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# Prevalence and impact of faecal incontinence among individuals with Rome IV irritable bowel syndrome

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## Summary

**Background:** Little is known about faecal incontinence (FI) in individuals with irritable bowel syndrome (IBS).

**Aims:** To compare characteristics of people with IBS reporting FI, compared with people with IBS who do not report FI.

**Methods:** We collected demographic, gastrointestinal and psychological symptoms, healthcare usage, direct healthcare costs, impact on work and activities of daily living, and quality of life data from individuals with Rome IV-defined IBS. We asked participants about FI, assigning presence or absence according to Rome-IV criteria.

**Results:** Of 752 participants with Rome IV IBS, 202 (26.9%) met Rome IV criteria for FI. Individuals with FI were older ($p < 0.001$), more likely to have IBS-D (47.0% vs. 39.0%, $p = 0.008$), and less likely to have attained a university or postgraduate level of education (31.2% vs. 45.6%, $p < 0.001$), or to have an annual income of ≥£30,000 (18.2% vs. 32.9%, $p < 0.001$). They were more likely to report urgency (44.6% vs. 19.1%, $p < 0.001$) as their most troublesome symptom and a greater proportion had severe IBS symptom scores, abnormal depression scores, higher somatic symptom-reporting scores or higher gastrointestinal symptom-specific anxiety scores ($p < 0.01$ for trend for all analyses). Mean health-related quality of life scores were significantly lower among those with, compared with those without, FI ($p < 0.001$). Finally, FI was associated with higher IBS-related direct healthcare costs ($p = 0.002$).

**Conclusions:** Among individuals with Rome IV IBS, one-in-four repo rted FI according to Rome IV criteria. Physicians should ask patients with IBS about FI routinely.

Christopher J. Black and Alexander C. Ford are joint last authors.

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## 1 | INTRODUCTION

Irritable bowel syndrome (IBS) is a common disorder of gut-brain interaction, affecting between 5% and 10% of the global population.[1] It is characterised by recurrent abdominal pain in association with a change in stool frequency and/or consistency, but the underlying pathophysiology is complex meaning that the cause of IBS is unknown.[2] As a result, it is defined and classified using a symptom-based system proposed by the Rome Foundation, with the latest iteration being the Rome IV criteria.[3] Despite not affecting life expectancy,[4,5] IBS has a substantial impact, with those affected reporting that their quality of life is impaired to a similar degree to those with chronic organic diseases.[6,7] IBS affects individuals' ability to work and participate in family and social life.[8–11] In addition, direct healthcare costs of IBS are considerable, estimated at between £1.3 and £2 billion per year in a recent UK study.[12]

Faecal incontinence (FI), which is defined as the accidental leakage of stools,[13] is another common gastrointestinal disorder. It affects between 1% and 16% of the population, depending on the definition of FI used.[14–18] In moving from the Rome III criteria for FI to Rome IV, the required symptom frequency threshold was increased from at least two episodes in the last 3 months to at least two episodes over 4 weeks in the last 3 months. The need to rule out structural or organic causes of FI was also removed.[13,19] FI also has a negative impact on quality of life, including causing embarrassment, anxiety, a fear of going or eating out, often leading to social isolation, and the need to regularly carry a change of clothes or wear incontinence pads.[20,21] The sensitive nature of FI makes it a taboo subject and many people are reluctant to discuss these with family members or even doctors.[22,23] Individuals with IBS may also experience FI, with some investigators reporting that IBS is an independent risk factor for FI.[15,24]

Only a few studies have examined the prevalence of FI among individuals with IBS and none have used the Rome criteria, the gold standard diagnostic criteria, to define FI.[22,25,26] Simren et al[25] examined the prevalence of FI in large sample of patients with Rome III-defined IBS and its association with various clinical factors. However, the sample included in this study may not be representative of those with IBS, as participants were recruited from tertiary care centres and those with severe physical or psychiatric diseases were excluded. In addition, data in this study were collected from two separate cohorts, one from the USA and one from Sweden, using different questionnaires, meaning that the authors were unable to analyse key variables, including psychological symptoms, together.

Given the lack of definitive data in this area, we examined the prevalence of FI in IBS, as well as the characteristics of those with and without FI, in a cross-sectional study recruiting a large cohort of people with Rome IV-defined IBS. We hypothesised that FI would be common in IBS, that prevalence may depend on IBS subtype, and that individuals with coexisting FI and IBS, compared to those with IBS only, would have worse gastrointestinal and psychological symptoms, worse impairment at work and in activities of daily living, poorer health-related quality of life, and higher direct healthcare costs of IBS.

