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Food avoidance and fasting in patients with inflammatory bowel disease: Experience from the Nancy IBD nutrition clinic

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Abstract

Background: Patients with inflammatory bowel disease (IBD) consider that their diet is important for controlling symptoms and frequently ask their physician for additional guidance on this matter. The objectives of the present study of patients with IBD were to characterize the prevalence of exclusion diets and fasting and to identify associated risk factors.

Methods: Using an anonymous questionnaire, we screened patients attending our IBD nutrition clinic between November 2021 and April 2022 for exclusion diets. The avoidance of a food category completely was defined as total exclusion and avoidance most of the time was defined as partial exclusion. We also asked patients whether they fasted totally, intermittently, or partially.

Result: A total of 434 patients with IBD were included. On inclusion, 159 patients (36.6%) totally excluded at least one food category and 271 (62.4%) partially excluded at least one food. Intermittent, total, or partial fasting was reported by 30.8% of the patients. Disease activity (odds ratio (OR) [95% confidence interval] = 1.7 [1.1–2.7], $p = 0.0130$) and treatment with a small-molecule or an investigational drug (OR = 4.0 [1.5–10.6], $p = 0.0059$) were independently associated with an exclusion diet. A history of stenosis (OR = 2.0 [1.2–3.2], $p = 0.0063$) and active disease (OR = 1.9 [1.2–3.1], $p = 0.0059$) were associated with fasting.

Conclusion: In this real-world study, approximately two-thirds of our patients with IBD reported the partial or total exclusion of at least one food category and one third reported fasting. A systematic nutritional evaluation might improve clinical management and quality of care for patients with IBD both Crohn's disease and ulcerative colitis.

Olivier Bonsack and Bénédicte Caron contributed equally to this manuscript.

KEYWORDS
Crohn's disease, exclusion diet, fasting, food, IBD, inflammatory bowel disease, nutrition, questionnaire, relapse, ulcerative colitis

INTRODUCTION

Inflammatory bowel disease (IBD) is a chronic condition that usually follows a relapsing-remitting course.[1] Recent research evidence points to a plausible role of diet and the microbiome in the pathogenesis of Crohn's disease (CD) and ulcerative colitis (UC). Patients with IBD consider their diet to be important for controlling symptoms and frequently ask their physician for additional guidance on this matter.[2,3] Most of these patients feel that they are intolerant to various food items and so may restrict their diet accordingly.[4] Importantly, self-prescribed food avoidance fails to prevent relapse[2] but can lead to poor outcomes with regard to mental health, quality of life, nutritional status, and nutritional deficiencies.[5] Other factors that influence food avoidance are limited or unclear dietary guidance[4] and advice from alternative health practitioners. In 2020, the International Organization for the Study of Inflammatory Bowel Diseases published a dietary guidance consensus.[6] It refers to several dietary patterns that are commonly recommended to patients with IBD (e.g. the Mediterranean diet, a specific carbohydrate diet, and the Crohn's disease exclusion diet).[6–8] However, the lack of clinical trials of dietary patterns precluded the formulation of strong recommendations. Bowel rest failed to cure patients with IBD[9] but fasting might control symptoms.[10,11] Many observational studies have described food avoidance in IBD in an attempt to identify dietary patterns related to the disease onset,[12–21] digestive symptoms[22,23] and dietary beliefs.[2,24] Only a few studies have examined how food avoidance and fasting vary according to the IBD subtype, the CD site, and the history of surgery and complications[3,25,26]. Furthermore, these studies were limited by a small sample size and a lack of data (due to the use of a self-questionnaire). Some patients were unaware of their disease site(s), and self-reported data on disease distribution and the history of fistula or strictures are not necessarily reliable. We hypothesized that a better understanding of the relationship between food avoidance and IBD patients' characteristics would help refine the patients' nutritional counselling and stimulate future nutritional research.

Hence, the primary objective of the present study was to estimate the frequency of the total dietary exclusion of at least one food category among patients being followed up for IBD. The secondary objectives of the study were to estimate the prevalence of a total and/or partial exclusion diet, describe the food exclusion patterns, estimate the proportion of patients who experimented with fasting, and describe the patients' reasons for testing or adopting an exclusion diet.

