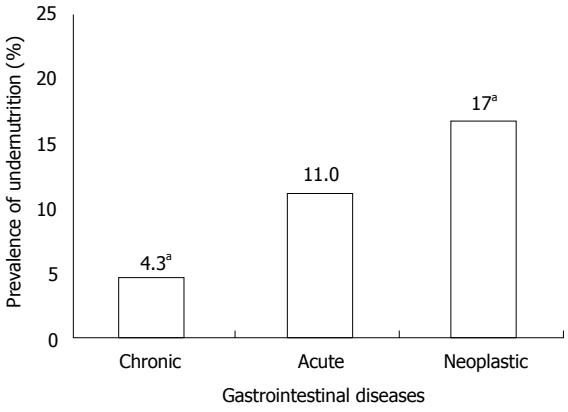

Figure 1 Prevalence of undernutrition in presentations of acute, chronic and neoplastic gastrointestinal diseases. [a]*P* = 0.03, neoplastic *vs* chronic. Linear trend test: *P* = 0.01.

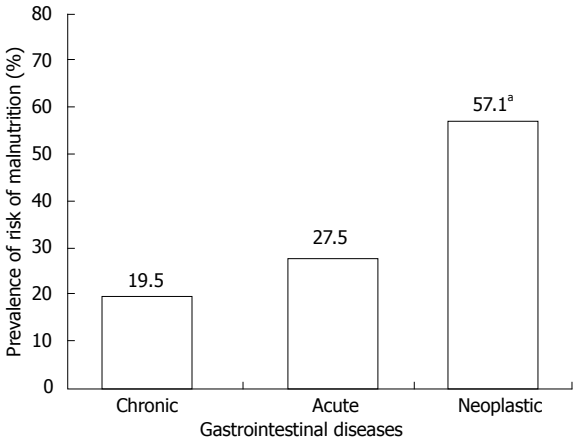

Figure 2 Prevalence of risk of malnutrition in presentations of acute, chronic and neoplastic gastrointestinal diseases. [a]*P* < 0.007, neoplastic *vs* chronic and acute.

28.3%, but this rate reached 33.3% in those hospitalized.

DISCUSSION

This study was designed to define the nutritional state of patients with gastroenterological disease. Regarding the diseases included in this study, we want to specify that cirrhotic patients were excluded because of the obscuring effect of compartmentalized ascites on body weight[31,36,49]. However, diseases causing reduced albumin levels, which decreases oncotic pressure and allows for diffuse fluid leakage into the interstitial space, were not excluded, as fluid retention has to be considered a direct consequence of malnutrition.

Our data found that undernutrition affected approximately 12% of all patients; in particular, we documented that the rate of prevalence of undernutrition was significantly higher in inpatients (20%) than in outpatients. This is a consequence of the fact that acute diseases requiring hospitalization reduce caloric intake because of the presence of abdominal pain, diarrhea and vomiting. The use of tools to evaluate the risk of malnutrition should allow us to focus our attention on patients who have not yet begun to lose weight.

It was also interesting to note that younger and neoplastic inpatients were more frequently malnourished than the other groups, and this was due to the high rate of chronic inflammatory gastrointestinal diseases in our younger population (IBD: 11.4% *vs* 1.4% and celiac disease: 3.5% *vs* 0% in < 65-year-old and > 65-year-old patients, respectively) and the metabolic abnormalities characterizing cancer cachexia. Indeed, logistic regression confirmed that (1) the rate of undernutrition increased with the severity of disease; and (2) gastrointestinal cancer was a risk factor for undernutrition.

Very little data can be found in the literature concerning the prevalence rates of undernutrition in gastroenterology units. In our population, the prevalence of undernutrition was similar to those reported in other European[8] and Italian studies[28] but differed from other studies[9,29,30,50] because of both (1) the different tools used to evaluate malnutrition; and (2) the diverse stages of disease. In this study, we reported for the first time (1) the rate of undernutrition in gastroenterology outpatients; and (2) the correlation of undernutrition with hospital admission.

Regarding the risk of malnutrition, we want to emphasize that all of the screening tools we used were well-validated in identifying the patients who would develop undernutrition in the absence of an adequate nutritional care plan and that the NRS-2002 has shown a good predictive value for mortality, length of stay and complications. Few data have been published about the risk of malnutrition in the gastroenterology population[9,10,50]. In this study, we demonstrated that, in the gastroenterology department, inpatient and elderly patients had a greater frequency of risk of malnutrition than outpatients and younger patients, especially if affected by cancer; additionally, this risk was lower for those with chronic gastrointestinal disease. We must also highlight the fact that the NRS-2002 in inpatients was more frequently influenced by a reduction in caloric intake than by weight loss.