## 2 | METHODS

### 2.1 | Participants and setting

We recruited individuals registered with ContactME-IBS, a national UK registry of people with IBS who are interested in research.[27] We have reported data from this cohort previously.[8,12,28,29] Briefly, the registry is run by County Durham and Darlington National Health Service (NHS) Foundation Trust and recruits individuals in the UK through advertisements in primary care, hospital clinics, pharmacies or on social media. Individuals enrol by completing a short questionnaire about bowel symptoms and providing contact details. Of the 4280 registrants, 2268 (53%) have seen their primary care physician with IBS, and another 1455 (34%) have seen a gastroenterologist. We contacted all individuals registered with ContactME-IBS, via electronic mailshot, in July 2021. There were no exclusion criteria other than inability to understand written English. All responses were stored in an online database and non-responders received a reminder email in August 2021. Participants had a chance of winning one of three gift cards (worth £200, £100 or £50) in return for completing the questionnaire. The University of Leeds research ethics committee approved the study in March 2021 (MREC 20–051).

### 2.2 | Data collection and synthesis

#### 2.2.1 | Demographic and symptom data

We collected demographic data, including age, sex, lifestyle (tobacco and alcohol consumption), ethnicity, marital status, educational level and annual income. We defined the presence of IBS using the Rome IV questionnaire,[30] according to the proposed scoring algorithm.[3] We categorised IBS subtype according to the proportion of time stools were abnormal according to the Bristol stool form scale. We asked participants about the presence and frequency ("Never", "Less than one day per month", "One day per month", "Two to three days per month", "Once a week", "Two to three days a week", "Most days", "Every day", "Multiple times per day or all the time") of accidental leakage of liquid or solid stool in the last 3 months and assigned the presence of FI if individuals reported at least two episodes of accidental leakage of stools every 4 weeks in the last 3 months, as recommended by the Rome IV criteria.[13] We also asked all participants to provide time since their diagnosis of IBS and whether IBS was triggered after an acute enteric infection, as well as their most troublesome symptom from a list of five possibilities, including abdominal pain, constipation, diarrhoea, bloating or urgency.

### 2.2.2 | IBS symptom severity, mood, somatic symptoms and gastrointestinal symptom-specific anxiety

We assessed symptom severity using the IBS severity scoring system (IBS-SSS),[31] which has a maximum score of 500 points; <75 points indicates remission, 75–174 points mild, 175–299 points moderate and 300–500 points severe symptoms. We used the hospital anxiety and depression scale (HADS) to collect anxiety and depression data,[32] with a total score ranging from 0 to 21 for either anxiety or depression. We categorised severity for each into normal (total HADS depression or anxiety score 0–7), borderline normal (8–10) or abnormal (≥11), as recommended. We collected somatic symptom-reporting data using the patient health questionnaire-12 (PHQ-12),[33] derived from the validated PHQ-15.[34] The total PHQ-12 score ranges from 0 to 24. We categorised severity into high (total PHQ-12 ≥ 13), medium (8–12), low (4–7) or minimal (≤3). We used the visceral sensitivity index (VSI),[35] which measures gastrointestinal symptom-specific anxiety. Replies to each of the 15 items are provided on a 6-point scale from "strongly disagree" (score 0) to "strongly agree" (score 5). We divided these data into equally sized tertiles, as there are no validated cut offs to define low, medium or high levels of gastrointestinal symptom-specific anxiety.

### 2.2.3 | Impact of IBS on work and activities of daily living

We used the work productivity and activity impairment questionnaire for irritable bowel syndrome (WPAI:IBS),[36] which is validated to assess level of work productivity loss in employed people with IBS, as well as impairment in activities of daily living. There are four domains: absenteeism (percentage of work hours missed because of IBS); presenteeism (percentage of impairment experienced at work because of IBS); overall work impairment (percentage of work productivity loss); or activity impairment (percentage impairment in activities of daily living). We also used the work and social adjustment scale (WSAS),[37] which has been used by others to measure impact of IBS on ability to work, manage at home, engage in social or private leisure activities, or maintain close relationships.[38–41] The five domains are scored on a 9-point scale from "not at all" (score 0), through "definitely" (score 4), to "very severely" (score 8). We dichotomised presence (score ≥4 ("definitely" impacting)) or absence (score <4) of an impact of IBS on home management activities, social or private leisure activities, or maintaining close relationships.

### 2.2.4 | Quality of life

We used the irritable bowel syndrome quality of life (IBS-QOL), a validated IBS-specific questionnaire, to measure health-related quality of life.[42,43] This consists of 34 items ranked on a 5-point Likert scale ranging from 0 to 4, with a total possible score of 0–136. We transformed scores to a 0 to 100-point scale with zero indicating worst quality of life and 100 indicating best quality of life. We also administered the EQ-5D,[44] a generic health-related quality of life questionnaire from EuroQOL, used widely in healthcare. We utilised the EQ-5D-5L instrument,[45] consisting of five items capturing different aspects of health, including mobility, self-care, ability to carry out usual activities, pain/discomfort and anxiety/depression. Each item has five levels of responses, giving a total of 3125 possible health states. We mapped each health state to obtain a utility score for a UK population using a crosswalk calculator,[46] a mapping function recommended by the National Institute for Health and Care Excellence.[47]

