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Disorders of gut-brain interaction: Highly prevalent and burdensome yet under-taught within medical education

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[Correction added on 12 July 2022, after first online publication: A Graphical Abstract has been added.]

Abstract

Background and Objective: To determine the population prevalence and associated health impairment of disorders of gut-brain interaction (DGBI) across Great Britain, and the emphasis placed upon them within medical education.

Methods: An Internet-based cross-sectional health survey was completed by 1906 general population adults across Great Britain without self-reported organic GI disease. The survey enquired for demographics, symptom-based criteria for Rome IV DGBI, healthcare use, non-GI somatic symptoms, and quality of life. As a separate analysis, we evaluated which DGBI are considered core knowledge at undergraduate medical school level and post-graduate specialization level for Gastroenterologists and General Practitioners.

Results: The overall prevalence of DGBI across Great Britain was 37%, being similar for England (37%), Scotland (33%), and Wales (36%); $p = 0.66$. There was no difference between English regions (range 33%–43%, $p = 0.26$). The prevalence of DGBI was highest in those aged 18–40 years (40%), then 40–64 years (37%), and least amongst those ≥65 years (29%); $p < 0.001$. The most common DGBI were bowel disorders (30%), followed by gastroduodenal (10.5%), anorectal (8.1%) and oesophageal disorders (6.2%). Individuals with DGBI were significantly more likely than those without DGBI to have increased GI-related healthcare visits, medication use, surgical interventions, non-GI somatic symptoms, and reduced quality of life. One-in-three people with DGBI had multiple GI organ regions involved and this correlated with increased health impairment ($p < 0.001$).

The only DGBI mentioned across all medical training curricula is irritable bowel syndrome, while the General Practitioner and Gastroenterology Curricula also recognise the outdated term non-ulcer dyspepsia (as opposed to functional dyspepsia). The 2010 Gastroenterology Curriculum also includes functional constipation and disordered defecation, with the incoming 2022 iteration adding in

functional upper GI syndromes, functional abdominal pain, and opioid-induced GI disturbances.

Conclusion: Disorders of gut-brain interaction are common across Great Britain and incur substantial health impairment. However, they are generally under-taught within the British medical education system. Increasing awareness and education of disorders of gut-brain interaction might improve patient outcomes.

KEYWORDS
constipation, DGBI, disorders of gut-brain interaction, FGID, functional gastrointestinal disorders, IBS, irritable bowel syndrome, motility, motility disorders

INTRODUCTION

Disorders of gut-brain interaction (DGBI), previously known as functional gastrointestinal disorders (FGIDs), are clusters of chronic gastrointestinal symptoms that occur in the absence of organic disease.[1,2] While irritable bowel syndrome and functional dyspepsia are the most commonly recognised and researched DGBI, there are in total 33 DGBI which can arise from any region within the gastrointestinal tract, including the esophagus, gastroduodenum, bowel, biliary, centrally mediated, and anorectum (Supplementary Table A). The pathophysiology of DGBI is not completely known but can be best understood on the basis of the biopsychosocial model of illness and relates to any combination of visceral hypersensitivity, motility disturbances, altered mucosal and immune function, altered gut microbiota, and altered central nervous system processing.[1,2]

A recent epidemiological study conducted by the Rome Foundation concluded that over 40% of adults across the globe fulfil symptom-based criteria for a DGBI and incur considerable health impairment, healthcare use and reduced quality of life.[3] Indeed, DGBI are amongst the most commonly encountered gastrointestinal conditions seen within clinical practice, with conditions such as irritable bowel syndrome accounting for almost a third of all gastroenterology cases seen in primary care.[4] These conditions are costly both to the patient and healthcare sector due to their chronic remitting-relapsing nature. Establishing an early diagnosis, primarily through the recognition of key symptoms and elimination of inappropriate investigations, followed by individualized treatment can optimise patient care and reduce direct costs associated with DGBI.[5] It is therefore essential that primary and secondary-care physicians gain a greater understanding of the prevalence and impact of DGBI, and have the competencies to identify and manage these patients through their undergraduate, post-graduate, and continued medical education training.

To our knowledge no study has looked at the prevalence of DGBI within a specific geographical region and the emphasis placed upon them at all levels of medical education. We sought to examine this issue within Great Britain.

