

Psychological profiles of irritable bowel syndrome patients with different phenotypes

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Background/Aims: Abnormal psychological profiles are frequently found in patients with functional gastrointestinal disorders (FGIDs). The present study aimed to evaluate the psychological profiles of FGID patients with irritable bowel syndrome (IBS), and IBS phenotypes. **Methods:** In 608 FGID patients, including 235 with IBS, have filled a Rome III questionnaire and the French version of the Minnesota Multiphasic Personality Inventory 2. Data analysis was performed using univariate analysis and multivariate logistic regression. **Results:** This study shows that IBS patients have abnormal psychological profiles with more significant symptom exaggeration and decreased test defensiveness than non-IBS patients. They have a significantly higher score for all clinical scales. Logistic regression analysis showed in IBS patients a decrease of body mass index ($P=0.002$), and test defensiveness score K ($P=0.001$) and an increase of Hypochondriasis ($P<0.001$) and Masculinity-Femininity scale ($P=0.018$). By comparison with non-IBS patients, IBS-constipation, IBS-diarrhea, and mixed IBS patients have increased Hypochondriasis value and Depression score, mixed IBS patients have higher Psychasthenia score and higher Hypomania score. No item was significantly different in the IBS-unspecified group. **Conclusions:** This study shows that IBS patients have different psychological profiles than other FGID patients and that psychological characteristics are associated with IBS phenotypes except for patients with unsubtyped IBS. (**Intest Res 2020;18:459-468**)

Key Words: Irritable bowel syndrome; MMPI-2; Depression; Sex; Life stress events

INTRODUCTION

Irritable bowel syndrome (IBS) is a functional bowel disorder defined by the presence of chronic or recurring symptoms that include abdominal pain and discomfort (for Rome III criteria,¹ but not for Rome IV criteria²), flatulence, bloating, and altered bowel habits.¹ IBS is a disorder of unknown etiology; there are no known biochemical, structural, or physiological abnormalities to characterize IBS. The prevalence of IBS in

Western populations is estimated to be between 5% and 20%.³ Sex ratio, frequencies of abnormal transit or defecation disorders, association to dyspepsia vary strongly according to different countries.³

In order to test adult personality, the Minnesota Multiphasic Personality Inventory (MMPI) is the most widely used psychometric test.⁴ The psychological profile of many patients with digestive disorders was previously assessed with this test.⁵⁻⁷ The MMPI-2, a significant revision of the MMPI, standardized on a national sample of U.S. adults,⁸ introduced a wide variety of subscales to help clinicians in the interpretation of the results of the original clinical scales.

To understanding illness and human health in their entire contexts, the biopsychosocial approach⁹ was proposed and

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used to analyze functional gastrointestinal disorders (FGIDs) such as IBS in the Rome III presentation.¹⁰ In this hypothesis, IBS results from dysfunction of the enteric and central nervous system, which is manifested as dysmotility and/or visceral hypersensitivity and is modified by psychosocial processes. In this multicausal pathology, biological and psychological factors interact to determine the disease activity and experience of illness. IBS symptoms can be associated with psychological co-morbidities: anxiety disorders, depression, somatoform disorders, and phobic disorders.¹¹ This psychological profile explains an exaggerated intestinal pain and emotional distress.¹²

Nevertheless, most of these studies do not use the Rome criteria,¹³ and MMPI was never used to characterize IBS subtypes as defined by the Rome III criteria. IBS is a clinically defined disorder without physiopathologic processes.¹⁴ We hypothesize that different IBS subtypes are associated with different personality profiles. The present study aims to evaluate the psychological profile of IBS and IBS subtypes in a cohort of outpatients consulting for FGID in a tertiary center by using a normalized psychometric test, the MMPI-2.

METHODS

1. Subjects

Between September 2010 and December 2014, 1,293 outpatients were consecutively referred by gastroenterologists to our Center for Functional GI and Motility Disorders in the Gastroenterology Clinic of the Avicenne Hospital, a tertiary center for FGID management. A full clinical evaluation, including morphological (endoscopy or radiology) and the exclusion of metabolic, endocrinologic, and neurologic etiologies, failed to yield an organic cause for their complaint. The use of narcotics and previous surgery of the gastrointestinal tract were exclusion criteria. A single investigator (M.B.) independently confirmed the validity of the initial FGID diagnosis.

We ask the patients that have not initially filled in the MMPI questionnaire to do so at the second clinical visit. In toto, 608 patients (69% female), aged 44.5 ± 17.0 years (mean \pm standard deviation [SD]), body mass index (BMI) 26.5 ± 6.0 kg/m², filled in the personality questionnaire and a standard Rome III adult diagnosis questionnaire.

2. Methods

Following the French legislation, this study was registered in the French National Agency for drug safety (decision number:

2015-A01661-48). We perform the present study according to the provisions of the Declaration of Helsinki. Informed written consent was obtained from each patient.

3. Study Design

The design of the present study is a retrospective observational study.

4. Clinical Questionnaire

Patients in the gastroenterologist's office filled out a standard Rome III adult diagnosis questionnaire for FGIDs.¹⁵

For functional bowel disorders, the diagnosis of IBS was based on the report of recurrent abdominal pain or discomfort at least 3 days per month in the last 3 months associated with 2 or more of the following: improvement with defecation, beginning associated with a change in frequency of stool, or with a change in form (appearance) of stool. Subtypes of IBS (IBS with constipation [IBS-C], IBS with diarrhea [IBS-D], mixed IBS [IBS-M], and unsubtyped IBS [IBS-U]) were defined according to the Rome III criteria.¹ In the absence of IBS, the diagnosis of other functional bowel disorders (bloating, constipation, diarrhea, and unspecified) was made. Finally, nonspecific bowel disorders were diagnosed by exclusion when bowel disorders were present but did not meet the criteria mentioned above.

Functional esophageal¹⁶ (heartburn, chest pain, dysphagia, globus), gastroduodenal¹⁷ (dyspepsia, postprandial distress syndrome, epigastric pain syndrome, aerophagia), anorectal¹⁸ (fecal incontinence, anorectal pain, including levator ani syndrome proctalgia fugax, difficult defecation), disorders and abdominal pain¹⁹ were diagnosed according to the Rome III criteria.

5. Psychological Profiles

We used the MMPI-2 to assess the psychological profile as previously described.²⁰ The individual raw MMPI-2 score was converted to a T-scale score (mean \pm SD, 50 ± 10), which is age and sex-adjusted to the healthy controls.²¹ Briefly, for each subject, the MMPI-2 is scored by 6 validity scales namely L, F, Fb, K, true response inconsistency (TRIN), and variable response inconsistency (VRIN), and 10 clinical scales namely 1-Hypochondriasis, 2-Depression, 3-Hysteria, 4-Psychopathic deviate, 5-Masculinity-Femininity, 6-Paranoia, 7-Psychasthenia, 8-Schizophrenia, 9-Hypomania, and 10-Social introversion. Sixty other items, also calculated, are described in the Supplementary Text.

6. Statistical Analysis

We used IBM SPSS software version 20.0 (IBM Corp., Armonk, NY, USA) to carry statistical analyses and express the results for quantitative parameters as mean ±SD. Differences among the groups were searched by one-way analysis of variance using Bonferroni correction for multiple comparisons with post hoc tests. Analysis of qualitative variables was used chi-square tests.

Logistic regression was used for data analysis that systematically included IBS as the dependent variable and as independent variables, BMI, and the validity and clinical MMPI-2 scales. For the analysis of the psychological characteristics of the IBS subtypes, 2 multinomial logistic regression models, adjusted for BMI, with the non-IBS and the unspecified IBS subtype used as reference groups, were created for each group. The backward selection was used for model selection during all multivariate logistic regression. Statistically significant variables ($P < 0.05$) remained in the adjusted model.

RESULTS

1. Patients Characteristics

The Rome questionnaire divided the 608 FGIDs patients into 235 IBS patients (39%; 77 for IBS-C, 68 for IBS-D, 54 for IBS-M, 36 for IBS-U) and 373 non-IBS patients (61%) (Table 1). IBS and non-IBS patients have similar age and sex ratio, but non-IBS patients have higher BMI than IBS patients ($P < 0.001$). Among the 4 IBS subtypes, IBS-C patients are more frequently of female sex than IBS-M patients ($P = 0.003$) and have lower BMI than IBS-D ($P = 0.002$) and IBS-U ($P = 0.002$) patients. The univariate analysis shows that IBS patients report a higher prevalence of chest pain ($P < 0.001$), dysphagia ($P = 0.004$), postprandial distress syndrome ($P < 0.001$), nonspecific dyspepsia ($P < 0.001$), aerophagia ($P < 0.001$), and levator ani syndrome ($P = 0.004$).

2. Psychological Characteristics of IBS Patients

IBS patients show higher symptom exaggeration than non-IBS patients ($P < 0.001$) and decreased test defensiveness score ($P < 0.001$) (Table 2, Supplementary Table 1). IBS patients have a significantly higher score for all clinical scales: Hypochondriasis ($P < 0.001$), Depression ($P < 0.001$), Hysteria ($P < 0.001$), Psychopathic deviate ($P = 0.005$), Masculinity-Femininity ($P < 0.001$), Paranoia ($P < 0.001$), Psychasthenia ($P < 0.001$), Schizophrenia ($P < 0.001$), Hypomania ($P = 0.005$) and Social introversion ($P = 0.042$). The results of the content, supplementary

Table 1. Demographics and Clinical Description of the Population

Variable	All patients	IBS	Non-IBS	P-value
No. of patients	608 (100)	235 (39)	373 (61)	-
Age (yr)	44.5 ± 17.0	46.2 ± 16.9	43.5 ± 17.0	0.852
Female sex	419 (69)	166 (71)	253 (68)	0.262
BMI (kg/m ²)	26.5 ± 6.0	25.4 ± 5.5	27.2 ± 6.2	< 0.001
Esophagus				
Globus	118 (19)	53 (23)	65 (17)	0.074
Regurgitation	61 (10)	28 (12)	33 (9)	0.139
Chest pain	161 (26)	90 (38)	71 (19)	< 0.001
Heartburn	186 (31)	94 (40)	92 (25)	< 0.001
Dysphagia	118 (19)	59 (25)	59 (16)	0.004
Gastroduodenal				
Epigastric pain	44 (7)	24 (10)	20 (5)	0.019
Postprandial distress	105 (17)	64 (27)	41 (11)	< 0.001
Nonspecific dyspepsia	153 (25)	90 (38)	63 (17)	< 0.001
Aerophagia	163 (27)	94 (40)	69 (18)	< 0.001
Bowel				
All IBS subtypes	235 (39)	235 (100)	0	-
IBS constipation	77 (13)	77 (33)	0	
IBS diarrhea	68 (11)	68 (29)	0	
IBS mixed	54 (9)	54 (23)	0	
IBS unspecified	36 (6)	36 (15)	0	
Constipation	89 (15)	0	89 (24)	
Diarrhea	71 (12)	0	71 (19)	
Bloating	42 (7)	0	42 (11)	
Nonspecific	60 (10)	0	60 (16)	
Abdominal pain	37 (6)	0	37 (10)	
Anorectal				
Soiling	60 (10)	33 (14)	27 (7)	0.005
Fecal incontinence	48 (8)	20 (9)	28 (8)	0.382
Levator Ani syndrome	35 (6)	25 (11)	10 (3)	< 0.001
Proctalgia Fugax	41 (7)	25 (11)	16 (4)	0.002
Nonspecific anorectal pain	36 (6)	23 (10)	13 (3)	0.001
Obstructed defecation	216 (36)	127 (54)	89 (24)	< 0.001

Values are presented as number (%) or mean ± standard deviation. IBS, irritable bowel syndrome; BMI, body mass index.

and Harris-Lingoes scales for IBS and non-IBS patients are shown in the Supplementary Text.