### 2.2.5 | IBS-related resource use

We collected data on healthcare usage related to a person's IBS over the 12 months prior to recruitment. We asked them to report number of appointments (primary care physicians, gastroenterologists, specialist nurses, dietitians or psychologists), number of investigations (blood or stool tests, endoscopies, radiological investigations or breath tests), number of unplanned emergency department attendances or inpatient admissions (including length of stay in days), and over the counter or prescribed drug usage (in months). We applied costs (in £UK) for primary care physician appointments from Unit Costs of Health and Social Care 2020,[48] and other appointments, investigations or unplanned inpatient days in secondary care using 2019/20 NHS National Cost Collection Data.[49] We assumed all appointments were follow-up appointments, which cost less than a new patient appointment. We applied the lowest price for a 1-month supply of each drug using the British National Formulary online.[50]

## 2.3 | Statistical analysis

All participants who met Rome IV criteria for IBS were included in the statistical analysis. We examined the characteristics of individuals with, compared with those without, Rome IV-defined FI. Categorical variables such as sex, IBS subtype, IBS-SSS severity, presence or absence of abnormal anxiety or depression scores, level of somatic symptom reporting, level of gastrointestinal symptom-specific anxiety, and level of IBS-related quality of life were compared between individuals with and those without FI using a $\chi^2$ test. Data such as age, costs of IBS-related resource use, and scores for absenteeism, presenteeism, overall work impairment or activity impairment were compared between these two groups using an independent samples $t$ test or Mann–Whitney $U$ test. Statistical significance was defined as a $p < 0.01$. We used a logistic regression model, controlling for all baseline data, to examine independent associations with FI, and reported the results with odds ratios (ORs) with 95% confidence intervals (CIs). The variance in the data explained by the logistical regression model was assessed using the Nagelkerke $R^2$ statistic. We performed all analyses using SPSS for Windows (version 27.0 SPSS).

## 3 | RESULTS

In total, 1278 (29.9%) of 4280 registrants [mean age 47.2 years (range 18–89 years), 1086 (85.0%) female] completed the questionnaire. Of these, 752 (58.8%) met Rome IV criteria for IBS [mean age 45.3 years (range 18–81 years), 655 (87.1%) female and 729 (96.9%) White]. There were 136 (18.1%) individuals with IBS with constipation (IBS-C), 306 (40.7%) with IBS-D and 301 (40.0%) with IBS with mixed bowel habits (IBS-M). Of the 752 individuals with Rome IV IBS, 415 (55.2%) had experienced at least one episode of accidental leakage of stools in the last 3 months and 202 (26.9%) met the Rome IV criteria for FI (Figure 1). Mean IBS-QOL and EQ-5D scores ($p < 0.001$ for trend for both) significantly decreased as the frequency of accidental leakage of stools increases among participants with Rome IV IBS (Figure 2). Mean IBS-QOL (38.0 (SD 21.9) vs. 51.8 (SD 21.1), $p < 0.001$) and EQ-5D (0.451 (SD 0.320) vs. 0.611 (SD 0.254), $p < 0.001$) scores were significantly lower among those with, compared with those without, Rome IV FI.

### 3.1 | Characteristics of individuals with Rome IV IBS with, and impact of, Faecal incontinence

Among all 752 individuals with Rome IV IBS, those who suffered from FI, according to the Rome IV criteria, were older (mean age 51.4 (SD 13.7) vs. 43.1 (SD 14.6), $p < 0.001$), and were less likely to have attained a university or postgraduate level of education (31.2% vs. 45.6%, $p < 0.001$) or have an annual income of £30,000 or more (18.2% vs. 32.9%, $p < 0.001$) (Table 1). FI was not associated with sex, marital status, tobacco or alcohol use, ethnicity, post-infection IBS status, duration of IBS diagnosis or number of drugs individuals used for IBS in the 12 months prior to study recruitment. A significantly higher proportion of participants with FI had IBS-D (47.0% vs. 39.0%) and a smaller proportion of participants IBS-C (11.4% vs. 20.9%) ($p = 0.008$). Individuals with FI were significantly more likely to report urgency (44.6% vs. 19.1%) and less likely to report bloating or distension (17.3% vs. 33.3%) as their most troublesome symptom ($p < 0.001$). A greater proportion of those with FI had severe IBS according to the IBS-SSS ($p < 0.001$ for trend), abnormal HADS-depression scores ($p < 0.001$ for trend), higher somatic symptom-reporting scores ($p < 0.001$ for trend), or higher VSI scores ($p = 0.003$ for trend), but there was no significant difference in the proportion with abnormal HADS-anxiety scores.

