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Is body mass index associated with symptom severity and health-related quality of life in irritable bowel syndrome? A cross-sectional study

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ABSTRACT

Objective The aim of this study was to describe the body mass index (BMI) distribution in patients with irritable bowel syndrome (IBS) based on the Rome III criteria and to evaluate the association of BMI with symptom severity and quality of life (QOL).

Methods A cross-sectional study was carried out in patients visiting our outpatient functional gastrointestinal disorders specialty clinic. IBS diagnosis was made based on Rome III criteria. IBS symptom severity was investigated using the IBS severity score system. QOL was assessed using the Short Form 36 Health Survey, which consists of physical health and mental health.

Results 366 patients (252 women) who fulfilled Rome III criteria and provided complete BMI data (23.90±5.22 kg/m^2) were included. Overall, 59.0% of patients with IBS were in the normal weight range, 30.3% were overweight or obese, and 10.7% were underweight. Both physical and mental health decreased significantly with the severity of symptoms (all p<0.01), while controlling for several covariates (age, gender, family status, education status and IBS subtypes). Obesity and symptom severity (β=−0.177, $\triangle R^2$=0.037, p<0.01; β=−0.387, $\triangle R^2$=0.147, p<0.01) were significant negative factors that influencing physical health. Symptom severity (β=−0.301, $\triangle R^2$=0.084, p<0.01) was significant negative factor that influencing mental health. However, BMI didn't account for additional variance in mental health (p>0.05).

Conclusion Being overweight is a common phenomenon in patients with IBS regardless of IBS subtype. The association between QOL and symptom severity followed a negative dose-response pattern. Patients with higher BMI, especially obese patients, were more frequently in poor physical health. However, this kind of relationship was not found in BMI and mental health.

Strengths and limitations of this study

- ► This study uses a large and well-described patient cohort with a validated diagnosis of irritable bowel syndrome (IBS) based on the Rome III criteria.
- ► The association between quality of life (QOL) and symptom severity followed a negative dose-response pattern.
- ► Patients with higher body mass index (BMI) were more frequently in poor physical health. However, this kind of relationship was not found in BMI and mental health of QOL.
- ► The study was cross-sectional, therefore it is not possible to infer causation.
- ► BMI cannot fully reflect the impact of the factors of fatty mass, dietary habit, other lifestyle factors such as physical exercise on IBS.

INTRODUCTION

Irritable bowel syndrome (IBS) is a chronic and common functional bowel disorder that is characterised by recurrent abdominal pain or discomfort associated with altered bowel habits.[1] According to the Rome III criteria, IBS is classified into four subtypes (IBS with diarrhoea (IBS-D), IBS with constipation (IBS-C), mixed IBS (IBS-M) and unsubtyped IBS (IBS-U)) based on the predominant abdominal symptomatology.[1] It has been frequently reported that IBS leads to impaired quality of life (QOL).[2–4] The symptoms of IBS are associated with different eating habits.[5] In a recent randomised controlled trial, a diet low in fermentable oligosaccharides, disaccharides, monosaccharides and polyols was shown to improve the IBS-D patients' QOL, anxiety and activity impairment.[6]

Epidemiological studies have shown that as many as 16.5% of adults in European countries are obese (body mass index (BMI) >30 kg/m^2)[7], and that the incidence of obesity is increasing.[8] Additionally, a cross-sectional multicentre study found that more than 63% of outpatients and 80% of inpatients in gastroenterological centres suffered from significant changes in body composition.[9] In addition, underweight (BMI <18.5 kg/m^2) or obese body condition (BMI >30 kg/m^2) are both associated with multiple abdominal symptoms leading to reduced QOL.[10 11] Although extensive research has been carried out on the prevalence of obesity in the general population and in connection with numerous

diseases, there are only little published data on the prevalence and clinical relevance of nutritional status and body mass in patients with IBS. Choung *et al*[12] found no association between IBS status and BMI. However, this study was a population-based study. Studies with large enough sample size based on clinic patients are missing so far.

Therefore, the aim of this study was to describe the BMI distribution in patients with IBS based on the Rome III criteria and to evaluate the association of BMI with symptom severity and the physical health and mental health of QOL.

METHODS

This cross-sectional survey included patients evaluated at the functional gastrointestinal disorders (FGIDs) specialty clinic of the department of general internal medicine and psychosomatics of Heidelberg University Hospital, which is a tertiary care facility. All patients who completed our routine baseline documentation were enrolled. The routine data from individual health records were transferred into the database and pseudonymised.