Key summary

What is the established knowledge

- Disorders of gut-brain interaction (DGBI), previously known as functional gastrointestinal disorders, are chronic gastrointestinal symptoms that occur in the absence of organic disease.
- The prevalence and impact of DGBI within a specific geographical region, and the emphasis placed upon them within medical education has not previously been studied.

What are the new findings from this study

- DGBI affect 1-in-3 adults within Great Britain, with a similar prevalence across England, Scotland and Wales.
- DGBI are associated with significant health impairment compared to those without DGBI, that is, more doctor visits, medication use, surgical interventions, non-GI somatic symptoms, and reduced quality of life.
- Despite the high prevalence of DGBI, and their substantial detriment to health, they are sparsely recognised or taught within the British under- and post-graduate medical education system.
- Increasing awareness and education of DGBI might improve patient outcomes.

METHODS

Determining the prevalence of DGBI and their associated heath impairment

A global market survey company (Qualtrics Inc.) was commissioned in the year 2015 to provide a nationally representative general population sample of adults from the United Kingdom, United States, and Canada. As detailed elsewhere, quota-based sampling was used to generate demographically balanced and population-representative samples with regards to age, sex, and education level.[6] The data

was used to determine the prevalence and impact of DGBI across the 3 countries which has previously been published.[6–11] For the purpose of this study we analysed the UK data only.

Of the 2100 adults who consented to participate in the study, 1994 completed a comprehensive online general health survey. Of these, 88 individuals who reported a history of known organic GI disease (i.e. inflammatory bowel disease, coeliac disease, upper or lower GI cancer) were excluded, leaving a study population of 1906 adults who provided the following data:

i. **Demographics**—including age, gender, and region of residence within Great Britain (England, Scotland, and Wales). For those living in England, we also enquired for county region of residence.
ii. **Medical history**—including weekly use of GI-related medication (laxatives, anti-diarrhoeals, antiemetics, acid-suppressing drugs, antispasmodics) and reported past abdominal surgical history (cholecystectomy, appendectomy, hysterectomy, bowel resection, and other pelvic or abdominal surgery). Individuals were also asked if they had ever consulted a healthcare professional for GI-related symptoms.
iii. **Rome IV diagnostic questionnaire to screen for DGBI**[12]—this validated questionnaire is benchmarked as the principal diagnostic tool for DGBI, and their inclusion into clinical trials and epidemiological surveys. For the purpose of this study, we report individuals meeting criteria for DGBI and then categorised them into one of the six anatomical GI regions that they belong to that is, oesophageal, gastroduodenal, pancreatobiliary, bowel, anorectal, and centrally-mediated disorders of GI pain. However, as there were only two cases of functional pancreatobiliary and no cases of centrally-mediated disorders of GI pain, we chose to exclude these from further analysis.
iv. **Patient health questionnaire (PHQ)-12 non-GI somatic symptom scale**[13,14]—the PHQ-12 is a modified version of the widely used PHQ-15 somatic symptom questionnaire that excludes the three GI symptoms (nausea, abdominal pain, altered bowel habit), as these are likely to be directly related to DGBI. As a result, the PHQ-12 only records bothersome non-GI somatic symptoms over the past month. The 12 symptoms assessed are back pain, limb pain, headaches, chest pain, dizziness, fainting spells, palpitations, breathlessness, menstrual cramps, dyspareunia, insomnia, and lethargy. Subjects were asked to rate how much they were troubled by these 12 symptoms over the last four weeks as 0 ("not bothered at all"), 1 ("bothered a little"), or 2 ("bothered a lot"). The PHQ-12 responses can be used to calculate (a) the number of sites reporting somatic symptoms (ranging from 0 to 12), (b) the overall non-GI somatic symptom severity score (ranging from 0 to 24), and (c) their severity category (mild, PHQ ≤3; low, PHQ 4–7; medium, PHQ 8–12; high, PHQ ≥13). Higher scores are generally considered to reflect a psychological tendency to report and experience a high amount of general bodily symptoms.
v. **Short-form (SF)-8 quality of life score**[15]—this validated questionnaire is commonly used in large scale epidemiological studies to assess general health-related quality of life (QOL) over the past month. The eight items enquire about physical functioning, physical role, bodily pain, general health perceptions, vitality, social functioning, emotional role, and mental health. The scores are normalised to the general population that has a mean score of 50.[15] A high score represents better QOL, whereas low scores represent poorer QOL.