A higher proportion of those with FI-reported low IBS-QOL scores (48.5% vs. 25.6%, $p < 0.001$). Although levels of absenteeism, presenteeism or overall work impairment were higher among participants with FI, these differences did not reach statistical significance. Individuals with FI, compared with those without, reported a significantly higher median activity impairment (60.0% [interquartile range (IQR): 30.0%–80.0%) vs. 40.0% (IQR: 20.0%–60.0%), $p < 0.001$]. A greater proportion of participants with FI reported that IBS affected their home management, social leisure activities,

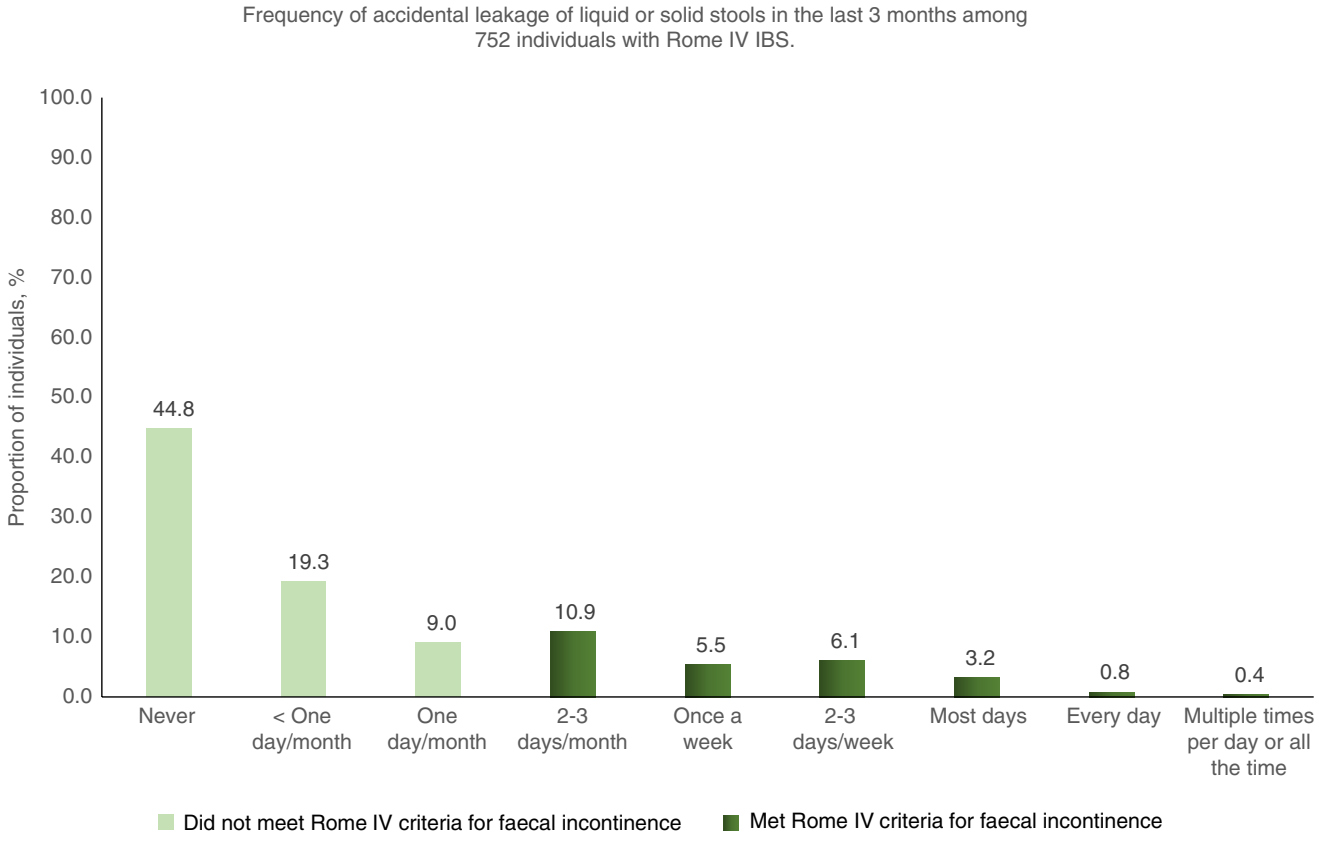


FIGURE 1 Frequency of accidental leakage of stools in the last 3 months among 752 individuals with Rome IV IBS.

