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Italian validation of the IBD-disk tool for the assessment of disability in inflammatory bowel diseases: A cross-sectional multicenter study

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ABSTRACT

Introduction: IBD-Disk is a simple, easy-to-use, and self-administered analogue visual tool for assessing disability in patients with Inflammatory Bowel Disease (IBD). However, it has not yet been validated in Italian. This study aims to validate IBD-Disk in an Italian cross-sectional multicentre study.

Methods: This study was conducted in eight IBD centres from February 2023 to October 2023. After forward-backwards translation of IBD-Disk into Italian, patients consecutively completed IBD-Disk (at baseline and after 7 days), IBD-Disability Index (IBD-DI) and IBDQ-32 for quality of life.

Results: We enrolled 767 patients (377, 49,2% CD; 390, 50,8% UC) who completed the IBD-Disk [median score of 30 (IQR=11–52)]. Internal consistency was excellent, with Cronbach's α of 0.92 (95%CI=0.92–0.92). To evaluate the validity, the IBD-Disk was compared with the IBD-DI and IBDQ-32, revealing a significant positive correlation of 0.70 (95% CI=0.66–0.73; $p<0.001$) and 0.83 ($r=0.83$, 95% CI=0.80–0.85; $p<0.001$), respectively. The intraclass correlation coefficient (ICC) was 0.84 (95% CI=0.82–0.86) for test-retest. Female gender, clinically active IBD and the presence of extraintestinal manifestations led to higher IBD-Disk scores.

Conclusion: This study validated the IBD-Disk in a large cohort of Italian IBD patients, demonstrating that it is a valid, reliable and responsive tool for quantifying IBD-related disability. This validation facilitates its integration into the daily clinical management of IBD patients.

1. Introduction

Inflammatory Bowel Diseases (IBD), such as ulcerative colitis (UC) and Crohn's Disease (CD), are chronic gastrointestinal disorders with a rising incidence and prevalence worldwide [1]. These conditions are characterised by a lifelong relapsing-remitting course, significantly impacting psychological, familial, social, and

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professional aspects of life. Consequently, they can greatly affect health-related quality of life (HRQoL) and contribute to disability [2].

In recent years, improving quality of life (QoL) and achieving an absence of disability have become crucial therapeutic goals for patients with IBD [3].These objectives are now incorporated as key endpoints in IBD disease-modification trials [4]. As a result, the increasing need for reliable tools to assess QoL and disability has driven researchers and healthcare professionals to develop and validate instruments that accurately reflect the full impact of IBD on patients' lives [5]. These tools are essential not only for assessing the effectiveness of new treatments but also for guiding clinical decision-making and providing comprehensive care tailored to the individual needs of IBD patients [6].

Disability is a complex phenomenon that describes an illness's impact on an individual's participation in life activities, reflecting an interaction between the characteristics of a person's body and the features of the society in which they live [5,7,8]; this concept differs from QoL which refers to one's emotional experience regarding these limitations and restrictions [9]. The IBD Disability Index (IBD DI) was the first tool developed in collaboration with the World Health Organization (WHO) to assess disability in patients with IBD [7,10]. Despite its robustness, a healthcare professional must administer the IBD-DI, making it time-consuming and challenging to use in daily clinical practice [5]. Consequently, it is generally employed in clinical trials rather than routine care. To overcome these limitations, the IBD-Disk [8], a visual tool based on the Pso-disk—used to assess the burden of psoriasis on patients—was developed [11]. The IBD-Disk is a self-administered, patient-friendly adaptation of the IBD-DI, developed through an online iterative Delphi consensus process by a Steering Committee of 14 gastroenterologists [8]. This tool includes 10 items assessing abdominal pain, defecation, social life, professional life, sleep, energy, anxiety, self-image, sexual functions, and joint pain. Patients rate each item on an 11-point visual analogue scale, ranging from 0 ("absolutely disagree") to 10 ("absolutely agree"). Each answer corresponds to a point on the "disk", and each point can be connected to the others to form a polygon. The area of the polygon can be interpreted as the disease's burden on the health-related disability, allowing changes to be tracked over time. The IBD-Disk was developed and validated in English, hence its successful dissemination requires both cultural adaptation and translation. As a result, the IBD-Disk has already been tested and validated in many languages. [12–15]. However, no Italian validation has been conducted to date. Additionally, certain aspects, such as the added value of food and diet for patients, are still missing. Accordingly, addressing these gaps is essential to ensure that the tool fully meets the needs and expectations of patients and physicians.

Therefore, we aimed to validate the use of the IBD-disk in Italy and evaluate its consistency with the IBD-DI. The secondary objectives were to assess the reliability of the IBD-Disk, including its reproducibility and internal consistency, and to identify clinical factors associated with disability. We also developed a modified version of the IBD-disk (mIBD-Disk) and evaluated its consistency with the IBD-DI.

2. Methods

2.1. Study design

This was a cross-sectional multicenter study conducted in eight Italian IBD referral centres. Patient recruitment was consecutive, between February 2023 and October 2023. Follow-up with patients was completed in November 2023.

2.2. Ethics

The local Research Ethics Committee of each participating centre approved the protocol after the approval of the coordinating centre in Naples (n° 2–2023–11,051). The study was conducted under Good Clinical Practice Guidelines and the ethical principles of the Declaration of Helsinki. All patients provided written informed consent.