In our population, the NRS-2002 disclosed a risk of malnutrition in 36.7% of the inpatients. This value was lower than that reported in a Danish study evaluating gastro-surgery patients[9] but higher than data from Romanian gastroenterology departments[50].

Moreover, while young inpatients were undernourished or at risk of malnutrition at a similar prevalence, elderly inpatients were at a greater risk of malnutrition. These data indicate that the management of malnutrition in gastrointestinal departments should have different targets according to patients' age: We should probably treat undernutrition with artificial nutrition in younger patients, while oral supplementation should be recommended to prevent malnutrition in elderly patients. Very limited data are available on the evaluation of the risk of malnutrition in outpatients. In this setting, our data indicated that patients with nutritional risk were more often affected by chronic disease, in which the catabolic

effects of inflammatory cytokines influence nutritional status[4,51,52].

Overweight and obesity represent another aspect of malnutrition that entails excessive fat mass in body composition. In recent years, a number of works have reported an increasing incidence of obesity in the general population, but data on the prevalence of obesity and overweight in the gastroenterological population have been limited. The average prevalence of overweight-obesity in our study was 22.7%; this rate of obesity was lower than those reported in a hospital setting in previous Italian[28-30] reports but was higher than the Italian general population rate, especially in outpatients.

We also found that approximately 10% of the obese and overweight hospitalized patients were undernourished and that the risk of malnutrition was present in more than one-third of the obese and overweight gastroenterological patients, with rates that reached 80% in > 65-year-old obese inpatients.

The prevalence of obesity and overweight in outpatients was higher than in inpatients but was not statistically significant.

It is not surprising that in obese patients, undernutrition and risk of malnutrition could be present at the same time. An involuntary weight loss > 10% and/or reduction in caloric intake allowed us to identify patients who, despite having excess weight, met the criteria for malnutrition or risk of malnutrition. These data indicate that we must keep in mind that even obese patients can be malnourished and that we must investigate the risk of malnutrition especially among elderly gastroenterological patients, regardless of their weight at admission.

A possible bias of this study was the voluntary participation of the gastrointestinal units including centers that paid major attention to nutritional aspects. Another limitation of this work was the difference in the population size and in the frequency of disease, which was often determined by each center's particular experience; it was thus difficult to study undernutrition and the risk of malnutrition for each single disease.

Overall, our data noted that 55% of inpatients and 22% of outpatients were undernourished and at risk of malnutrition and that half of the outpatients and nearly one-third of inpatients were obese or overweight. In our population, only 19.7% and 36.6% of inpatients and outpatients, respectively, did not present nutritional abnormalities (weight loss, risk of malnutrition, overweight or obesity). These data indicate that 80.3% of inpatients and 63.4% of outpatients would require nutritional competence in gastrointestinal units to assess the degree of malnutrition, to correctly design appropriate therapeutic programs to improve protein-caloric alterations and to prevent complications.

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COMMENTS

Background

Malnutrition has adverse effects on clinical outcomes, but many health care workers do not adequately consider it as a relevant aspect of the clinical management of patients. In the literature, few data are available regarding the prevalence of malnutrition (undernutrition, obesity,) and risk of malnutrition in European and Italian gastroenterology departments, with rates that depend on the criteria adopted for their identification, the medical or surgical setting and the age of the patients.

Research frontiers

A better understanding of the prevalence of malnutrition and nutritional risk according to the severity of disease (chronic, acute and cancer) in outpatients and inpatients would facilitate the identification of patients with impairment of nutritional status and with adequate nutritional management.

Innovations and breakthroughs

For the first time, they studied undernutrition, risk of malnutrition (using three different nutritional screening tools) and obesity according to the severity of gastroenterological disease (chronic, acute and cancer) in both admitted patients and outpatients.

Applications

The authors' data showed that there was a different distribution of undernutrition, risk of malnutrition and obesity according to the severity of disease and age group among inpatients and outpatients, which indicates that an appropriate nutritional care plan in gastrointestinal departments to achieve different nutritional targets may be needed.

