The Prevalence and Burden of Avoidant/Restrictive Food Intake Disorder (ARFID) Symptoms in Adults with Disorders of Gut-Brain Interaction: A Population-Based Study

Rosie Flack[1,2], Grace Brownlow[1,2], Helen Burton-Murray[3,4], Olafur Palsson[5], Imran Aziz[1,2]

1. Division of Clinical Medicine, School of Medicine and Population Health, University of Sheffield, UK
2. Academic Department of Gastroenterology, Sheffield Teaching Hospitals, Sheffield, UK
3. Department of Medicine, Division of Gastroenterology, Massachusetts General Hospital, Boston, MA, USA
4. Harvard Medical School, Boston, MA, USA
5. Center for Functional GI and Motility Disorders, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Corresponding author: Dr Imran Aziz, Academic Unit of Gastroenterology, Sheffield Teaching Hospitals NHS Foundation Trust and University of Sheffield, Sheffield, S10 2JF, United Kingdom

Email: imran.aziz1@nhs.net

Contributions: IA and OSP conceived the study; all authors contributed to the study design and its conduct. All authors analyzed the data and wrote the manuscript.

Conflict on interests: RF, GB, OSP and IA declare no relevant conflict of interests. HBM receives royalties from Oxford University Press for their book *Cognitive Behavioral Therapy for Rumination Syndrome*. HBM receives royalties from Cambridge University Press for her forthcoming book on functional bowel disorders.

Ethical approval: Before data collection started, the study was reviewed by the Institutional Review Board (IRB) at the University of North Carolina (Chapel Hill, NC, USA), and the University of Sheffield (Sheffield, UK). It was deemed IRB exempt because all study participants were anonymous to the investigators. All authors had access to the study data and reviewed and approved the final manuscript.

Funding: The survey was funded by Tillotts Pharma and Novonesis. This work was also supported by the National Institute of Diabetes and Digestive and Kidney Diseases (K23 DK131334 - HBM). The funders had no role in study design, data collection, data analysis, data interpretation or writing of the report.

Transparency statement: Data available on reasonable request

ABSTRACT

Background & Aims: Individuals with disorders of gut-brain interaction (DGBI) may experience avoidant/restrictive food intake disorder (ARFID) symptoms. However, extant findings have been limited to specialist neurogastroenterology clinics. We assessed the association between DGBI and ARFID within the adult general population.

Methods: A population-based Internet survey with pre-defined demographic quotas was conducted across the UK and USA in 2023. The survey included the Rome IV diagnostic questionnaire for DGBI, the Nine-Item ARFID Screen (NIAS), and questions regarding demographics, body mass index, non-gastrointestinal somatic symptoms, anxiety and depression, quality of life and healthcare use.

Results: 4002 adults (median age 46 [range 18-91] years, 50% female) completed the survey, of whom 1704 (42.6%) had symptoms compatible with at least one DGBI.

The prevalence of ARFID-positive screens was significantly higher among participants with DGBI compared to those without DGBI (34.6% vs. 19.4%, adjusted OR 1.67, 95% CI 1.43-1.94), with similar findings noted in each country. Among participants with DGBI, positive ARFID screens by NIAS subscale were lack of interest in eating (21.5%), sensory-based avoidance (18.1%) and fear of aversive consequences (9.9%).

The presence of ARFID increased with the number of DGBI anatomical regions, ranging from 19.4% in those with no DGBI, 27.7% with DGBI in one region, 39.5% for DGBI in two regions, 50.0% for DGBI in three regions, and 61.4% for DGBI in four regions ($p<0.001$).

Individuals with DGBI plus ARFID, compared to those with DGBI alone, were significantly more likely to be underweight (7.9% vs. 1.5%), have greater non-gastrointestinal somatic symptoms and psychological distress, reduced mental and physical quality of life, and increased healthcare utilization.

Conclusion: Positive ARFID screens are common in DGBI and associated with increased general health burden. Routine screening for ARFID in DGBI will inform the multi-integrated care plan provided by clinicians, dietitians, and psychologists.

Key words: Disorders of Gut-Brain Interaction; ARFID; Irritable Bowel Syndrome; Functional Dyspepsia; Healthcare utilization.

Introduction

Disorders of gut-brain interaction (DGBI) are clusters of chronic gastrointestinal symptoms that occur in the absence of organic or structural disease.[1] In total, there are 33 identified DGBI in different regions within the gastrointestinal tract, including the esophagus, gastroduodenum, bowel, biliary and anorectum.[1] The Rome Foundation Global Epidemiological Survey (RFGES) conducted in 2017 found that 40% of adults across the globe fulfill symptom-based criteria for at least one DGBI,[2] and that one in three people with DGBI have multiple overlapping regions of the gastrointestinal tract affected.[3] Individuals with DGBI incur considerable health impairment, and have increased healthcare utilization and reduced quality of life.[2,3] DGBI are associated with psychological distress, somatic symptom reporting, and eating disorders, with recent interest in the latter mainly focusing on the concept of avoidant/restrictive food intake disorder (ARFID).[4]

ARFID was introduced in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) in 2013.[5] It is defined by a persistent failure to meet nutritional and/or energy needs, resulting in at least one of the following: significant weight loss, significant nutritional deficiencies, reliance on enteral feeding or oral nutritional supplements, or substantial interference with psychosocial functioning.[5] Unlike anorexia nervosa and bulimia nervosa, ARFID is not driven by concerns about body weight or shape. Instead, it is typically associated with one or more of the following drivers: lack of interest in eating, sensory-based avoidance (e.g. due to taste, texture or smell) and/or fear of aversive consequences such as choking, vomiting or abdominal pain.[6] In the case of medical conditions, avoidant/restrictive eating in ARFID must be above and beyond what would be expected and/or warrant independent clinical attention.[7]

There is growing evidence to suggest a notable overlap between DGBI and ARFID. A recent scoping review of 18 studies found that the prevalence of ARFID symptoms ranged from 10-80% in neurogastroenterology patients, depending on the diagnostic criteria used.[8] However, marked heterogeneity was noted between the studies and the tools used to assess the presence of ARFID symptoms.[8] Moreover, these findings may not be representative of the general population, as they are limited to

individuals engaged with specialized healthcare services, thus prone to selection bias.

We aimed to assess the prevalence and burden of elevated ARFID symptoms among individuals with DGBI within the general population. Our *a priori* hypotheses were that i) ARFID symptoms are common among individuals with DGBI, ii) the prevalence and severity of ARFID symptoms increases with the number of affected DGBI regions, and iii) individuals with DGBI who meet screening criteria for ARFID experience greater health burden than those with DGBI alone.

Methods

Study design and participant recruitment

A population-based Internet survey was conducted across the UK and USA by Qualtrics Inc. (Provo, Utah, USA) between 31st October and 15th December 2023. Predefined demographic quotas were applied for each country to ensure population-representative samples with regards to age (40% aged 18-39 years, 40% aged 40-64 years and 20% aged 65 years and over) and sex (50% male: 50% female). Similar to the RFGES conducted in the year 2017,[2] we aimed for a sample size of approximately 2000 adults per country.

Participants were invited to complete a "general health survey" without specific reference to gastrointestinal or eating disorder symptoms. Following electronic informed consent, participants completed the survey online. No personally identifiable information was collected. Quality assurance procedures included restricting responses to one per device, mandatory completion of applicable questions and exclusion of participants who failed two attention checks or who displayed excessive inconsistency across repeated gastrointestinal diagnostic questions.

Questionnaires

The survey contained questions covering basic demographics (age, gender, ethnicity, country of residence), body mass index (BMI, using self-reported height and weight), medical history and healthcare utilization, the Rome IV Diagnostic Questionnaire for adult DGBI,[9] the Nine-Item ARFID Screen (NIAS),[10] anxiety and depression (Patient Health Questionnaire (PHQ-4),[11] non-gastrointestinal somatic symptoms (PHQ-12),[12] and health-related quality of life (QOL, using PROMIS Global-10).[13] Further details are provided below:

i). **Medical history and healthcare utilization** – individuals were asked about history of organic GI disease (i.e. celiac disease, peptic ulcer disease, diverticulitis, inflammatory bowel disease or GI cancer) which excluded them from having a DGBI regardless of whether they also fulfilled the Rome IV diagnostic questionnaire.

