IJMS INTERNATIONAL JOURNAL of MEDICAL STUDENTS

Original Article

Prevalence and Burden of Disorders of Gut-Brain Interaction Among UK Medical Students

Lydia C. Brown,[1] Imran Aziz.[2]

Abstract

Background: Disorders of Gut-Brain Interaction (DGBI) affect 40% of the general population and are associated with substantial health impairment. Medical students reportedly have among the highest rates of DGBI, although data is mainly from Asia and Africa. We addressed this issue within a UK-based university. **Methods:** An online survey was completed by 378 of 1621 medical students. Demographics, medical history, and gastrointestinal symptoms were collected, the latter using a modified Rome IV questionnaire to determine the presence of DGBI symptoms over the last 3 months. Additional validated questionnaires screened for somatization, psychological distress, eating disorders, quality of life, and burnout. **Results:** DGBI were present in 76% (n=289/378), of which two-of-three had multiple affected sites. The most frequent DGBI were gastroduodenal (57%), followed by bowel (49%), esophageal (29%), and anorectal (26%) disorders. Approximately 50% of students with DGBI experienced painful gastrointestinal symptoms at least one day/week. Students with DGBI, compared to those without, had significantly higher anxiety and depression scores, increased somatic symptom reporting, reduced mental and physical quality of life, poorer eating habits, and more frequent medication use (p-values, all<0.05). They were also at significantly higher risk of burnout, through study exhaustion and disengagement. The greatest health impairment was seen in those with multiple, painful, DGBI. Only 23% and 5% of students with DGBI had consulted a primary care provider and gastroenterologist, respectively. **Conclusion:** Medical students commonly experience DGBI and associated health burden, yet infrequently seek help. Greater awareness may lead to increased support, improved health, and better study engagement.

Introduction

Disorders of Gut Brain Interaction (DGBI), formerly known as functional gastrointestinal disorders, are defined as chronic gastrointestinal symptoms in the absence of organic gastrointestinal disease to explain the symptoms (i.e. no evidence of infection, inflammatory diseases, ulcers, or cancer).[1] The pathophysiology of DGBI is not fully known but can be best understood based on the biopsychosocial model of illness, and relates to any combination of visceral hypersensitivity, motility disturbances, alterations in mucosal and immune function, gut microbiota, and central nervous system processing.[1] Whilst irritable bowel syndrome (IBS) and functional dyspepsia are the most commonly recognized DGBI, there are a total of 22 DGBI which can arise from any of the following six anatomical regions within the gastrointestinal (GI) tract; the esophagus, gastroduodenum, bowel, biliary, centrally mediated, and anorectum.

A recent global epidemiological study reported that over 40% of adults fulfill symptom-based criteria for a DGBI and incur considerable physical and mental health impairment, high healthcare utilization, decreased work productivity, and reduced quality of life.[2] Furthermore, one-in-three individuals with DGBI in the general population have multiple anatomical regions affected, which is associated with even greater health impairment.[3] Finally, eating disorders are common in patients with DGBI attending tertiary care medical centers, although their prevalence among people with DGBI within the community is unknown.[4]

There is data to suggest that medical students have amongst the highest rates of DGBI, with prevalence rates exceeding those reported within the general population (*Supplementary Table*). This, in part, may be explained by medical students across the globe experiencing high levels of stress, anxiety, depression, and burnout,[5,6] which could lead to gut symptoms through the bi-directional communication between the brain-gut axis. As shown in *Supplementary Table* the prevalence of IBS in medical students ranges from 4.8-61.7% (compared to 3.8% in the global adult population),[2] while the prevalence of functional dyspepsia ranges from 0.66-34.8% (compared to 7.2% globally).[2] However, most of this literature comes from Asia and Africa, and predominantly focuses on IBS and functional dyspepsia as opposed to all other DGBI, and with limited information on the general overall burden of DGBI amongst this cohort. As such, the present study aimed to determine the prevalence and burden of DGBI amongst medical students in the United Kingdom (UK).

[1] Third-year Medical Student. University of Sheffield, United Kingdom

[2] Academic Unit of Gastroenterology, Sheffield Teaching Hospitals & University of Sheffield, United Kingdom.

About the Author: *Lydia Brown has undertaken a BMedSci research degree at the University of Sheffield. This body of work has been presented as a poster abstract at the British Society of Gastroenterology and the United European Gastroenterology Week in 2023.*

Correspondence:

Imran Aziz

Address: Sheffield S10 2TN, UK

Email: imran.aziz1@nhs.net

Editor: Francisco J. Bonilla-Escobar
Student Editors:Hang-Long (Ron) Li &Carlos de la Cruz-de la Cruz
Proof reader: Laeeqa Manji
Layout Editor: Julián A. Zapata Ríos

Submission: Nov 10, 2023
Revisions: Dec 6,2023
Responses: Dec 12, 2023
Acceptance: Mar 22, 2024
Publication: Mar 25, 2024
Process: Peer-reviewed

Methods

Following internal university assessment and ethical approval (ref 044371), this cross-sectional study was conducted at the University of Sheffield medical school during the academic year 2022-2023. Individuals currently enrolled within the medical school were invited in November 2022 to complete an online survey (using Google forms platform) regarding general physical and mental health. Completing and submitting the online survey was deemed as informed consent. The study was anonymous as no personal identification details were recorded (i.e., name, date of birth, university registration number, e-mail address). No financial incentives were provided.