Terminology

Undernutrition: When patients presented an unintentional (*i.e.*, without voluntary dietary restriction) weight loss > 10% in the last 3-6 mo; The MUST (Malnutrition Universal Screening Tool), NRS-2002 (Nutritional Risk Screening Score 2002) and MNA (Mini Nutritional Assessment) are three screening nutritional tests that identify patients at risk of malnutrition; BMI: Body mass index (calculated by dividing the weight in kg by the square of height in meters). Obesity: BMI $\geqslant$ 30; overweight: BMI between 25 and 29.9.

Peer-review

The authors have excluded cirrhotics because of the obscuring effect of ascitis and or edema. Inflammatory diseases may cause a drop in serum albumin

levels that decrease oncotic pressure and favors fluid leakage to the interstitial space, that may reach up to 5 l before edema is clinically evident.

REFERENCES

1 **Cederholm T**, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, Muscaritoli M, Nyulasi I, Ockenga J, Schneider SM, de van der Schueren MA, Singer P. Diagnostic criteria for malnutrition - An ESPEN Consensus Statement. *Clin Nutr* 2015; **34**: 335-340 [PMID: 25799486 DOI: 10.1016/j.clnu.2015.03.001]

2 **Lancha A**, Frühbeck G, Gómez-Ambrosi J. Peripheral signalling involved in energy homeostasis control. *Nutr Res Rev* 2012; **25**: 223-248 [PMID: 23174510 DOI: 10.1017/S0954422412000145]

3 **Stofkova A**. Leptin and adiponectin: from energy and metabolic dysbalance to inflammation and autoimmunity. *Endocr Regul* 2009; **43**: 157-168 [PMID: 19908934]

4 **Roubenoff R**. Molecular basis of inflammation: relationships between catabolic cytokines, hormones, energy balance, and muscle. *JPEN J Parenter Enteral Nutr* 2008; **32**: 630-632 [PMID: 18974242 DOI: 10.1177/0148607108324875]

5 **Amitani M**, Asakawa A, Amitani H, Inui A. Control of food intake and muscle wasting in cachexia. *Int J Biochem Cell Biol* 2013; **45**: 2179-2185 [PMID: 23911307 DOI: 10.1016/j.biocel.2013.07.016]

6 **McWhirter JP**, Pennington CR. Incidence and recognition of malnutrition in hospital. *BMJ* 1994; **308**: 945-948 [PMID: 8173401 DOI: 10.1136/bmj.308.6934.945]

7 **Imoberdorf R**, Meier R, Krebs P, Hangartner PJ, Hess B, Stäubli M, Wegmann D, Rühlin M, Ballmer PE. Prevalence of undernutrition on admission to Swiss hospitals. *Clin Nutr* 2010; **29**: 38-41 [PMID: 19573958 DOI: 10.1016/j.clnu.2009.06.005]

8 **Edington J**, Boorman J, Durrant ER, Perkins A, Giffin CV, James R, Thomson JM, Oldroyd JC, Smith JC, Torrance AD, Blackshaw V, Green S, Hill CJ, Berry C, McKenzie C, Vicca N, Ward JE, Coles SJ. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. *Clin Nutr* 2000; **19**: 191-195 [PMID: 10895110 DOI: 10.1054/clnu.1999.0121]

9 **Rasmussen HH**, Kondrup J, Staun M, Ladefoged K, Kristensen H, Wengler A. Prevalence of patients at nutritional risk in Danish hospitals. *Clin Nutr* 2004; **23**: 1009-1015 [PMID: 15380890 DOI: 10.1016/j.clnu.2004.01.001]

10 **Pirlich M**, Schütz T, Norman K, Gastell S, Lübke HJ, Bischoff SC, Bolder U, Frieling T, Güldenzoph H, Hahn K, Jauch KW, Schindler K, Stein J, Volkert D, Weimann A, Werner H, Wolf C, Zürcher G, Bauer P, Lochs H. The German hospital malnutrition study. *Clin Nutr* 2006; **25**: 563-572 [PMID: 16698132 DOI: 10.1016/j.clnu.2006.03.005]

11 **Norman K**, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008; **27**: 5-15 [PMID: 18061312 DOI: 10.1016/j.clnu.2007.10.007]

12 **Kyle UG**, Pirlich M, Schuetz T, Lochs H, Pichard C. Is nutritional depletion by Nutritional Risk Index associated with increased length of hospital stay? A population-based study. *JPEN J Parenter Enteral Nutr* 2004; **28**: 99-104 [PMID: 15080604 DOI: 10.1177/0148607104 02800299]