As shown in Fig. 1, the multivariate logistic regression found that IBS group is characterized by decreased BMI ($P = 0.002$; odds ratio [OR], 0.957; 95% confidence interval [CI], 0.930–0.984), decreased test defensiveness score ($P = 0.001$; OR, 0.972; 95% CI, 0.955–0.989) and increased scales for Hypochondria-

Table 2. MMPI Validity and Clinical Scales in IBS and Non-IBS Patients

Scale	All FGIDs patients	IBS patients	Non-IBS patients	P-value
Validity scales				
L scale	56.9 ± 10.7	56.4 ± 10.7	57.2 ± 10.7	0.382
Infrequency scale (F)	59.2 ± 16.7	63.1 ± 18.0	56.7 ± 15.3	<0.001
Infrequency scale back (Fb)	58.9 ± 17.7	62.7 ± 20.3	56.6 ± 15.4	<0.001
K scale	48.4 ± 10.5	46.7 ± 10.3	49.4 ± 10.4	0.002
TRIN	59.6 ± 9.0	59.6 ± 9.3	59.6 ± 8.7	0.910
VRIN	54.8 ± 10.9	55.2 ± 10.6	54.5 ± 11.1	0.418
Clinical scales				
1 Hypochondriasis (Hs)	66.8 ± 13.6	72.0 ± 12.7	63.5 ± 13.1	<0.001
2 Depression (D)	61.8 ± 12.2	64.9 ± 12.4	59.8 ± 11.7	<0.001
3 Hysteria (Hy)	60.4 ± 13.9	65.0 ± 14.2	57.6 ± 12.9	<0.001
4 Psychopathic deviate (Pd)	53.7 ± 12.3	55.4 ± 12.6	52.6 ± 12.0	0.005
5 Masculinity-Femininity (Mf)	52.9 ± 10.8	54.2 ± 10.8	52.0 ± 10.6	<0.001
6 Paranoia (Pa)	55.8 ± 14.7	59.2 ± 15.9	53.6 ± 13.4	<0.001
7 Psychasthenia (Pt)	56.7 ± 12.2	59.8 ± 12.3	54.8 ± 11.8	<0.001
8 Schizophrenia (Sc)	57.1 ± 13.9	60.6 ± 14.4	54.9 ± 13.1	<0.001
9 Hypomania (Ma)	50.8 ± 11.5	52.4 ± 12.5	49.7 ± 10.7	0.005
10 Social introversion (Si)	55.0 ± 10.1	56.0 ± 10.1	54.3 ± 10.0	0.042

Values are presented as mean ± standard deviation.

MMPI, Minnesota Multiphasic Personality Inventory; IBS, irritable bowel syndrome; FGIDs, functional gastrointestinal disorders; TRIN, true response inconsistency; VRIN, variable response inconsistency.

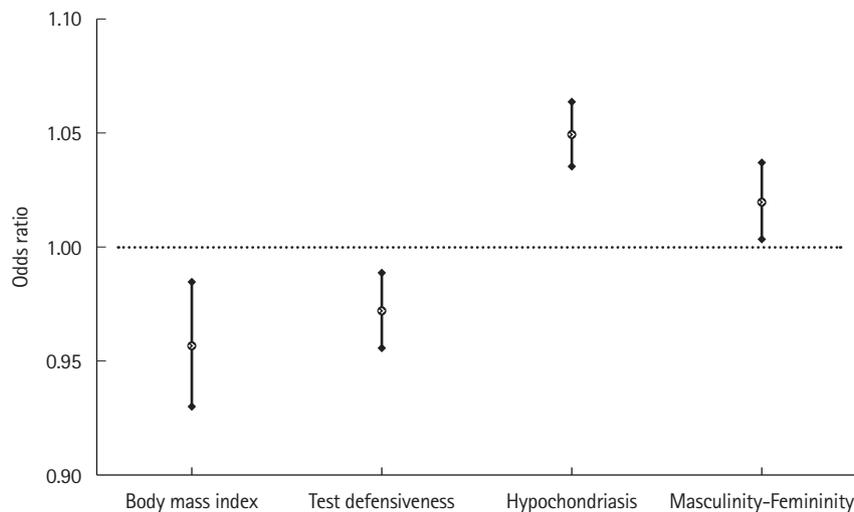


Fig. 1. Graphical representation of the odds ratio and their 95% confidence interval of significant demographics and validity and clinical Minnesota Multiphasic Personality Inventory 2 scales ($P < 0.01$) in irritable bowel syndrome patients compared with patients with other functional gastrointestinal disorders.

sis ($P < 0.001$; OR, 1.049; 95% CI, 1.035–1.064) and Masculinity-Femininity ($P = 0.018$; OR, 1.020; 95% CI, 1.003–1.037).

The frequency of abnormal clinical scales is shown in the Supplementary Tables 2 and 3 and analyzed in the Supplementary Text.

3. Demographics and Psychological Characteristics of IBS Subtypes Patients

By comparison with non-IBS patients (Table 3, Supplementary Table 4), IBS-C patients have a more frequently female sex ($P < 0.01$) and a lower BMI ($P < 0.001$) while IBS-M patients

Table 3. Demographics and MMPI Validity and Clinical Scales of IBS Subtypes Patients

Variable	IBS-C	IBS-D	IBS-M	IBS-U	P-value
Demographics					
No. of patients	77 (33)	68 (29)	54 (23)	36 (15)	
Age (yr)	43.8 ± 15.6	46.6 ± 15.6	47.6 ± 18.0	46.6 ± 15.5	0.561
Female sex	66 (86)	46 (68)	31 (57)	23 (64)	0.003
BMI (kg/m ²)	23.8 ± 4.9	27.4 ± 7.3	24.3 ± 5.2	26.3 ± 5.4	0.001
Validity scales					
L scale	57.9 ± 10.6	57.1 ± 11.2	53.9 ± 10.2	56.0 ± 10.8	0.194
Infrequency scale (F)	60.8 ± 16.9	62.5 ± 17.5	69.1 ± 17.2	60.2 ± 20.7	0.039
Infrequency back (Fb)	60.9 ± 19.2	61.9 ± 21.5	68.2 ± 18.3	59.5 ± 22.2	0.135
K scale	48.0 ± 10.1	46.8 ± 10.7	43.5 ± 9.7	48.6 ± 10.5	0.061
TRIN	59.7 ± 9.8	59.4 ± 8.3	60.7 ± 10.2	57.8 ± 8.7	0.553
VRIN	55.2 ± 10.6	54.8 ± 11.3	55.8 ± 9.8	55.2 ± 10.4	0.967
Clinical scales					
1 Hypochondriasis (Hs)	71.8 ± 13.4	71.1 ± 10.0	75.6 ± 13.2	68.3 ± 13.7	0.046
2 Depression (D)	64.6 ± 11.5	65.3 ± 10.8	68.2 ± 13.3	59.7 ± 14.2	0.015
3 Hysteria (Hy)	63.8 ± 13.9	66.3 ± 12.4	67.8 ± 16.8	61.2 ± 13.4	0.128
4 Psychopathic deviate (Pd)	53.9 ± 12.0	54.2 ± 11.7	59.1 ± 14.7	55.6 ± 11.8	0.098
5 Masculinity-Femininity (Mf)	54.5 ± 11.0	53.6 ± 11.4	55.4 ± 10.4	53.1 ± 10.3	0.728
6 Paranoia (Pa)	57.3 ± 15.7	58.3 ± 15.7	64.3 ± 14.8	57.2 ± 17.3	0.058
7 Psychasthenia (Pt)	58.5 ± 11.9	59.2 ± 11.0	63.8 ± 12.5	57.7 ± 14.0	0.046
8 Schizophrenia (Sc)	53.1 ± 12.4	49.5 ± 11.7	55.6 ± 12.9	51.8 ± 12.5	0.051
9 Hypomania (Ma)	59.0 ± 12.6	59.0 ± 14.2	66.2 ± 13.9	58.9 ± 17.4	0.013
10 Social introversion (Si)	55.2 ± 9.8	57.1 ± 9.7	57.4 ± 9.9	53.8 ± 11.7	0.267

Values are presented as number (%) or mean ± standard deviation.

MMPI, Minnesota Multiphasic Personality Inventory; IBS, irritable bowel syndrome; IBS-C, IBS-constipation; IBS-D, IBS-diarrhea; IBS-M, mixed IBS; IBS-U, IBS-unspecified; BMI, body mass index; TRIN, true response inconsistency; VRIN, variable response inconsistency.

have lower BMI ($P=0.014$).

Among the IBS patients, IBS subgroups show a significant difference for one validity scale, Infrequency scale with the highest value for the IBS-M group ($P<0.001$ vs. non-IBS patients and $P=0.040$ vs. IBS-C patients) and 4 clinical scales: Hypochondriasis, Depression, Psychasthenia, and Hypomania. The differences of the content, supplementary, and Harris-Lingoes scales are shown in the Supplementary Table 3 and described in the Supplementary Text.