2.3. Study population

Patients aged over 18 years old with an established diagnosis of IBD (UC, CD and IBD-unclassified) since at least 3 months were consecutively enrolled in the outpatient clinic. Exclusion criteria included uncertain IBD diagnosis, ongoing pregnancy or breast-feeding, or physical, psychological, or mental status interfering with the patient's ability to sign the informed consent or to fill in the questionnaires.

First, the IBD-Disk was translated into Italian in accordance with the cross-cultural adaptation process. The goal of the translation and adaptation was to develop a version of the IBD-Disk conceptually equivalent to the original sounded natural in Italian and easy to understand and respond to [15,16]. The entire process followed the recommendations provided by the COSMIN (Consensus-based Standards for the Selectionof health Measurement INstruments) [17]. The translation and adaptation algorithm consisted of two steps,

Step 1—Forward translation: Two bilingual translators translated the questionnaire, compared their versions, and reconciled discrepancies.
Step 2—Backward translation: Two native English translators from the UK translated the questionnaire into English and compared it with the original IBD-Disk.

Subsequently, the prefinal version was tested for lack of ambiguity in 5 IBD patients (using the Three-Step Test Interview method). No alterations to the prefinal version were needed. Alongside the original version of the IBD-Disk, patients were also asked to respond to a question regarding the disease's impact on their eating habits. This additional question was incorporated into the IBD-Disk, resulting in the modified version, referred to as the m IBD-Disk. The time required to complete both versions was approximately 10–15 min per patient.

Two preliminary meetings were held prior to the validation process between the centers involved in the study. The first meeting focused on presenting the protocol and the IBD-Disk, while the second meeting was dedicated to discussing preliminary data and aligning on the standardization of the IBD-Disk compilation. The final version of the Italian translation of the IBD-Disk and mIBD-Disk is included in Supplementary Figure 1.

At the baseline visit (T0), patients were administered the Italian version of the IBD-Disk, mIBD-Disk and IBD-DI [18]. Furthermore, they underwent IBDQ-32 [19] assessment to measure their quality of life. An IBD-Disk score of >40 was set as a threshold to estimate the presence of moderate-to-severe disability [20,21], while IBDQ-32 value < 169 indicated a low quality of life [22,23].

To evaluate the score's test-retest reliability, patients were also asked to complete the IBD-Disk and the mIBD-Disk again 7 days after the baseline visit and submit it to the principal investigator.

Clinical data collected at baseline included sex, age, body mass index (BMI), smoking habits, oral contraceptive use, family history of IBD, previous appendectomy, history of intestinal resection or perianal surgery, presence of stoma and/or seton, prior biological therapy, response to biological therapy, Charlson Comorbidity Index (CCI), location of CD (Montreal classification) or extent of UC, clinical activity in CD (Harvey Bradshaw Index, HBI)

or UC (partial Mayo score), biomarker levels if available, such as C-reactive protein (CRP) and faecal calprotectin. Additionally, we assessed the presence of active or past history of extraintestinal manifestations (EIM), endoscopic activity in CD (SES-CD or Rutgeerts score) or UC (Mayo endoscopic score), drug administration route (oral, topical, subcutaneous, intravenous), and current therapy (oral and topical mesalamine, systemic or topical corticosteroids, traditional immunosuppressants, infliximab, adalimumab, golimumab, vedolizumab, ustekinumab, tofacitinib).

2.4. Statistical analysis

Standard descriptive statistics were used to describe the sample: mean ± standard deviation (std. dev) or median with 25th and 75th percentile in case of numerical variables and absolute frequencies with percentages in case of categorical factors. Accordingly, T-test for independent samples, Mann-Whitney U Test and the Chi Square or Fisher exact test were used for between group comparisons. Assessment of correlation between IBD-Disk and IBD-DI was based on the Pearson coefficient when analysing the total score or using the non-parametric Spearman coefficient when considering single items. In this case, median regression models were also estimated to graphically represent the relationship between the two scores (IBD-DI and IBD-Disk).

Internal Consistency was assessed using Chronbach alpha with the corresponding 95% Confidence Interval (CI). Intraclass Correlation Coefficient (ICC) was used to measure test-retest reliability in a sub-sample of subjects who repeated the IBD-Disk evaluation within 7–14 days after the baseline visit; for the computation of ICC, the two occasions (raters) were considered as fixed.

Association between IBD-Disk score and the IBDQ-32 measure of Quality of Life was further investigated using ROC Curve analysis in order to detect the value of IBD-Disk able to discriminate subjects with poor quality of life (defined as an IBDQ-32 value $<$ 169).

Univariate a multivariable linear regression models were estimated to identify those demographical and clinical factors associated with the IBD-Disk total score in the whole population and after stratifying by IBD diagnosis.

All statistical analyses were conducted using R platform, ver. 4.4 (R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.)

3. Results

3.1. Characteristics of the IBD population

A total of 850 questionnaires from consecutive IBD patients were collected. After excluding 83 (9.8%) patients due to missing data in the questionnaires, our cohort included 767 (90.2%) individuals diagnosed with IBD, among whom 376 (49.0%) were females.

Overall, 377 (49.2%) had a diagnosis of CD, while 390 (50.8%) had UC. The median age of participants at enrollment was 42 (IQR=30–57). The majority of individuals (418; 54.5%) held a high school diploma and were either employees (384; 50.1%) or professionals (100; 13.0%). Notably, over a quarter (198, 25.8%) reported having no current occupation. The socio-demographic and clinical characteristics of the included patients are summarised in Table 1 and Table 2.