Evaluating the inclusion of DGBI within the British medical education system

As a separate analysis, we evaluated the inclusion of DGBI, FGIDs (the previous and most widely used term for this group of disorders) and related terms at undergraduate level for medical students, and post-graduate specialization level for Gastroenterologists and General Practitioners. We searched for the keywords of "functional gastrointestinal disorders", "disorders of gut-brain interaction", "gut-brain axis", "biopychosocial model", as well as screening for individuals FGIDS, such as irritable bowel syndrome and functional dyspepsia. If these search terms were found, we then specifically assessed the free text with regards to any relevant explanations towards their diagnosis and management. This was done by evaluating three main documents:

i. The Speciality Training Curriculum for Gastroenterology (https://www.gmc-uk.org › Curricula)—published by the Joint Royal Colleges of Physicians Training Board in 2010, this curriculum defines the competencies needed to gain a certificate of completion of training in gastroenterology. As of August 2022, a new updated curriculum for Gastroenterology training will be implemented (https://www.jrcptb.org.uk/specialties).
ii. The Royal College of General Practitioners Curriculum (https://www.rcgp.org.uk › training › document-version)—published in 2016, this document encompasses the Clinical Modules section which states some of the areas of clinical practice that will be encountered as a General Practitioner.
iii. Medical Licensing Assessment content map (https://www.gmc-uk.org › medical-licensing-assessment)—published by the General Medical Council, this document will be introduced in 2023 and sets out a range of professional knowledge, skills and behaviours to be tested in final year medical students so that they can meet a safe threshold to practice medicine.

Statistics

SPSS version 27.0 was used to analyse the questionnaire data. There were no missing data points as the online questionnaire required participants to complete each question before continuing. Categorical variables were summarised by descriptive statistics including total numbers and percentages, with comparisons between groups performed using the chi-square test. Odds ratios (OR) with 95%

confidence intervals (95% C.I) were presented as appropriate. The mean and standard deviation of continuous variables was calculated, with differences between independent groups assessed using the unpaired Student's *t* test. Correlations were assessed using Pearson's test. For all statistical tests *p*-values of <0.05 were significant.

RESULTS

Baseline characteristics

Of the 1906 individuals who completed the survey, 1646 lived in England, 153 in Scotland and 107 in Wales. The mean-age of participants was 47 years (SD 16.8), with 49% female and 93% of white race.

Prevalence of Rome IV DGBI across Great Britain

The overall prevalence of fulfilling symptom-based criteria for any Rome IV DGBI across Great Britain was 37% ($n = 700$ of 1906), being similar for England (37%), Scotland (33%), and Wales (36%); $p = 0.66$ (Figure 1). There were no significant differences across English regions, ranging from 33% to 44%, $p = 0.26$ (Supplementary Table B).

The most common DGBI were bowel disorders at 30% (range 27.5%–31%), followed by gastroduodenal disorders at 10.5% (range 8.4%–12.4%), anorectal disorders at 8.1% (range 7.8%–10.5%) and oesophageal disorders at 6.2% (5.8%–12.1%). The prevalence of individual DGBI within those organ domains is listed in Table 1, with the clinically most recognised conditions of functional dyspepsia and irritable bowel syndrome accounting for 7.5% and 5.4%, respectively. While the prevalence rates of other DGBI were in general similar across the countries, there was a significantly higher prevalence of functional heartburn in Wales and belching in Scotland.

There was a statistically significant difference in the prevalence of all DGBI across age groups, being highest in those aged 18–40 years at 40%, followed by 37% for those aged between 40 and 64 years, and least amongst those aged 65 years and over at 29%; $p < 0.001$. This pattern was seen for gastroduodenal ($p < 0.001$) and bowel disorders ($p = 0.003$), but not for oesophageal and anorectal disorders (Figure 2).