By comparison with non-IBS patients, IBS-C, IBS-D, and IBS-M patients have increased Hypochondriasis ($P<0.001$ for these 3 groups), increased Depression ($P=0.013$ for IBS-C, $P=0.005$ for IBS-D, and $P<0.001$ for IBS-M), IBS-M patient have higher Psychasthenia ($P<0.001$) and higher Hypomania ($P=0.004$). No item was significantly different in the IBS-U group.

The multinomial logistic regression shows that, by compari-

son with the non-IBS patients (Fig. 2), IBS-C patients have lower BMI ($P<0.001$; OR, 0.911; 95% CI, 0.869–0.954) and increased value for Hypochondriasis ($P=0.001$; OR, 1.058; 95% CI, 1.022–1.095) and Masculinity-Femininity scale ($P=0.034$; OR, 1.028; 95% CI, 1.002–1.055), the IBS-D patients have increased Hysteria score ($P=0.003$; OR, 1.059; 95% CI, 1.020–1.099) and the IBS-M patients have decreased BMI ($P=0.005$; OR, 0.922; 95% CI, 0.871–0.976), decreased test defensiveness score ($P=0.036$; OR, 0.946; 95% CI, 0.898–0.996) and increased Hypochondriasis scale ($P=0.008$; OR, 1.058; 95% CI, 1.015–1.103). In contrast, no significant association was found with the IBS-U group.

By comparison to IBS-U patients, the multinomial logistic regression shows that IBS-C patients gave increased Depression score ($P=0.011$; OR, 1.095; 95% CI, 1.021–1.174) and decreased BMI ($P=0.018$; OR, 0.909; 95% CI, 0.839–0.983), the

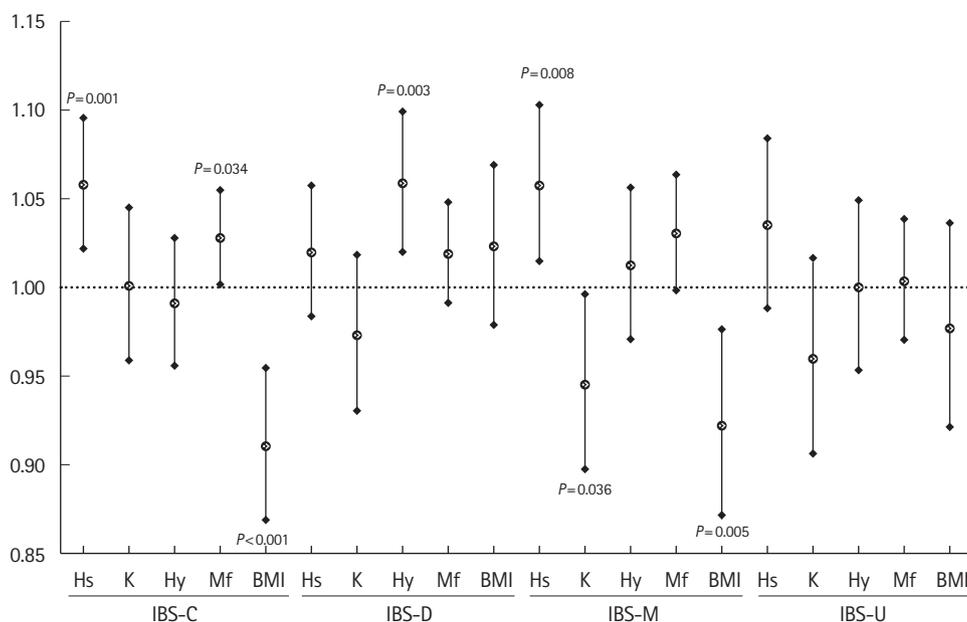


Fig. 2. Graphical representation of the odds ratio and their 95% confidence interval of clinical and psychological significant items in at least one IBS subgroup (Hs, K, Hy, Mf, BMI) in IBS phenotypes compared with patients with other functional gastrointestinal disorders. IBS, irritable bowel syndrome; IBS-C, constipation-IBS; IBS-D, diarrhea-IBS; IBS-M, mixed IBS; IBS-U, unspecified IBS; Hs, Hypochondriasis; K, test defensiveness; Hy, Hysteria; Mf, Masculinity-Femininity; BMI, body mass index.

IBS-M patients have only decreased BMI ($P=0.030$; OR, 0.909; 95% CI, 0.835–0.991) while the IBS-D patients were not significantly different.

The frequency of abnormal values is shown in Supplementary Tables 5 and 6 and analyzed in the Supplementary Text. Briefly, the multinomial logistic regression shows that, as compared to the non-IBS patients, only IBS-C and IBS-M patients are associated with an increased frequency of abnormal Hypochondriasis score: for IBS-C patients ($P=0.001$; OR, 2.958; 95% CI, 1.603–5.458), and IBS-M patients ($P=0.003$; OR, 3.245; 95% CI, 1.489–7.070).

DISCUSSION

This study confirms the existence of significant psychological characteristics in IBS patients. They have higher symptom exaggeration than non-IBS patients ($P<0.001$), and higher score for all clinical scales. Also, psychological characteristics associated with IBS phenotypes, except IBS-U, were found. By comparison with the non-IBS patients, IBS-C patients have a higher score for Hypochondriasis and Masculinity-Femininity scale, IBS-D patients have a higher score for Hysteria, and the IBS-M patients have decreased test defensiveness score and increased Hypochondriasis scale. By comparison to IBS-U pa-

tients, IBS-C patients reported a higher score of Depression.

We used a French validated translation of the MMPI 2. This 567 items-test usually takes between 1 and 2 hours to complete depending on the reading level. To avoid any bias, we excluded from the study patients unable to respond to the entire test (5% of FGIDs patients) and patients with organic diseases. Data are based on the other 608 patients.

The MMPI has been commonly used to assess medical patients (chronic pain,²² chronic pelvic pain,²³ premenstrual symptoms²⁴) and to explore patients with digestive disorders of known (inflammatory bowel disease), or of unknown origin: dyspepsia,²⁵ nutcracker esophagus,²⁶ slow transit constipation,⁷ or IBS.²⁷⁻³⁰

In previous clinical studies, IBS patients were compared to healthy controls 28 or in patients with extra digestive pain.⁷ The present study uses other FGIDs patients as the control group for 2 reasons. First, MMPI scales used are T scores with a known distribution in the healthy population (mean \pm SD, 50 ± 10), according to the gender and age; second, other FGID patients suffer from another chronic digestive disorder. The main superiority of the MMPI on other psychological tests is the presence of validity scales to validate the questionnaires.³¹ Nevertheless, the high correlation between the MMPI clinical scales limits the power of this test.³² The improved version of

the MMPI, the MMPI-3, which has a slightly different item pool, could correct this limitation.

The MMPI-2 uses 6 validity scales, but the Infrequency scale is significantly different between IBS patients and non-IBS patients. The F scale, defined by 60 items of the MMPI-2 test, is used to identify attempts at “faking good” or “faking bad.” High scores on this item characterize people that are trying to appear better or worse than they are. F score is higher in IBS patients than in non-IBS patients. Abnormal F score is found more often in IBS patients than non-IBS patients ($n = 22$ [17.6%] vs. $n = 17$ [7.7%]; $P = 0.009$), but there is no difference among the IBS subgroups ($P = 0.670$).

The other validity scales were not different between IBS and non-IBS patients (Table 2). The L scale was developed to detect patients that positively present themselves. Despite the mean L scores are higher than the normal range (45–55), this score was not different between IBS and non-IBS patients, nor between the different IBS phenotypes. L scores between 56 and 64, indicative of individuals who have a tendency to resort to denial mechanisms, or are more conforming than usual, was observed in 35% of IBS patients and 32% of non-IBS patients ($P = 0.425$).

The K scale measures defensiveness and assesses the willingness of the client to disclose personal information and to discuss his/her problems. The K scale is lower in IBS patients than in non-IBS patients, but it does not change with the IBS phenotypes.

In the present study, all clinical scales were different between IBS and non-IBS patients. Nevertheless, after multivariate analysis, only 2 scales remained significant: Hypochondriasis and Masculinity-Femininity.

The Supplementary Text contains the discussion of results on content, supplementary, and Harris-Lingoes scales.

Surprisingly, although all clinical scales were higher in IBS patients than in the other FGID patients, only 1 validity scale (F) and 2 clinical scales (Depression and Hypomania) varied significantly according to the IBS subtype. In a previous study using IBS subgroups clinically and not Rome III defined subgroups, it was found, contrarily to our study, only significant differences on scales K, F, and Social introversion.³³ Nevertheless, post hoc analysis revealed that for scale K, the IBS-D group scored higher than both the IBS-C and IBS-M groups. In contrast, while on scale Social introversion the pain-diarrhea group only scored higher than the pain-constipation group, but this study did not use the Rome III criteria, and did not include logistic analysis. In the present study, the different IBS

phenotypes are characterized by specific psychological profiles as compared to non-IBS patients or IBS-U patients, despite the main differences are found between IBS and non-IBS FGID patients.

The IBS-C group has higher values for the scales K, Anxiety, and lower values for the scales Schizophrenia, and Masculine gender role than non-IBS patients. These patients have a defensive approach to the test and lack of confidence. As reported in previous studies, we found in the IBS-C group, a tendency to exaggerate physical symptoms³⁴ related to a psychological need to exaggerate and complain, and increased preoccupation about one’s health. The IBS-C group also has a higher frequency of patients with abnormal Hypochondriasis scale (see Supplementary Text).

As previously found in a limited group of Iranian IBS patients,³⁵ IBS-D patients have a higher value for the Infrequency scale, in favor of overall psychopathology, resentment, or moodiness.

By comparison with the non-IBS group, IBS-M patients have lower values for the VRIN scale, the best measure of random, or inconsistent responding. They also have a lower Masculine gender role scale, as previously described in 70 non-subtyped male IBS patients,³⁶ a lower Fears scale, lower Low self-esteem scale, and a larger Psychasthenia scale. In this group, a higher frequency of patients with abnormal Hypochondriasis scores was found (see Supplementary Text). Previously, it was found that IBS-M patients reported a higher number of somatic symptoms than IBS-C and mostly IBS-D patients.³⁷ These results could explain the results of the present study.

However, as compared to the non-IBS patients, only IBS-C and IBS-M patients are associated with an increased frequency of abnormal Hypochondriasis score. The frequency of abnormal Hypochondriasis score could be associated with the high frequency of overlapping disorders in IBS patients.^{38,39}

One major limitation of the present study is that the studied population is a population referred to a tertiary center focusing on FGIDs. Consequently, the expectation would be that there would be a higher level of co-morbid psychiatric distress. The present results could not be predictive of similar findings in a community population.