Information was also sought regarding healthcare visits, classes of medications used regularly (laxatives, antidiarrheals, antiemetics, antacids, antispasmodics, analgesics, anxiolytics and antidepressants), and any history of abdominal surgery (cholecystectomy, appendectomy, hysterectomy, bowel resection or any other abdominal surgery).

ii). **Rome IV diagnostic questionnaire**[9] – This validated questionnaire is benchmarked as the diagnostic tool for DGBI, their inclusion into clinical trials, and for performing epidemiological surveys. For the purpose of our study, we present individual DGBI but also categorized in accordance with the six-region division of these disorders in the Rome diagnostic system, i.e. esophageal, gastroduodenal, gallbladder, bowel, anorectal, and centrally mediated disorders of GI pain. However, due to a lack of cases, we excluded centrally mediated disorders of GI pain (n=1) and biliary disorders (n=7) from further analysis.

iii). Nine-Item ARFID Screen (NIAS)[10] – this validated questionnaire comprises nine statements, each rated on a 6-point Likert scale. The nine statements are: 1) *"I am a picky eater"*, 2) *"I dislike most of the foods that other people eat"*, 3) *"The list of foods that I like and will eat is shorter than the list of foods I won't eat"*, 4) *"I am not very interested in eating; I seem to have a smaller appetite than other people"*, 5) "*I have to push myself to eat regular meals throughout the day, or to eat a large enough amount of food at meals"*, 6) *"Even when I am eating a food I really like, it is hard for me to eat a large enough volume at meals"*, 7) *"I avoid or put off eating because I am afraid of gastrointestinal discomfort, choking or vomiting"*, 8) "*I restrict myself to certain foods because I am afraid that other foods will cause gastrointestinal discomfort, choking or vomiting"*, and 9) *"I eat small portions because I am afraid of gastrointestinal discomfort, choking or vomiting"*.

Each response is scored from 0 ("strongly disagree") to 5 ("strongly agree"), resulting in a total score out of 45. The NIAS has three subscales intended to map on to each of the three prototypical ARFID motivations, each with its own cut-off score validated in an eating disorder sample for a positive screen: NIAS-Picky for sensory-based avoidance (statements 1-3) requires a score of ≥10, NIAS-Interest for lack of interest in eating (statements 4-6) requires a score of ≥9, and NIAS-Fear for fear of aversive consequences (statements 7-9) requires a score of ≥10.[14] Internal consistency in our

sample was high for all subscales as indicated by Cronbach's alpha; 0.825 for NIAS-Picky, 0.844 for NIAS-Appetite, and 0.899 for NIAS-Fear.

iv). PHQ-4 anxiety and depression[11] – Respondents were asked how often, over the past two weeks, they have been bothered by the following: 1) Feeling anxious, nervous or on edge, 2) Not being able to stop or control worrying, 3) Little interest or pleasure in doing things, and 4) Feeling down, depressed or hopeless. Responses are scored as follows: 0 ("not at all"), 1 ("several days"), 2 ("more than half the days") and 3 ("nearly every day"). Scores are totaled to provide a combined anxiety and depression score (range 0-12), an anxiety score (sum of the first two questions, range 0-6) and a depression score (sum of the last two questions, range 0-6). An anxiety or depression score of ≥3 indicates clinically significant anxiety or depression, respectively.

v). PHQ-12 non-gastrointestinal somatic scale[12] – this is a modified version of the PHQ-15 that excludes gastrointestinal symptoms (i.e. nausea, abdominal pain and altered bowel habits) to provide a more accurate somatization score for individuals with DGBI. Participants were asked how much they had been bothered by the following symptoms over the past four weeks: 1) Back pain, 2) Pain in their arms, legs or joints, 3) Headaches, 4) Chest pain, 5) Dizziness, 6) Fainting spells, 7) Feeling your heart pound or race, 8) Shortness of breath, 9) Pain or problems during sexual intercourse, 10) Feeling tired or having low energy, 11) Trouble sleeping, and 12) Menstrual cramps or problems with your period (for individuals who menstruate). Responses were scored as follows: 0 ("not bothered at all"), 1 ("bothered a little") and 2 ("bothered a lot"). Higher scores indicate greater distress around somatic symptoms. There are four severity levels: minimal (0-3), low (4-7), medium (8-12) and high (13 or more).

vi). PROMIS Global-10 quality of life (QOL)[13] **–** this comprises 10 questions covering the following domains: general health, quality of life, mental and physical health, social activities, relationships and roles, ability to carry out physical activities, emotional distress, fatigue and pain. There are several steps to first calculate a raw score and then convert into a T-score and standard error.[15] A T-score of 50 represents the population mean and a lower T-score indicates worse QOL. This variable was dichotomized as a score of <50 (below average QOL) or a score of

≥50. Additionally, two questions that relate to social functioning (satisfaction with their social activities and relationships, and how well they are able to carry out their usual social activities and roles) were examined.

Statistical analyses

All statistical analyses were conducted using SPSS version 29.0 (SPSS Inc., Chicago, Illinois, USA), with a significance level set at $p<0.05$. Categorical variables were analyzed using contingency tables, unadjusted odds ratio (OR) with 95% confidence intervals (95% CI), and chi-square tests when ≥80% of expected cell counts exceeded five and all were greater than one. For 2x2 tables not meeting these assumptions, Yates' continuity correction or Fisher's exact test was applied as appropriate. Additionally, adjusted OR (aOR) values with 95% CI were used to adjust for factors such as age, sex, ethnicity and mood disorders as necessary as these are potential confounders in DGBI and ARFID.[2,16] Continuous variables were not normally distributed within the groups, so were summarized using median and interquartile range (IQR) and compared between groups using the Mann-Whitney U test (for two groups) or Kruskal-Wallis test (for three or more groups), with Bonferroni correction for multiple comparisons (alpha level 0.01). Correlations between continuous variables were assessed using Spearman's rho.

Results

Baseline characteristics

A total of 4002 participants completed the survey, of which 2002 were from the UK and 2000 from the USA. The sample was 50.0% female, median age 46 years (IQR 29 years) and 81.7% of White ethnicity. This was similar across the UK and USA; supplementary table.

The prevalence of DGBI in the general population

In the combined sample from both countries, 42.6% (n=1704/4002) of participants had symptoms compatible with a DGBI. The prevalence of DGBI in the UK population was 41.2% (n=825/2002) and in the USA it was 44.0% (n=879/2000). Individuals with DGBI were significantly more likely to be female (48.3% vs. 36.9%, p<0.001), and of younger median age (42 vs. 49 years, p<0.001), than those without DGBI.

The prevalence of having one region of the gastrointestinal tract affected by a DGBI was 24.8% (n=993), followed by 11.7% (n=468) with two DGBI regions, 4.3% (n=172) with three, and 1.7% (n=70) with DGBI in four regions. These findings align to the high prevalence of DGBI, and their overlapping tendencies, that have been previously published by the RGFES and recently updated following the COVID-19 pandemic.[2,3,17]

The prevalence of ARFID in adults with DGBI

Of the 1704 individuals with DGBI across both countries, 34.6% (n=590) had a positive ARFID screen. In the UK population, 31.0% (n=256/825) of individuals with DGBI screened positive for ARFID, while in the USA population it was 38.0% (n=334/879).

A positive ARFID screen was significantly more common in those with DGBI vs. without DGBI (34.6% vs. 19.4%, aOR 1.67, 95% CI 1.43-1.94, p<0.001); figure 1.

Moreover, those with a DGBI were significantly more likely to screen positive for all three ARFID presentations: sensory-based avoidance by NIAS-Picky (18.1% vs. 10.8%, aOR 1.39, 95% CI 1.15-1.69), lack of interest in eating by NIAS-Interest (21.5% vs. 10.7%, aOR 1.70, 95% CI 1.42-2.05) and fear of aversive consequences by NIAS-Fear (9.9% vs. 3.4%, aOR 2.29, 95% CI 1.72-3.06). Among individuals with DGBI and ARFID, approximately a third of cases had overlapping ARFID subtypes; figure 2.

We also evaluated the prevalence of positive ARFID screen according to DGBI regions, as detailed in table 1. This revealed that 42.1% of those with esophageal DGBI had a positive ARFID screen, 49.2% of those with a gastroduodenal DGBI, 33.1% of those with a bowel DGBI and 41.8% of those with an anorectal DGBI. The prevalence of ARFID positive screens amongst the most commonly recognized DGBI, i.e. functional dyspepsia and IBS, was 56.2% and 50.4%, respectively. Again, individuals with DGBI in any region were significantly more likely than those without DGBI in the same regions to screen positive for ARFID; table 1 and supplementary table 1. The overlap of ARFID presentations was similar across the different DGBI regions; supplementary figure 1.

Characteristics, and burden, of individuals with DGBI +/- ARFID

Individuals with DGBI and a positive ARFID screen were significantly more likely than those without ARFID symptoms to be of female sex (61.0% vs. 54.3%, OR 1.32, 95% CI 1.08-1.61, p=0.008), younger age (median 39 years vs. 44 years, p<0.001), and of non-White ethnicity (20.8% vs. 16.4%, OR 1.34, 95% CI 1.04-1.73, p=0.024); table 2.

Further, individuals with both a DGBI and a positive ARFID screen experienced a significantly greater health burden than those with DGBI alone; table 2. This included higher rates of anxiety (51.0% vs. 33.0%, p<0.001), depression (49.2% vs. 32.0%, p<0.001), somatic symptoms (63.7% vs. 43.1%, p<0.001), doctor visits (14.7% vs. 9.6%, p=0.001), and medication use (83.7% vs. 72.4%, p<0.001). They also reported significantly lower mental (p=0.018) and physical (p<0.001) QOL scores, reduced satisfaction with social activities and relationships (21.4% vs. 14.5%, p<0.001) and

greater difficulty carrying out usual social activities and roles (13.2% vs. 6.4%, p<0.001). Individuals with DGBI and a positive ARFID screen were significantly more likely, than those without ARFID, to be underweight with a BMI of <18.5 (7.9% vs. 1.5%, aOR 5.36, 95% CI 2.78-10.33, p<0.001). A further interesting observation was that 25.5% and 30.4% of people with DGBI and ARFID were in the overweight and obese categories; table 2.