Key summary

Summarize the established knowledge on this subject

- Diet is an important topic for patients with IBD.
- Patients with IBD consider their diet to be important for controlling symptoms and frequently ask their physician for additional guidance on this matter.
- Self-prescribed food avoidance fails to prevent relapse but can lead to poor outcomes with regard to mental health, quality of life, nutritional status, and nutritional deficiencies.

What are the significant and/or new findings of this study?

- Total or partial exclusion diets are highly prevalent in IBD patients.
- In the present study, 36.6% of patients stated that they had adopted a total exclusion diet for at least one food category and 62.4% stated that they had adopted a partial exclusion diet.
- 30.8% of patients had already practiced intermittent, total, or partial fasting
- This study identified two predictors influencing the occurrence of the exclusion diet in the IBD population: active disease, and the use of a small-molecule drug or an investigational drug.

METHODS

Study population

The study was conducted at Nancy University Hospital (Nancy, France), where a nutrition IBD clinic had been created early in 2021. At the clinic, we have developed screening tools for detecting food avoidance. All consecutive IBD patients seen from November 2021 to April 2022 in an outpatient setting (whether for a flare or during a scheduled visit) or in an infusion unit were invited to participate in the study. The main inclusion criteria were age 18 or over and a confirmed diagnosis of UC or CD (according to the standard criteria). Individuals with small bowel syndrome were excluded.

Data collection

A study information sheet and a questionnaire were given to the patients. This questionnaire was used in routine practice from November 2021 onwards and did not require ethical approval or patient consent. The questionnaire collected sociodemographic data (age and sex) and clinical data (regular tobacco use, previous IBD surgery, disease characteristic, IBD treatments, and the presence of extraintestinal manifestations). Data on disease activity at the time they completed the questionnaire were also collected; active disease corresponded to the need for corticoid treatment or a treatment change (other than changes in IBD treatment prompted by poor tolerance). Further information on the disease characteristics and treatments was obtained from the patient's electronic medical records. For entering, these data were collected in an Excel database that was anonymized.

Patients described their habits with regard to 15 food categories at the time they completed the questionnaire; for each category, they indicated whether they avoided it completely (defined as total exclusion) or avoided it most of the time (defined as partial exclusion). The patients were also asked to state whether they had ever experimented with fasting, and if so, to state the reason for fasting and the duration of fasting. Fasting for more than 24 h was defined as total fasting, fasting for less than 24 h or skipping meals was defined as intermittent fasting, and calorie restriction without skipping meals was defined as partial fasting.

Statistical analysis

The study data were handled in Microsoft Excel® 2013 (Microsoft Corp.). The data management procedures ensured that individual patients could not be identified and that the data remained confidential.

Categorical variables were quoted as the frequency (percentage), and continuous variables were quoted as the median [interquartile range (IQR)]. We analysed the study population as a whole and the UC and CD subgroups. Bivariate regression analyses were used to probe associations between variables of interest and the probability of having a total exclusion diet, a total and/or partial exclusion diet, and fasting practices. The absence of a deviation from linearity was checked for categorical and continuous variables. If the data deviated from linearity, they were dichotomized by grouping the variable's modalities (for categorical variables) or by applying the median value (continuous variables). Variables with a p-value <0.05 in the bivariate analysis were fed into a multivariate logistic regression model. Candidate variables were selected by applying an input threshold of $p < 0.2$ and an output threshold of $p < 0.05$. The strength of an association was described as the odds ratio (OR) and its 95% confidence interval (CI). The threshold for statistical significance was set to 0.05. All statistical analyses were performed using SAS software (version 9.4, SAS Institute Inc.).

RESULTS

Characteristics of the study participants

A total of 434 patients (237 females (54.6%)) were included in the study (Table 1). The median [IQR] age was 39 [18–84], and there were 101 active smokers (23.3%). Three hundred and twelve patients had CD (71.9%) and 122 had UC (28.1%). The median [IQR] age at IBD diagnosis was 24.5 [2–67].

The median weight was 70 kg [39–150], the median height was 170 cm [137–199], and the median body mass index (BMI) was 24 [14.6–46.3] kg/m^2. In this cohort, 51.7% (n = 224) of patients had a BMI between 18.5 and 25 kg/m^2, and 42% (n = 182) had a BMI higher than 25.