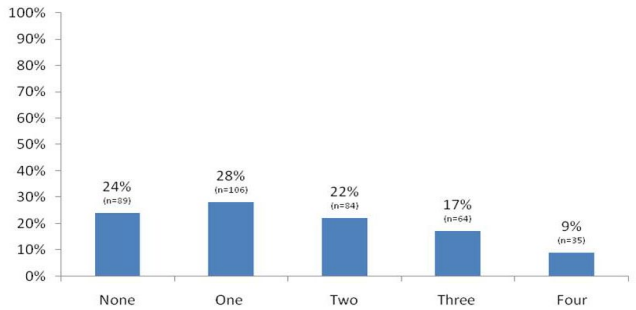
The following questionnaires were completed:

1. Demographics – age, gender, ethnicity, sexual orientation, year of study, and any substance use (i.e., tobacco, cannabis, alcohol, illicit drugs).
2. Medical history - this included any previous organic gastrointestinal diagnosis (i.e., inflammatory bowel disease, eosinophilic esophagitis, coeliac disease, gastrointestinal cancers), anxiety, depression, eating disorders, COVID-19 infection, and gastrointestinal surgery.

   Individuals were also asked whether they took any of the following medications more than once per week – laxatives, anti-diarrheal, antiemetics, antispasmodics, acid-suppressive drugs, non-opioid/opioid painkillers, and medication for anxiety and/or depression.
3. Healthcare utilization – individuals were asked if they had sought healthcare from their primary health care provider, a mental health specialist, or a gastroenterologist since starting at university.
4. Modified version of the Rome IV diagnostic questionnaire for DGBI[7] – in the interest of minimizing this 86 point questionnaire, we selected 17 questions that specifically enquired for the presence of the following gastrointestinal symptoms: a) feeling of a lump or something stuck in the throat, b) pain in the middle of your chest, c) heartburn, d) food sticking in your chest after swallowing or going down slowly, e) felt so full after a regular sized meal, f) unable to finish a regular sized meal because you felt too full, g) pain or burning in your upper abdomen, h) nausea, i) vomiting, j) food coming back up into your mouth after you swallowed it, k) belching, l) pain in your lower abdomen, m) bloating or noticed your belly looks unusually large, n) constipation (i.e. hard stools or going several days without having a bowel movement), o) diarrhea (i.e. watery mushy stools, or have many bowel movements in a day), p) accidental leakage of stool, and q) aching, pain or pressure in the rectum when you were not having a bowel movement.
   - Individuals were asked to record how frequently they experienced the above symptoms in the last 3 months, with the following options available - never, less than 2-3 days a month, 1 day a week, 2-3 days a week, most days, everyday, or multiple times per day.

     For DGBI to be considered then, in most instances, the relevant symptoms had to be present at least 1 day per week e.g., for functional dyspepsia, nausea and vomiting syndromes, IBS (abdominal pain and altered bowel habit), and functional bloating. However, for the other DGBI to be considered, the symptom frequencies were at least 1 day per month for functional anorectal disorders, at least 2-3 days per month for fecal incontinence or rumination, at least 2-3 days per week for functional chest pain/heartburn/constipation/ diarrhea, and most days for belching.
   - Based on these answers - and in the absence of known organic GI disease - we were able to consider 17 DGBI across 4 anatomical regions (esophagus, gastroduodenal, bowel and anorectal), with gallbladder disorders and centrally mediated disorders of gastrointestinal pain excluded due to their rarity in epidemiological studies.[2] In addition, some umbrella disorders were used instead of individual disorders, e.g. functional nausea and vomiting disorders was used to encompass chronic nausea vomiting syndrome, cyclic vomiting syndrome, and cannabinoid hyperemesis syndrome.
   - We further sub-divided DGBI into painful or non-painful, based on whether individuals experienced painful symptoms from any gastrointestinal organ domain at least one day per week.
5. SCOFF questionnaire[8] – this is a validated 5-question self-report screening tool for eating disorders, frequently used within primary care in the UK.[9] The validated cut-off of two or more positive responses was used to determine the presence of an eating disorder.[9]
6. Patient Health Questionnaire (PHQ)-12 somatization score[10] – this validated questionnaire asks how "bothered" individuals have been by twelve non-GI somatic symptoms over the past 4 weeks. Each answer ranges from 0 (not bothered at all) to 2 (bothered a lot). Thus, a higher score indicates a higher level of somatization, with the combined total ranging from 0-24. In addition, the number of affected somatic sites can be assessed, with a range of 0-12.
7. Hospital Anxiety and Depression Scale (HADS) questionnaire[11] - this validated questionnaire comprises 14 questions, with the results subsequently divided into two subscales for anxiety and depression score. A score of 11 or more in each subscale was considered to be evidence of clinical anxiety or depression, respectively.[11]
8. Short Form (SF)-8 questionnaire[12] – this validated 8-item questionnaire is used in epidemiological studies to assess general health related quality of life (QOL) over the past 4 weeks. The 8 items can be aggregated to form a physical component score (PCS) and mental component score (MCS), ranging from 0-100. A low MCS or PCS represents poorer QOL, whilst a high score represents better QOL.