Patients recruitment

From January 2011 to December 2016, patients' clinical data were consecutively collected from our outpatient FGIDs clinic at Heidelberg University Hospital for this explorative and descriptive study. All patients ≥18 years of age, who voluntarily signed an informed consent, were included, if they fulfilled the Rome III criteria for the diagnosis of IBS.[1] There was no exclusion criteria. The subtype criteria for IBS were based on stool consistency as assessed by the Bristol Stool Scale and Rome III criteria.[13] Demographic data including gender, age, family status, level of education and residence, were also collected at baseline using the Psychosomatic Basis Documentation Questionnaire.[14]

Patient involvement

No patients were involved in conducting the study. However, in order to increase the clinical relevance of the study, we established an advisory group to advise the research project.

Measurement of IBS symptom severity

Patients rated the severity of their IBS symptoms by completing the IBS severity score system (IBS-SSS).[15] The IBS-SSS has a maximum score of 500 and comprises five items: frequency and intensity of abdominal pain, severity of abdominal distension, dissatisfaction with bowel habits and interference of IBS with daily life. Based on validated cut-off values, three IBS severity subgroups can be distinguished: mild (IBS-SSS: 75–175), moderate (IBS-SSS: 175–300) and severe (IBS-SSS:>300). The German version of this questionnaire was validated by Betz *et al*[16], and the total score was computed in accordance with the manual.

Measurement of BMI

BMI was calculated as the individual's self-reported body weight (kg) divided by the square of their height (m). BMI was categorised according to the WHO classification of physical status[17]: underweight (BMI <18.5 kg/m²), normal weight (BMI 18.5–25 kg/m²), overweight (25–30 kg/m²) or obese body condition (BMI >30 kg/m²).

Measurement of QOL

QOL was measured using the Short Form 36 Health Survey (SF-36).[18] SF-36 is a 36-item, patient-reported survey of patient QOL, which consists of a physical and mental health indexes. The SF-36 is widely used and well validated for assessing generic health outcomes. Each scale is directly transformed into a 0–100 scale. Lower scores represent a higher degree of disability. Validation of the German version was performed by Morfeld *et al*.[19]

Statistical analysis

Routine data were transformed into an SPSS file and evaluated using the statistical program SPSS (IBM, V.22.0). Descriptive statistics are presented as the means and SD for continuous variables and as absolute numbers and percentages for categorical variables. All analyses were explorative and not of a confirmatory nature. All primary and secondary variables were first tested for normal distribution. For normally distributed variables, the mean and SD were calculated. Variables that lacked a normal distribution were reported using the median and IQR. The Mann-Whitney U Test was used to assess the level of significance because a number of participants differed between the groups. Comparison of sociodemographic and anthropometric data according to BMI was performed using analysis of variance (ANOVA) and non-parametric tests in the first instance. Where significant group differences were detected based on ANOVA, post-hoc least significant difference tests were conducted to compare the study groups in a pairwise fashion. We also used the Pearson correlation coefficients to investigate the linear association between demographics, BMI, clinical and psychological features. Hierarchical multiple regression was used to help understand the impact of potential confounders as well as the predictive role of BMI in physical health and mental health of QOL. We tested the impact of the confounders (gender, age, family status, education status and IBS subtypes) in model 1. In model 2, we added the symptom severity. BMI categories (underweight, normal weight, overweight and obesity) were added in model 3. All tests were two-sided, and statistical significance was accepted if $p<0.05$.

RESULTS

Characteristics of study sample

A total of 576 patients completed the questionnaire. Excluding 113 patients whose Rome III criteria data were partly missing, 366 patients with IBS were enrolled in this study (114 men, 252 women; mean BMI 23.90±5.22 kg/

Table 1 Distribution of BMI at symptom severity and QOL based on several demographic and clinical features (n=366)