The cause-effect relationship between abnormal psychological traits and IBS symptoms remains controversial. Our data and other reports illustrate that abnormal psychological profiles do exist in IBS patients seeking medical help.⁴⁰ On the other hand, Drossman et al.¹³ reported that psychological profiles in IBS nonpatients and subjects showing IBS symptoms

but never seeking medical help were not different from the psychological profiles of healthy controls. From these observations, it was proposed that abnormal psychological behaviors are closely related to IBS patients seeking medical help. However, the control population of our study was composed of FGIDs patients with the same history of chronic functional digestive disease.

This study has some clinical implications. The present results tend to associate IBS to specific psychological profile rather than to a pattern of health care seeking pattern but also shows that abnormal scales are found in only a minority of IBS patients. In consequence, the use of antidepressant drugs must be proposed to only a limited percentage of patients as well as tricyclic or selective serotonin reuptake inhibitor antidepressants.⁴¹ Besides, the difference classically performed between tricyclic antidepressants in case of diarrhea and abdominal pain, and selective serotonin reuptake inhibitor antidepressants for IBS patients with abdominal pain and constipation must be reevaluated,⁴² mainly in IBS-U patients. Thus, the tailored management of IBS patients must be the rule, including medical treatment of the predominant cardinal symptom:⁴³ constipation, diarrhea, bloating, and abdominal pain in combination with dietary and psychological interventions.

To conclude, the present study shows that IBS patients, as compared with non-IBS patients, have significant increases in all clinical MMPI scales. Furthermore, we found significant differences in the psychological profiles according to the different IBS phenotypes.

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

AUTHOR CONTRIBUTION

Conception and the design of the study: Bouchoucha M. Analysis of data: Bouchoucha M. Interpretation of the data: Bouchoucha M, Devroede G, Benamouzig R. Writing - original draft: Bouchoucha M, Devroede G, Benamouzig R. Writing - review and editing: all authors. Approval of final manuscript:

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SUPPLEMENTARY MATERIAL

Supplementary materials are available at the Intestinal Research website (<https://www.irjournal.org>).

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See “Psychological profiles of irritable bowel syndrome patients with different phenotypes” on page 459-468.

SUPPLEMENTARY TEXT

1. Description of the Additional Items

Sixty additional items are used in the Minnesota Multiphasic Personality Inventory 2 (MMPI-2): 15 content, 14 supplementary, and 31 Harris-Lingoes scales:

- The 15 content scales are Anxiety (ANX), Fears (FRS), Obsessiveness (OBS), Depression (DEP), Health concerns (HEA), Bizarre mentation (BIZ), Anger (ANG), Cynicism (CYN), Antisocial practices (ASP), Type A behavior (TPA), Low-self-esteem (LSE), Social discomfort (SOD), Family problems (FAM), Work interference (WRK), and Negative treatment indicators (TRT).
- The 14 supplementary scales are ego strength (Es), MacAndrew alcoholism revised scale (Mac-R), addiction potential scale (APS), addiction acknowledgment scale (AAS), anxiety scale (A), repression scale (R), over-controlled hostility (O-H), dominance scale (Do), social responsibility scale (Re), college maladjustment (Mt), post-traumatic stress disorder scale (PK), post-traumatic stress disorder scale (PS), masculine gender role (GM), feminine gender role (GF).
- The 31 Harris-Lingoes scales were derived for the MMPI-2, and are used for scales Depression (D), Hysteria (Hy), Psychopathic deviate (Pd), Paranoia (Pa), Schizophrenia (Sc), Hypomania (Ma) and Social introversion (Si). These scales are Subjective Depression (D1), Psychomotor retardation (D2), Physical malfunctioning (D3), Mental dullness (D4), Brooding (D5), Denial of social anxiety (Hy1), Need for affection (Hy2), Lassitude malaise (Hy3), Somatic complaints (Hy4), Inhibition of aggression (Hy5), Familial discord (Pd1), Authority problems (Pd2), Social imperturbability (Pd3), Social alienation (Pd4), Self-alienation (Pd5), Persecutory ideas (Pa1), Poignancy (Pa2), Naiveté (Pa3), Social alienation (Sc1), Emotional alienation (Sc2), Lack of ego mastery, cognitive (Sc3), Lack of ego mastery, conative (Sc4), Lack of ego mastery, defective inhibition (Sc5), Bizarre sensory experiences (Sc6), Amorality (Ma1), Psychomotor acceleration (Ma2), Imperturbability (Ma3), Ego inflation (Ma4), Shyness/Self-consciousness (Si1), Social avoidance (Si2), and Alienation-self and others (Si3).

2. Differences in T Scores on the Psychological Characteristics of IBS Patients

The results of the content, supplementary and Harris-Lingoes scales for irritable bowel syndrome (IBS) and non-IBS patients are shown in the Supplementary Table 1.

IBS patients have significantly higher scales for 10 of the 15 content scales: Anxiety (ANX, $P < 0.001$), Obsessiveness (OBS, $P = 0.001$), Depression (DEP, $P < 0.001$), Health concern (HEA, $P < 0.001$), Bizarre mentation (BIZ, $P = 0.006$), Anger (ANG, $P < 0.001$), Cynicism (CYN, $P = 0.004$), Family problems (FAM, $P < 0.001$), Work interference (WRK, $P < 0.001$) and Negative treatment indicators (TRT, $P < 0.001$). Only the Fears scale (FRS, $P = 0.071$) was not different from other functional gastrointestinal disorders (FGIDs) patients.

Among supplementary scales, IBS patients have significantly lower values for 3 items: Ego strength (Es, $P < 0.001$), Dominance scale (Do, $P = 0.002$) and Masculine gender role (GM, $P = 0.001$), and significantly higher values for 5 items: Anxiety scale (A, $P < 0.001$), College maladjustment (Mt, $P < 0.001$), Marital distress score (MDS, $P < 0.001$), and the 2 Post-traumatic stress disorder scales (PS; $P < 0.001$ and PK, $P < 0.001$).

Among the 31 Harris-Lingoes scales, 18 were higher in IBS patients: Subjective depression (D1, $P < 0.001$), Physical malfunctioning (D3, $P < 0.001$) Mental dullness (D4, $P < 0.001$), Brooding (D5, $P = 0.001$), Lassitude malaise (Hy3, $P < 0.001$), Somatic complaints (Hy4, $P < 0.001$), Social alienation (Pd4, $P = 0.001$), Self-alienation (Pd5, $P < 0.001$), Persecutory ideas (Pa1, $P = 0.001$), Poignancy (Pa2, $P < 0.001$), Social alienation (Sc1, $P < 0.001$), Emotional alienation (Sc2, $P < 0.001$), Lack of ego mastery, cognitive (Sc3, $P < 0.001$), Lack of ego mastery, conative (Sc4, $P < 0.001$), Lack of ego mastery, defective inhibition (Sc5, $P < 0.001$), Bizarre sensory experiences (Sc6, $P < 0.001$), Ego inflation (Ma4, $P = 0.003$), Alienation-self and others (Si3, $P < 0.001$).

3. Frequency of Abnormal Values

We report in Supplementary Table 2 the frequency of subjects that in IBS and non-IBS groups have scored in the abnormal range ($T > 70$). Globally, IBS patients have a higher frequency of 2 abnormal validity scales and 5 clinical scales. The results of the content, supplementary and Harris-Lingoes scales are shown in the Supplementary Table 3 and described in the fourth paragraph of the supplementary text.

Concerning validity scales, IBS patients report a significant higher abnormal scale for Infrequency scale (F, $P < 0.001$) and for Infrequency scale back (Fb, $P < 0.001$), and among clinical scales, IBS patients have a significantly higher frequency of abnormal score for 5 items: Hypochondriasis (Hs, $P < 0.001$), Depression (D, $P < 0.001$), Hysteria (Hy, $P < 0.001$), Paranoia (Pa, $P < 0.001$), and Schizophrenia (Sc, $P < 0.001$).

The logistic regression shows that IBS group is associated to a significant increased frequency of abnormal value for Infrequency scale (F; $P = 0.004$; odds ratio [OR], 1.861; 95% confidence interval [CI], 1.219–2.839) and Hypochondriasis (Hs; $P < 0.001$; OR, 2.908; 95% CI, 2.059–4.107).

4. Frequency of Abnormal Values of the Additional Items

The Supplementary Table 3 summarizes the results of this analysis. Among content scales, IBS patients have a significantly higher frequency of abnormal scales for Anxiety (ANX, $P < 0.001$), Depression (DEP, $P < 0.001$), Health concern (HEA, $P < 0.001$), Bizarre mentation (BIZ, $P = 0.007$), Cynicism (CYN, $P = 0.005$), and Work interference (WRK, $P < 0.001$).

IBS patients also report a significantly higher frequency of abnormal scales for 5 supplementary scales: Addiction acknowledgment scale (APS, $P = 0.004$), Anxiety scale (A, $P < 0.001$), College maladjustment (Mt, $P = 0.007$), and the 2 Post-traumatic stress disorder scales (PK, $P = 0.001$ and PS, $P < 0.001$).

Among the Harris-Lingoes scales, IBS patients report a higher frequency of abnormal scales for Subjective depression (D1, $P < 0.001$), Physical malfunctioning (D3, $P < 0.001$), Mental dullness (D4, $P < 0.001$), Brooding (D5, $P = 0.007$), Lassitude malaise (Hy3, $P < 0.001$), Somatic complaints (Hy4, $P < 0.001$), Social alienation (Pd4, $P = 0.001$), Self-alienation (Sc2, $P = 0.001$), Persecutory ideas (Pa1, $P < 0.001$), Poignancy (Pa2, $P < 0.001$), Social alienation (Pd4, $P = 0.007$), Emotional alienation (Sc2, $P = 0.001$), Lack of ego mastery, cognitive (Sc3, $P = 0.001$), Lack of ego mastery, conative (Sc4, $P < 0.001$), Lack of ego mastery, defective inhibition (Sc5, $P < 0.001$), Bizarre sensory experiences (Sc6, $P < 0.001$), and Alienation-self and others (Si3, $P = 0.006$).

5. Psychological Characteristics of IBS Subtypes Patients

The results of the content, supplementary and Harris-Lingoes scales among IBS patients are shown in the Supplementary Table 4.