Overall, 422 (55.0%) patients exhibited mild clinical activity, with a median HBI score of 5 (IQR=2–7) for CD and a median pMAYO score of 2 (IQR=0–4) for UC. Regarding endoscopic activity, the majority of patients with CD (449, 58.5%) demonstrated mild activity, with a median SES-CD score of 4 (IQR=2–7) and a median Rutgeerts score of 2 (IQR=1–4). Similarly, we observed a median MES of 1 (IQR=1–2) for UC with 189 (48,5%) endoscopically active (MES$>$1) patients.

482 patients (62,8%) reported no comorbidity assessed with the CCI.

Active EIMs were present in 377 (49.2%) patients, primarily manifesting as peripheral arthritis (66.3%) or spondyloarthritis (20.2%).

Regarding medications, 526 (68.6%) patients were undergoing biological therapy, with 151 (19.7%) having previously experienced bio-failure. Details are summarised in Table 1.

3.2. Italian IBD-Disk validity

A good correlation was found between the total scores of IBD-Disk and IBD-DI, with a Pearson coefficient of 0.70 (CIs 95%=0.66–0.73; $p < 0.001$) and a consistent pattern in UC and CD patients (Fig. 1). No differences were observed in patients with a clinically active disease ($r = 0.70$; 95% CI: 0.63 to 0.75) or patients in remission ($r = 0.67$; 95% CI: 0.62 to 0.71). When we examined the correlation for each item, the median values of IBD-Disk showed a stepped pattern, gradually increasing from the lowest to the highest values across different response groups of IBD-DI (Fig. 2), with all associated median regression coefficients significantly different from 0. These findings suggest a good consistency between the IBD-Disk scores and the corresponding items in the IBD-DI questionnaire.

3.3. Italian IBD-Disk reproducibility

Test-retest reliability was estimated using the sample of patients who completed the questionnaire within 7–14 days after the baseline visit (median=9; IQR= 7–12). The reproducibility, expressed as ICC, was good (0.84; 95% CI: 0.82 to 0.86) in the overall sample and slightly higher in UC patients compared to CD patients (0.88 and 0.80, respectively) and in patients with a clinically active disease compared to patients in remission (0.89 and 80, respectively). In the overall sample, among the items included in the IBD-Disk, all showed good reproducibility, except for sexual function, which exhibited moderate reproducibility (Supplementary Figure 2). IBD disk and mIBD-Disk values both at baseline and after 7 days are reported in Table 3.

3.4. Italian IBD-Disk internal consistency

Cronbach's coefficient alpha for the overall IBD-Disk score was 0.92 (95% CI: 0.92 to 0.92), showing good consistency for the assessment tool. No relevant differences were observed when assessing internal consistency in CD and UC patients (Chronbach alpha: 0.916; 95% CI: 0.912 to 0.920 and 0.920; 95% CI: 0.916 to 0.924, respectively) or in patients with a clinically active disease and patients in remission (Chronbach alpha: 0.908; 95% CI: 0.902 to 0.913 and 0.916; 95% CI: 0.913 to 0.920, respectively). In a sensitivity analysis, leaving out one item per time, Cronbach's coefficient alpha consistently remained at a value $\geq$ 0.91.

3.5. Relationship between QOL and IBD-Disk

In the correlation analysis between the IBD-Disk and IBDQ-32, we observed a Pearson correlation coefficient of 0.83 (95% CI: 0.80 to 0.85; $p < 0.001$), indicating a strong correlation between the two measures.

When assessing QoL, 362 patients (47.2%) reported experiencing low QoL defined as an IBDQ-32 value $<$ 169. When the IBD-Disk was used for discriminating patients reduced QoL through ROC curve analysis, the area under the curve (AUC) was equal to 0.90 (95% CI: 0.88 to 0.92; $p < 0.001$)

Table 1
Clinical characteristics of the study population at baseline.

	Total (n = 767)	CD (n = 377)	UC (n = 390)
Type of IBD, n (%)			
CD	377 (49,2)	NA	NA
UC	390 (50,8)		
Gender, n (%)			
Male	391 (51,0%)	214 (43,2%)	177 (45,4%)
Female	376 (49,0%)	163 (56,8%)	213 (54,6%)
Age at diagnosis (y), median (IQR)	29 (19–41)	28 (19–43)	29 (20–40)
Age at baseline (y), median (IQR)	42 (30–57)	44 (29,5–58,0)	42 (31–56,3)
Disease duration (y), median (IQR)	15 (6–40)	14 (6–36)	17 (7–60)
Previous surgery for IBD, n (%)	191 (24,9%)	161 (42,7%)	30 (7,7%)
Ostomy, n (%)	19 (2,5%)	14 (3,7%)	5 (1,3%)
BMI (kg/m^2), median (IQR)	23 (20,9–25,6)	23 (21–25,9)	23 (20,8–25,4)
CD disease location, n (%)			
Ileal	NA	115 (15,0%)	NA
Colonic		41 (5,3%)	
Ileo-colonic		221 (28,8%)	
Perianal disease		77 (20,5%)	
CD disease behaviour, n (%)			
Inflammatory	NA	184 (48,8%)	NA
Stricturing		127 (33,7%)	
Penetrating		66 (17,5%)	
UC disease location, n (%)			
Proctitis	NA	NA	63 (16,2%)
Left colitis			152 (39,0%)
Pancolitis			175 (44,9%)
Clinically active disease, n (%)	422 (55,0%)	209 (55,4%)* HBI	213 (54,6%)^ pMAYO
Endoscopically active disease, n (%)	449 (58,5%)	260 (69,0%)	189 (48,5%)
		SES-CD>2	MES>1
Active EIMs, n (%)			
Peripheral arthritis	250 (66,3%)	131 (66,8%)	119 (65,7%)
Spondyloarthritis	76 (20,2%)	36 (18,4%)	40 (22,1%)
PSC	8 (2,1%)	2 (1,0%)	6 (3,3%)
Others	43 (11,4%)	27 (13,8%)	16 (8,8%)
IBD-related medications, n (%)			
Mesalamine	446 (58,1%)	77 (20,4%)	369 (94,6%)
ISS	82 (10,7%)	47 (12,5%)	35 (9,0%)
Infliximab	198 (25,8%)	90 (23,9%)	108 (27,7%)
Adalimumab	119 (15,5%)	100 (26,5%)	19 (16,4%)
Golimumab	1 (0,1%)	1 (0,3%)	–
Vedolizumab	115 (15,0%)	51 (13,5%)	64 (16,4%)
Ustekinumab	68 (8,9%)	49 (13,0%)	19 (4,9%)
Tofacitinib	21 (2,7%)	–	21 (2,7%)
Upadacitinib	4 (0,5%)	1 (0,3%)	3 (0,8%)
Previous failure to biological therapy, n (%)	151 (19,7%)	82 (21,8%)	69 (17,7%)