Patients were being treated with anti-tumour necrosis factor (TNF) agents (n = 210 (48.4%)), vedolizumab (n = 65 (14.9%)), ustekinumab (n = 66 (15.2%)), a small-molecule drug or an investigational drug (n = 22 (5.1%)). Forty-six patients (10.6%) were not being treated at the time of inclusion. A total of 147 (33.9%) patients had undergone surgery for IBD.

Among the patients with CD, the disease was limited to the ileum in 137 cases (43.9%), to the colon in 65 (20.8%), to the ileum and the colon in 96 (30.8%), and to the upper gastrointestinal tract in 14 (4.5%). The majority of patients with UC (54.9%) had pancolitis.

30.4% of patients had active disease.

Fasting and diet

In this cohort, 159 patients (36.6%) totally excluded at least one food category (Table 2). The most frequently excluded categories were fibre (74 out of 434, 17%), raw vegetables (67 out of 434, 15.4%), leguminous vegetables (65 out of 434, 14.9%), dairy products (49 out of 434, 11.3%), and raw fruits (45 out of 434, 10.4%). Two hundred and seventy-one patients (62.4%) partially excluded at least one food category. The most frequently avoided categories after the diagnosis of IBD were raw vegetables (105 out of 434, 24.2%), fatty foods (96 out of 434, 22.1%), leguminous vegetables (92 out of 434, 21.2%), fibre (87 out of 434, 20%), and dairy products (82 out of 434, 18.9%).

With regard to fasting practices, a total of 134 (30.8%) patients had already practiced intermittent, total, or partial fasting for IBD-related reasons, weight loss, or religious reasons (Table 3). Seventy-six of these patients (17.5%) had practiced fasting to control IBD-related gastrointestinal symptoms (abdominal pain or diarrhoea), 47 (10.8%) had practiced fasting during a flare-up, and 27 (6.2%) had practiced fasting during disease remission. In all cases, the fasting had been initiated by the patient.

Factors associated with a total exclusion diet

In a multivariate analysis, female sex (OR [95% CI] = 0.6 [0.4–0.9], p = 0.0197) and treatment with vedolizumab (OR = 0.5 [0.3–0.9],

TABLE 1 Characteristics of the study population.

Characteristics	*n* = 434
Female sex, *n* (%)	237 (54.6)
Age (in years), median [IQR]	39 [22]
Current smoker, *n* (%)	101 (23.3)
Age (y) at diagnosis, median [IQR]	24.5 [16.75]
<17	69 (15.9)
17–40	294 (67.7)
>40	71 (16.3)
Duration of IBD (in years) at inclusion, median [IQR]	11 [14]
Type of IBD, *n* (%)	
Crohn's disease	312 (71.9)
Ulcerative colitis	122 (28.1)
Active disease at inclusion, *n* (%)	132 (30.4)
Montreal classification—disease phenotype, *n* (%)	
B1: Non-structuring, non-penetrating	85 (27.2)
B2: Stricturing	62 (19.9)
B3: Penetrating	165 (52.9)
Montreal classification—Crohn's disease site, *n* (%)	
L1 Terminal ileum	137 (43.9)
L2 Colonic	65 (20.8)
L3 Ileocolonic	96 (30.8)
L4 Upper gastrointestinal tract	14 (4.5)
Perineal disease—Crohn's disease, *n* (%)	114 (36.5)
Montreal classification—ulcerative colitis site, *n* (%)	
E1 Proctitis	14 (11.5)
E2 Left-sided	41 (33.6)
E3 pancolitis	67 (54.9)
IBD treatment, *n* (%)	
None	46 (10.6)
Steroids	11 (2.5)
5-aminosalicylates	28 (6.5)
Immunosuppressants	23 (5.3)
Anti-TNF agents	210 (48.4)
Ustekinumab	66 (15.2)
Vedolizumab	65 (14.9)
Other (e.g. Janus kinase inhibitors and investigational drugs)	22 (5.1)
IBD surgery, *n* (%)	147 (33.9)
Extraintestinal manifestations, *n* (%)	81 (18.7)
Ankylosing spondylitis	41 (9.4)
Psoriasis	25 (5.8)
Primary sclerosing cholangitis	12 (2.8)
Uveitis	2 (0.05)
Weight (kg), median [IQR]	70 [20]
Body mass index (kg/m^2), median [IQR]	24 [6.5]