Health impairment in people with DGBI

As shown in Table 2, individuals with symptoms compatible with DGBI, compared to those without DGBI, were younger (mean age 45 vs. 48 years, $p = 0.001$), more likely to be female (62% vs. 42%,

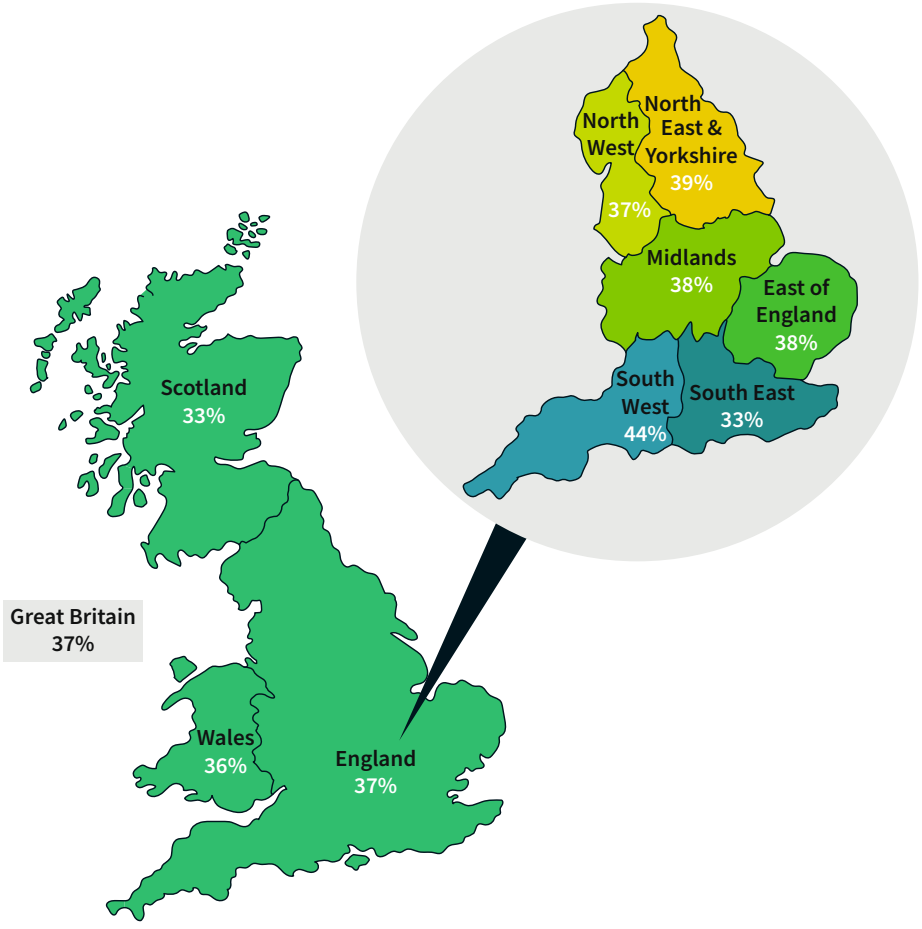

FIGURE 1 Prevalence of disorders of gut-brain interaction (DGBI) across Great Britain

TABLE 1 Prevalence of disorders of gut-brain interaction (DGBI) across great Britain

Prevalence of DGBI	Great Britain (n = 1906)	England (n = 1646)	Scotland (n = 153)	Wales (n = 107)	p-value (across countries)
Any DGBI	700 (37%)	610 (37%)	51 (33%)	39 (36%)	0.66
A. Oesophageal disorders					
Functional chest pain	28 (1.5%)	23 (1.4%)	1 (0.7%)	4 (3.7%)	0.14
Functional heartburn	32 (1.7%)	23 (1.4%)	3 (2.0%)	6 (5.6%)	0.004
Globus	17 (0.9%)	13 (0.8%)	2 (1.3%)	2 (1.9%)	0.44
Functional dysphagia	65 (3.4%)	57 (3.5%)	5 (3.3%)	3 (2.8%)	0.93
Any oesophageal disorder	119 (6.2%)	96 (5.8%)	10 (6.5%)	13 (12.1%)	0.03
B. Gastroduodenal disorders					
Functional dyspepsia	145 (7.5%)	121 (7.4%)	15 (9.8%)	8 (7.5%)	0.55
Belching disorder	19 (1.0%)	12 (0.7%)	6 (3.9%)	1 (0.9%)	<0.001
Rumination syndrome	60 (3.1%)	50 (3.0%)	6 (3.9%)	4 (3.7%)	0.78
Nausea and vomiting disorders	32 (1.7%)	29 (1.8%)	2 (1.3%)	1 (0.9%)	0.76
Any gastroduodenal disorder	201 (10.5%)	173 (10.5%)	19 (12.4%)	9 (8.4%)	0.58
C. Bowel disorders					
Irritable bowel syndrome (IBS)	103 (5.4%)	84 (5.1%)	11 (7.2%)	8 (7.5%)	0.34
Functional constipation	138 (7.2%)	119 (7.2%)	13 (8.5%)	6 (5.6%)	0.68
Opioid-induced constipation	36 (1.9%)	32 (1.9%)	3 (2.0%)	1 (0.9%)	0.76
Functional diarrhoea	74 (3.9%)	65 (3.9%)	6 (3.9%)	3 (2.8%)	0.84
Functional bloating/distension	68 (3.6%)	64 (3.9%)	2 (1.3%)	2 (1.9%)	0.16
Unspecified functional bowel disorder	165 (8.5%)	139 (8.4%)	10 (6.5%)	14 (13.1%)	0.16
Any bowel disorder	567 (29.7%)	492 (29.9%)	42 (27.5%)	33 (30.8%)	0.97
D. Anorectal disorders					
Faecal incontinence	50 (2.6%)	41 (2.5%)	4 (2.6%)	3 (2.8%)	0.98
Levator ani syndrome	27 (1.4%)	21 (1.3%)	5 (3.3%)	1 (0.9%)	0.13
Proctalgia fugax	98 (5.0%)	79 (4.8%)	8 (5.2%)	8 (7.5%)	0.46
Any anorectal disorder	154 (8.1%)	128 (7.8%)	16 (10.5%)	10 (9.3%)	0.45