Abbreviations: IBD, Inflammatory bowel disease; BMI, body mass index; CD, Crohn's disease; UC, ulcerative colitis; IQR, interquartile ranges; NA, not available; EIMs, extraintestinal manifestations; PSC, Primary sclerosing cholangitis; EN, erythema nodosum; PD, pyoderma gangrenosum; ISS, immunosuppressants.
*HBI ≥5; ^pMAYO≥2.

Table 2
Social characteristics of the study population at baseline.

	Total (n = 767)	CD (n = 377)	UC (n = 390)
Education level, n (%)			
None	14 (1,8%)	7 (1,9%)	7 (1,8%)
Primary school degree	9 (1,2%)	2 (0,5%)	7 (1,8%)
Middle school degree	130 (16,9%)	74 (19,6%)	56 (14,4%)
High school degree	418 (54,5%)	205 (54,4%)	213 (54,6%)
Bachelor's degree	196 (25,6%)	89 (23,6%)	107 (27,4%)
Occupational status, n (%)			
None	198 (25,8%)	97 (25,7%)	101 (25,9%)
Student	85 (11,1%)	45 (11,9%)	40 (10,3%)
Employee	384 (50,1%)	192 (50,9%)	192 (49,2%)
Professional	100 (13,0%)	43 (11,4%)	57 (14,6%)

Abbreviations: CD, Crohn's disease; UC, ulcerative colitis.

with a cut-off value of IBD-Disk ≥37 predicting poor QoL and sensitivity and specificity of 0.79 (95% CI: 0.75 to 0.84) and 0.89 (95% CI: 0.85 to 0.91), respectively (Supplementary Figure 3).

3.6. Questionnaire scores and association with clinical factors

The average (± standard deviation) total IBD-Disk score was 33.4+−24.6 (median: 30; IQR=11–52), with a total of 294 (38.3%) patients experiencing moderate-to-severe disability. Among them, 108 (36.7%) patients were in clinical remission. An overview of the association between clinical and socio-demographic characteristics and IBD-Disk values is presented in Table 4.

In the overall IBD population, at univariate analysis, the educational level did not influence the IBD–Disk score. Female gender was associated with higher IBD-Disk levels (mean difference =14.1; 95% CI:10.7 to 17.4;$p < 0.001$). When considering the clinical factors potentially associated with IBD-Disk levels, no difference was observed between CD and UC (no difference emerged between diagnosis nor in per-item analysis, as shown in Table 4). Likewise, there were no significant differences concerning previous and/or actual pharmacological and surgical treatments. The presence of EIM, both in the past and active, was instead associated with higher IBD-Disk score values (+25.1; 95% CI: 22.1 to 28.1; $p < 0.001$ and +27.3; 95% CI: 24.4 to 30.3; $p < 0.001$, respectively). Clinically active disease was also associated with an increase in the