Abbreviations: IBD, inflammatory bowel disease; IQR, interquartile range; TNF, tumour necrosis factor.

p = 0.0189) were independently associated with a lower likelihood of a total exclusion diet, whereas active disease (OR = 1.7 [1.1–2.7], p = 0.0130) and the use of a small-molecule drug or an investigational drug (OR = 4.0 [1.5–10.6], p = 0.0059) were associated with a higher likelihood of a total exclusion diet in the global cohort (Table 4). In patients with CD, an age > 39 years (OR = 1.6 [1.0–2.6], p = 0.0485) and the use of a small-molecule drug or an investigational drug (OR = 5.1 [1.6–16.6], p = 0.0064) were associated with a higher likelihood of a total exclusion diet (Supplementary Table S1). No factor was associated with a total exclusion diet in patients with UC (Supplementary Table S2).

Factors associated with a partial and/or total exclusion diet

In a multivariate analysis, female sex (OR = 0.5 [0.3–0.8], p = 0.0013) and treatment with an anti-TNF agent (OR = 0.6 [0.4–0.9], p = 0.013) were independently associated with a lower likelihood of an exclusion diet (whether partial or total) in the global cohort (Table 5). In patients with CD, an age > 39 years (OR = 1.8 [1.1–3.0], p = 0.0190) was associated with a higher likelihood of a total exclusion diet (Supplementary Table S3). In patients with CD, male sex (OR = 0.5 [0.3–0.8], p = 0.0033) was independently associated with a lower likelihood of an exclusion diet (whether partial or total). In patients with UC, treatment with an anti-TNF agent (OR = 0.4 [0.2–0.9], p = 0.0250) was independently associated with a lower likelihood of an exclusion diet (whether partial or total) (Supplementary Table S4).

Factors associated with fasting

A multivariate analysis showed that an age at IBD diagnosis >24.5 (OR = 0.6 [0.4–1], p = 0.0427) was independently associated with a lower likelihood of fasting, whereas a history of stenosis (OR = 2.0 [1.2–3.2], p = 0.0063) and active disease (OR = 1.9 [1.2–3.1], p = 0.0059) were associated with a higher likelihood of fasting in the global cohort (Table 6). No factor was associated with fasting in patients with CD (Supplementary Table S5). In

TABLE 2 Exclusion diets.

Food category	Total exclusion diet *n* = 159 (36.6%)	Partial exclusion diet *n* = 271 (62.4%)	Total and/or partial exclusion diet *n* = 303 (69.8%)
Fibre, *n* (%)	74 (17)	87 (20)	161 (37)
Raw vegetables, *n* (%)	67 (15.4)	105 (24.2)	172 (39.6)
Leguminous vegetables, *n* (%)	65 (14.9)	92 (21.2)	157 (36.2)
Dairy product, *n* (%)	49 (11.3)	82 (18.9)	131 (30.2)
Raw fruit, *n* (%)	45 (10.4)	62 (14.3)	107 (24.7)
Cooked vegetables, *n* (%)	36 (8.3)	55 (12.7)	91 (20.9)
Cooked fruit, *n* (%)	26 (5.9)	22 (5)	48 (11.1)
Fatty foods, *n* (%)	19 (4.4)	96 (22.1)	115 (26.5)
Eggs, *n* (%)	7 (1.6)	25 (5.8)	32 (7.4)
Sweet foods, *n* (%)	7 (1.6)	34 (7.8)	41 (9.4)
Gluten, *n* (%)	8 (1.8)	32 (7.4)	40 (9.2)
Meat, *n* (%)	4 (0.9)	51 (11.7)	55 (12.7)
Fish, *n* (%)	2 (0.5)	5 (1.1)	7 (1.6)
Starchy foods, *n* (%)	1 (0.2)	21 (4.8)	22 (5)
FODMAPs, *n* (%)	1 (0.2)	10 (2.3)	40 (9.2)

Abbreviation: FODMAPs, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols.

TABLE 3 Fasting.