OR = 2.2), and had greater healthcare utilization, including more healthcare visits (OR = 4.4), GI medication use (OR = 3.4) and surgical interventions (OR = 1.8). They also experienced reduced quality of life across all physical and mental domains ($p < 0.001$). Finally, individuals with DGBI had significantly higher mean PHQ-12 non-GI somatic symptom scores (6.6 vs. 3.2, $p < 0.001$), more somatic sites involved (5.0 vs. 2.7, $p < 0.001$), with a greater proportion having medium-high severity levels (32% vs. 8%, OR 6.9).

Of the 700 individuals with a DGBI, two-thirds (65%, n = 458) had one GI organ region involved whereas one-third (35%, n = 242) had multiple GI regions involved; with 169 (24%) having two regions, 46 (7%) having three regions and 27 (4%) with four regions. The accumulation of FGIDs correlated with increased non-GI somatic symptoms ($r = 0.47$, $p < 0.001$), reduced mental ($r = -0.38$, $p < 0.001$) and physical QOL ($r = -0.36$, $p < 0.001$).

Teaching of DGBI within the British medical education system

The Medical Licensing Assessment undergraduate content map only mentions irritable syndrome as a condition to be aware of but does not expand on this further with regards to the biopsychosocial model, its diagnosis or management. Other DGBI are not mentioned.

The Royal College of General Practitioners Curriculum module on digestive health mentions irritable bowel syndrome and the outdated term non-ulcer dyspepsia (as opposed to functional dyspepsia), in addition to appreciating their link with psychosocial and dietary factors. There is no specific mention that these conditions are FGIDs or DGBI.

The Speciality Gastroenterology Training Curriculum from 2010, and the incoming 2022 iteration, include a core module entitled

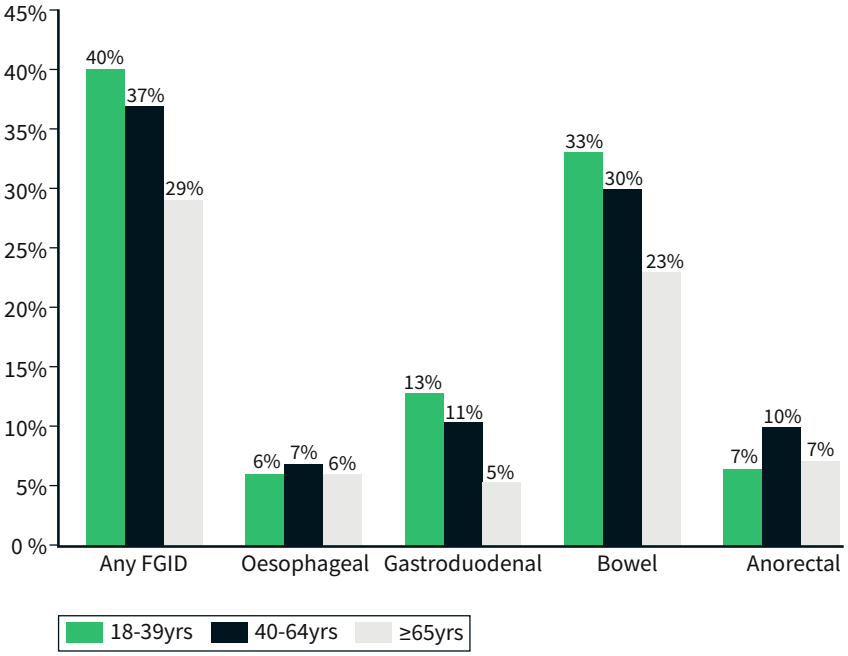

FIGURE 2 Prevalence of disorders of gut-brain interaction (DGBI) according to age group