		BMI	Symptom severity	QOL	
				Physical health	Mental health
	N	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Gender					
Male	114	24.30 (3.48)	280.27 (78.23)	42.21 (7.87)*	39.41 (12.76)
Female	252	23.71 (5.84)	292.10 (76.14)	40.21 (9.16)	39.23 (11.84)
Age					
18–49	264	23.36 (5.14)*	293.39 (77.52)*	41.28 (8.21)	38.32 (12.17)*
>50	102	25.29 (5.12)	275.55 (74.04)	39.69 (10.19)	41.80 (11.67)
Family status					
Single	160	22.69 (4.13)†	298.15 (71.90)	41.42 (7.69)	37.96 (12.09)
Marr‡	164	25.19 (5.07)	281.94 (82.67)	40.58 (9.59)	40.32 (12.18)
Divo‡	37	23.50 (5.11)	283.11 (69.13)	39.45 (10.12)	40.87 (11.20)
Education status					
Below Hs‡	97	24.62 (6.19)	296.31 (71.99)	38.40 (9.33)*	40.51 (12.35)
Above Hs‡	232	23.68 (4.87)	286.54 (81.60)	42.10 (8.47)	38.60 (12.02)
IBS subtypes					
IBS-C	37	23.38 (5.34)	293.13 (82.41)	40.76 (9.33)	40.43 (12.30)
IBS-D	151	24.69 (5.93)§	293.96 (78.00)	40.57 (9.17)	38.74 (12.88)
IBS-M	168	23.22 (4.01)	283.53 (73.19)	41.09 (8.40)	38.98 (11.39)

IBS-U was not included in the analysis because the sample size is too small.
Symptom severity based on IBS-SSS: mild (IBS-SSS: 75–175), moderate (IBS-SSS: 175–300) and severe (IBS-SSS: >300).
QOL based on SF-36: range from 0 ('highest disability') to 100 ('no disability').
*P<0.05.
†P<0.05 for post-hoc comparison between single and married or unmarried cohabitation.
‡Marr, married or unmarried cohabitation; Divo, divorced or widowed; Hs, high school.
§P<0.05 for post-hoc comparison between IBS-D and IBS-M.
BMI, body mass index; IBS-C, irritable bowel syndrome (IBS) with constipation; IBS-D, IBS with diarrhoea; IBS-M, mixed IBS; IBS-SSS, severity score system; QOL, quality of life.

m^2). The demographic and baseline characteristics of the patients with IBS among the different subtypes are summarised in table 1. Of the included subjects, the most frequent IBS subtype was IBS-M (45.9%), followed by IBS-D (41.3%) and IBS-C (10.1%). Only 59.0% of patients with IBS were within the normal weight range, whereas 30.3% were overweight or obese and only a minority were underweight (10.7%). The percentage of obese patients was highest in IBS-D (17.9%, p<0.01). Taking gender into account, 5.3% of men and 13.1% of women were underweight. Additionally, 7.0% of men and 13.1% of women were obese, and 26.3% of men and 15.9% of women were overweight. Overall, patients reported moderate to severe IBS symptom severity (IBS-SSS range: 125–484) and lower QOL (physical health range of SF-36: 15.19–64.00, mental health range of SF-36: 7.89–65.85).

Correlations between BMI, symptom severity and QOL

Pearson product–moment correlations indicated that high BMI values and elevated symptom severity were associated with poorer QOL. As shown in table 2, BMI was negatively correlated with physical health (r=–0.177, p<0.01).

Table 2 Correlation matrix for the study variables in patients with irritable bowel syndrome

	BMI	Age	Symptom severity	Physical health	Mental health
BMI	1.00				
Age	0.173**	1.00			
Symptom severity	0.055	–0.129*	1.00		
Physical health	–0.177**	–0.085	–0.349**	1.00	
Mental health	0.033	0.167**	–0.268**	0.029	1.00

*P<0.05; **P<0.01.
BMI, body mass index.

Symptom severity was negatively correlated with physical health (r=−0.394, p<0.01) and mental health (r=−0.268, p<0.01). Additionally, age was negatively correlated with symptom severity (r=−0.129, p<0.05) and positively correlated with physical health (r=0.167, p<0.01).

Characteristics of BMI, symptom severity and QOL across demographic and IBS subtypes

As shown in table 1, male reported significantly higher physical health problems than female (t=2.141, p<0.05). Compared with older patients (age >50), the younger patients (age 18–49) reported significantly lower BMI level (t=−3.20, p<0.01), greater symptom severity (t=2.039, p<0.05) and worse mental health (t=−2.528, p<0.05). Patients living with a stable partner (married or unmarried cohabitation) had higher BMI compared with single participants (t=−4.397, p<0.01). The patients with below high school education reported significantly higher physical health problems than those who with above high school education (t=−3.376, p<0.01). Compared with patients with IBS-M, the patients with IBS-D reported significantly higher BMI level (t=−2.572, p<0.05).