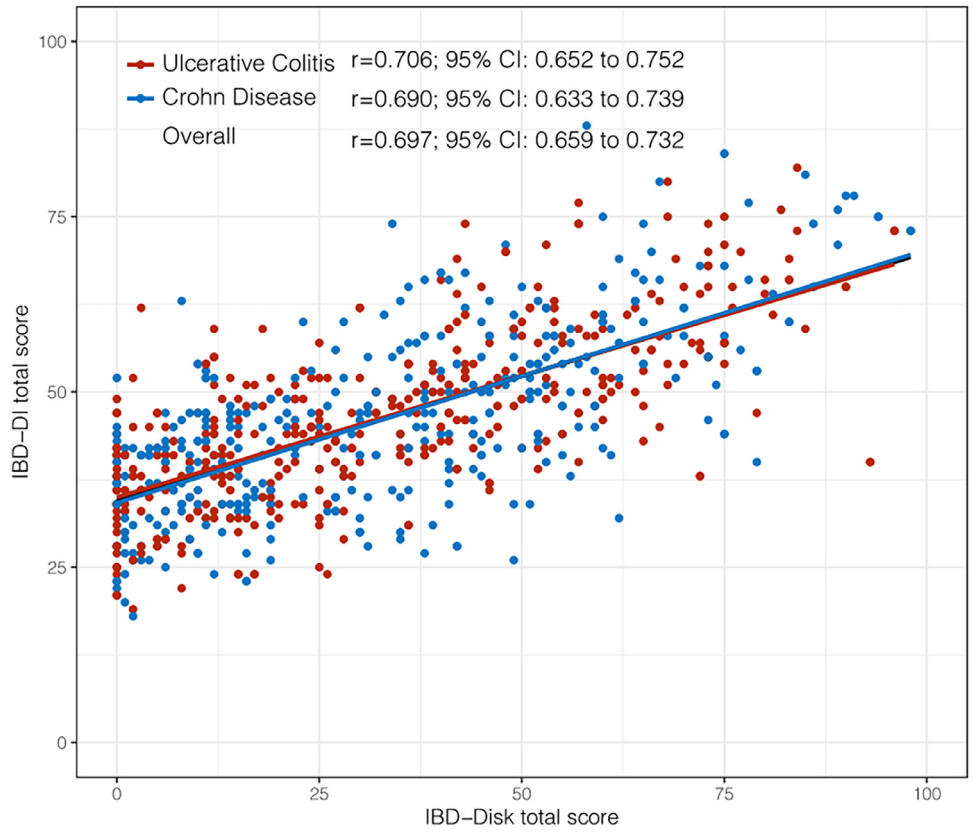

Fig. 1. Correlation graph between IBD-Disk and IBD-DI total scores, with a Pearson coefficient of 0.70 (CIs 95%=0.66–0.73; $p < 0.001$).

Table 3
Per-item analysis of IBD-Disk median and m IBD-Disk score baseline and after 7 days.

Domain	Total baseline score ($n = 767$) Median (IQR)	Total day 7 score ($n = 767$) Median (IQR)	p-value
Abdominal pain	3 (0–6)	2 (0–5)	0.80
Defecation	1 (0–5)	2 (0–5)	0.14
Social life	1 (0–5)	1 (0–5)	0.39
Professional life	2 (0–5)	2 (0–5)	0.55
Sleep	4 (1–7)	4 (1–7)	0.50
Energy	4 (1–7)	5 (1–7)	0.94
Anxiety	3 (1–7)	3 (1–6)	0.29
Self image	2 (1–7)	3 (0–6)	0.67
Sexual functions	1 (0–5)	1 (0–5)	0.16
Joint pain	3 (0–6)	3 (0–7)	0.39
Food habits	2 (0–6)	3 (0–6)	0.65

IBD-Disk score (+8.7; 95% CI:4.6 to 12.8; $p < 0.001$). At multivariate analysis, female gender, presence of active EIMs and a clinically active disease remained the only independent factors significantly associated with higher IBD-Disk scores in the overall IBD population. A very similar pattern was observed when stratifying patients according to diagnosis (Supplementary Tables 1 and 2). In particular, being female (+12.8; 95% CI: 5.5 to 20.2; $p < 0.001$ and +7.7; 95% CI: 3.2 to 12.2;$p = 0.001$ in CD and UC patients, respectively), having active EIM (+31.4; 95% CI: 19.4 to 43.5; $p < 0.001$ and +20.5; 95% CI: 10.8 to 30.3; $p < 0.001$ in CD and UC patients, respectively) and clinically active disease (+8.6; 95% CI: 0.2 to 17.0); $p = 0.045$ and +8.3; 95% CI: 3.5 to 13; $p = 0.001$ in CD and UC patients, respectively) emerged as independent predictors of higher IBD-Disk scores at multivariate analysis, while specific disease features such as location, behaviour, or extension were not associated with IBD-Disk scores.

3.7. Development and validation of m IBD-disk

There was a good correlation between the mIBD-Disk and the IBD-DI ($r = 0.70$; 95% CI: $p < 0.001$). The median score for the item 'food' was 2 (0–6) with no significant difference between CD and UC ($p = 0.65$). Reproducibility was excellent, with an intraclass correlation coefficient of 0.90 and high internal consistency (Cronbach's $\alpha = 0.918$, 95% confidence interval: 0.915 to 0.921). Receiver Operating Characteristic (ROC) curves were plotted to assess the ability of the mIBD-Disk to identify poor quality of life, defined as an IBDQ score below 169 and revealed an area under the ROC curve (AUROC) of 0.91 (95% CI:0.88 to 0.93).

4. Discussion

In recent years, disability has gained increasing attention as a crucial long-term target of IBD management [3].

This study has validated the IBD-Disk within an Italian cohort of IBD patients, aiming to standardize disability assessments across Italian IBD centers. By implementing this tool, this initiative seeks to broaden its benefits, enabling both patients and physicians to more effectively assess and manage IBD-related disability. The Italian version of IBD-Disk demonstrated a good correlation with the IBD-DI, good concurrent validity per item, high internal consistency, and excellent reproducibility with no relevant differences observed in CD and UC or in patients with a clinically active disease and patients in remission.