Functional Gut Disorders, where the learning objectives highlighted include understanding their pathophysiology with regards to the brain-gut axis and relevant factors in the genesis of symptoms, such as dysmotility and the role of psychological distress. The section also mentions the need for appropriate and judicious use of investigations, making a clear diagnosis, and knowing the evidence-based treatment options for these conditions. The specific conditions mentioned in the 2010 version are irritable bowel syndrome, constipation and disordered defecation. However, the syndromes recognised to cause disordered defecation within the 2010 specialization curriculum did not include anorectal DGBI (e.g., dyssenergic defecation, proctalgia fugax, faecal incontinence, levator ani syndrome) but were considered as spurious diarrhoea, obstructed defecation, Hirschsprung's disease. The incoming 2022 Gastroenterology Training Curriculum also mentions non-ulcer dyspepsia (as opposed to functional dyspepsia), functional upper GI syndromes (without stating the individual conditions), functional abdominal pain (as opposed to centrally-mediated disorders of GI pain), and opioid-induced GI disturbances.

DISCUSSION

To our knowledge, this is the first study to evaluate the population prevalence of DGBI, previously known as FGIDs, across Great Britain and their inclusion as taught modules within the medical curricula. It found that DGBI are highly prevalent across all regions of Great Britain, affecting over a third of the general adult population, and associated with significant health impairment and healthcare utilisation. However, teaching on DGBI within the undergraduate and postgraduate medical education system does not reflect the prevalence and burden of these disorders. The only DGBI mentioned across all medical training curricula is irritable bowel syndrome, while the General Practitioner and Gastroenterology Training Curricula also recognise the outdated term non-ulcer dyspepsia (as opposed to functional dyspepsia). The 2010 Gastroenterology Training Curriculum also includes functional constipation and disordered defecation, with the incoming 2022 iteration adding in functional upper GI syndromes, functional abdominal pain, and opioid-induced GI disturbances.

The prevalence and impact of DGBI within Great Britain, as seen in our study, mirrors that of a recent global study where 40% of the world's population were noted to have a DGBI and incur substantial health burden.[3] Moreover, both studies share a similar prevalence of DGBI within Great Britain, which adds strength to the robustness and reliability of the findings. For example, the overall prevalence of DGBI within Great Britain was 37% versus 36.7%, while for the most commonly recognised DGBI such as functional dyspepsia it was 7.5% versus 6.6%, for irritable bowel syndrome 5.4% versus 4%, functional constipation 7.2% versus 8.6%, functional diarrhoea 3.9% versus 4.5%, and for functional bloating and distension 3.6% versus 3.8%.[3]

Our findings have important implications for medical education as they suggest that medical students and physicians are, in general, not being adequately trained to look after the most common gastrointestinal conditions. These concerns have also been echoed by gastroenterology trainees across Australia, Europe, and the United States, and are likely to resonate across the globe.[16–18] A recent survey of gastroenterology trainees within the United States reported that (a) ~50% have sometimes witnessed dismissive attitudes from their attendings and peers towards patients with DGBI, (b)

TABLE 2 Comparison between those with and without disorders of gut-brain interaction (DGBI)