	Fasting for IBD	Fasting for IBD, weight loss or religious purposes
Fasting, *n* (%)	76 (17.5)	134 (30.8)
Intermittent fasting	33 (7.6)	73 (16.8)
Total fasting	30 (6.9)	41 (9.4)
Partial fasting	20 (4.6)	27 (6.2)
During remission	27 (6.2)	56 (12.9)
During an IBD flare	47 (10.8)	48 (11)
Motivation, *n* (%)		
Transit control	47 (10.8)	47 (10.8)
Pain control	57 (13.1)	57 (13.1)

Abbreviation: IBD, inflammatory bowel disease.

patients with UC, absence of treatment (OR = 8.7 [1.9–39.3], $p = 0.0051$) and active disease (OR = 4.0 [1.4–11.1], $p = 0.0076$) were associated with a higher likelihood of a total exclusion diet (Supplementary Table S6).

DISCUSSION

Diet is an important topic for patients with IBD. More than half of the patients with IBD believe that their symptoms are induced or exacerbated by specific foods.[27,28] Commonly identified foods include fruits, vegetables, dairy products, spicy foods, processed foods, nuts, seeds, alcohol, and foods with a high fat content.[24,29]

In the present study, 36.6% of patients stated that they had adopted a total exclusion diet for at least one food category and 62.4% stated that they had adopted a partial exclusion diet. The most frequently excluded food categories were raw vegetables, fatty foods, leguminous vegetables, fibre, and dairy products. These findings are in line with literature reports in which raw vegetables were perceived to be an IBD relapse risk factor.[24] The results for fibre, raw vegetables, and leguminous vegetables might be explained by perceived links between these food categories and bloating and diarrhoea, such as dietary fibre and galacto-oligosaccharides in leguminous vegetables and fructo-oligosaccharides and fructans in raw vegetables. Furthermore, cooking vegetables is associated with a decrease in the insoluble dietary fibre content (e.g., cellulose), which

TABLE 4 Factors associated with a total exclusion diet.

Variables		Total exclusion diet, *n* (%)	Bivariate OR [95% CI]	*p* value	Multivariate OR [95% CI]	*p* value
Sex	Male	99 (41.8)	1	0.0152	1	0.0197
	Female	60 (30.5)	0.6 [0.4–0.9]		0.6 [0.4–0.9]	
Age	<39 years	68 (32.4)	1	0.0753		
	>39 years	91 (40.6)	1.4 [1–2.1]			
BMI	<18.5 kg/m^2	13 (48.1)	1.5 [0.7–3.3]	0.2394		
	18.5–25 kg/m^2	86 (38.4)	1			
	>25 kg/m^2	60 (33.0)	0.8 [0.5–1.2]			
Smoking	None	92 (34.3)	1	0.2978		
	Current	38 (37.6)	1.2 [0.7–1.9]			
	Cessation	29 (44.6)	1.5 [0.9–2.7]			
Treatment	Steroids	14 (50)	1.8 [0.8–3.9]	0.1337		
	5-ASA	4 (36.4)	1 [0.3–3.4]	0.9849		
	Immunosuppressant	7 (30.4)	0.7 [0.5–1.1]	0.5272		
	Anti-TNF	69 (32.9)	0.7 [0.5–1.1]	0.1141		
	Ustekinumab	23 (35.4)	0.9 [0.5–1.6]	0.8215		
	Vedolizumab	17 (25.8)	0.6 [0.3–1]	0.0487	0.5 [0.3–0.9]	0.0189
	Other	16 (72.7)	5 [1.9–13.1]	0.0010	4.0 [1.5–10.6]	0.0059
	None	21 (47.7)	1.7 [0.9–3.1]	0.1100		
IBD type	UC	44 (36.1)	1	0.8777		
	CD	115 (36.9)	1 [0.7–1.6]			
Perineal disease	No	120 (37.5)	1	0.5315		
	Yes	39 (34.2)	1 [0.6–1.4]			
Stenosis	No	120 (36.5)	1	0.9013		
	Yes	39 (37.1)	1 [0.7–1.6]			
Intestinal resection	No	96 (33.4)	1	0.0548		
	Yes	63 (42.9)	1.5 [1–2.2]			
Disease duration	<11 years	72 (34.3)	1	0.3254		
	>11 years	87 (38.8)	1.2 [0.8–1.8]			
Age at diagnosis	<24.5 years	75 (34.6)	1	0.3701		
	>24.5 years	84 (38.7)	1.2 [0.8–1.8]			
Disease activity	No	100 (33.1)	1	0.0217	1	
	Yes	59 (44.7)	1.6 [1.1–2.5]		1.7 [1.1–2.7]	0.0130
Extraintestinal manifestations	No	127 (36)	1	0.5524		
	Yes	32 (39.5)	1.2 [0.7–1.9]			