Indeed, the IBD-Disk is designed to dynamically assess the influence of IBD on different aspects of a patient's life. It not only helps gastroenterologists to identify patient needs but also has the

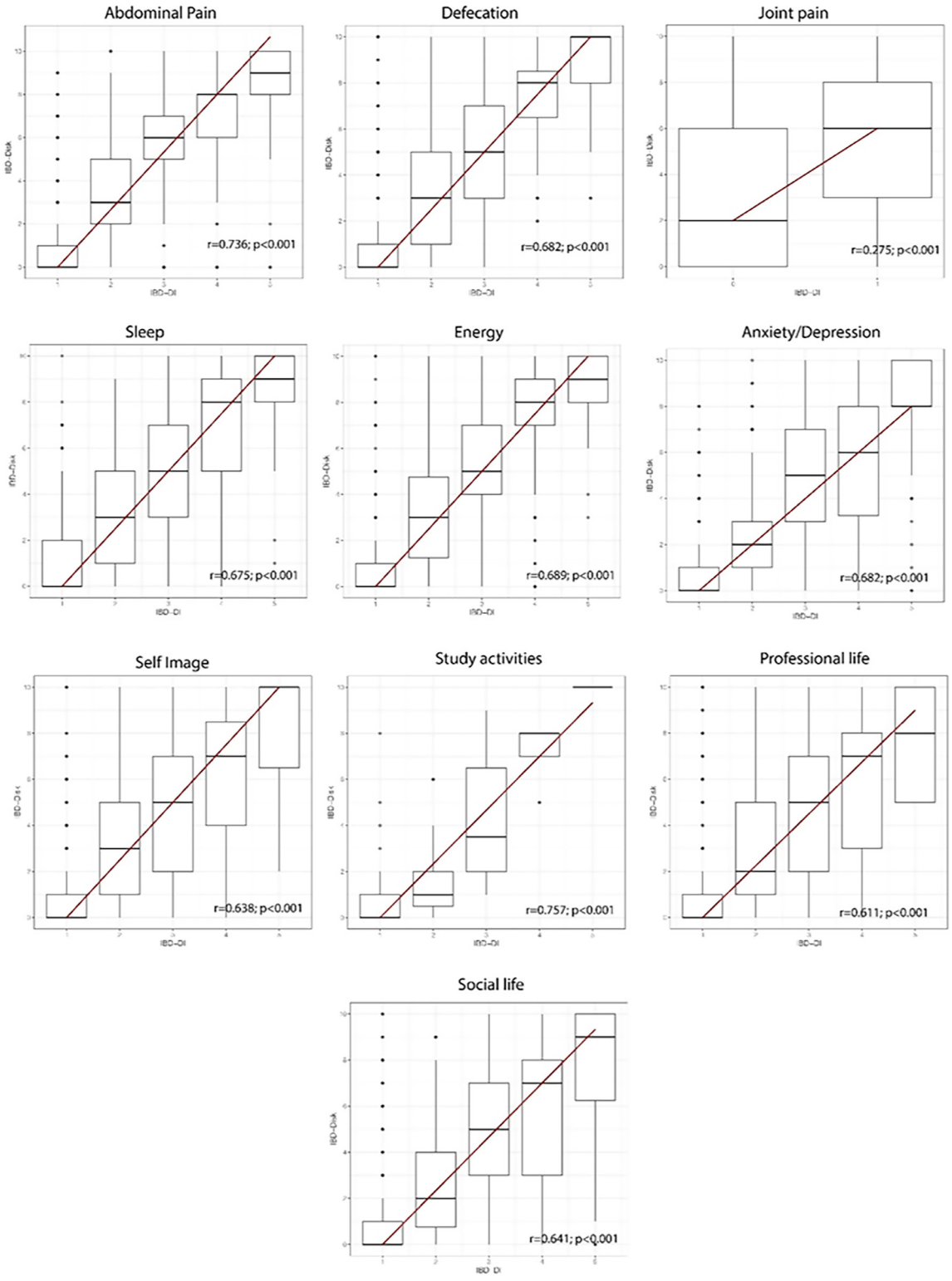

Fig. 2. Correlation coefficients at per item analysis.

potential to guide targeted clinical interventions. By facilitating discussions on issues beyond stool frequency and abdominal pain, the IBD-Disk encourages meaningful patient engagement and supports comprehensive care throughout all stages of the disease [8]

Notably, in this study slightly more than one-third of patients in clinical remission reported moderate to severe disability with an IBD-Disk score of 40 or more. This finding highlights the significant role of psychological factors in determining perceived disability, independent of actual disease activity. In fact, these factors can affect both the severity and progression of symptoms, underscoring the need to consider psychological well-being in the management of IBD [6,24–26].

However, the relationship between IBD activity and psychological health is clearly bidirectional [25]. Research focusing on patients in remission, has revealed that those with symptoms of common mental and mood disorders are more likely to experi-

Table 4
Univariate and multivariable associations with IBD-Disk score in the overall population.