Association between number of affected DGBI regions and ARFID

As the number of anatomical GI regions affected by DGBI increased, the prevalence of positive ARFID screens and its severity also increased. Positive ARFID screens were present in 19.4% of individuals without a DGBI, increasing to 27.7% in those with one affected region, 39.5% with two, 50.0% with three, and 61.4% with four regions with DGBI (p<0.001, figure 3). Similar findings were observed in ARFID severity, with median total scores rising from 9 in individuals without DGBI to 10, 14, 18 and 20 in those with one, two, three and four affected regions, respectively (r=0.23, p<0.001). A comparable pattern emerged across individual ARFID subtypes.

Discussion

To our knowledge, this is the first study to assess the prevalence of ARFID symptoms amongst individuals with DGBI within the adult general population. This study found that DGBI are highly prevalent, affecting 42.6% of adults in the UK and USA. Approximately one in three individuals with DGBI screened positive for ARFID, which was significantly higher than those without DGBI. Individuals with DGBI and ARFID, compared those with DGBI alone, demonstrated greater general health impairment in terms of higher rates of psychological distress, somatic symptom reporting, healthcare utilization, and being in the underweight BMI category. They also demonstrated reduced quality of life, lower satisfaction with social activities and relationships, and greater difficulty engaging in daily social and occupational roles. Finally, as the number of anatomical GI regions affected by DGBI increased, so did both the prevalence and severity of ARFID symptoms.

Our findings add to the growing literature which reports a common association between DGBI and ARFID.[8] However, previous studies have largely been restricted to specialist neurogastroenterology clinics, that have mainly evaluated ARFID in specific DGBIs (as opposed to across all DGBI), and used heterogeneous methodology including non-validated screening tools. This limits generalizability, whereas the strengths of our study are that, i) we sampled a large number of individuals across the general population of two countries based on nationally representative demographics, ii) used homogeneous methodology and validated screening tools (e.g. Rome IV diagnostic questionnaire and the NIAS) to assess for the prevalence of all DGBI and a positive ARFID screen, and iii) reduced selection bias by introducing the study as one evaluating general health, without mentioning research looking at GI or eating disorders.

However, there are limitations to our study which warrant consideration. First, from this cross-sectional dataset we report an association between DGBI and ARFID, but not direction of causality. While individuals in specialist neurogastroenterology clinics have a high prevalence of ARFID symptoms,[18,19] a high proportion of individuals with eating disorders fulfill criteria for DGBI. For example, 83-98% of females undergoing inpatient treatment for eating disorders, and 39% of individuals attending outpatient clinics for eating disorders, meet criteria for a DGBI.[20-23] A retrospective temporal

study reported that 82% of individuals with both conditions experienced the onset of an eating disorder prior to developing a DGBI.[24] On the other hand, individuals with DGBI are more likely to experience triggering events for ARFID, such as choking, vomiting, abdominal pain and/or bowel disturbances.[25] These distressing episodes can lead to the sudden onset of avoidant or restrictive eating due to a fear of recurrence.[25] Individuals with DGBI may also experience visceral hypersensitivity and heightened sensory responses to normal eating and digestion, leading to GI-specific anxiety.[25] Over time, this hypervigilance towards GI sensations exacerbates symptoms, reinforcing a learned fear response to eating and promoting restrictive eating behaviours.[25] Further, patients with DGBI frequently use exclusion diets as a method of symptom control, which may inadvertently reinforce avoidant or restrictive eating behaviors when not under the guidance of a dietitian.[25] The low FODMAP diet which is often recommended for IBS, has been linked to an increased risk of restrictive eating patterns.[26] A retrospective study found that individuals who had attempted an exclusion diet were over three times more likely to exhibit ARFID symptoms.[27] However, it must also be acknowledged that while ARFID and DGBI frequently co-occur, they may not be linked and can develop independently of each other, with separate, non-overlapping factors contributing to the maintenance of each disorder.[25]

A second limitation is that gender minority groups were not captured in our survey, which may have led to an underestimation of ARFID prevalence, given they are at risk for eating disorders.[16,28] Third, our study used self-reported data and we did not have access to medical records nor could we perform clinical investigations to confirm the diagnosis of DGBI or ARFID. Reassuringly, most people who have symptoms compatible with a DGBI do not have organic disease and, in our dataset, those who reported a doctor diagnosis of celiac disease, inflammatory bowel disease or GI cancer were excluded from having a DGBI.[29,30] For those individuals who screened positive for possible ARFID using the NIAS, comprehensive multidisciplinary assessment involving medical, psychological and nutritional services would be needed to confirm the diagnosis.[31] This team-based approach is critical to evaluate nutritional status, identify psychosocial or behavioral factors, and rule out other causes of restrictive eating, ensuring accurate diagnosis and appropriate care. For example, the diagnosis of ARFID requires exclusion of body

dysmorphia, which would be more aligned to eating disorders such an anorexia nervosa and bulimia nervosa.[5] Similarly, the diagnosis of ARFID requires that that the avoidant/restrictive eating is associated with significant medical (e.g., weight loss, nutrient deficiencies, reliance on supplemental nutrition) and/or psychosocial impairments (e.g., inability to eat socially).[7] These factors were not explored in our study. We also were not able to determine if symptoms endorsed on the NIAS were above and beyond what would be expected in the context of a DGBI and/or warrant independent clinical attention.[25,32] Nevertheless, regardless of the final diagnosis, our data suggests that ARFID symptoms are common amongst individuals with DGBI. Our study also reveals that a notable proportion of individuals (19.4%) without DGBI had a positive ARFID screen. While this seems high for the general population, it is unlikely that this was related to selection bias as the survey recruitment made no mention of exploring eating behaviors. However, this high prevalence could possibly be linked to other increasingly diagnosed medical conditions e.g. neurodiversity is reported to affect 1 in 7 adults within the general population,[33] and associated with ARFID.[34]

Finally, while the NIAS cutoff scores have been validated in individuals with clinically-diagnosed ARFID, they have not yet been validated in adults with DGBI. Some investigators have suggested using a higher ARFID subscale cut-off scores of ≥12 in DGBI.[35] In anticipation for possible changes to ARFID criteria in the future, we conducted a separate sensitivity analysis using higher cutoffs (i.e. subscale scores $\geq$12; supplementary table 2 and supplementary figure 2). Even with the higher subscale cutoffs, a positive ARFID screen was still common in those with DGBI (17.7%) and amongst individuals DGBI, e.g. 27.7% in IBS and 32.0% in functional dyspepsia.

In summary, we suggest that routine screening for ARFID be performed in individuals consulting with any DGBI. This could be performed using brief, validated, screening tools such as the NIAS, to start a conversation about a patient's relationship with eating.[10,32] Where implementation of tools like the NIAS is not possible, clinicians may consider asking patients an open-ended question like *"tell me about your relationship with food"* and/or completing a brief 24-hour dietary recall.[25,32] It is important to screen people of all BMI, as our study showed that of those with a DGBI

and ARFID, a substantial proportion are normal weight (36.2%), overweight (25.5%) or obese (30.4%). This may be because many individuals with ARFID do not experience weight loss or that some individuals experience significant weight loss albeit remain at a higher weight status – significant weight suppression can still represent a malnourished state. It is important to remember that ARFID affects individuals across the weight-spectrum.[25]

Early identification of ARFID amongst people with DGBI could then facilitate timely intervention from a multidisciplinary team approach, whereby combined intervention from physicians, nurses, dietitians and psychologists might improve patient outcomes. An Australian study reported better long term outcomes in patients with DGBI who received a multi-integrated care approach compared with a gastroenterologist alone.[36,37] Similar randomized trials are needed in DGBI and ARFID, measuring various end-points including gastrointestinal, psychological, quality of life, healthcare use and cost, and nutritional well-being. Cognitive behavioral therapy for ARFID in the context of DGBI has also shown promising early results.[38] Further, increasing FODMAP intake through an exposure-based therapy vs. stress-management for IBS mediated IBS symptom improvement in one study.[39] Digital self-help interventions based on this may offer accessible options, especially given pressures on healthcare systems, but empirically-supported options are not yet available.

In conclusion, positive ARFID screens are common in DGBI and associated with increased general health burden. Routine screening for ARFID in DGBI will help provide a tailored, multi-integrated care plan that addresses both gastrointestinal and eating disorder-related symptoms.