	DGBI (*n* = 700)	No DGBI (*n* = 1206)	*p*-value	Odds ratio (95% C.I)
Demographics				
Mean age, yrs (SD)	45.3 (16.6)	48.0 (17.0)	0.001	-
Female sex	432 (62%)	504 (42%)	<0.001	2.2 (2.6–4.2)
PHQ-12 non-GI somatic symptoms				
Mean number of somatic sites, max = 12 (SD)	5.0 (2.4)	2.7 (2.2)	<0.001	-
Mean PHQ-12 total score (SD)	6.6 (3.8)	3.2 (2.8)	<0.001	-
Medium-high severity levels (PHQ-12 ≥ 8)	257 (32%)	93 (8%)	<0.001	6.9 (5.3–9.0)
Quality of life				
Mean physical functioning (SD)	45.4 (9.7)	50.3 (6.7)	<0.001	-
Mean role physical (SD)	45.7 (10.2)	51.1 (6.6)	<0.001	-
Mean bodily pain (SD)	46.8 (9.4)	54.3 (7.7)	<0.001	-
Mean general health (SD)	42.7 (8.0)	48.7 (6.9)	<0.001	-
Mean vitality (SD)	44.7 (8.3)	51.2 (7.6)	<0.001	-
Mean social functioning (SD)	45.1 (10.3)	51.6 (6.7)	<0.001	-
Mean role emotional (SD)	45.4 (8.7)	50.1 (5.2)	<0.001	-
Mental health (SD)	44.0 (11.4)	51.4 (8.3)	<0.001	-
GI-medication use				
Laxatives	82 (11.7%)	17 (1.4%)	<0.001	9.2 (5.5–15.8)
Antidiarrheals	36 (5.1%)	12 (1.0%)	<0.001	5.4 (2.8–10.4)
Antiemetics	29 (4.1%)	11 (0.9%)	<0.001	4.7 (2.3–9.5)
Acid-supressing drugs	184 (26.3%)	138 (11.4%)	<0.001	2.8 (2.2–3.5)
Antispasmodics	55 (7.9%)	13 (1.1%)	<0.001	7.8 (4.2–14.4)
Any of the above GI medication	238 (34%)	160 (13%)	<0.001	3.4 (2.6–4.2)
Surgical history				
Cholecystectomy	35 (5.0%)	33 (2.7%)	0.01	1.8 (1.15–3.1)
Appendectomy	72 (10.3%)	94 (7.8%)	0.06	1.4 (0.98–1.9)
Hysterectomy	43 (6.1%)	31 (2.6%)	<0.001	2.5 (1.6–4.0)
Bowel resection	12 (1.7%)	8 (0.7%)	0.03	2.6 (1.1–6.4)
Other pelvic or abdominal surgery	67 (9.6%)	51 (4.2%)	<0.001	2.4 (1.6–3.5)
Any of the above GI surgery	172 (25%)	183 (15%)	<0.001	1.8 (1.4–2.3)
GI health care utilization	278 (40%)	159 (13%)	<0.001	4.4 (3.5–5.4)

~21% felt frustrated or burnt out when seeing patients with DGBI, (c) ~40% preferred not to see a patient with DGBI, and (d) ~27% felt uncomfortable titrating neuromodulators.[19] A lack of familiarity can lead to incorrect diagnosis and management, and perhaps a perception that these disorders lack importance, culminating in suboptimal care. In fact, general practitioners and non-expert gastroenterologists are more likely to experience difficulties in confidently diagnosing common DGBI such as irritable bowel syndrome than they are inflammatory bowel disease.[20] Moreover, effective communication skills are essential in medicine but can be particularly challenging in patients with DGBI (or indeed any functional or somatic disorder) for which clinicians largely feel unprepared and undertrained.[21,22] Educational masterclasses and simulation-based training for functional disorders have been shown to improve diagnostic confidence and communication skills, which subsequently leads to better patient-provider relationship and reduced healthcare costs.[21,22] Since 2007, the Rome Foundation has created educational tools to help physicians optimise their competencies when managing patients with DGBI (https://theromefoundation.org). However, these workshops are accessed primarily by those with a specific interest in neurogastroenterology, so many clinicians who encounter such patients on a daily basis may not be aware of their availability. Hence, it

is paramount that undergraduate and relevant post-graduate curricula are tailored towards educating on DGBI, not just through didactic lectures but also simulations. While it might be overly optimistic to expect teaching on each specific DGBI, particular attention should be paid to understanding the broad concept of DGBI, specifically focusing on those conditions most frequently encountered in every day clinical practise, that is, irritable bowel syndrome, functional constipation, functional dyspepsia, and functional heartburn. It is reassuring that the latest Gastroenterology Training Curriculum, which is to be implemented in August 2022 and will replace the 2010 version, has included more functional gastrointestinal conditions; similar updates would also be welcomed in the General Practitioner and Medical School curricula.