	Total (n = 767)				
		Univariate		Multivariable	
	Mean ± Std Dev.	Mean difference (95% CI)	p-value	Mean difference (95% CI)	p-value
Type of IBD					
CD	33+−24.4	−0.8 (−4.3 to 2.7)	0.644		0.486
UC	33.8+−24.8	ref.		ref.	
Gender					
Male	26.5+−23	ref.		ref.	
Female	40.6+−24.2	14.1 (10.7 to 17.4)	<0.001	9.2 (5.4 to 12.9)	<0.001
Education level					
None	37.1+−26.7	ref.		ref.	
Primary school degree	24.7+−19.5	−12.4 (−33 to 8.2)	0.238	0.9 (−23.6 to 25.4)	0.944
Middle school degree	36.3+−24.8	−0.8 (−14.3 to 12.8)	0.913	0.6 (−15 to 16.2)	0.944
High school degree	34+−25.2	−3.1 (−16.2 to 10)	0.642	1.4 (−13.7 to 16.5)	0.856
Bachelor's degree	30.4+−23.1	−6.7 (−20 to 6.7)	0.328	1 (−14.4 to 16.4)	0.896
Occupational status					
None	36.6+−25.8	ref.		ref.	
Student	29.6+−23.3	−7 (−13.2 to −0.7)	0.029	0.8 (−5.9 to 7.5)	0.807
Employee	33.8+−24.9	−2.8 (−7 to 1.4)	0.195	2.9 (−1.8 to 7.7)	0.226
Professional	28.9+−21.3	−7.6 (−13.6 to −1.7)	0.011	3.3 (−3.3 to 10)	0.324
Previous surgery for IBD					
No	32.8+−25.1	ref.		ref.	
Yes	35.3+−23.1	2.6 (−1.5 to 6.6)	0.211	−5.5 (−12.7 to 1.8)	0.140
EIMs					
Yes	46.2+−23.5	25.1 (22.1 to 28.1)	<0.001	−0.1 (−7.3 to 7.1)	0.974
No	21+−18.7	ref.		ref.	
Biological therapy					
Yes	34.9+−25.2	2.5 (−1 to 6.1)	0.162	−0.8 (−5.4 to 3.7)	0.717
No	32.3+−24.2	ref.		ref.	
Previous failure to Biological therapy					
Yes	35.5+−24.1	2.7 (−1.7 to 7.1)	0.232	3.1 (−2.9 to 9)	0.312
No	32.9+−24.7	ref.		ref.	
Active EIMs					
Yes	48.7+−22.3	27.3 (24.4 to 30.3)	<0.001	26.4 (19.2 to 33.6)	<0.001
No	21.4+−19.1	ref.		ref.	
Clinically active disease					
Yes	41.9+−24.8	13.1 (9.6 to 16.6)	<0.001	8.7 (4.6 to 12.8)	<0.001
No	28.8+−23.2	ref.		ref.	
Endoscopically active disease					
Yes	33.7+−25	4.8 (−0.4 to 10.1)	0.070	0.9 (−3.5 to 5.4)	0.679
No	28.9+−24.4	ref.		ref.	

ence disease flare-ups and require intensified treatment [27]. Similarly, a recent meta-analysis found that depression and anxiety are strong predictors of worse clinical outcomes in IBD, including increased risk of flare-ups, hospitalizations, emergency department visits, therapy escalation, and surgery [25]. Conversely, patients with active disease who do not have a history of mental disorders are still at higher risk for developing anxiety or depression in the future because of the burden of disease, highlighting a gut-brain axis effect [26–28]. In this context, the IBD-Disk can track symptom trajectories over time and guide appropriate interventions. By screening for psychological symptoms, the IBD-Disk helps to mitigate the impact of poor mental health on IBD activity and vice versa, ultimately improving patient outcomes and the overall course of the disease [29].

When we investigated social and clinical factors associated with disability, our findings align with previous reports on IBD-related disability. Consistent with a recent multinational cross-sectional survey of 1972 IBD patients worldwide, women had higher rates of IBD-related disability compared with men [30]. Various mechanisms, including biological and psychosocial factors, have been proposed to explain the greater degree of disability experienced by women. Female sex hormones such as 17β-oestradiol, progesterone, and luteinizing hormone influence several gut-specific processes and can exacerbate clinical symptoms [31]. Additionally, women are more likely than men to develop affective disorders and show a higher susceptibility to mood and anxiety disorders with studies showing that up to 65% of women with IBD experience depressive and anxiety disorders [32]. They also report greater concerns about their body image and functionality compared to their male counterparts [33].

Disease activity is another significant factor contributing to disability [13,21,34,35]. Not surprisingly, when a patient's disease is clinically active, inflammation may contribute relatively more to experienced disability.

Furthermore, EIM can significantly impact disability by affecting energy levels, fatigue, joint pain, and work productivity [34,35]. These factors contribute to higher rates of absenteeism, presenteeism, and impairment in daily activities among individuals with IBD compared to the general population, resulting in increased indirect costs associated with managing the condition [21,36–38].

However, as a potential limitation of the tool, we have to highlight that the IBD-Disk overlooks certain aspects of daily life that could be relevant for patients. Specifically, factors related to diet and nutrition, which are significant concerns for individuals with IBD, may have a considerable impact on disability. Accordingly, we included a question about food habits alongside IBD-Disk to address this gap.

Noticeably, dietary habits have also been implicated in contributing to depression and anxiety [39]. Many patients alter their diets post-diagnosis, often without medical guidance. They report spending more time reading food labels, preparing their own meals, avoiding take-out, and frequently cooking separately from

their families [39]. Furthermore they often avoid eating out, mainly because they fear the urgent need for toilets, which are not always easily accessible, or to trigger intestinal symptoms [40]. Consequently, many patients decline social outings with friends, colleagues, or family members [41]. This frustration related to food choices contributes to increased stress and anxiety and impacts their level of disability.

The study's strength lies in its robust statistical power, stemming from its prospective, multicenter design and the extensive patient cohort. Furthermore, the study's sample represents diverse geographic areas across Italy enhancing the representativeness and generalizability of the findings. Additionally, the innovative advancements in mIBD-Disk suggest opportunities for refining and expanding the IBD-Disk tool to incorporate previously overlooked aspects.

Nonetheless, there are some limitations to consider. Firstly, there is a notable selection bias regarding the enrollment of patients, primarily restricted to those attending outpatient clinics in tertiary referral centres. However, we believe the outpatient clinic setting is ideal for implementing the IBD-Disk as it can be utilised during waiting times, thereby improving consultation efficiency and timing.