Table 1: Prevalence, and odds ratios, of positive ARFID screens among individuals with DGBI

Condition	N	ARFID, n (%)	OR (95% CI) of ARFID in those with DGBI vs. without that DGBI	Adjusted OR (95% CI) of ARFID in those with DGBI vs. without that DGBI
Any DGBI	1704	590 (34.6%)	2.21 (1.91-2.55)	1.67 (1.43-1.94)
Any esophageal DGBI	404	170 (42.1%)	2.30 (1.86-2.84)	1.79 (1.44-2.24)
Functional chest pain	81	26 (32.1%)	1.36 (0.85-2.19)	0.94 (0.57-1.53)
Functional heartburn	110	61 (55.5%)	3.73 (2.54-5.47)	3.16 (2.12-4.70)
Reflux hypersensitivity	68	33 (48.5%)	2.76 (1.71-4.46)	2.18 (1.32-3.59)
Globus	33	7 (21.2%)	0.77 (0.33-1.78)	0.81 (0.34-1.92)
Functional dysphagia	227	109 (48.0%)	2.84 (2.17-3.73)	2.24 (1.69-2.97)
Any gastroduodenal DGBI	655	322 (49.2%)	3.57 (3.00-4.25)	2.75 (2.29-3.30)
Functional dyspepsia	475	267 (56.2%)	4.61 (3.78-5.62)	3.59 (2.92-4.41)
Postprandial distress syndrome	418	242 (57.9%)	4.84 (3.92-5.97)	3.77 (3.03-4.68)
Epigastric pain syndrome	169	108 (63.9%)	5.55 (4.02-7.66)	4.16 (2.98-5.80)
Belching disorders	40	20 (50.0%)	2.90 (1.56-5.42)	1.98 (1.04-3.76)
Nausea and vomiting disorders	150	91 (60.7%)	4.75 (3.40-6.65)	3.35 (2.37-4.75)
Chronic nausea and vomiting disorder	81	49 (60.5%)	4.56 (2.90-7.16)	2.95 (1.85-4.71)
Cyclical vomiting syndrome	73	46 (63.0%)	5.07 (3.13-8.19)	4.02 (2.44-6.61)
Cannabinoid hyperemesis syndrome	16	11 (68.8%)	6.36 (2.21-18.36)	3.51 (1.19-10.37)
Rumination syndrome	167	60 (35.9%)	1.65 (1.19-2.28)	1.28 (0.91-1.79)
Any bowel DGBI	1302	431 (33.1%)	1.72 (1.48-1.99)	1.30 (1.11-1.51)
Irritable bowel syndrome (IBS)	242	122 (50.4%)	3.17 (2.44-4.12)	2.12 (1.61-2.79)
IBS with predominant constipation	79	43 (54.4%)	3.53 (2.25-5.53)	2.36 (1.48-3.75)
IBS with predominant diarrhoea	67	31 (46.3%)	2.51 (1.55-4.09)	1.73 (1.05-2.86)
IBS with mixed bowel habits	88	45 (51.1%)	3.09 (2.02-4.72)	2.02 (1.30-3.13)
IBS unclassified	8	3 (37.5%)	1.72 (0.41-7.22)	1.31 (0.29-5.89)
Functional constipation	360	117 (32.5%)	1.43 (1.13-1.80)	1.20 (0.94-1.53)
Functional diarrhea	219	63 (28.8%)	1.17 (0.86-1.58)	1.00 (0.73-1.36)
Functional abdominal bloating/distension	143	33 (23.1%)	0.86 (0.58-1.27)	0.70 (0.46-1.05)
Unspecified functional bowel disorder	300	79 (26.3%)	1.03 (0.79-1.34)	0.90 (0.68-1.19)
Opioid-induced constipation	64	28 (43.8%)	2.26 (1.37-3.73)	1.97 (1.18-3.32)
Any anorectal DGBI	364	152 (41.8%)	2.24 (1.79-2.79)	1.73 (1.37-2.18)
Faecal incontinence	125	57 (45.6%)	2.49 (1.74-3.56)	2.25 (1.54-3.27)
Levator Ani syndrome	77	41 (53.2%)	3.36 (2.13-5.29)	2.33 (1.46-3.73)
Proctalgia fugax	214	80 (37.4%)	1.77 (1.33-2.36)	1.31 (0.97-1.77)

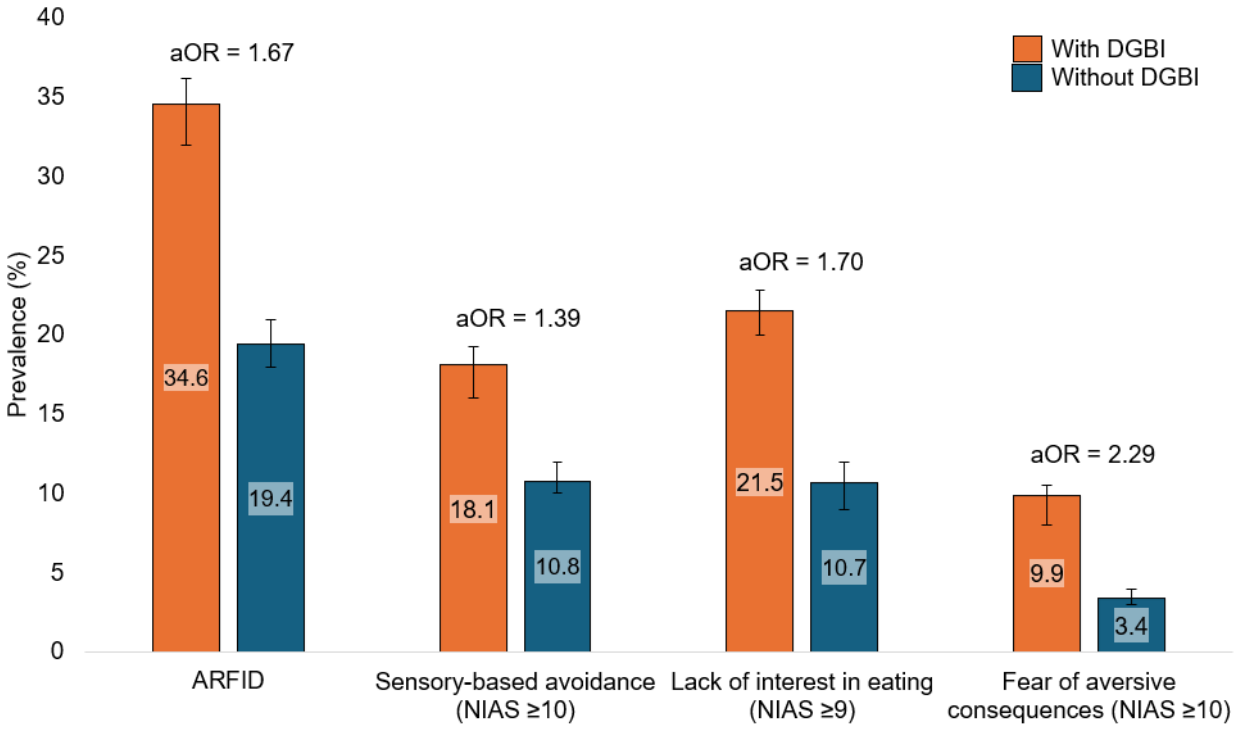
* Adjusted for age, sex, and mood disorders