The analysis showed significant differences for one content scale, Cynicism (CYN, $P = 0.009$), 6 supplementary scales, Ego strength (Es, $P = 0.002$), Dominance (Do, $P = 0.003$), College maladjustment (Mt, $P < 0.001$), Post-traumatic stress disorder (PK, $P = 0.005$ and PS, $P = 0.009$), Masculine gender role (GM, $P = 0.009$) and 18 Harris-Lingoes scales: 4 subscales of depression (D1, $P < 0.001$; D3, $P < 0.001$; D4, $P < 0.001$; and D5, $P = 0.001$), 2 subscales of Hysteria (Hy3 and Hy4, $P < 0.001$ for each item), 2 subscales of Psychopathic deviate (Pd4 and Pd5, $P < 0.001$ for each), 2 subscales of Paranoia (Pa1, $P = 0.001$ and Pa2, $P < 0.001$), all 6 subscales of Schizophrenia ($P < 0.001$ for all items), 1 subscale of Hypomania (Ma4, $P = 0.001$) and 1 subscale of social introversion (Si3, $P < 0.001$).

As shown in the Supplementary Table 4, abnormal scales ($T > 70$) are found in 3 supplementary scales: College Maladjustment (Mt, $P = 0.002$), and the 2 Post-Traumatic Stress Disorder scales PK ($P = 0.001$) and PS ($P = 0.002$), and 2 of the 31 Harris-Lingoes scales: Physical malfunctioning (D3, $P < 0.001$) and Lack of ego mastery, cognitive (Sc3, $P = 0.003$).

6. Frequency of Abnormal Values in the Different IBS Subtypes

Supplementary Table 5 shows the frequency of subjects in each IBS subgroup with validity and clinical scales in the abnormal range ($T > 70$). Supplementary Table 6 shows the frequency of abnormal content, supplementary, and Harris-Lingoes MMPI scales according to the IBS phenotypes.

Differences in the frequency of abnormal scales are found in only 2 clinical scales (Supplementary Table 5): Paranoia (Pa, $P < 0.006$), and Schizophrenia (Sc, $P = 0.001$).

7. Discussion of the Content, Supplementary and Harris-Lingoes Scales

Classically, patients suffering from IBS who ask for medical help because of their intestinal symptoms, present emotional problems such as depression and anxiety and have a neurotic personality.^{1,2} Our findings agree with previous studies conducted among patients inferring that IBS patients tend to have more neurotic and depressed personalities than normal subjects.^{2,3}

By comparison to other FGIDs patients, the elevated depression and hysteria scales indicate a personality background characterized by severe emotional disturbance involving low self-esteem, lack of self-confidence, and somatic over-concern. The elevated paranoia scale indicates that IBS patients tend to be more suspicious, oversensitive, and even more negative in their attitudes towards people.

In IBS patients, the increase of hysteria,³⁻⁵ Masculinity-Femininity,⁶ and paranoia^{3,5} scales were previously described, but these increases were noted by comparison to healthy controls. Our results indicate that the increase of these 3 scales is mainly associated with IBS in FGIDs patients. Other scales found significant after univariate analysis were also described in IBS patients: Hypochondriasis,^{4,5,7} Depression,^{1,3-5,7,8} Psychasthenia,⁹ Schizophrenia,^{10,11} and Hypomania.⁷ Nevertheless, only Hypochondriasis remains significant after multivariate analysis in the present study. The high level of hypochondriasis associated with the high frequency of abnormal score for this item tends to use hypochondriasis as an important psychological factor in IBS patients. This factor was previously characterized as a risk factor for post-infectious IBS,^{12,13} and associated with severe symptoms.¹⁴

The analysis of content, supplementary, and Harris-Lingoes scales shows that by comparison to non-IBS patients, Anxiety, and Health concern only remain significantly higher in IBS patients after multivariate analysis.

High anxiety level is frequently reported in IBS patients^{1,5,8,15,16} whatever the used test (State and Trait anxiety, Hospital Anxiety, and Depression Scale). In the MMPI-2 test, high anxiety is associated with tension, worry, fears of losing one's mind, lack of confidence, and somatic indications of anxiety such as heart pounding, shortness of breath, and disturbed sleep.¹⁷ High Health concern scale is frequently associated with gastrointestinal symptoms, neurological symptoms, sensory problems, dermatological problems, pain, and respiratory problems.¹⁷

Health concern was also found high in patients with chronic headache,^{18,19} in patients with inflammatory bowel diseases²⁰ and IBS patients, in those that report severe symptoms,²¹ poor quality of life,²² and food-related symptoms.²³

Three scales (Ego strength, Dominance scale, Masculine gender role) were lower in IBS patients. However, these changes were not confirmed after multivariate analysis. It was shown previously that Masculine gender scale correlated with psychological well-being,²⁴ and that Masculine gender scale and Feminine gender scale are more related to personality traits of interpersonal potency and sensitivity, respectively than to masculinity and femininity.²⁵ In previous studies, psychosocial adaptation to cancer was related to a patient's ego strength, Ego strength scale correlating positively with a patient's use of effective coping strategies.²⁶ Similarly, weakened ego strength was closely associated with several forms of psychological distress, especially depressive symptoms in patients with multiple sclerosis.²⁷

On the 31 Harris-Limoges scales, 17 were significantly higher in IBS patients, but only one scale, Shyness/Self-consciousness, remain significantly lower after multivariate analysis. This Social Introversion subscale was found as a risk factor for anorexia nervosa/purging type.²⁸ It was shown that the combined Shyness/Self-Consciousness (Si1) and Social Avoidance (Si2) subscales correlated highly with Social Discomfort and are apparent measures of the social introversion construct.

Concerning abnormal values, IBS was associated with 3 Harris-Limoges scales: an increase of abnormal Poignancy, a Paranoia subscale, an increase of abnormal Lack of ego mastery, conative, a Schizophrenia subscale. Poignancy is the depressive component of the Paranoia scale. The items connote excessive emotional sensitivity or vulnerability. Similarly, high value for Lack of ego mastery, conative is in favor of depression, difficulty coping, inertia, regression into fantasy, and pessimism.

It should be noted that the mean T scores of our IBS patients on the Hypochondriasis, Depression, and Hysteria scales were significantly higher from a statistical point of view than those of other FGID's controls. However, their mean T scores were not above 70 and, therefore, not clinically significant. A group of IBS patients can have psychological conditions on the average that are not psychiatrically significant, yet display similar colonic motor and myoelectric behavior in stress and rest to IBS patients in other studies with psychiatrically significant conditions.⁴ Our data support our belief that the psychiatric condition of IBS patients may be an important factor in the clinical expression of IBS,⁴ but no significant correlation was found between cholinergic innervation and MMPI scales in a study on 40 Rome I IBS patients.³

Another concern is that there is no assessment of IBS or FGID severity, quality of life, or other factors that might affect the MMPI results. IBS patients with more severe pain could score more abnormally on MMPI, and despite IBS patients are a chronic pain population, those with milder symptoms could have more marked psychological abnormalities. Some specific tests were used to assess the IBS severity (e.g., IBS-quality of life,²⁹⁻³¹ IBS-symptom severity score³²). Change of IBS symptom and severity is well known.³³⁻³⁶ The MMPI-2 was conceptualized to be a measure of longstanding traits, and to be robust to changes over time. The day to day variation of IBS severity^{34,35} have a low influence on the MMPI scales.³⁷

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Supplementary Table 1. MMPI Content, Supplementary and Harris-Lingoes Scales in IBS and Non-IBS Patients

Scale	All FGIDs patients	IBS patients	Non-IBS patients	P-value
Content scales				
Anxiety (ANX)	55.1 ± 12.4	58.4 ± 12.3	53.0 ± 12.0	< 0.001
Fears (FRS)	56.6 ± 12.3	57.7 ± 12.7	55.9 ± 12.0	0.082
Obsessiveness (OBS)	54.1 ± 12.5	56.2 ± 12.5	52.7 ± 12.3	0.001
Depression (DEP)	55.0 ± 12.5	57.9 ± 12.9	53.2 ± 11.8	< 0.001
Health concern (HEA)	65.9 ± 13.5	71.5 ± 12.4	62.4 ± 13.0	< 0.001
Bizarre mentation (BIZ)	55.0 ± 14.7	57.1 ± 16.0	53.7 ± 13.6	0.006
Anger (ANG)	50.8 ± 10.6	52.7 ± 11.0	49.6 ± 10.1	< 0.001
Cynicism (CYN)	55.8 ± 12.4	57.7 ± 13.0	54.7 ± 11.9	0.004
Antisocial practices (ASP)	52.0 ± 10.6	53.1 ± 11.1	51.3 ± 10.2	0.033
Type A behaviors (TPA)	52.0 ± 11.2	53.3 ± 11.4	51.3 ± 11.1	0.031
Low self-esteem (LES)	53.1 ± 12.4	54.5 ± 13.2	52.2 ± 11.8	0.022
Social discomfort (SOD)	53.2 ± 10.6	54.3 ± 11.1	52.5 ± 10.2	0.039
Family problems (FAM)	53.3 ± 12.0	56.0 ± 12.3	51.6 ± 11.5	< 0.001
Work interference (WRK)	55.1 ± 12.4	58.0 ± 12.7	53.3 ± 11.9	< 0.001
Negative treatment indicators (TRT)	56.5 ± 13.6	59.0 ± 14.2	54.9 ± 12.9	< 0.001
Supplementary scales				
Ego strength (Es)	41.0 ± 9.6	38.4 ± 8.8	42.7 ± 9.7	< 0.001
MacAndrew alcoholism revised scale (Mac-R)	51.0 ± 10.2	51.5 ± 11.4	50.8 ± 9.4	0.411
Addiction potential scale (APS)	46.1 ± 9.6	47.2 ± 10.3	45.5 ± 9.1	0.033
Addiction acknowledgment scale (AAS)	50.9 ± 13.2	52.5 ± 14.8	50.0 ± 12.1	0.022
Anxiety scale (A)	56.8 ± 12.1	60.3 ± 12.0	54.5 ± 11.6	< 0.001
Repression scale (R)	53.9 ± 10.4	53.9 ± 10.5	53.9 ± 10.4	0.943
Overcontrolled hostility (O-H)	52.2 ± 10.7	52.6 ± 10.6	52.0 ± 10.7	0.499
Dominance scale (Do)	45.4 ± 9.8	43.9 ± 9.9	46.4 ± 9.6	0.002
Social responsibility scale (Re)	49.9 ± 10.4	49.1 ± 11.2	50.5 ± 9.9	0.114
College maladjustment (Mt)	57.6 ± 12.4	61.6 ± 12.5	55.1 ± 11.6	< 0.001
Marital distress score (MDS)	55.5 ± 13.5	58.3 ± 14.2	53.8 ± 12.8	< 0.001
Post-traumatic stress disorder scale (PK)	56.5 ± 13.2	60.0 ± 13.2	54.4 ± 12.8	< 0.001
Post-traumatic stress disorder scale (PS)	57.4 ± 13.4	61.2 ± 13.6	55.1 ± 12.7	< 0.001
Masculine gender role (GM)	44.4 ± 9.7	42.8 ± 9.2	45.5 ± 9.9	0.001
Feminine gender role (GF)	49.2 ± 10.5	48.3 ± 10.9	49.8 ± 10.3	0.085
Harris-Lingoes scales				
Subjective depression (D1)	58.3 ± 12.1	61.4 ± 12.3	56.3 ± 11.6	< 0.001
Psychomotor retardation (D2)	53.9 ± 9.8	54.5 ± 9.8	53.5 ± 9.8	0.193
Physical malfunctioning (D3)	63.4 ± 12.8	67.4 ± 12.9	60.9 ± 12.1	< 0.001
Mental dullness (D4)	56.3 ± 13.1	59.5 ± 13.2	54.2 ± 12.7	< 0.001
Brooding (D5)	53.9 ± 11.6	55.8 ± 11.7	52.7 ± 11.4	0.001
Denial of social anxiety (Hy1)	48.6 ± 9.6	48.1 ± 10.0	48.9 ± 9.3	0.293
Need for affection (Hy2)	46.2 ± 10.1	45.6 ± 10.1	46.5 ± 10.1	0.303
Lassitude malaise (Hy3)	62.5 ± 13.5	67.3 ± 13.3	59.5 ± 12.8	< 0.001