Additionally, the majority of patients had mild clinical activity or were in remission and hence did not fully represent all IBD patients. However, it is expected that clinically active patients are more disabled because the disease itself determines the level of disability [36]. Conversely, patients in remission are often underestimated, yet they still require attention, as they may exhibit psychological disorders that can predict poorer future clinical outcomes [27]. Therefore, it is important to screen for disability-related symptoms in both active and inactive patients and, if these symptoms are present, consider them as therapeutic targets. Indeed, improvements in mood may directly influence immune system processes and inflammation [29].

In conclusion, the present study highlights the validity and reliability of the Italian version of the IBD-Disk as a standardized tool for quantifying disability in routine practice among IBD patients, paving the way for its broader dissemination in Italy. Implementing IBD-Disk may offer a more holistic approach to IBD care, potentially improving both patient well-being and objective disease outcomes [6]. However, there is a need for a more comprehensive version of the IBD-Disk, incorporating missing aspects that can be relevant for patients daily lives and supporting the integration of mental and physical healthcare in IBD care. Further research is warranted to adequately assess the long-term impact of interventions on IBD-Disk parameters and to explore the tool's responsiveness to change over time.

Disclosures

OMN has served as a speaker for Janssen, Ferring, Takeda, Pfizer, and Fresenius Kabi, Nòos, CaDiGroup

MA received consulting fees from NikkisoEurope, Mundipharma, Janssen, Abbvie, Ferring, Galapagos and Pfizer.

AO has served as an advisory board member for AbbVie, Galapagos, MSD, Janssen, Pfizer, and Takeda Pharmaceuticals and received lecture grants from AbbVie, MSD, Sofar, Chiesi, Janssen, Pfizer, and Takeda Pharmaceuticals.

AR has served as an advisory board for Abbvie, MSD, Takeda, Janssen, Pfizer

SD has received lecture/consulting fees from AbbVie, Allergan, Biogen, Boehringer Ingelheim, Celgene, Celltrion, Ferring, Hospira, Johnson & Johnson, Merck, Merck Sharp & Dohme, Mundipharma, Pfizer, Sandoz, Takeda, TiGenix, UCB, and Vifor

ES has served as speaker for Abbvie, Abivax, Agave, AG-Pharma, Alfasigma, Apoteca, Biosline, CaDiGroup, Celltrion, Dr Falk, EG Stada Group, Fenix Pharma, Galapagos, Johnson&Johnson, JB Pharmaceuticals, Innovamedica/Adacyte, Eli Lilly, Malesci, Mayoly Biohealth, Montefarco, Novartis, Omega Pharma, Pfizer, Rafa, Reckitt Benckiser, Sandoz, Sanofi/Regeneron, SILA, Sofar, Takeda, Tillots, Unifarco; has served as consultant for Abbvie, Agave, Alfasigma, Biogen, Bristol-Myers Squibb, Celltrion, Dr. Falk, Eli Lilly, Fenix Pharma, Ferring, Giuliani, Grunenthal, Johnson&Johnson, JB Pharmaceuticals, Merck & Co, Nestlè, Pfizer, Reckitt Benckiser, Sanofi/Regeneron, SILA, Sofar, Takeda, Unifarco; he received research support from Bonollo, Difass, Pfizer, Reckitt Benckiser, Sanofi/Regeneron, SILA, Sofar, Unifarco, Zeta Farmaceutici.

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AT has served as advisory board for Abbvie, Takeda, Janssen.

AV: has received speaker fees from Abbvie, Alfasigma, Celltrion, Lilly, Takeda, Pfizer, Johnson and Johnson, Ferring, Zambon; Consultant and advisory board for Abbvie, Celltrion, Takeda, Pfizer, Johnson and Johnson, Ferring

FC has served as consultant to Abbvie, MSD, Takeda, Janssen, Roche, Celgene, Bristol Myers Squibb, Galapagos, Gilead, Pfizer, Mundipharma, Galapagos, Biogen, received lecture fees from Abbvie, Ferring, Takeda, Allergy Therapeutics, Janssen, Pfizer, Biogen, and unrestricted research grants from Giuliani, Takeda, Abbvie

Ethics approval statement

Our local ethical committee approved the study protocol in accordance with the Helsinki Ethical Declaration.

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Conflict of interest

All authors declare no conflict of interest regarding this manuscript.

Author contribution

Olga Maria Nardone: Conceptualization, Writing – original draft, Writing – review & editing. **Dario Bruzzese:** Formal analysis, Writing – original draft, Writing – review & editing. **Mariangela Allocca:** Writing – review & editing. **Giulio Calabrese:** Data curation, Writing – original draft, Writing – review & editing. **Flavio Caprioli:** Data curation, Writing – review & editing. **Silvio Danese:** Writing – review & editing. **Massimo Claudio Fantini:** Data curation, Writing – review & editing. **Sara Onali:** Data curation, Writing – review & editing. **Ambrogio Orlando:** Data curation, Writing – review & editing. **Antonio Rispo:** Data curation, Writing – review & editing. **Edoardo Savarino:** Data curation, Writing – review & editing. **Alessandra Soriano:** Data curation, Writing – review & editing. **Angela Variola:** Data curation, Writing – review & editing. **Fabiana Castiglione:** Data curation, Writing – review & editing, Supervision, Validation.

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APPENDIX A

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Supplementary materials

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