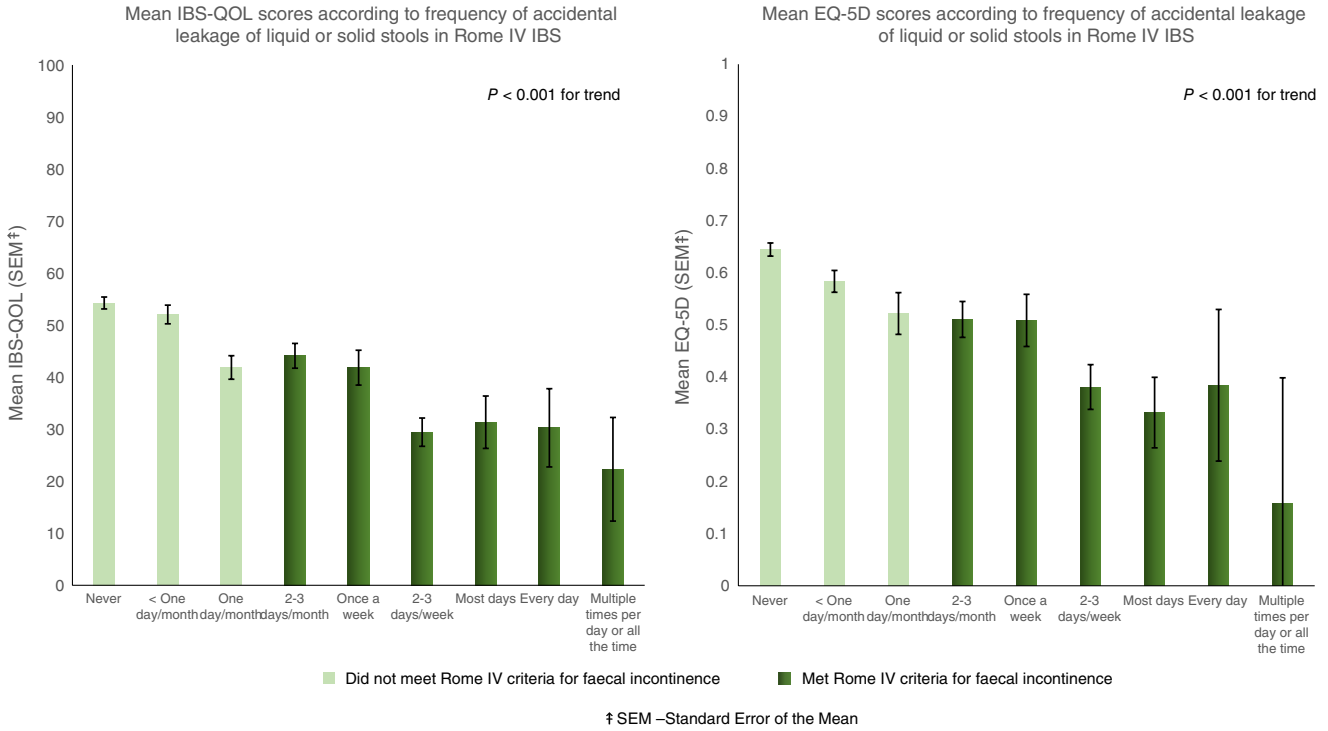


**FIGURE 2** Mean IBS-QOL and EQ-5D scores (SEM) according to the frequency of accidental leakage of stools in the last 3 months among individuals with Rome IV IBS. SEM, standard error of the mean.

private leisure activities and close relationships ($p < 0.001$ for trend for all analyses). Finally, mean annual total direct healthcare costs of IBS (£754.26 (standard deviation (SD) £1103.70) vs. £490.06 (SD £989.05), $p = 0.002$) and cost of investigations (£228.90 (SD £420.06) vs. £133.23 (£322.11), $p < 0.001$) were significantly higher in those with FI.

Following logistic regression controlling for all data, those earning £30,000 or more (OR = 0.48; 95% CI: 0.28–0.81) were less likely to have Rome IV-defined FI, whereas older participants (OR per year = 1.07; 95% CI: 1.05–1.09), those with urgency as their most troublesome symptom (OR = 3.75; 95% CI: 1.98–7.11), and those with impairment in their private leisure activities (OR = 2.43; 95% CI: 1.29–4.57) more likely. The logistic regression model explained 39.7% of the variance of the data.

## 4 | DISCUSSION

This cross-sectional study recruited individuals with Rome IV IBS and assessed the proportion reporting FI, according to the Rome IV criteria, as well as examining the characteristics of those with and without FI. Over 50% of those with Rome IV IBS reported accidental leakage of stools in the last 3 months and one-in-four met the Rome IV criteria for FI. Both disease-specific and generic quality of life scores were significantly reduced with increasing frequency of any FI in the last 3 months, irrespective of whether they met the stricter Rome IV criteria. In univariate analysis, those with Rome IV FI were more likely to be older, to have IBS-D, report urgency as their most troublesome symptom, have severe IBS symptoms and higher depression, somatic symptom-reporting and gastrointestinal symptom-specific anxiety scores. A higher proportion of those with FI reported impairment in all aspects of activities of daily living, including home management, social leisure activities, private leisure activities and close relationships, but we did not observe a similar effect of FI in terms of impairment at work. FI was also associated with higher costs of investigations and direct IBS-related healthcare costs. After logistic regression, annual income of less than £30,000, older age, urgency and impairment in private leisure activities were associated with Rome IV FI.