The influences of BMI in physical health and mental health of QOL

As shown in table 3, the hierarchical multiple regression examined the relationship between dependent variable (physical health) and independent variables (symptom severity and BMI). Model 1 was significant (F=2.252, p<0.05) and explained 5.2% of the variance in physical health. Education status (β=0.174, p<0.01) was a significant positive factor that influencing physical health. In model 2, symptom severity significantly added to the amount of explained variance ($\triangle R^2$=0.147, $\triangle$F=52.498, p<0.01). In model 3, BMI also significantly added to the amount of explained variance ($\triangle R^2$=0.037, $\triangle$F=4.605, p<0.01). Obesity (β=−0.177, p<0.01) was a significant negative factor that influencing physical health. Similarly, when mental health was used as the dependent variable, model 1 was insignificant (F=0.854, p>0.05). In model 2, symptom severity significantly increased the amount of explained variance ($\triangle R^2$=0.084, $\triangle$F=26.824, p<0.01). In model 3, BMI didn't account for an additional significant amount of variance in mental health ($\triangle R^2$=0.007, $\triangle$F=0.772, p>0.05).

DISCUSSION

This study sought to describe the BMI distribution in patients with IBS based on the Rome III criteria and to evaluate the association of BMI with symptom severity and the physical health and mental health of QOL. Therefore, we used standardised questionnaires and medical records to confirm the diagnosis and to assess patient symptoms and QOL.

Our data show that being overweight is a common phenomenon in patients with IBS regardless of IBS subtype. These findings are in agreement with the results of a previous study based on obese patients in France, which found that 30.0% of obese patients had IBS.[20] We found that almost 40% of patients with IBS were not in the normal weight range, which is consistent with previous results.[21] Notably, the overweight and obesity rates in the general adult population in Germany[7] are higher than those found in our IBS cohort. According to the German Health Update,[7] in 2012, the overweight rate of adults was 36.2%, and the obesity rate was 16.5%. Interestingly, the distribution of weight was similar between the different IBS groups. In particular, there was no difference between IBS-C and IBS-M. Notably, in IBS-D, the percentage of obese patients reached 17.9%. Lee *et al*[22] evaluated the relationship between visceral adipose tissue and the risk of IBS and suggested that disturbances of visceral fat may be more common in patients with IBS-D. In addition, another Korean study found increased intestinal permeability in patients with IBS-D.[23] One possible explanation is that the increase in visceral fat leads to an increase in intestinal osmolality[24] and then leads to the chronic diarrhoea. These studies, however, were confined to patients from South Korea.

IBS has a significant impact on patients' QOL.[25] Our data show an association between symptom severity and QOL with regard to physical and mental health. The patients in our study reported moderate to severe IBS symptom severity and lower QOL. Further, this association followed a negative dose-response pattern. Our findings partially match those of Amouretti *et al*,[26] who found that patients with IBS who reported their symptoms as severe or very severe had a very poor QOL compared with those who reported their symptoms as moderate. However, their study did not distinguish between physical and mental health and did not consider the effects of confounding factors such as BMI. This is an interesting but not completely new result which gives rise to the question of what mechanisms are responsible for this association.

Through the hierarchical multiple regression, we tested the relationship between dependent variable (QOL) and independent variables (symptom severity and BMI). We controlled for the impact of the confounders (gender, age, family status, education status and IBS subtypes). The correlation between symptom severity and QOL was significantly negative, no matter which BMI category was. Our findings show that obesity was significant negative predictor of physical health. Patients with higher BMI were more frequently in poor physical health. This is in line with previous studies,[11] in that increasing BMI is associated with increased upper gastrointestinal symptoms, bloating and diarrhoea. Obesity may lead to more physiological stress on organs. Richards *et al*[27] reported that obese patients have more severe pain and are to a larger extent restricted in their daily functioning compared with patients of normal weight. An additional finding of our study was that BMI didn't account for an additional significant amount of variance in mental health. This was inconsistent with findings by Mykletun *et al*,[28] who found

Table 3 Results of hierarchical multiple regression relating physical health and mental health to symptom severity and BMI