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Supplementary Table 1. Continued

Scale	All FGIDs patients	IBS patients	Non-IBS patients	P-value
Somatic complaints (Hy4)	61.2 ± 12.7	65.1 ± 12.6	58.7 ± 12.2	< 0.001
Inhibition of aggression (Hy5)	50.9 ± 10.3	50.5 ± 10.6	51.1 ± 10.1	0.497
Familial discord (Pd1)	51.6 ± 11.1	52.9 ± 11.1	50.8 ± 11.1	0.023
Authority problems (Pd2)	48.6 ± 10.0	48.9 ± 10.2	48.4 ± 9.8	0.554
Social imperturbability (Pd3)	48.0 ± 9.6	47.6 ± 9.8	48.3 ± 9.5	0.363
Social alienation (Pd4)	55.1 ± 13.2	57.3 ± 14.1	53.6 ± 12.5	0.001
Self-alienation (Pd5)	53.2 ± 12.7	55.7 ± 13.2	51.6 ± 12.0	< 0.001
Persecutory ideas (Pa1)	59.4 ± 16.8	62.3 ± 18.8	57.5 ± 15.2	0.001
Poignancy (Pa2)	54.2 ± 11.7	57.0 ± 12.8	52.4 ± 10.6	< 0.001
Naiveté (Pa3)	46.8 ± 9.9	46.5 ± 9.9	47.1 ± 9.9	0.469
Social alienation (Sc1)	55.4 ± 13.8	57.9 ± 14.5	53.8 ± 13.1	< 0.001
Emotional alienation (Sc2)	54.7 ± 13.9	57.6 ± 15.3	52.8 ± 12.6	< 0.001
Lack of ego mastery, cognitive (Sc3)	55.7 ± 14.1	59.3 ± 14.6	53.3 ± 13.2	< 0.001
Lack of ego mastery, conative (Sc4)	55.2 ± 13.8	58.9 ± 14.8	52.8 ± 12.6	< 0.001
Lack of ego mastery, defective inhibition (Sc5)	52.0 ± 12.4	54.6 ± 13.2	50.4 ± 11.6	< 0.001
Bizarre sensory experiences (Sc6)	58.5 ± 14.6	62.5 ± 15.2	55.9 ± 13.7	< 0.001
Amorality (Ma1)	50.6 ± 9.7	51.2 ± 10.0	50.3 ± 9.6	0.281
Psychomotor acceleration (Ma2)	47.9 ± 10.0	49.1 ± 10.0	47.2 ± 9.9	0.022
Imperturbability (Ma3)	48.9 ± 10.1	49.1 ± 10.4	48.8 ± 10.0	0.712
Ego inflation (Ma4)	53.1 ± 11.4	54.8 ± 11.7	52.0 ± 11.2	0.003
Shyness/self-consciousness (Si1)	51.8 ± 9.5	51.8 ± 10.0	51.8 ± 9.3	0.943
Social avoidance (Si2)	52.9 ± 10.2	54.2 ± 10.3	52.1 ± 10.0	0.013
Alienation-self and others (Si3)	56.2 ± 12.5	58.4 ± 12.8	54.8 ± 12.2	< 0.001

Value are presented as mean ± standard deviation.

MMPI, Minnesota Multiphasic Personality Inventory; IBS, Irritable bowel syndrome; FGID, functional gastrointestinal disorder.

Supplementary Table 2. Frequency of Abnormal MMPI Scales in IBS and Non-IBS Patients

Scale	All FGIDs patients	IBS patients	Non-IBS patients	P-value
Validity scales				
L scale	78 (13)	34 (14)	44 (12)	0.201
Infrequency scale (F)	120 (20)	66 (28)	54 (14)	<0.001
Infrequency scale back (Fb)	115 (19)	60 (26)	55 (15)	<0.001
K scale	18 (3)	7 (3)	11 (3)	0.582
TRIN	69 (11)	33 (14)	36 (10)	0.064
VRIN	64 (11)	25 (11)	39 (10)	0.522
Clinical scales				
1 Hypochondriasis (Hs)	261 (43)	141 (60)	120 (32)	<0.001
2 Depression (D)	149 (25)	77 (33)	72 (19)	<0.001
3 Hysteria (Hy)	145 (24)	82 (35)	63 (17)	<0.001
4 Psychopathic deviate (Pd)	59 (10)	28 (12)	31 (8)	0.094
5 Masculinity-Femininity (Mf)	49 (8)	22 (9)	27 (7)	0.216
6 Paranoia (Pa)	89 (15)	50 (21)	39 (10)	<0.001
7 Psychasthenia (Pt)	95 (16)	46 (20)	49 (13)	0.023
8 Schizophrenia (Sc)	103 (17)	55 (23)	48 (13)	<0.001
9 Hypomania (Ma)	46 (8)	25 (11)	21 (6)	0.018
10 Social introversion (Si)	51 (8)	23 (10)	28 (8)	0.200

Values are presented as number (%).

MMPI, Minnesota Multiphasic Personality Inventory; IBS, Irritable bowel syndrome; FGID, functional gastrointestinal disorder; TRIN, true response inconsistency; VRIN, variable response inconsistency.

Supplementary Table 3. Frequency of Abnormal MMPI Content, Supplementary and Harris-Lingoes Scales in IBS and Non-IBS Patients

Scale	All FGIDs patients	IBS patients	Non-IBS patients	P-value
Content scales				
Anxiety (ANX)	94 (15)	51 (22)	43 (12)	<0.001
Fears (FRS)	91 (15)	42 (18)	49 (13)	0.071
Obsessiveness (OBS)	81 (13)	39 (17)	42 (11)	0.040
Depression (DEP)	78 (13)	45 (19)	33 (9)	<0.001
Health concern (HEA)	222 (37)	127 (54)	95 (25)	<0.001
Bizarre mentation (BIZ)	81 (13)	42 (18)	39 (10)	0.007
Anger (ANG)	32 (5)	15 (6)	17 (5)	0.212
Cynicism (CYN)	117 (19)	58 (25)	59 (16)	0.005
Antisocial practices (ASP)	51 (8)	23 (10)	28 (8)	0.200
Type A behaviors (TPA)	58 (10)	27 (11)	31 (8)	0.124
Low self-esteem (LES)	59 (10)	26 (11)	33 (9)	0.223
Social discomfort (SOD)	50 (8)	26 (11)	24 (6)	0.032
Family problems (FAM)	60 (10)	30 (13)	30 (8)	0.040
Work interference (WRK)	88 (14)	48 (20)	40 (11)	<0.001
Negative treatment indicators (TRT)	104 (17)	51 (22)	53 (14)	0.012
Supplementary scales				
Ego strength (Es)	0	0	0	-
MacAndrew alcoholism revised scale (Mac-R)	33 (5)	20 (9)	13 (3)	0.007
Addiction potential scale (APS)	7 (1)	5 (2)	2 (1)	0.083
Addiction acknowledgment scale (AAS)	45 (7)	25 (11)	20 (5)	0.013
Anxiety scale (A)	112 (18)	60 (26)	52 (14)	<0.001
Repression scale (R)	38 (6)	13 (6)	25 (7)	0.345
Overcontrolled hostility (O-H)	41 (7)	16 (7)	25 (7)	0.541
Dominance scale (Do)	3 (0)	0	3 (1)	0.230
Social responsibility scale (Re)	6 (1)	3 (1)	3 (1)	0.428
College maladjustment (Mt)	113 (19)	65 (28)	48 (13)	<0.001
Marital distress score (MDS)	108 (18)	54 (23)	54 (14)	0.006
Post-traumatic stress disorder scale (PK)	100 (16)	55 (23)	45 (12)	<0.001
Post-traumatic stress disorder scale (PS)	105 (17)	59 (25)	46 (12)	<0.001
Masculine gender role (GM)	2 (0)	1 (0)	1 (0)	0.624
Feminine gender role (GF)	15 (2)	7 (3)	8 (2)	0.347
Harris-Lingoes scales				
Subjective depression (D1)	118 (19)	53 (14)	65 (28)	<0.001
Psychomotor retardation (D2)	44 (7)	25 (7)	19 (8)	0.313
Physical malfunctioning (D3)	203 (33)	95 (25)	108 (46)	<0.001
Mental dullness (D4)	103 (17)	43 (12)	60 (26)	<0.001
Brooding (D5)	61 (10)	28 (8)	33 (14)	0.007
Denial of social anxiety (Hy1)	0	0	0	-
Need for affection (Hy2)	6 (1)	4 (1)	2 (1)	0.572
Lassitude malaise (Hy3)	167 (27)	72 (19)	95 (40)	<0.001