We recruited over 750 individuals who met the Rome IV criteria for IBS. We also applied the Rome IV criteria strictly to define the presence of FI, which enabled us to estimate prevalence of Rome IV FI among those with Rome IV IBS. Our sample consisted of individuals who are likely to represent those with IBS in the UK because some had never seen a doctor, some had seen a primary care physician, and some had seen a gastroenterologist. Study participants represented a relatively broad spectrum of individuals in the UK with a wide age range, different levels of education, income brackets and relationship status. Symptoms of FI and IBS are embarrassing, and may even be a taboo subject for some individuals, with one study showing that only 50% of those with accidental faecal leakage reported these symptoms to their doctor.[22] Using an online questionnaire with minimal identifiable data, rather than face-to-face interview, is likely to have allowed us to estimate the true prevalence of FI in IBS more closely. Collecting data directly from individuals, rather than relying on existing databases, is also likely to have

**TABLE 1** Characteristics of individuals with, compared with those without, Rome IV-defined faecal incontinence in Rome IV IBS.

| | Faecal incontinence | | |
|---|---|---|---|
| | Yes ($n = 202$) | No ($n = 550$) | $p$ value* |
| Female (%) | 180 (89.1) | 475 (86.4) | 0.32 |
| Mean age (SD) | 51.4 (13.7) | 43.1 (14.6) | <0.001 |
| Married (%) | 133 (65.8) | 354 (64.4) | 0.71 |
| Smoker (%) | 26 (12.9) | 56 (10.2) | 0.29 |
| Alcohol use (%) | 105 (52.0) | 334 (60.7) | 0.03 |
| University or postgraduate level of education (%) | 63 (31.2) | 251 (45.6) | <0.001 |
| White ethnicity (%) | 195 (96.5) | 534 (97.1) | 0.70 |
| Annual income of £30,000 or more (%) | 33 (18.2) | 164 (32.9) | <0.001 |
| IBS after acute enteric infection (%) | 28 (13.9) | 63 (11.5) | 0.37 |
| Seen a primary care physician regarding IBS in the last 12 months (%) | 94 (46.5) | 200 (36.4) | 0.01 |
| Seen a gastroenterologist regarding IBS in the last 12 months (%) | 47 (23.3) | 100 (18.2) | 0.12 |
| IBS subtype (%) | | | |
| IBS-C | 23 (11.4) | 113 (20.9) | |
| IBS-D | 95 (47.0) | 211 (39.0) | |
| IBS-M | 84 (41.6) | 217 (40.1) | 0.008 |
| Most troublesome symptom (%) | | | |
| Abdominal pain | 38 (18.8) | 131 (23.8) | |
| Constipation | 11 (5.4) | 42 (7.6) | |
| Diarrhoea | 28 (13.9) | 89 (16.2) | |
| Bloating/distension | 35 (17.3) | 183 (33.3) | |
| Urgency | 90 (44.6) | 105 (19.1) | <0.001 |
| Duration of IBS diagnosis, year(s) (%) | | | |
| 1 | 7 (3.5) | 18 (3.3) | |
| 2 | 10 (5.0) | 31 (5.6) | |
| 3 | 10 (5.0) | 44 (8.0) | |
| 4 | 9 (4.5) | 24 (4.4) | |
| 5 | 7 (3.5) | 31 (5.6) | |
| >5 | 159 (78.7) | 402 (73.1) | 0.54 |
| Number of IBS drugs in the last 12 months (%) | | | |
| 0 | 21 (10.4) | 75 (13.6) | |
| 1 | 45 (22.3) | 144 (26.2) | |
| 2 | 59 (29.2) | 137 (24.9) | |
| 3 | 41 (20.3) | 88 (16.0) | |
| 4 | 17 (8.4) | 59 (10.7) | |
| ≥5 | 19 (9.4) | 47 (8.5) | 0.34 |
| IBS-SSS severity (%) | | | |
| Mild | 17 (8.4) | 69 (12.7) | |
| Moderate | 63 (31.2) | 237 (43.6) | |
| Severe | 122 (60.4) | 237 (43.6) | <0.001 |
| HADS anxiety categories (%) | | | |
| Normal | 42 (20.8) | 158 (28.7) | |
| Borderline abnormal | 43 (21.3) | 131 (23.8) | |
| Abnormal | 117 (57.9) | 261 (47.5) | 0.03 |