	Model 1		Model 2		Model 3		Model summary			
	β	t	β	t	β	t	F	R^2	ΔF	ΔR^2
Physical health										
Age	−0.081	−1.093	−0.116	−1.688	−0.141	−2.063*	2.252*	0.052*	–	–
Gender	−0.061	−1.052	−0.050	−0.937	−0.033	−0.611				
Single and Marr†	−0.020	−0.263	0.003	0.048	−0.030	−0.439				
Divo† and Marr†	−0.043	−0.697	−0.035	−0.609	−0.035	−0.621				
Education	0.174	2.913**	0.150	2.725**	0.130	2.404*				
IBS-C and IBS-D	0.032	0.529	0.024	0.438	−0.004	−0.081				
IBS-M and IBS-D	0.048	0.775	0.003	0.049	−0.030	−0.529				
Symptom severity	–	–	−0.389	−7.246**	−0.387	−7.295**	8.007**	0.200**	52.498**	0.147**
Under† and normal	–	–	–	–	−0.003	−0.060	7.965**	0.237**	4.605**	0.037**
Over† and normal	–	–	–	–	0.067	1.193				
Obesity and normal	–	–	–	–	−0.177	−3.170**				
Mental health										
Age	0.159	2.106*	0.133	1.834	0.119	1.611	0.854	0.020	–	–
Gender	−0.029	−0.499	−0.021	−0.375	−0.006	−0.110				
Single and Marr†	0.052	0.690	0.070	0.958	0.068	0.922				
Divo† and Marr†	−0.020	−0.316	−0.014	−0.224	−0.007	−0.117				
Education	−0.045	−0.750	−0.064	−1.092	−0.066	−1.133				
IBS-C and IBS-D	0.024	0.381	0.018	0.300	0.009	0.144				
IBS-M and IBS-D	0.022	0.356	−0.012	−0.194	−0.025	−0.408				
Symptom severity	–	–	−0.294	−5.179**	−0.301	−5.263	4.168	0.105**	26.824**	0.084**
Under† and normal	–	–	–	–	−0.077	−1.307	3.234**	0.112**	0.772	0.007
Over† and normal	–	–	–	–	0.017	0.280				
Obesity and normal	–	–	–	–	−0.041	−0.684				

Model 1 factors: age, gender, family status, education status, IBS subtypes.
Model 2 factors: age, gender, family status, education status, IBS subtypes, symptom severity.
Model3 factors: age, gender, family status, education status, IBS subtypes, symptom severity, BMI categories.
IBS-U was not included in the analysis, because the sample size is too small.
Normal weight, BMI 18.5–25 kg/m²; obesity, BMI >30 kg/m²; overweight, BMI 25–30 kg/m²; underweight, BMI <18.5 kg/m².
*P<0.05; **P<0.01.
†Marr, married or unmarried cohabitation; Divo, divorced or widowed; Under, underweight; Over, overweight.
BMI, body mass index; IBS-C, irritable bowel syndrome (IBS) with constipation; IBS-D, IBS with diarrhoea; IBS-M, mixed IBS.

that BMI had significant association with IBS with regard to anxiety and mood disorders. However, their study evaluated only female patients. The findings of genome-wide association studies, from the genetic perspective, suggest the presence of many genetic loci each with a small effect influencing susceptibility to mental health symptoms (depression and anxiety).[29] We can therefore hypothesise that, the unpredictable association between risk of mental health and BMI in our study may be due to non-modifiable genetic influences which predispose individuals to bad mental health.

Several limitations of this study must be taken into account. First, the study was cross-sectional, therefore, it is impossible to infer causation. Second, BMI was based on the self-reported height and weight of patients and computed without objective measurement, therefore bias may have been introduced. Patients may occasionally under-report or over-report their weight and height leading to an underestimation of underweight or obese patients. However, in the Nutrinet-Santé study, researchers reported that deviations in self-reported BMIs from questionnaires can be ignored because their results confirmed the validity and agreement of self-reported data with measured data.[30 31] The choice of SF-36 as the only QOL tool may partly miss the relationship between symptom severity and QOL. Moreover, BMI is associated with a multitude of different factors, such as genetics, fatty mass, dietary habit or physical exercise. Thus, BMI cannot fully reflect the impact of those factors on IBS in more details, and more research is needed. The strengths of this study, however, are the use of a large patient cohort with a validated diagnosis of IBS based on the Rome III criteria.

To conclude, being overweight is a common phenomenon in patients with IBS regardless of IBS subtypes. Our data further suggest that overweight and obesity may have a relevant influence on QOL. Patients with higher BMI were more frequently in poor physical health. The findings have some implications for future practice. Clinical doctors should pay special attention to abnormal weight in patients with IBS as this maybe an indicator of a poorer QOL, especially with regard to the physical health.

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