Table 2: Characteristics of individuals with DGBI +/- ARFID

	DGBI + ARFID (n=590)	DGBI - ARFID (n=1114)	OR (95% CI)	Adjusted OR** (95% CI)
Female sex	360 (61.0%)	605 (54.3%)	1.32 (1.08-1.61)	-
Median age (IQR)	39.0 (26.0)	44.0 (25.0)	-	-
Age categories				
18-39 yrs	296 (50.2%)	457 (41.0%)		
40-64 yrs	235 (39.8%)	487 (43.7%)	-	-
65+ yrs	59 (10.0%)	170 (15.3%)		
Non-White ethnicity, n (%)	123 (20.8%)	183 (16.4%)	1.34 (1.04-1.73)	-
BMI *	n=428	n=870		
Underweight (<18.5)	34 (7.9%)	13 (1.5%)		
Normal weight (18.5-24.9)	155 (36.2%)	285 (32.8%)	-	-
Overweight (25-29.9)	109 (25.5%)	256 (29.4%)		
Obese (30+)	130 (30.4%)	316 (36.3%)		
Anxiety (PHQ-4 subscale≥3)	301 (51.0%)	368 (33.0%)	2.11 (1.72-2.59)	1.91 (1.55-2.36)
Depression (PHQ-4 subscale≥3)	290 (49.2%)	356 (32.0%)	2.06 (1.68-2.53)	1.91 (1.55-2.36)
Moderate to high somatic symptom reporting (PHQ-12 ≥8)	376 (63.7%)	480 (43.1%)	2.32 (1.89-2.85)	2.10 (1.70-2.60)
Quality of life (PROMIS 10)				
Below average physical QOL	502 (85.1%)	827 (74.2%)	1.98 (1.52-2.58)	1.97 (1.51-2.57)
Below average mental QOL	486 (82.4%)	843 (75.7%)	1.50 (1.17-1.93)	1.36 (1.06-1.76)
Poor satisfaction with social activities and relationships	126 (21.4%)	161 (14.5%)	1.61 (1.24-2.08)	1.61 (1.24-2.08)
Difficulty performing usual social activities and roles	78 (13.2%)	71 (6.4%)	2.24 (1.60-3.14)	2.36 (1.68-3.33)
Healthcare Utilisation				
Appendectomy	80 (13.6%)	117 (10.5%)	1.34 (0.99-1.81)	1.49 (1.09-2.03)
Cholecystectomy	64 (10.8%)	103 (9.2%)	1.19 (0.86-1.66)	1.33 (0.95-1.88)
Hysterectomy	44 (7.5%)	67 (6.0%)	1.26 (0.85-1.87)	1.42 (0.93-2.17)
Bowel resection	8 (1.4%)	6 (0.5%)	2.54 (0.88-7.35)	2.61 (0.89-7.64)
Laxatives	144 (24.4%)	130 (11.7%)	2.44 (1.88-3.18)	2.59 (1.98-3.38)
Antidiarrheals	80 (13.6%)	89 (8.0%)	1.81 (1.31-2.49)	1.80 (1.30-2.50)
Antiemetics	110 (18.6%)	81 (7.3%)	2.92 (2.15-3.97)	2.81 (2.06-3.83)
Acid suppressants	255 (43.2%)	388 (34.8%)	1.42 (1.16-1.75)	1.56 (1.26-1.92)
Analgesia	326 (55.3%)	479 (43.0%)	1.64 (1.34-2.00)	1.64 (1.34-2.00)
Antispasmodics	103 (17.5%)	133 (11.9%)	1.56 (1.18-2.06)	1.56 (1.18-2.07)
Anxiolytics	219 (37.1%)	287 (25.8%)	1.70 (1.37-2.11)	1.66 (1.33-2.06)
Antidepressants	219 (37.1%)	301 (27.0%)	1.59 (1.29-1.97)	1.59 (1.28-1.97)
Sedatives	168 (28.5%)	196 (17.6%)	1.87 (1.47-2.36)	1.86 (1.46-2.36)
Any of the above medication	494 (83.7%)	807 (72.4%)	1.96 (1.52-2.53)	2.04 (1.57-2.65)
Very concerned re bowels	167 (28.3%)	139 (12.5%)	2.77 (2.15-3.56)	2.77 (2.14-3.58)
GI-related healthcare visits	264 (44.7%)	384 (34.5%)	1.54 (1.26-1.89)	1.57 (1.28-1.93)
Doctor visits ≥ 1 per month	87 (14.7%)	107 (9.6%)	1.63 (1.20-2.20)	1.66 (1.23-2.26)

* BMI was not available in all participants ** adjusted for age, sex and ethnicity

Figure 1: The prevalence of positive screens for ARFID in those with, and without, DGBI.



Note: The error bars represent 95% CI

Figure 2: The overlap of ARFID subtypes in individuals with DGBI.

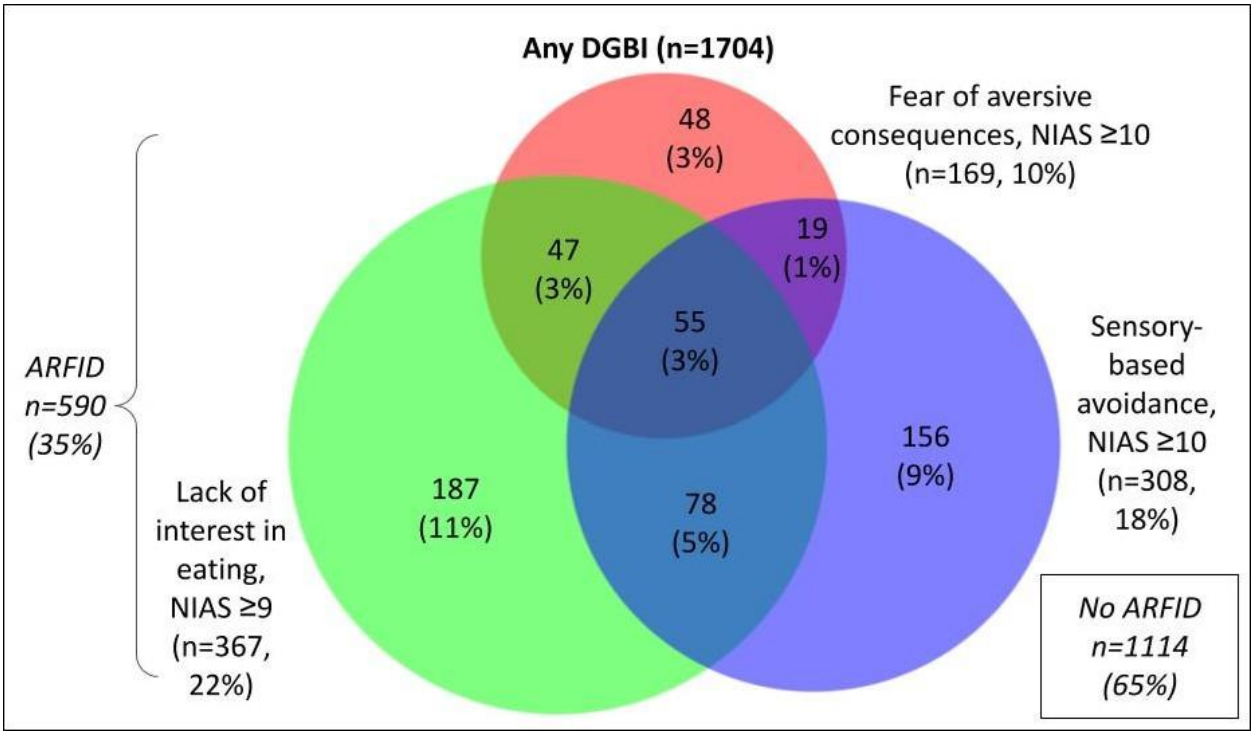
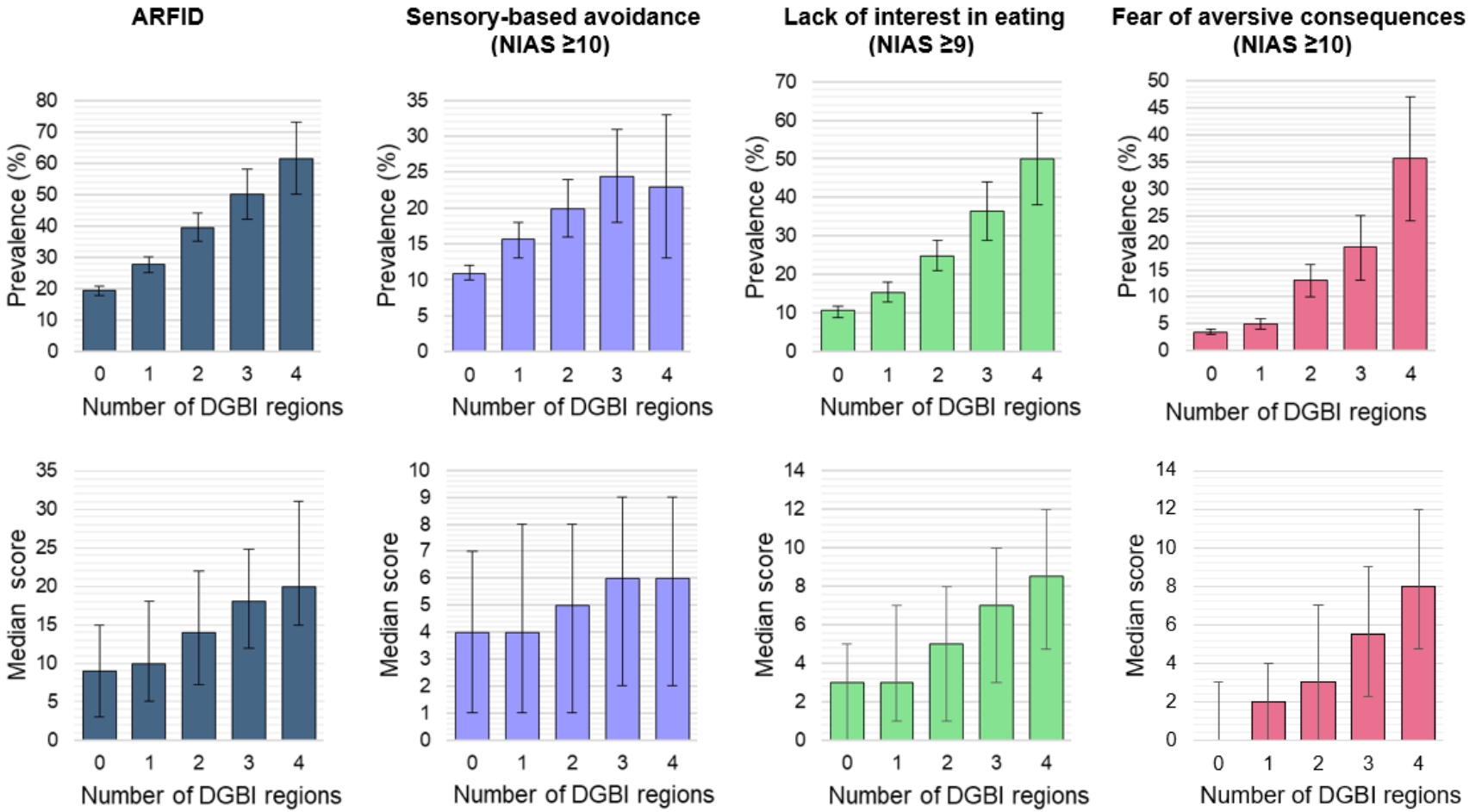