TABLE 1 (Continued)

| | Faecal incontinence | | |
|---|---|---|---|
| | Yes ($n$ = 202) | No ($n$ = 550) | $p$ value* |
| HADS depression categories (%) | | | |
| Normal | 79 (39.1) | 325 (59.1) | |
| Borderline abnormal | 48 (23.8) | 117 (21.3) | |
| Abnormal | 75 (37.1) | 108 (19.6) | <0.001 |
| PHQ-12 severity (%) | | | |
| Low | 5 (2.5) | 31 (5.6) | |
| Mild | 27 (13.4) | 149 (27.1) | |
| Moderate | 79 (39.1) | 228 (41.5) | |
| Severe | 91 (45.0) | 142 (25.8) | <0.001 |
| VSI scores (%) | | | |
| Low | 48 (23.8) | 199 (36.2) | |
| Medium | 69 (34.2) | 178 (32.4) | |
| High | 85 (42.1) | 173 (31.5) | 0.003 |
| IBS-QOL scores (%) | | | |
| Low | 98 (48.5) | 141 (25.6) | |
| Medium | 64 (31.7) | 188 (34.2) | |
| High | 40 (19.8) | 221 (40.2) | <0.001 |
| WPAI:IBS, median % (IQR) | | | |
| Absenteeism | 0.0 (0.0–7.63) | 0.0 (0.0–2.33) | 0.01 |
| Presenteeism | 50.0 (20.0–70.0) | 30.0 (20.0–60.0) | 0.01 |
| Overall work impairment | 47.8 (10.0–70.5) | 30.0 (10.0–57.1) | 0.03 |
| Activity impairment | 60.0 (30.0–80.0) | 40.0 (20.0–60.0) | <0.001 |
| WSAS (%) | | | |
| IBS affected home management | 96 (47.5) | 124 (22.5) | <0.001 |
| IBS affected social leisure activities | 145 (71.8) | 278 (50.5) | <0.001 |
| IBS affected private leisure activities | 96 (47.5) | 111 (20.2) | <0.001 |
| IBS affected close relationships | 81 (40.1) | 122 (22.2) | <0.001 |
| Mean costs of IBS in £UK (SD) | | | |
| Appointments | 311.62 (680.11) | 194.90 (531.76) | 0.01 |
| Investigations | 228.90 (420.06) | 133.23 (322.11) | <0.001 |
| IBS-related medications | 76.71 (99.17) | 71.85 (95.64) | 0.54 |
| Unplanned attendances | 137.03 (463.88) | 90.08 (426.04) | 0.19 |
| Total direct healthcare costs | 754.26 (1103.70) | 490.06 (989.05) | 0.002 |

*$p$ value for Pearson $\chi^2$ for comparison of categorical data. Independent samples $t$ test for continuous data, and Mann–Whitney $U$ test for all four dimensions of Work Productivity and Activity Impairment: Irritable Bowel Syndrome.

strengthened our study because of the inaccuracy of a diagnosis of FI in such databases.[23] We obtained near-complete data collection because of the use of mandatory fields in our online questionnaire and used validated questionnaires to examine gastrointestinal, psychological symptoms, impact of IBS on work and activities of daily living, and quality of life.

We recruited individuals with self-reported IBS from a national UK registry rather than those with IBS from a primary, secondary or tertiary care setting, so we were unable to check participants medical records to rule out other conditions such as coeliac disease, bile acid diarrhoea or inflammatory bowel disease, which may mimic or co-exist with IBS.[51–54] However, IBS is more prevalent than these conditions and UK national guidance recommends these conditions are ruled out prior to or considered when diagnosing IBS.[55,56] In addition, almost 90% of the ContactME-IBS registrants have seen either a primary care physician or gastroenterologist for IBS, nearly 80% of study participants had IBS for at least 5 years, and all participants were registered with an IBS research registry. We, therefore, believe it reasonable to assume that they genuinely had IBS. Our participants were all UK residents and 97% were White, so our results

may not be relevant to those outside the UK or from other ethnic groups. In addition, only 18% of the responders had IBS-C, whereas IBS-C, IBS-D and IBS-M all have a similar prevalence in the general population.[57] This over-representation of people with IBS-D and IBS-M in our study may, therefore, have inflated the prevalence of FI. Using an online questionnaire with mandatory fields means that some individuals may have accessed the questionnaire but chose not to complete it. Our overall response rate of 30% could be considered low, but these were individuals who had expressed an interest in taking part in IBS research, participation is not mandated as part of the registry, and we still recruited over 700 people with Rome IV IBS. However, we cannot exclude the fact that those with more severe symptoms chose to take part and that, as a result, the prevalence of FI has been overestimated. However, examining the prevalence of and risk factors for, FI was not the primary aim of our study, so we feel this is unlikely. For similar reasons, we did not ask participants to report other medical conditions like diabetes, neurological disorders or anal sphincter trauma resulting from obstetric injury, which may contribute to FI. Adding the presence or absence of these disorders may have strengthened our logistic regression analysis. We also did not ask participants about sexual practices, such as anal intercourse, which have been shown to be associated with FI in other studies.[58] As previously discussed, FI was not the primary aim of the study and we did not ask participants whether FI symptom onset was of at least 6 months. We also did not ask participants to differentiate between obvious stool seepage, staining of underwear, mucus secretion or flatus incontinence specifically, with the latter two not included in the Rome IV criteria for FI,[13] partly because these can only be differentiated accurately through detailed history taking.