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Supplementary Table 3. Continued

Scale	All FGIDs patients	IBS patients	Non-IBS patients	P-value
Somatic complaints (Hy4)	174 (29)	75 (20)	99 (42)	<0.001
Inhibition of aggression (Hy5)	4 (1)	2 (1)	2 (1)	0.502
Familial discord (Pd1)	55 (9)	31 (8)	24 (10)	0.256
Authority problems (Pd2)	19 (3)	11 (3)	8 (3)	0.463
Social imperturbability (Pd3)	0	0	0	-
Social alienation (Pd4)	76 (13)	33 (9)	43 (18)	0.001
Self-alienation (Pd5)	57 (9)	23 (6)	34 (14)	0.001
Persecutory ideas (Pa1)	133 (22)	64 (17)	69 (29)	<0.001
Poignancy (Pa2)	69 (11)	27 (7)	42 (18)	<0.001
Naiveté (Pa3)	18 (3)	11 (3)	7 (3)	0.582
Social alienation (Sc1)	97 (16)	48 (13)	49 (21)	0.007
Emotional alienation (Sc2)	102 (17)	48 (13)	54 (23)	0.001
Lack of ego mastery, cognitive (Sc3)	102 (17)	48 (13)	54 (23)	0.001
Lack of ego mastery, conative (Sc4)	105 (17)	39 (10)	66 (28)	<0.001
Lack of ego mastery, defective inhibition (Sc5)	63 (10)	27 (7)	36 (15)	0.001
Bizarre sensory experiences (Sc6)	130 (21)	56 (15)	74 (31)	<0.001
Amorality (Ma1)	13 (2)	8 (2)	5 (2)	0.615
Psychomotor acceleration (Ma2)	8 (1)	5 (1)	3 (1)	0.626
Imperturbability (Ma3)	7 (1)	4 (1)	3 (1)	0.551
Ego inflation (Ma4)	43 (7)	25 (7)	18 (8)	0.384
Shyness/self-consciousness (Si1)	24 (4)	15 (4)	9 (4)	0.544
Social avoidance (Si2)	37 (6)	18 (5)	19 (8)	0.073
Alienation-self and others (Si3)	101 (17)	50 (13)	51 (22)	0.006

Value are presented as number (%).

MMPI, Minnesota Multiphasic Personality Inventory; IBS, Irritable bowel syndrome; FGID, functional gastrointestinal disorder.

Supplementary Table 4. MMPI Content, Supplementary and Harris-Lingoes Scales of IBS Subtypes Patients

Variable	IBS-C	IBS-D	IBS-M	IBS-U	P-value
Content scales					
Anxiety (ANX)	57.4 ± 12.2	57.5 ± 11.3	62.6 ± 11.2	55.9 ± 14.6	0.031
Fears (FRS)	56.1 ± 12.0	59.0 ± 14.0	59.0 ± 11.1	56.8 ± 14.1	0.439
Obsessiveness (OBS)	55.3 ± 12.3	54.4 ± 11.8	60.8 ± 12.9	54.9 ± 12.3	0.020
Depression (DEP)	55.9 ± 12.6	57.9 ± 12.4	62.5 ± 11.9	55.0 ± 14.7	0.013
Health concern (HEA)	70.9 ± 12.4	70.7 ± 11.4	75.7 ± 11.6	68.1 ± 14.4	0.025
Bizarre mentation (BIZ)	55.7 ± 16.0	55.7 ± 15.5	62.4 ± 12.8	54.7 ± 19.7	0.050
Anger (ANG)	51.0 ± 9.7	51.7 ± 10.9	56.4 ± 12.1	53.0 ± 10.8	0.033
Cynicism (CYN)	58.4 ± 13.1	54.7 ± 11.4	62.0 ± 13.2	54.9 ± 13.5	0.009
Antisocial practices (ASP)	52.6 ± 11.6	52.1 ± 10.3	57.0 ± 10.9	50.4 ± 11.1	0.025
Type A behaviors (TPA)	53.1 ± 11.9	51.1 ± 9.7	57.2 ± 12.5	52.1 ± 10.6	0.024
Low self-esteem (LES)	54.4 ± 13.1	54.5 ± 11.7	56.0 ± 12.8	52.5 ± 16.3	0.664
Social discomfort (SOD)	53.0 ± 10.1	55.4 ± 11.5	55.4 ± 11.8	53.1 ± 11.8	0.462
Family problems (FAM)	54.6 ± 11.3	55.4 ± 13.4	58.9 ± 11.1	55.4 ± 13.7	0.245
Work interference (WRK)	57.4 ± 12.6	56.8 ± 11.4	62.1 ± 12.2	55.1 ± 14.6	0.035
Negative treatment indicators (TRT)	58.3 ± 14.0	57.4 ± 13.2	63.4 ± 13.2	56.9 ± 16.8	0.074
Supplementary scales					
Ego strength (Es)	39.6 ± 8.7	38.4 ± 8.2	34.6 ± 7.7	41.3 ± 10.2	0.002
MacAndrew alcoholism revised scale (Mac-R)	51.5 ± 11.0	48.9 ± 11.0	55.3 ± 12.8	50.4 ± 9.7	0.020
Addiction potential scale (APS)	46.9 ± 10.2	46.3 ± 9.8	48.7 ± 11.3	47.1 ± 10.1	0.628
Addiction acknowledgment scale (AAS)	49.1 ± 11.3	54.3 ± 17.6	56.2 ± 13.6	50.8 ± 16.1	0.029
Anxiety scale (A)	59.7 ± 11.3	60.3 ± 11.2	64.1 ± 11.5	56.1 ± 14.3	0.019
Repression scale (R)	53.6 ± 11.4	55.2 ± 8.9	52.8 ± 10.6	53.6 ± 11.3	0.613
Overcontrolled hostility (O-H)	52.4 ± 11.0	53.2 ± 10.6	52.0 ± 10.0	52.5 ± 11.0	0.935
Dominance scale (Do)	43.6 ± 9.8	45.7 ± 8.4	40.1 ± 9.5	46.8 ± 11.9	0.003
Social responsibility scale (Re)	50.5 ± 10.2	50.4 ± 10.7	44.6 ± 12.1	50.4 ± 11.5	0.010
College maladjustment (Mt)	60.4 ± 11.2	59.8 ± 11.7	68.0 ± 12.9	58.0 ± 13.2	< 0.001
Marital distress score (MDS)	56.1 ± 12.9	57.6 ± 14.5	62.5 ± 14.6	57.8 ± 14.8	0.078
Post-traumatic stress disorder scale (PK)	58.3 ± 12.5	58.8 ± 12.5	65.5 ± 12.7	57.5 ± 14.8	0.005
Post-traumatic stress disorder scale (PS)	59.6 ± 13.0	60.4 ± 12.7	66.5 ± 13.4	58.1 ± 15.1	0.009
Masculine gender role (GM)	42.8 ± 8.6	43.3 ± 9.1	39.7 ± 8.0	46.3 ± 11.4	0.009
Feminine gender role (GF)	49.2 ± 11.3	49.1 ± 10.0	45.6 ± 11.4	48.7 ± 10.4	0.230
Harris-Lingoes scales					
Subjective depression (D1)	59.3 ± 11.2	62.1 ± 11.3	65.4 ± 12.6	58.4 ± 14.1	< 0.001
Psychomotor retardation (D2)	54.4 ± 8.4	56.8 ± 8.4	53.1 ± 11.6	52.5 ± 11.7	0.087
Physical malfunctioning (D3)	69.8 ± 12.3	65.3 ± 11.9	71.5 ± 13.0	60.6 ± 13.1	< 0.001
Mental dullness (D4)	57.4 ± 12.8	59.2 ± 12.5	63.8 ± 13.1	58.5 ± 14.7	< 0.001
Brooding (D5)	53.5 ± 11.4	56.4 ± 11.1	59.4 ± 11.1	54.3 ± 13.4	0.001
Denial of social anxiety (Hy1)	48.5 ± 9.6	47.4 ± 10.2	47.0 ± 10.0	49.9 ± 10.8	0.455
Need for affection (Hy2)	45.1 ± 10.2	47.2 ± 10.5	43.5 ± 8.8	47.1 ± 10.5	0.179
Lassitude malaise (Hy3)	66.0 ± 12.7	67.1 ± 13.0	71.8 ± 14.1	63.8 ± 12.7	< 0.001

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Supplementary Table 4. Continued

Variable	IBS-C	IBS-D	IBS-M	IBS-U	P-value
Somatic complaints (Hy4)	63.9 ± 12.0	66.1 ± 12.4	68.4 ± 11.8	60.8 ± 14.0	<0.001
Inhibition of aggression (Hy5)	51.5 ± 10.8	51.1 ± 10.0	49.5 ± 12.3	49.0 ± 8.3	0.630
Familial discord (Pd1)	52.1 ± 10.4	52.3 ± 11.6	53.9 ± 9.9	54.1 ± 13.2	0.154
Authority problems (Pd2)	46.0 ± 8.3	50.3 ± 11.2	50.8 ± 11.2	49.6 ± 9.3	0.037
Social imperturbability (Pd3)	47.9 ± 8.5	47.0 ± 9.9	46.7 ± 11.1	49.3 ± 10.4	0.599
Social alienation (Pd4)	55.7 ± 14.5	55.9 ± 13.3	62.2 ± 13.5	56.1 ± 14.3	<0.001
Self-alienation (Pd5)	54.7 ± 13.4	53.3 ± 11.8	61.3 ± 13.6	54.3 ± 13.1	<0.001
Persecutory ideas (Pa1)	61.4 ± 18.9	60.8 ± 17.1	67.5 ± 18.3	59.3 ± 21.6	0.001
Poignancy (Pa2)	55.5 ± 11.7	56.7 ± 12.2	62.1 ± 13.6	53.3 ± 13.4	<0.001
Naiveté (Pa3)	45.6 ± 9.6	47.0 ± 9.7	45.2 ± 10.0	49.1 ± 10.3	0.302
Social alienation (Sc1)	45.6 ± 9.6	47.0 ± 9.7	45.2 ± 10.0	49.1 ± 10.3	<0.001
Emotional alienation (Sc2)	55.0 ± 11.8	57.0 ± 17.8	62.1 ± 14.5	57.7 ± 17.2	<0.001
Lack of ego mastery, cognitive (Sc3)	58.2 ± 13.8	57.8 ± 13.1	64.4 ± 15.8	56.9 ± 15.6	<0.001
Lack of ego mastery, conative (Sc4)	57.5 ± 12.7	57.1 ± 14.9	64.8 ± 16.0	56.8 ± 14.9	<0.001
Lack of ego mastery, defective inhibition (Sc5)	53.6 ± 13.5	53.5 ± 12.7	59.0 ± 11.4	52.2 ± 15.0	<0.001
Bizarre sensory experiences (Sc6)	61.4 ± 13.9	60.4 ± 13.8	69.4 ± 15.2	58.6 ± 17.5	<0.001
Amorality (Ma1)	51.5 ± 9.4	51.3 ± 11.6	51.6 ± 8.8	49.6 ± 9.7	0.690
Psychomotor acceleration (Ma2)	50.2 ± 9.5	47.1 ± 10.0	50.6 ± 10.5	48.2 ± 9.8	0.035
Imperturbability (Ma3)	49.7 ± 10.7	47.8 ± 11.1	49.0 ± 8.8	50.7 ± 10.8	0.679
Ego inflation (Ma4)	53.5 ± 11.5	53.0 ± 11.3	59.1 ± 10.9	54.4 ± 12.9	0.001
Shyness/Self-consciousness (Si1)	50.9 ± 9.7	52.7 ± 9.6	52.2 ± 10.0	51.0 ± 11.4	0.810
Social avoidance (Si2)	52.8 ± 8.8	56.3 ± 11.2	54.5 ± 11.1	52.7 ± 10.3	0.022
Alienation-self and others (Si3)	57.6 ± 12.9	57.2 ± 11.5	62.8 ± 13.1	56.0 ± 13.7	<0.001