Figure 3: The association between the number of DGBI regions and prevalence/severity of ARFID



Note: The error bars in the top row represent 95% CI, while the error bars in the second row represent IQR

References

1. Drossman DA. Functional gastrointestinal disorders: History, pathophysiology, clinical features, and Rome IV. *Gastroenterology*. 2016;150(6):1262-1279. doi:10.1053/j.gastro.2016.02.032
2. Sperber AD, Bangdiwala SI, Drossman DA, et al. Worldwide prevalence and burden of functional gastrointestinal disorders, results of Rome Foundation global study. *Gastroenterology*. 2021;160(1):99-114. doi:10.1053/j.gastro.2020.04.014
3. Sperber AD, Freud T, Aziz I, et al. Greater overlap of Rome IV disorders of gut-brain interactions leads to increased disease severity and poorer quality of life. *Clinical Gastroenterology and Hepatology*. 2022;20(5):945-956. doi:10.1016/j.cgh.2021.05.042
4. Staller K, Abber SR, Burton Murray H. The intersection between eating disorders and gastrointestinal disorders: A narrative review and practical guide. *The Lancet Gastroenterology & Hepatology*. 2023;8(6):565-578.
5. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. Fifth ed. American Psychiatric Association; 2013:chap Feeding and eating disorders.
6. Thomas JJ, Lawson EA, Micali N, Misra M, Deckersbach T, Eddy KT. Avoidant/restrictive food intake disorder: a three dimensional model of neurobiology with implications for etiology and treatment. *Current Psychiatry Reports*. 2017;19(8):54. doi:10.1007/s11920-017-0795-5
7. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders : DSM-5-TR*. 5th edition, text revision. ed. DSM-5-TR. Washington, DC : American Psychiatric Association Publishing,; 2022.
8. Mikhael-Moussa H, Bertrand V, Lejeune E, et al. The association of avoidant/restrictive food intake disorder (ARFID) and neurogastroenterology disorders (including disorders of gut-brain interaction [DGBI]): A scoping review. *Neurogastroenterology & Motility*. 2025;e70039
9. Palsson OS, Whitehead WE, Van Tilburg MAL, et al. Development and validation of the Rome IV Diagnostic Questionnaire for adults. *Gastroenterology*. 2016;150(6):1481-1491. doi:10.1053/j.gastro.2016.02.014
10. Zickgraf HF, Ellis JM. Initial validation of the Nine Item Avoidant/Restrictive Food Intake disorder Screen (NIAS): A measure of three restrictive eating patterns. *Appetite*. 2018;123:32-42. doi:10.1016/j.appet.2017.11.111
11. Löwe B, Wahl I, Rose M, et al. A 4-item measure of depression and anxiety: Validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. *Journal of Affective Disorders*. 2010;122(1-2):86-95. doi:10.1016/j.jad.2009.06.019
12. Spiller RC, Humes DJ, Campbell E, et al. The Patient Health Questionnaire 12 Somatic Symptom scale as a predictor of symptom severity and consulting behaviour in patients with irritable bowel syndrome and symptomatic diverticular disease. *Alimentary Pharmacology & Therapeutics*. 2010;32(6):811-820. doi:10.1111/j.1365-2036.2010.04402.x
13. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the Patient-Reported Outcomes Measurement Information System (PROMIS) Global items. *Quality of Life Research*. 2009;18(7):873-880. doi:10.1007/s11136-009-9496-9
14. Burton-Murray H, Dreier MJ, Zickgraf HF, et al. Validation of the Nine Item ARFID Screen (NIAS) subscales for distinguishing ARFID presentations and screening for ARFID. *The International Journal of Eating Disorders*. 2021;54(10):1782-1792. doi:10.1002/eat.23520
15. PROMIS - Global Health. Global health scoring manual. Accessed 5th May, 2025. https://www.healthmeasures.net/images/PROMIS/manuals/Scoring_Manuals_/PROMIS_Global_Health_Scoring_Manual.pdf
16. D'Adamo L, Smolar L, Balantekin KN, Taylor CB, Wilfley DE, Fitzsimmons-Craft EE. Prevalence, characteristics, and correlates of probable avoidant/restrictive food intake disorder

among adult respondents to the National Eating Disorders Association online screen: A cross-sectional study. *Journal of Eating Disorders*. 2023;11(214)doi:10.1186/s40337-023-00939-0
17. Palsson O, Simren M, Sperber AD, Bangdiwala S, Hreinsson JP, Aziz I. The Prevalence and Burden of Disorders of Gut-Brain Interaction (DGBI) before versus after the COVID-19 Pandemic. *Clin Gastroenterol Hepatol*. 2025;doi:10.1016/j.cgh.2025.07.012
18. Burton-Murray H, Riddle M, Rao F, et al. Eating disorder symptoms, including avoidant/restrictive food intake disorder, in patients with disorders of gut-brain interaction. *Neurogastroenterology and Motility*. 2022;34(8)doi:10.1111/nmo.14258
19. Burton-Murray H, Bailey AP, Keshishian AC, et al. Prevalence and characteristics of avoidant/restrictive food intake disorder in adult neurogastroenterology patients. *Clinical Gastroenterology and Hepatology*. 2020;18(9):1995-2002. doi:10.1016/j.cgh.2019.10.030
20. Boyd C, Abraham S, Kellow J. Appearance and disappearance of functional gastrointestinal disorders in patients with eating disorders. *Neurogastroenterology and Motility*. 2010;22(12):1279-1283. doi:10.1111/j.1365-2982.2010.01576.x
21. Wang X, Luscombe GM, Boyd C, Kellow J, Abraham S. Functional gastrointestinal disorders in eating disorder patients: Altered distribution and predictors using ROME III compared to ROME II criteria. *World Journal of Gastroenterology*. 2014;20(43):16293-16299. doi:10.3748/wjg.v20.i43.16293
22. Boyd C, Abraham S, Kellow J. Psychological features are important predictors of functional gastrointestinal disorders in patients with eating disorders. *Scandinavian Journal of Gastroenterology*. 2005;40(8):929-935. doi:10.1080/00365520510015836
23. Burton-Murray H, Kuo B, Eddy KT, et al. Disorders of gut–brain interaction common among outpatients with eating disorders including avoidant/restrictive food intake disorder. *The International Journal of Eating Disorders*. 2021;54(6):952-958. doi:10.1002/eat.23414
24. Almeida MN, Atkins M, Garcia-Fischer I, et al. Gastrointestinal diagnoses in patients with eating disorders: A retrospective cohort study 2010–2020. *Neurogastroenterology and Motility*. 2024;36(6)doi:10.1111/nmo.14782
25. Weeks I, Abber SR, Thomas JJ, et al. The intersection of disorders of gut-brain interaction with avoidant/restrictive food intake disorder. *Journal of Clinical Gastroenterology*. 2023;57(7):651-662. doi:10.1097/mcg.0000000000001853
26. Simons M, Taft TH, Doerfler B, et al. Narrative review: Risk of eating disorders and nutritional deficiencies with dietary therapies for irritable bowel syndrome. *Neurogastroenterology and Motility*. 2022;34(1)doi:10.1111/nmo.14188
27. Atkins M, Zar-Kessler C, Madva EN, et al. History of trying exclusion diets and association with avoidant/restrictive food intake disorder in neurogastroenterology patients: A retrospective chart review. *Neurogastroenterology and Motility*. 2023;35(3)doi:10.1111/nmo.14513
28. MacDonald DE, Liebman R, Trottier K. Clinical characteristics, treatment course and outcome of adults treated for avoidant/restrictive food intake disorder (ARFID) at a tertiary care eating disorders program. *Journal of Eating Disorders*. 2024;12(1):15-13.
29. Asghar Z, Thoufeeq M, Kurien M, et al. Diagnostic Yield of Colonoscopy in Patients With Symptoms Compatible With Rome IV Functional Bowel Disorders. *Clin Gastroenterol Hepatol*. Feb 2022;20(2):334-341.e3. doi:10.1016/j.cgh.2020.08.062
30. Nasseri-Moghaddam S, Mousavian AH, Kasaeian A, et al. What Is the Prevalence of Clinically Significant Endoscopic Findings in Subjects with Dyspepsia? Updated Systematic Review and Meta-analysis. *Clin Gastroenterol Hepatol*. Jun 20 2022;doi:10.1016/j.cgh.2022.05.041
31. Ramirez Z, Gunturu S. Avoidant restrictive food intake disorder. *StatPearls*. 2024;