The inadequate provision of medical education and training seen in the field of neurogastroenterology may be associated with the relatively low adoption of this speciality as a career choice.[16–18] It is perceived by young doctors as less prestigious than endoscopy, inflammatory bowel disease, hepatology, or GI cancer. Remuneration for clinical practice and funding for research in neurogastroenterology are low compared to the other fields.[18,23] Many DGBI patients are seen as posing difficult challenges to their provider, who may perceive their relationship with these patients as frustrating and not professionally satisfying. This further diminishes the incentive to specialize in this field. However, lifelong interest in neurogastroenterology can be stimulated through implementing dedicated apprenticeship-based training programs under the tutelage of experts.[23,24] One-month training at a high-volume centre can facilitate rapid learning of neurogastroenterology, the essentials of the diagnostic process, patient-provider communication, and patient-centred care, and the indications, basic interpretation and utility of motility tests.[24] Moreover, the teaching experience can be an enriching and rewarding endeavour for the mentors, who find that interactions with trainees can lead to them challenging assumptions and dogmas, and lend itself to new research questions or changes in clinical practice.[23] Putting similar schemes into place for medical students might help engage and bolster their interest in pursuing a career in neurogastroenterology.[25,26]

The study has some limitations. The diagnosis of DGBI was based upon the Rome IV diagnostic questionnaire and was not subsequently confirmed by a clinician or further investigations. We did not have access to the medical records of participants to confirm past medical or surgical history. Our study used an internet-based survey and due to its methodology we did not have a denominator to calculate the response rate. There is also inherent sample bias introduced by using an online methodology as it excludes households without Internet access. However, based on official UK statistics, the Internet was accessed every day, or almost every day, by 78% of adults (39.3 million) in Great Britain in 2015, when the study was conducted (https://www.ons.gov.uk). Furthermore, the alternative methods of data collection such as post, telephone, and personal interview are no longer feasible. In any event, the use of an online survey allowed a large quota-base sample to be collected that was representative of the population age, sex, and education level. We promoted the survey as one of general health and not GI-related. The curricula analysis was based on publically available documents, which serve as a guide as to the core knowledge required by under- and post-graduates but may not resemble the teaching provided within individual institutions. In addition, the inclusion of the search terms related to DGBI within curricula would not necessarily result in adequate competency-based outcomes for improving patient care.

In conclusion, DGBI, previously known as FGIDs, are common across all regions of Great Britain and cause substantial detriment to health and quality of life. However, there is little coverage of DGBI within the British undergraduate and postgraduate medical education system. Increasing awareness and education of DGBI might improve patient outcomes.

AUTHOR CONTRIBUTIONS

Imran Aziz, Olafur Palsson, Magnus Simren, Ami D. Sperber, Hans Törnblom, and William Whitehead contributed to the study design and its conduct. Julia Simons, Umair Shajee and Imran Aziz analysed the data and wrote the initial manuscript. All authors had access to the study data, revised the manuscript and approved the final version of the article. Imran Aziz is guarantor of the article.

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CONFLICT OF INTEREST

MS has received unrestricted research grants from Danone Nutricia Research and Glycom and served as a Consultant/Advisory Board member or speaker for Biocodex, Danone Nutricia Research, Ironwood, Genetic Analysis AS, Glycom, Tillotts, Menarini, Takeda, Kyowa Kirin, Arena, Adnovate, Alimentary Health, AlfaSigma, Falk Foundation and Shire. HT has served as Consultant/Advisory Board member for Almirall and Shire. OSP has received salary support from a research grants from Takeda Pharmaceuticals, Salix Pharmaceuticals and the Rome Foundation, from a consulting agreement with Glycom A/S, Ironwood Pharmaceuticals and an educational grant provided by Takeda Pharmaceuticals, and received a speaker honorarium in educational programmes supported by Ironwood Pharmaceuticals, Takeda Pharmaceuticals and the Rome Foundation. WEW received research grants from Takeda, Ironwood, Salix, and the Rome Foundation; served as a consultant to Biomerica USA, Ono Pharmaceuticals and Ferring; and received unrestricted educational grants from Takeda and Ferring. ADS has served as a consultant and speaker for Takeda-Israel and has received a research grant from them and as a consultant for Abbvie-Israel. JS, SU, and IA have no declarations.

DATA AVAILABILITY STATEMENT

On reasonable request.

ETHICS APPROVAL

The study was deemed IRB exempt by the University of Sheffield, UK, as all participants were anonymous to the investigators.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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