Abbreviations: 5-ASA, 5-aminosalicylate; BMI, body mass index; CD, Crohn's disease; CI, confidence interval; IBD, inflammatory bowel disease; OR, odd ratio; TNF, tumour necrosis factor; UC, ulcerative colitis.

might facilitate digestion; this might explain why raw vegetables are more frequently avoided than cooked vegetables.[30] Furthermore, the literature data suggest that a third of patients with IBD experience functional gastrointestinal symptoms compatible with irritable bowel syndrome.[31] Patients with IBD reportedly consider that fast foods, fatty meats, and fatty, fried, or oily foods are linked to symptom onset or exacerbation.[3,24,26,29,32] The avoidance of dairy products is common among patients with IBD.[28] Morton et al. reported that cream and ice cream were most frequently avoided by patients with IBD.[28] The association between IBD symptoms and dairy products might be attributable to lactose intolerance, a term used to describe the onset of gastrointestinal symptoms in response

TABLE 5 Factors associated with total and/or partial exclusion diet.

Variables		Exclusion diet, *n* (%)	Bivariate OR [95% CI]	*p* value	Multivariate OR [95% CI]	*p* value
Sex	Male	183 (77.2)	1	0.0003	1	0.0013
	Female	120 (60.9)	0.5 [0.3–0.7]		0.5 [0.3–0.8]	
Age	<39 years	136 (64.8)	1	0.0269		
	>39 years	167 (74.6)	1.6 [1.1–2.4]			
BMI	<18.5 kg/m^2	20 (74.1)	1.1 [0.5–2.8]	0.5097		
	18.5–25 kg/m^2	161 (71.9)	1			
	>25 kg/m^2	122 (67.0)	0.8 [0.5–1.2]			
Smoker	Never	187 (69.8)	1	0.2879		
	Current	66 (65.3)	0.8 [0.5–1.3]	0.3014		
	Former	50 (76.9)	1.4 [0.8–2.7]	0.1575		
Treatment	Steroids	22 (78.6)	1.6 [0.6–4.1]	0.3014		
	5-ASA	10 (90.9)	4.4 [0.6–35]	0.1575		
	Immunosuppressant	13 (56.3)	0.5 [0.2–1.3]	0.1589		
	Anti-TNF	132 (62.9)	0.5 [0.3–0.8]	0.0024	0.6 [0.4–0.9]	0.0130
	Ustekinumab	45 (69.2)	1 [0.5–1.7]	0.9109		
	Vedolizumab	47 (71.2)	1.1 [0.6–1.9]	0.7884		
	Other	22 (100)		0.9755		
	None	36 (81.8)	2.1 [0.9–4.6]	0.0724		
IBD type	UC	82 (67.2)	1	0.4604		
	CD	221 (70.8)	1.2 [0.8–1.9]			
Perineal disease	No	224 (70)	1	0.8882		
	Yes	79 (69.3)	1 [0.6–1.5]			
Stenosis	No	234 (71.1)	1	0.2937		
	Yes	69 (65.7)	0.8 0.5–1.2]			
Intestinal resection	No	193 (67.2)	1	0.1044		
	Yes	110 (74.8)	1.4 [0.9–2.1]			
Disease duration	<11 years	139 (66.2)	1	0.1118		
	>11 years	164 (73.2)	1.4 [0.9–2.1]			
Age at diagnosis	<24.5 years	153 (70.5)	1	0.7538		
	>24.5 years	150 (69.1)	0.9 [0.6–1.4]			
Disease activity	No	201 (66.6)	1	0.0262		
	Yes	102 (77.3)	1.7 [1.1–2.7]			
Extraintestinal manifestations	No	240 (68)	1	0.0858		
	Yes	63 (77.8)	1.6 [0.9–2.9]			