32. Scarlata K, Zickgraf HF, Satherley R-M, et al. A call to action: Unraveling the nuance of adapted eating behaviors in individuals with gastrointestinal conditions. *Clinical Gastroenterology and Hepatology*. 2025;23(6):893-901.
33. Apperly IA, Lee R, van der Kleij SW, Devine RT. A transdiagnostic approach to neurodiversity in a representative population sample: The N+ 4 model. *JCPP Adv*. Jun 2024;4(2):e12219. doi:10.1002/jcv2.12219
34. Sader M, Weston A, Buchan K, et al. The Co-Occurrence of Autism and Avoidant/Restrictive Food Intake Disorder (ARFID): A Prevalence-Based Meta-Analysis. *Int J Eat Disord*. Mar 2025;58(3):473-488. doi:10.1002/eat.24369
35. Fink MC, Simons ML, Tomasino K, Burton-Murray H, Taft T. When is patient behavior indicative of avoidant restrictive food intake disorder (ARFID) vs reasonable response to digestive disease? *Clinical Gastroenterology and Hepatology*. 2022;20(6):1241-1250. doi:10.1016/S0016-5085(21)02326-X
36. Basnayake C, Kamm MA, Stanley A, et al. Standard gastroenterologist versus multidisciplinary treatment for functional gastrointestinal disorders (MANTRA): an open-label, single-centre, randomised controlled trial. *Lancet Gastroenterology & Hepatology*. 2020;5(10):890-899. doi:10.1016/S0016-5085(20)30874-X
37. Basnayake C, Kamm MA, Stanley A, et al. Long-term outcome of multidisciplinary versus standard gastroenterologist care for functional gastrointestinal disorders: A randomized trial. *Clinical Gastroenterology and Hepatology*. 2022;20(9):2102-2111.
38. Burton-Murray H, Weeks I, Becker KR, et al. Development of a brief cognitive-behavioral treatment for avoidant/restrictive food intake disorder in the context of disorders of gut–brain interaction: Initial feasibility, acceptability, and clinical outcomes. *The International Journal of Eating Disorders*. 2023;56(3):616-627. doi:10.1002/eat.23874
39. Biesiekierski JR, Manning LP, Murray HB, Vlaeyen JWS, Ljótsson B, Van Oudenhove L. Review article: Exclude or expose? The paradox of conceptually opposite treatments for irritable bowel syndrome. *Alimentary Pharmacology & Therapeutics*. 2022;56(4):592-605. doi:10.1111/apt.17111

Supplementary Material

The Prevalence and Burden of Avoidant/Restrictive Food Intake Disorder (ARFID) Symptoms in Adults with Disorders of Gut-Brain Interaction: A Population-Based Study

Supplementary Table 1: Participant demographics.

	Overall (n=4002)	UK (n=2002)	USA (n=2000)
Female sex, n (%)	2000 (50.0%)	1000 (50.0%)	1000 (50.0%)
Age categories, n (%)			
18-39 yrs	1596 (39.9%)	798 (39.9%)	798 (39.9%)
40-64 yrs	1606 (40.1%)	805 (40.2%)	801 (40.1%)
65+ yrs	800 (20.0%)	399 (19.9%)	401 (20.1%)
Ethnicity, n (%) *	n=3972	n=1985	n=1987
White/Caucasian	3246 (81.7%)	1728 (87.1%)	1518 (76.4%)
Asian	171 (4.3%)	114 (5.7%)	57 (2.9%)
Black/African-American	312 (7.9%)	80 (4.0%)	232 (11.7%)
Hispanic	115 (2.9%)	0 (0.0%)	115 (5.8%)
Other or Mixed ethnicity	128 (3.2%)	63 (3.2%)	65 (3.3%)

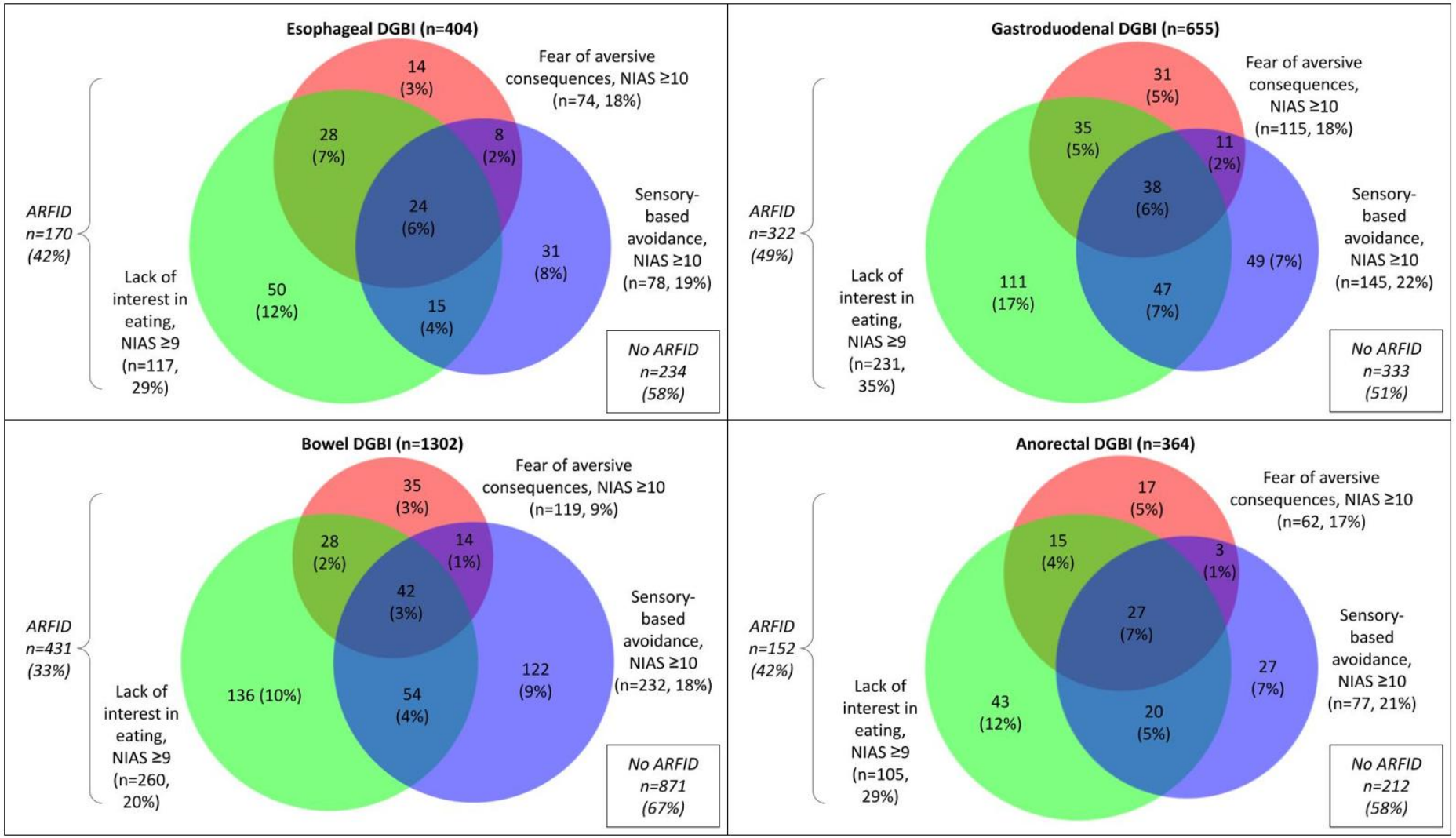
* Ethnicity was not available in all participants

Supplementary Table 2: Prevalence, and odds ratio, of positive screens for ARFID subtypes in those with or without DGBI.