Previous studies have examined the prevalence and impact of FI among patients with IBS.[22,25,26] However, to our knowledge, none have used the Rome criteria to define FI. Simren et al[25] reported 43% of the US cohort with Rome III IBS and 30% of the Swedish cohort experienced at least one episode of accidental leakage of stools in the last 3 months and 20% of the US cohort and 14% of the Swedish cohort experienced at least one episode of accidental leakage of stools in the last month. In comparison, our results showed a higher prevalence of both accidental leakage of stools in the last 3 months (55%) and Rome IV FI (27%). This may be because the Rome IV criteria select individuals with more severe IBS,[59] and as demonstrated in our study and the aforementioned two-nation study,[25] a significantly higher proportion of those with FI report more severe IBS symptoms. However, the Rome IV criteria for FI, which require at least two episodes of accidental leakage of stools over 4 weeks in the last 3 months, are more restrictive than the threshold of at least one episode of accidental leakage of stools in 1 month used in the aforementioned two-nation study.[25] Therefore, the higher prevalence of Rome IV-defined FI among those with Rome IV IBS is, perhaps, surprising. Two other studies examining this issue only investigated the lifetime prevalence of FI, rather than defining FI using a minimum symptom frequency threshold.[22,26] Despite similar results, in terms of associations with FI, few prior studies have recruited a representative sample of individuals with IBS, either only recruiting a referral population,[22,25] or including people with coeliac disease or inflammatory bowel disease.[26] The only other study to use a minimum threshold, albeit not the Rome criteria, to define FI only reported impact on quality of life and impairment at work in 83 and 23 participants, respectively.[25]

This study demonstrates that FI is common in IBS and that those with FI, compared with those without, have worse gastrointestinal and psychological symptoms, worse quality of life and that there is a greater impact of IBS on their activities of daily living and income. An age-related increase in prevalence of FI among IBS patients is unsurprising, and has been observed in previous studies.[14–18,60] Possible explanations for this include increased co-morbidities, reduced mobility and age-related anorectal anatomical changes.[61] Contrary to the common belief that FI is more prevalent in women because of childbirth, we did not observe an association between sex and FI. Although this may be because of the relatively small number of men in our study, previous studies have demonstrated similar results.[22,25] Population-based studies reporting FI in men and women have demonstrated conflicting results,[14–18] and the misconception that FI is more common in women may be because of underreporting by men in clinical practice. New onset FI has been reported to be associated with both anxiety and depression.[62] However, since none of the psychological co-morbidities were independently associated with FI in our study, this may be due to confounding factors, such as IBS severity. This is known to increase with increasing severity of, and incremental increases in number of, psychological comorbidities.[63] Lastly, although FI impacted on all aspects of private life, our results demonstrating only a trend towards impairment at work were surprising. This may be related to the fact that rates of employment were significantly lower among individuals with FI, or that this study was conducted during the COVID-19 pandemic, when there was a shift towards home working. However, the association between presence of FI and lower income we observed suggests that the debilitating nature of FI may impact on earning potential.

Our study has important implications. More than 50% of people with Rome IV IBS reported one or more episodes of FI in the last 3 months and one-in-four met the Rome IV criteria for FI. Quality of life scores were reduced with increasing frequency of accidental leakage of stools, irrespective of whether Rome IV criteria for FI were met. Those with FI were older, reported urgency as their predominant symptom, and had impairment in private leisure activities. They also had a lower annual income. FI appears to affect men and women with IBS equally and as previously discussed patients with FI may not readily disclose their symptoms. Physicians, therefore, need to be proactive in asking about FI to ensure that the full spectrum of patients' symptoms are captured. Future studies should investigate whether FI is responsive to treatment for IBS or whether specific alternative treatments should be offered to improve this debilitating symptom.

## AUTHOR CONTRIBUTIONS

**Vivek Goodoory:** Conceptualization (equal); data curation (equal); formal analysis (equal); investigation (equal); methodology (equal);

project administration (equal); writing – original draft (equal); writing – review and editing (equal). **Cho Ee Ng:** Conceptualization (equal); data curation (equal); investigation (equal); methodology (equal); project administration (equal); resources (equal); writing – review and editing (equal). **Christopher Black:** Conceptualization (equal); investigation (equal); methodology (equal); supervision (equal); writing – review and editing (equal). **Alexander Ford:** Conceptualization (equal); data curation (equal); formal analysis (equal); investigation (equal); methodology (lead); project administration (lead); resources (equal); supervision (lead); writing – original draft (equal); writing – review and editing (lead).

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## CONFLICT OF INTEREST STATEMENT

Vivek C. Goodoory: none. Cho Ee Ng: none. Christopher J. Black: none. Alexander C. Ford: none.

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