Abbreviations: 5-ASA, 5-aminosalicylate; BMI, body mass index; CD, Crohn's disease; CI, confidence interval; IBD, inflammatory bowel disease; OR, odd ratio; TNF, tumour necrosis factor; UC, ulcerative colitis.

to lactose consumption (usually due to lactase-deficiency-induced malabsorption).[33]

In the present study, 30.8% of patients had already practiced intermittent, total, or partial fasting. The majority of patients had practiced fasting to control gastrointestinal symptoms (abdominal pain or diarrhoea) related to IBD during a flare-up but also during remission. In 2008, a study found that Ramadan fasting had no adverse effect on 60 IBD patients in remission.[10] There was a nonsignificant improvement in the Crohn's Disease Activity Index among the patients with CD.[10] Among the patients with UC,

TABLE 6 Factors associated with fasting.

Variables		Fasting, *n* (%)	Bivariate OR [95% CI]	*p* value	Multivariate OR [95% CI]	*p* value
Sex	Male	59 (24.9)	1	0.6182		
	Female	45 (22.8)	0.9 [0.6–1.4]			
Age	<39 years	57 (27.1)	1	0.1338		
	>39 years	47 (21)	0.7 [0.5–1.1]			
BMI	<18.5 kg/m2	12 (44.4)	2.9 [1.3–6.5]	0.0408		
	18.5–25 kg/m2	49 (21.9)	1			
	>25 kg/m2	42 (23.1)	1.1 [0.7–1.7]			
Smoker	Never	60 (22.4)	1	0.3035		
	Current	30 (29.7)	1.5 [0.9–2.5]			
	Former	14 (21.5)	1 [0.5–1.8]			
Treatment	Steroids	5 (17.9)	0.7 [0.2–1.8]	0.4369		
	5-ASA	3 (27.3)	1.2 [0.3–4.6]	0.7947		
	Immunosuppressant	7 (30.4)	1.4 [0.6–3.5]	0.4567		
	Anti-TNF	47 (22.4)	0.8 [0.5–1.3]	0.4549		
	Ustekinumab	12 (18.5)	0.7 (0.3–1.3)	0.2623		
	Vedolizumab	18 (27.3)	1.2 [0.7–2.2]	0.4945		
	Other	8 (36.4)	1.9 [0.8–4.6]	0.1680		
	None	13 (29.5)	1.4 [0.7–2.7]	0.3616		
IBD type	UC	23 (18.9)	1	0.1205		
	CD	81 (26)	1.5 [0.9–2.5]			
Perineal disease	No	73 (22.8)	1	0.3474		
	Yes	31 (27.2)	1.3 (0.8–2.1)			
Stenosis	No	69 (21)	1	0.0105	1	0.0063
	Yes	35 (33.3)	1.9 [1.2–3.1]		2.0 [1.2–3.2]	
Intestinal resection	No	66 (23)	1	0.5100		
	Yes	38 (25.9)	1.2 [0.7–1.8]			
Disease duration	<11 years	51 (24.3)	1	0.8788		
	>11 years	53 (23.7)	1 [0.6–1.5]			
Age at diagnosis	<24.5 years	62 (28.6)	1	0.0252	1	0.0427
	>24.5 years	42 (19.4)	0.6 [0.4–0.9]		0.6 [0.4–1]	
Disease activity	No	61 (20.2)	1	0.0059	1	0.0059
	Yes	43 (32.6)	1.9 [1.2–3]		1.9 [1.2–3.1]	
Extraintestinal manifestations	No	84 (23.8)	1	0.8648		
	Yes	20 (24.7)	1 [0.6–1.8]			

Abbreviations: 5-ASA, 5-aminosalicylate; BMI, body mass index; CD, Crohn's disease; CI, confidence interval; IBD, inflammatory bowel disease; OR, odd ratio; TNF, tumour necrosis factor; UC, ulcerative colitis.

however, the Clinical Colitis Activity Index (including stool frequency, urgency, rectal bleeding, and general well-being) decreased significantly.[10]