		ARFID screen	Sensory-based avoidance, NIAS ≥10	Lack of interest in eating, NIAS ≥9	Fear of aversive consequences, NIAS ≥10
Any DGBI	No (n= 2298), n (%)	445 (19.4%)	249 (10.8%)	245 (10.7%)	78 (3.4%)
	Yes (n= 1704), n (%)	590 (34.6%)	308 (18.1%)	367 (21.5%)	169 (9.9%)
	OR (95% CI)	2.21 (1.91-2.55)	1.82 (1.52-2.17)	2.30 (1.93-2.74)	3.13 (2.38-4.13)
	Adjusted OR (95% CI)*	1.67 (1.43-1.94)	1.39 (1.15-1.69)	1.70 (1.42-2.05)	2.29 (1.72-3.06)
Esophageal DGBI	No (n= 3598), n (%)	865 (24.0%)	479 (13.3%)	495 (13.8%)	173 (4.8%)
	Yes (n= 404), n (%)	170 (42.1%)	78 (19.3%)	117 (29.0%)	74 (18.3%)
	OR (95% CI)	2.30 (1.86-2.84)	1.56 (1.20-2.03)	2.56 (2.02-3.23)	4.44 (3.31 - 5.96)
	Adjusted OR (95% CI)*	1.79 (1.44-2.24)	1.24 (0.94-1.63)	1.95 (1.53-2.50)	3.45 (2.54-4.70)
Gastroduodenal	No (n= 3347), n (%)	713 (21.3%)	412 (12.3%)	381 (11.4%)	132 (3.9%)
DGBI	Yes (n= 655), n (%)	322 (49.2%)	145 (22.1%)	231 (35.3%)	115 (17.6%)
	OR (95% CI)	3.57 (3.00-4.25)	2.03 (1.64-2.50)	4.24 (3.50-5.14)	5.19 (3.98-6.77)
	Adjusted OR (95% CI)*	2.75 (2.29-3.30)	1.54 (1.23-1.92)	3.25 (2.66-3.97)	3.88 (2.94-5.12)
Bowel DGBI	No (n= 2700), n (%)	604 (22.4%)	325 (12.0%)	352 (13.0%)	128 (4.7%)
	Yes (n= 1302), n (%)	431 (33.1%)	232 (17.8%)	260 (20.0%)	119 (9.1%)
	OR (95% CI)	1.72 (1.48-1.99)	1.58 (1.32-1.90)	1.66 (1.40-1.99)	2.02 (1.56-2.62)
	Adjusted OR (95% CI)*	1.30 (1.11-1.51)	1.23 (1.01-1.49)	1.23 (1.02-1.48)	1.47 (1.12-1.92)
Anorectal DGBI	No (n= 3638), n (%)	883 (24.3%)	480 (13.2%)	507 (13.9%)	185 (5.1%)
	Yes (n= 364), n (%)	152 (41.8%)	77 (21.2%)	105 (28.8%)	62 (17.0%)
	OR (95% CI)	2.24 (1.79-2.79)	1.77 (1.35-2.31)	2.50 (1.96-3.20)	3.83 (2.81-5.23)
	Adjusted OR (95% CI)*	1.73 (1.37-2.18)	1.41 (1.07-1.86)	1.90 (1.47-2.45)	2.92 (2.12-4.03)

*Adjusted for age, sex and mood disorders

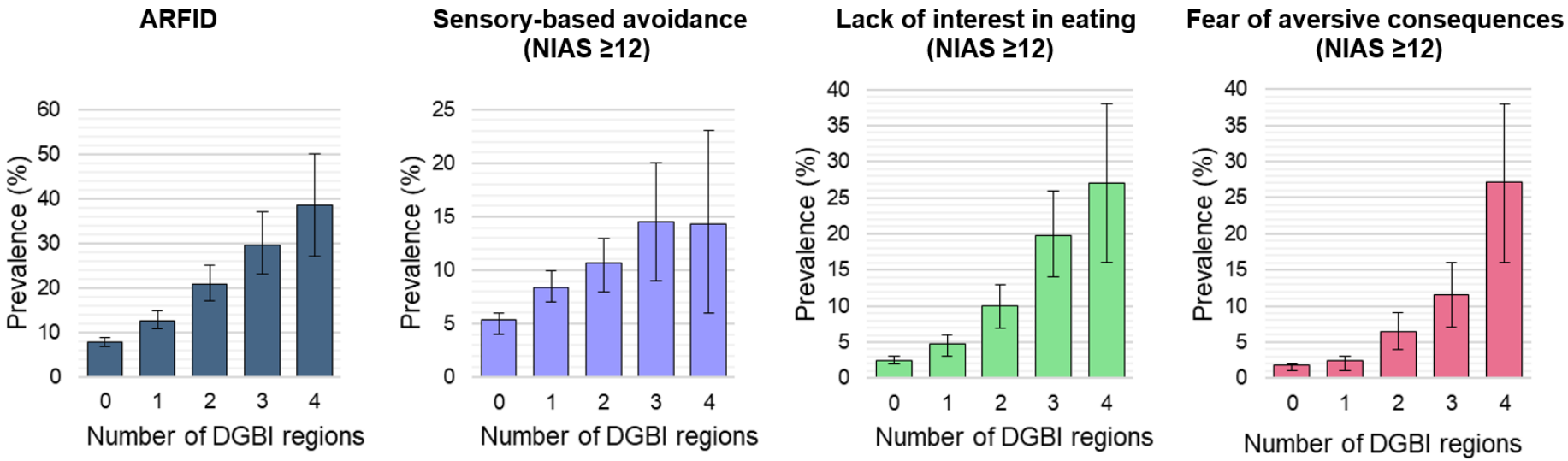
Supplementary Figure 1: Overlap of subtypes of ARFID by DGBI region.



Supplementary Table 3: Prevalence of positive ARFID screens *(based on a NIAS subscales ≥12*) among individuals with DGBI

Condition	N	ARFID screen, n (%)	Sensory-based avoidance [NIAS ≥12], n (%)	Lack of interest in eating [NIAS ≥12], n (%)	Fear of aversive consequences [NIAS ≥12], n (%)
Any DGBI	1704	302 (17.7%)	168 (9.9%)	147 (8.6%)	94 (5.5%)
Any esophageal DGBI	404	96 (23.8%)	42 (10.4%)	56 (13.9%)	47 (11.6%)
Functional chest pain	81	16 (19.8%)	8 (9.9%)	13 (16.0%)	1 (1.2%)
Functional heartburn	110	36 (32.7%)	15 (13.6%)	20 (18.2%)	21 (19.1%)
Reflux hypersensitivity	68	17 (25.0%)	5 (7.4%)	9 (13.2%)	11 (16.2%)
Globus	33	5 (15.2%)	2 (6.1%)	2 (6.1%)	1 (3.0%)
Functional dysphagia	227	62 (27.3%)	23 (10.1%)	35 (15.4%)	40 (17.6%)
Any gastroduodenal DGBI	655	180 (27.5%)	84 (12.8%)	103 (15.7%)	65 (9.9%)
Functional dyspepsia	475	152 (32.0%)	67 (14.1%)	91 (19.2%)	56 (11.8%)
Postprandial distress syndrome	418	139 (33.3%)	61 (14.6%)	85 (20.3%)	52 (12.4%)
Epigastric pain syndrome	169	67 (39.6%)	25 (14.8%)	41 (24.3%)	35 (20.7%)
Belching disorders	40	14 (35.0%)	7 (17.5%)	7 (17.5%)	9 (22.5%)
Nausea and vomiting disorders	150	56 (37.3%)	22 (14.7%)	35 (23.3%)	26 (17.3%)
Chronic nausea and vomiting disorder	81	37 (45.7%)	11 (13.6%)	22 (27.2%)	14 (17.3%)
Cyclical vomiting syndrome	73	25 (34.2%)	11 (15.1%)	17 (23.3%)	15 (20.5%)
Cannabinoid hyperemesis syndrome	16	4 (25.0%)	3 (18.8%)	2 (12.5%)	3 (18.8%)
Rumination syndrome	167	30 (18.0%)	18 (10.8%)	12 (7.2%)	10 (6.0%)
Any bowel DGBI	1302	218 (16.7%)	128 (9.8%)	108 (8.3%)	67 (5.1%)
Irritable bowel syndrome (IBS)	242	67 (27.7%)	34 (14.0%)	43 (17.8%)	34 (14.0%)
IBS with predominant constipation	79	28 (35.4%)	13 (16.5%)	19 (24.1%)	16 (20.3%)
IBS with predominant diarrhea	67	18 (26.9%)	8 (11.9%)	12 (17.9%)	9 (13.4%)
IBS with mixed bowel habits	88	19 (21.6%)	11 (12.5%)	11 (12.5%)	9 (10.2%)
IBS unclassified	8	2 (25.0%)	2 (25.0%)	1 (12.5%)	0 (0.0%)
Functional constipation	360	61 (16.9%)	34 (9.4%)	31 (8.6%)	14 (3.9%)
Functional diarrhea	219	29 (13.2%)	17 (7.8%)	11 (5.0%)	7 (3.2%)
Functional abdominal bloating/distension	143	15 (10.5%)	14 (9.8%)	4 (2.8%)	0 (0.0%)
Unspecified functional bowel disorder	300	40 (13.3%)	28 (9.3%)	15 (5.0%)	9 (3.0%)
Opioid-induced constipation	64	12 (18.8%)	6 (9.4%)	6 (9.4%)	4 (6.3%)
Functional biliary pain	7	4 (57.1%)	2 (28.6%)	1 (14.3%)	2 (28.6%)
Any anorectal DGBI	364	88 (24.2%)	44 (12.1%)	52 (14.3%)	41 (11.3%)
Fecal incontinence	125	32 (25.6%)	16 (12.8%)	19 (15.2%)	18 (14.4%)
Levator Ani syndrome	77	26 (33.8%)	9 (11.7%)	14 (18.2%)	17 (22.1%)
Proctalgia fugax	214	46 (21.5%)	27 (12.6%)	30 (14.0%)	18 (8.4%)

Supplementary Figure 2: The association between the number of DGBI regions and prevalence of ARFID *(based on NIAS subscales ≥12)*



Note: The error bars represent 95% CI