13 **Caccialanza R**, Klersy C, Cereda E, Cameletti B, Bonoldi A, Bonardi C, Marinelli M, Dionigi P. Nutritional parameters associated with prolonged hospital stay among ambulatory adult patients. *CMAJ* 2010; **182**: 1843-1849 [PMID: 20940233 DOI: 10.1503/cmaj.091977]

14 **Correia MI**, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003; **22**: 235-239 [PMID: 12765661 DOI: 10.1016/S0261-5614(02)00215-7]

15 **Takahashi PY**, Sauver JL, Olson TC, Huber JM, Cha SS, Ebbert JO. Association between underweight and hospitalization, emergency room visits, and mortality among patients in community medical homes. *Risk Manag Healthc Policy* 2013; **6**: 1-6 [PMID: 23378790 DOI: 10.2147/RMHP.S39976]

16 **Pérez de la Cruz A**, Lobo Támer G, Orduña Espinosa R, Mellado Pastor C, Aguayo de Hoyos E, Ruiz López MD. [Malnutrition in hospitalized patients: prevalence and economic impact]. *Med Clin* (Barc) 2004; **123**: 201-206 [PMID: 15282072 DOI: 10.1016/S0025-7753(04)74461-9]

17 **Beck AM**, Balknäs UN, Fürst P, Hasunen K, Jones L, Keller U, Melchior JC, Mikkelsen BE, Schauder P, Sivonen L, Zinck O, Øien H, Ovesen L. Food and nutritional care in hospitals: how to prevent undernutrition--report and guidelines from the Council of Europe. *Clin Nutr* 2001; **20**: 455-460 [PMID: 11534942 DOI: 10.1054/clnu.2001.0494]

18 **Kyle UG**, Kossovsky MP, Karsegard VL, Pichard C. Comparison of tools for nutritional assessment and screening at hospital admission: a population study. *Clin Nutr* 2006; **25**: 409-417 [PMID: 16356595 DOI: 10.1016/j.clnu.2005.11.001]

19 **Mowe M**, Bosaeus I, Rasmussen HH, Kondrup J, Unosson M, Rothenberg E, Irtun Ø. Insufficient nutritional knowledge among health care workers? *Clin Nutr* 2008; **27**: 196-202 [PMID: 18295936 DOI: 10.1016/j.clnu.2007.10.014]

20 **Kondrup J**, Allison SP, Elia M, Vellas B, Plauth M. ESPEN guidelines for nutrition screening 2002. *Clin Nutr* 2003; **22**: 415-421 [PMID: 12880610 DOI: 10.1016/S0261-5614(03)00098-0]

21 **Sorensen J**, Kondrup J, Prokopowicz J, Schiesser M, Krähenbühl L, Meier R, Liberda M. EuroOOPS: an international, multicentre study to implement nutritional risk screening and evaluate clinical outcome. *Clin Nutr* 2008; **27**: 340-349 [PMID: 18504063 DOI: 10.1016/j.clnu.2008.03.012]

22 **Velasco C**, García E, Rodríguez V, Frias L, Garriga R, Alvarez J, García-Peris P, León M. Comparison of four nutritional screening tools to detect nutritional risk in hospitalized patients: a multicentre study. *Eur J Clin Nutr* 2011; **65**: 269-274 [PMID: 21081958 DOI: 10.1038/ejcn.2010.243]

23 **Ambrose T**, Cullen S, Baker G, Smith M, Elia M, Leach R, De Silva A. Obesity: a window of opportunity to intervene? Characteristics and management of morbidly obese adult inpatients in three trusts in Southern England. *Clin Med* (Lond) 2013; **13**: 472-476 [PMID: 24115704 DOI: 10.7861/clinmedicine.13-5-472]

24 **Migliore E**, Pagano E, Mirabelli D, Baldi I, Gregori D, Zocchetti C, Tuzzi C, Balzola F, Petroni ML, Merletti F. Hospitalization rates and cost in severe or complicated obesity: an Italian cohort study. *BMC Public Health* 2013; **13**: 544 [PMID: 23738687 DOI: 10.1186/1471-2458-13-544]

25 **Luchsinger JA**, Lee WN, Carrasquillo O, Rabinowitz D, Shea S. Body mass index and hospitalization in the elderly. *J Am Geriatr Soc* 2003; **51**: 1615-1620 [PMID: 14687392 DOI: 10.1046/j.1532-5415.2003.51513.x]