Our study is the first to investigate factors associated with total or partial exclusion diets and fasting. We found that active disease and treatment with a small-molecule drug or an investigational drug were significantly associated with the adoption of an exclusion diet. This might be because patients with a flare-up are more likely to avoid eating certain types of food that they believe trigger symptom.[26] We found an association with the patient's treatment—

perhaps because patients being treated with a small-molecule drug or an investigational drug often have severe or refractory disease. These patients are therefore more likely to adopt a total exclusion diet. In our cohort, a history of bowel stenosis and active disease was significantly associated with fasting. This is consistent with Bergeron et al.'s finding that food avoidance was common among patients with IBD and especially in those with stricturing CD.[25] To date, several studies have compared the respective patterns of food avoidance in CD versus UC; half of the studies found that patients with CD were more likely to avoid food for perceived intolerance.[24–26,32] In our study, we did not identify a difference between CD and UC. However, in the subgroup analysis, factors associated with total or partial exclusion diets and fasting were different between patients with CD or UC.

The main strength of our study is the large number of patients. Furthermore, to our knowledge, this is the first study that specifically investigated factors associated with total or partial exclusion diets and fasting in a large cohort of consecutive IBD patients. For the assessment of disease activity, however, we did not use any valid indexes of disease activity or objective biomarkers. Because subjects were recruited from a referral centre, there is an implied selection bias towards an increased prevalence of severe or refractory disease, which seems to be associated with exclusion diet and fasting.

The ESPEN guideline suggests that patients with IBD are at risk and therefore should be screened for malnutrition at the time of diagnosis and thereafter on a regular basis.[34] Nutritional management can improve outcomes for patients with IBD. Therefore, it is appropriate to screen for and manage malnutrition using a multidisciplinary team.

In conclusion, total or partial exclusion diets are highly prevalent in IBD patients. This study identified two predictors influencing the occurrence of the exclusion diet in the IBD population: active disease and the use of a small-molecule drug or an investigational drug. Given the challenges to long-term dietary restriction and potential nutritional deficiencies, a systematic nutritional evaluation is needed to improve the quality of care.

AUTHOR CONTRIBUTIONS

Didier Quilliot and Laurent Peyrin-Biroulet conceived the study. Olivier Bonsack and Bénédicte Caron wrote the article and created tables. Cedric Baumann, Anne Charlotte Heba, Silvio Danese, Djesia Arnone, Patrick Netter, Silvio Danese, Didier Quilliot and Laurent Peyrin-Biroulet critically reviewed the manuscript content and supervised the project. The manuscript was approved by all the authors.

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CONFLICT OF INTEREST STATEMENT

Olivier Bonsack declares no conflict of interest. Bénédicte Caron has received lecture and/or consulting fees from Abbvie, Amgen, Celltrion, Ferring, Galapagos, Janssen, and Takeda. Cedric Baumann declares no conflict of interest. Anne Charlotte Heba declares no conflict of interest. Silvio Danese declares no conflict of interest. Djesia Arnone declares no conflict of interest. Patrick Netter declares no conflict of interest. Silvio Danese has served as a speaker, consultant, and advisory board member for Schering-Plough, AbbVie, Actelion, Alphawasserman, AstraZeneca, Cellerix, Cosmo Pharmaceuticals, Ferring, Genentech, Grunenthal, Johnson and Johnson, Millenium Takeda, MSD, Nikkiso Europe GmbH, Novo Nordisk, Nycomed, Pfizer, Pharmacosmos, UCB Pharma and Vifor. Didier Quilliot declares no conflict of interest. Laurent Peyrin-Biroulet declares personal fees from Galapagos, AbbVie, Janssen, Genentech, Ferring, Tillots, Celltrion, Takeda, Pfizer, Index Pharmaceuticals, Sandoz, Celgene, Biogen, Samsung Bioepis, Inotrem, Allergan, MSD, Roche, Arena, Gilead, Amgen, BMS, Vifor, Norgine, Mylan, Lilly, Fresenius Kabi, OSE Immunotherapeutics, Enthera, Theravance, Pandion Therapeutics, Gossamer Bio, Viatris and Thermo Fisher, grants from Abbvie, MSD, Takeda and Fresenius Kabi, and stock options from CTMA.

DATA AVAILABILITY STATEMENT

The data underlying this article are available in the article.

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SUPPORTING INFORMATION

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