Value are presented as mean ± standard deviation.

MMPI, Minnesota Multiphasic Personality Inventory; IBS, Irritable bowel syndrome; IBS-C, IBS-constipation; IBS-D, IBS-diarrhea; IBS-M, mixed IBS; IBS-U, IBS-unspecified.

Supplementary Table 5. Frequency of Abnormal MMPI Validity and Clinical Scales in IBS Phenotypes

Scale	IBS-C	IBS-D	IBS-M	IBS-U	P-value
Validity scales					
L scale	16 (21)	11 (16)	3 (6)	4 (11)	0.092
Infrequency scale (F)	19 (25)	19 (28)	22 (41)	6 (17)	0.070
Infrequency back (Fb)	17 (22)	16 (24)	22 (41)	5 (14)	0.021
K scale	2 (3)	1 (1)	2 (4)	2 (6)	0.682
TRIN	13 (17)	5 (7)	11 (20)	4 (11)	0.166
VRIN	10 (13)	10 (15)	2 (4)	3 (8)	0.207
Clinical scales					
1 Hypochondriasis (Hs)	48 (62)	37 (54)	38 (70)	18 (50)	0.173
2 Depression (D)	20 (26)	23 (34)	25 (46)	9 (25)	0.068
3 Hysteria (Hy)	27 (35)	24 (35)	22 (41)	9 (25)	0.499
4 Psychopathic deviate (Pd)	6 (8)	7 (10)	12 (22)	3 (8)	0.062
5 Masculinity-Femininity (Mf)	8 (10)	7 (10)	5 (9)	2 (6)	0.854
6 Paranoia (Pa)	9 (12)	14 (21)	20 (37)	7 (19)	0.006
7 Psychasthenia (Pt)	14 (18)	12 (18)	14 (26)	6 (17)	0.608
8 Schizophrenia (Sc)	14 (18)	12 (18)	24 (44)	5 (14)	0.001
9 Hypomania (Ma)	7 (9)	6 (9)	9 (17)	3 (8)	0.441
10 Social introversion (Si)	5 (6)	7 (10)	7 (13)	4 (11)	0.647

Values are presented as number (%).

MMPI, Minnesota Multiphasic Personality Inventory; IBS, Irritable bowel syndrome; IBS-C, IBS-constipation; IBS-D, IBS-diarrhea; IBS-M, mixed IBS; IBS-U, IBS-unspecified; TRIN, true response inconsistency; VRIN, variable response inconsistency.

Supplementary Table 6. Frequency of Abnormal MMPI Content, Supplementary and Harris-Lingoes Scales According to IBS Phenotypes

Scale	IBS-C	IBS-D	IBS-M	IBS-U	P-value
Content scales					
Anxiety (ANX)	18 (23)	18 (26)	19 (35)	5 (14)	0.143
Fears (FRS)	13 (17)	16 (24)	7 (13)	6 (17)	0.483
Obsessiveness (OBS)	11 (14)	7 (10)	16 (30)	5 (14)	0.028
Depression (DEP)	12 (16)	11 (16)	16 (30)	6 (17)	0.172
Health concern (HEA)	39 (51)	35 (51)	38 (70)	15 (42)	0.036
Bizarre mentation (BIZ)	10 (13)	11 (16)	16 (30)	5 (14)	0.076
Anger (ANG)	3 (4)	4 (6)	6 (11)	2 (6)	0.409
Cynicism (CYN)	21 (27)	10 (15)	21 (39)	6 (17)	0.012
Antisocial practices (ASP)	8 (10)	4 (6)	8 (15)	3 (8)	0.417
Type A behaviors (TPA)	8 (10)	5 (7)	11 (20)	3 (8)	0.123
Low self-esteem (LES)	10 (13)	4 (6)	7 (13)	5 (14)	0.451
Social discomfort (SOD)	3 (4)	12 (18)	8 (15)	3 (8)	0.045
Family problems (FAM)	5 (6)	12 (18)	8 (15)	5 (14)	0.220
Work interference (WRK)	14 (18)	12 (18)	17 (31)	5 (14)	0.135
Negative treatment indicators (TRT)	13 (17)	12 (18)	20 (37)	6 (17)	0.021
Supplementary scales					
Ego strength (Es)	0	0	0	0	-
MacAndrew alcoholism revised scale (Mac-R)	7 (9)	3 (4)	8 (15)	2 (6)	0.198
Addiction potential scale (APS)	3 (4)	0	2 (4)	0	0.255
Addiction acknowledgment scale (AAS)	3 (4)	8 (12)	9 (17)	5 (14)	0.101
Anxiety scale (A)	14 (18)	14 (21)	16 (30)	7 (19)	0.437
Repression scale (R)	5 (6)	3 (4)	3 (6)	2 (6)	0.960
Overcontrolled hostility (O-H)	7 (9)	4 (6)	3 (6)	2 (6)	0.814
Dominance scale (Do)	0	0	0	0	-
Social responsibility scale (Re)	0	1 (1)	1 (2)	1 (3)	0.615
College maladjustment (Mt)	18 (23)	15 (22)	26 (48)	6 (17)	0.002
Marital distress score (MDS)	11 (14)	14 (21)	18 (33)	11 (31)	0.047
Post-traumatic stress disorder scale (PK)	12 (16)	13 (19)	24 (44)	6 (17)	0.001
Post-traumatic stress disorder scale (PS)	13 (17)	16 (24)	24 (44)	6 (17)	0.002
Masculine gender role (GM)	0	0	0	1 (3)	0.136
Feminine gender role (GF)	3 (4)	1 (1)	2 (4)	1 (3)	0.834
Harris-Lingoes scales					
Subjective depression (D1)	17 (26)	19 (29)	21 (32)	8 (12)	0.162
Psychomotor retardation (D2)	3 (16)	5 (26)	5 (26)	6 (32)	0.137
Physical malfunctioning (D3)	42 (39)	24 (22)	34 (31)	8 (7)	<0.001
Mental dullness (D4)	15 (25)	19 (32)	18 (30)	8 (13)	0.305
Brooding (D5)	9 (27)	11 (33)	10 (30)	3 (9)	0.479
Denial of social anxiety (Hy1)	0	0	0	0	-
Need for affection (Hy2)	0	2 (100)	0	0	0.175
Lassitude malaise (Hy3)	27 (28)	27 (28)	30 (32)	11 (12)	0.057

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Supplementary Table 6. Continued

Scale	IBS-C	IBS-D	IBS-M	IBS-U	P-value
Somatic complaints (Hy4)	29 (29)	31 (31)	28 (28)	11 (11)	0.169
Inhibition of aggression (Hy5)	0	1 (50)	1 (50)	0	0.585
Familial discord (Pd1)	7 (29)	7 (29)	4 (17)	6 (25)	0.531
Authority problems (Pd2)	0	3 (38)	4 (50)	1 (13)	0.123
Social imperturbability (Pd3)	0	0	0	0	-
Social alienation (Pd4)	12 (28)	9 (21)	16 (37)	6 (14)	0.100
Self-alienation (Pd5)	9 (26)	6 (18)	15 (44)	4 (12)	0.016
Persecutory ideas (Pa1)	19 (28)	21 (30)	23 (33)	6 (9)	0.041
Poignancy (Pa2)	11 (26)	9 (21)	17 (40)	5 (12)	0.031
Naiveté (Pa3)	1 (14)	3 (43)	1 (14)	2 (29)	0.513
Social alienation (Sc1)	16 (33)	13 (27)	15 (31)	5 (10)	0.432
Emotional alienation (Sc2)	14 (26)	12 (22)	19 (35)	9 (17)	0.081
Lack of ego mastery, cognitive (Sc3)	16 (30)	12 (22)	22 (41)	4 (7)	0.003
Lack of ego mastery, conative (Sc4)	14 (21)	19 (29)	24 (36)	9 (14)	0.011
Lack of ego mastery, defective inhibition (Sc5)	13 (36)	9 (25)	10 (28)	4 (11)	0.731
Bizarre sensory experiences (Sc6)	22 (52)	20 (48)	0	0	0.039
Amorality (Ma1)	2 (40)	3 (60)	0	0	0.291
Psychomotor acceleration (Ma2)	2 (67)	0	0	1 (33)	0.349
Imperturbability (Ma3)	2 (67)	0	0	1 (33)	0.349
Ego inflation (Ma4)	4 (22)	4 (22)	6 (33)	4 (22)	0.479
Shyness/self-consciousness (Si1)	3 (33)	1 (11)	4 (44)	1 (11)	0.390
Social avoidance (Si2)	0	9 (50)	5 (28)	4 (22)	0.052
Alienation-self and others (Si3)	17 (33)	11 (22)	18 (35)	5 (10)	0.078

Values are presented as number (%).

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