26 **Han E**, Truesdale KP, Taber DR, Cai J, Juhaeri J, Stevens J. Impact of overweight and obesity on hospitalization: race and gender differences. *Int J Obes* (Lond) 2009; **33**: 249-256 [PMID: 19153585 DOI: 10.1038/ijo.2008.193]

27 **Ringbäck Weitoft G**, Eliasson M, Rosén M. Underweight, overweight and obesity as risk factors for mortality and hospitalization. *Scand J Public Health* 2008; **36**: 169-176 [PMID: 18519281 DOI: 10.1177/1403494807085080]

28 **Comi D,** Palmo A, Brugnani M, D'Amicis A, Costa A, D'Andrea F, Del Toma E, Domeniconi D, Fusco MA, Gatti E, Lesi C, Lucchin L. The hospital malnutrition Italian study. *Clin Nutr* 1998; **17** (Suppl 1): 52 [DOI: 10.1016/S0261-5614(98)80239-2]

29 **Lucchin L**, D'Amicis A, Gentile MG, Battistini NC, Fusco MA, Palmo A, Muscaritoli M, Contaldo F, Cereda E, the PIMAI group. An Italian investigation on nutritional risk at hospital admission: The PIMAI (Project: Iatrogenic MAlnutrition in Italy) study. *Clin Nutrit Metabol* 2009; **4**: 199-202 [DOI 10.1016/j.eclnm.2009.05.012]

30 **Cereda E**, Pedrolli C, Lucchin L, D'Amicis A, Gentile MG, Battistini NC, Fusco MA, Palmo A, Muscaritoli M. Fluid intake and nutritional risk in non-critically ill patients at hospital referral. *Br J Nutr* 2010; **104**: 878-885 [PMID: 20447327 DOI: 10.1017/S0007114510001492]

31 **Guglielmi FW,** Mastronuzzi T, Laddaga L, De Marco M, Scatigna F, Panella C, Francavilla A. Clinical utility of the bioelectrical impedance for evaluation body composition in patients with gastroenterological disease. *Ital J Gastroenterol* 1990; **22**: 250

32 **Guglielmi FW,** Mastronuzzi T, De Marco M, Laddaga L, Scatigna F, Panella C, Francavilla A. Calorimetric data of cirrhotic patients with

and without hepatocellular carcinoma: role of malnutrition. *Ital J Gastroenterol* 1991; **23**: 308-309

33 **Guglielmi FW**, Panella C, Buda A, Budillon G, Caregaro L, Clerici C, Conte D, Federico A, Gasbarrini G, Guglielmi A, Loguercio C, Losco A, Martines D, Mazzuoli S, Merli M, Mingrone G, Morelli A, Nardone G, Zoli G, Francavilla A. Nutritional state and energy balance in cirrhotic patients with or without hypermetabolism. Multicentre prospective study by the 'Nutritional Problems in Gastroenterology' Section of the Italian Society of Gastroenterology (SIGE). *Dig Liver Dis* 2005; **37**: 681-688 [PMID: 15978878 DOI: 10.1016/j.dld.2005.03.010]

34 **Loguercio C**, Sava E, Marmo R, del Vecchio Blanco C, Coltorti M. Malnutrition in cirrhotic patients: anthropometric measurements as a method of assessing nutritional status. *Br J Clin Pract* 1990; **44**: 98-101 [PMID: 2344428]

35 **Madden AM**, Morgan MY. A comparison of skinfold anthropometry and bioelectrical impedance analysis for measuring percentage body fat in patients with cirrhosis. *J Hepatol* 1994; **21**: 878-883 [PMID: 7890906 DOI: 10.1016/S0168-8278(94)80253-X]

36 **Morgan MY,** Madden AM, Soulsby CT, Morris RW. Derivation and Validation of a New Global Method for Assessing Nutritional Status in Patients with Cirrhosis. *Hepatology* 2006; **44**: 823-835 [PMID: 17006918 DOI 10.1002/hep.21358]

37 **Capristo E**, Addolorato G, Mingrone G, Greco AV, Gasbarrini G. Effect of disease localization on the anthropometric and metabolic features of Crohn's disease. *Am J Gastroenterol* 1998; **93**: 2411-2419 [PMID: 9860401 DOI: 10.1111/j.1572-0241.1998.00696.x]

38 **Guglielmi FW,** Rizzi M, Mazzuoli S, Regano N, Leogrande G, Addante A, Guglielmi A, Panella C, Francavilla A, Di Leo A. Negative energy balance in Crohn's disease causes malnutrition and impaired muscle function. *Dig Liver Dis* 2009; **41S**: S131 [DOI 10.1016/S1590-8658(09)60344-3]

39 **Mazzuoli S**, Addante I, Regano N, Rizzi M, Fregnan S, Leogrande G, Guglielmi A, Guglielmi FW. Prevalence of malnutrition in patients with moderate-severe Crohn's disease: the role of NRS2002. *Nutritional Therapy and Metabolism SINPE News* 2011; **4**: 9

40 **Hussain Z**, Quigley EM. Gastrointestinal issues in the assessment and management of the obese patient. *Gastroenterol Hepatol* (N Y) 2007; **3**: 559-569 [PMID: 21960865]

41 **Hurt RT**, Kulisek C, Buchanan LA, McClave SA. The obesity epidemic: challenges, health initiatives, and implications for gastroenterologists. *Gastroenterol Hepatol* (NY) 2010; **6**: 780-792 [PMID: 21301632]

42 **Kirovski G**, Schacherer D, Wobser H, Huber H, Niessen C, Beer C, Schölmerich J, Hellerbrand C. Prevalence of ultrasound-diagnosed non-alcoholic fatty liver disease in a hospital cohort and its association with anthropometric, biochemical and sonographic characteristics. *Int J Clin Exp Med* 2010; **3**: 202-210 [PMID: 20827318 DOI: 10.1055/s-0029-1246560]

43 **Vellinga A**, O'Donovan D, De La Harpe D. Length of stay and associated costs of obesity related hospital admissions in Ireland. *BMC Health Serv Res* 2008; **8**: 88 [PMID: 18426608 DOI: 10.1186/1472-6963-8-88]

44 **Stratton RJ**, Hackston A, Longmore D, Dixon R, Price S, Stroud M, King C, Elia M. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' ('MUST') for adults. *Br J Nutr* 2004; **92**: 799-808 [PMID: 15533269 DOI: 10.1079/BJN20041258]

45 **Kondrup J**, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003; **22**: 321-336 [PMID: 12765673 DOI: 10.1016/S0261-5614(02)00214-5]

46 **Guigoz Y**, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. *Nutr Rev* 1996; **54**: S59-S65 [PMID: 8919685 DOI: 10.1111/j.1753-4887.1996.tb03793.x]

47 **Vellas B**, Guigoz Y, Garry PJ, Nourhashemi F, Bennahum D, Lauque S, Albarede JL. The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. *Nutrition* 1999; **15**: 116-122 [PMID: 9990575 DOI: 10.1016/S0899-9007(98)00171-3]

48 **Guigoz Y**, Lauque S, Vellas BJ. Identifying the elderly at risk for malnutrition. The Mini Nutritional Assessment. *Clin Geriatr Med* 2002; **18**: 737-757 [PMID: 12608501 DOI: 10.1016/S0749-0690(02)00059-9]

49 **Fernandes SA**, Bassani L, Nunes FF, Aydos ME, Alves AV, Marroni CA. Nutritional assessment in patients with cirrhosis. *Arq Gastroenterol* 2012; **49**: 19-27 [PMID: 22481682]

50 **Gheorghe C**, Pascu O, Iacob R, Goldis A, Tantau M, Dumitru E, Dobru D, Miutescu E, Saftoiu A, Fraticiu A, Tomescu D, Gheorghe L. Nutritional Risk Screening and Prevalence of Malnutrition on Admission to Gastroenterology Departments: A Multicentric Study. *Chirurgia* (Bucur) 2013; **108**: 535-41

51 **Catapano G**, Pedone C, Nunziata E, Zizzo A, Passantino A, Incalzi RA. Nutrient intake and serum cytokine pattern in elderly people with heart failure. *Eur J Heart Fail* 2008; **10**: 428-434 [PMID: 18353717 DOI: 10.1016/j.ejheart.2008.02.016]

52 **Yang YM**, Sun TY, Liu XM. The role of serum leptin and tumor necrosis factor-alpha in malnutrition of male chronic obstructive pulmonary disease patients. *Chin Med J* (Engl) 2006; **119**: 628-633 [PMID: 16635406]

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