Figure 1. **The Number of Anatomical Regions Affected by Disorders of Gut Brain Interaction (DGBI) Amongst 378 Medical Students.**



9. Oldenburg Burnout Inventory (OLBI)[13] – this validated questionnaire assesses burnout, specifically in relation to work, across the two dimensions of OLBI-exhaustion and OLBI-disengagement. A higher score indicates a higher rate of burnout, with each subscale score ranging from 8-32. The questionnaire was adapted to make it more applicable to this study population, i.e., each time the word "work" appears in the questionnaire it was replaced by "work/ study".

Statistical Analysis

Categorical variables were summarized using descriptive statistics and compared using chi-squared test, or Fisher's exact test, as necessary. In addition, odds ratios (OR) with 95% confidence intervals (CI) were calculated for some categorical variables between those with and without symptoms compatible with DGBI, and separately between those with painful and non-painful DGBIs. Continuous variables were summarized using mean and standard deviation, with between-group comparison obtained using an independent samples t-test. Finally, bivariate correlation was used to examine the strength and direction of the relationship between continuous variables.

Statistical analysis was conducted using IBM SPSS version 28 (SPSS Inc, Chicago, Illinois, United States). The level of significant was set at a p-value of <0.05.

Results

Prevalence of DGBI

The online survey was disseminated to 1621 medical students of whom 378 completed, giving a response rate of 23%. The mean age of respondents was 21 years (SD 2.5), with 73% being female, and 70% of white ethnicity.

The prevalence of having at least one DGBI over the last 3 months amongst medical student respondents was 76% (n=289), with almost half affected by DGBI across multiple anatomical regions (*see* ***Figure 1***). Prevalence of all individual DGBIs studied are displayed in ***Table 1***. Amongst the entire cohort, the most frequently met diagnostic criteria for DGBI were gastroduodenal (n=214, 57%), followed by bowel (n=184, 49%), esophageal (n=110, 29%), and anorectal (n=98, 26%) disorders. IBS and functional dyspepsia affected 17% and 28% of the cohort respectively, while other common DGBI included functional nausea and vomiting (37%), belching disorders (26%), anorectal disorders (25%), functional bloating (23%), functional chest pain (16%), globus (15%), and functional dysphagia (11%).

Table 1. **Prevalence of Specific Disorders of Gut Brain Interaction (DGBI) Diagnoses Amongst Medical Students (n=378).**

Anatomical Region	Disorder of Gut-Brain Interaction	n (%)
Esophageal (n=110, 29%)	Globus	57 (15%)
	Functional chest pain	61 (16%)
	Functional heartburn	35 (9%)
	Functional dysphagia	40 (11%)
Gastroduodenal (n=214, 57%)	Functional dyspepsia (FD)	106 (28%)
	Post prandial distress syndrome (PDS)	78 (21%)
	Epigastric pain syndrome (EPS)	45 (12%)
	Functional nausea and vomiting disorders	141 (37%)
	Rumination syndrome	26 (7%)
	Belching disorders	98 (26%)
Bowel (n=184, 49%)	Irritable bowel syndrome (IBS)	63 (17%)
	Functional constipation	16 (4%)
	Functional diarrhea	14 (4%)
	Unspecified bowel disorder	3 (1%)
	Functional bloating	88 (23%)
Anorectal (n=98, 26%)	Fecal incontinence	12 (3%)
	Functional anorectal disorders	93 (25%)

Note: Functional nausea and vomiting disorders includes chronic nausea vomiting syndrome, cyclic vomiting syndrome, cannabinoid hyperemesis syndrome. Functional anorectal pain disorders include levator ani syndrome and proctalgia fugax.

Comparison of Medical Students with DGBI vs. No-DGBI

Table 2 compares the DGBI cohort against those with no-DGBI. There was no difference in mean age or year of study, including when stratified into pre-clinical and clinical students. However, medical students with DGBI were over twice as likely to be female than those without (77% vs. 61%, OR 2.1, 95% CI 1.3-3.6). There was no difference between the two cohorts regarding self-reported smoking status, alcohol use or illicit drug use. However, a high number of individuals reported consuming alcohol in both groups (over 70%), although no quantification regarding frequency or amount of alcohol was obtained.

Medical students with DGBI were significantly more likely than those without DGBI to have previously been diagnosed with anxiety (28% vs. 12%, p=0.003) and depression (23% vs. 10%, p=0.01). They were also significantly more likely to use at least one type of GI medication (15% vs. 1%, p<0.001), and non-opioid painkillers (30% vs. 9%, p<0.001), compared to those without DGBI. Whilst those with DGBI were more likely to have sought healthcare at university for their gastrointestinal symptoms, this was still relatively low, with only 23% consulting a primary care provider, 33% a mental health specialist, and 5% a gastroenterologist.

In accordance with the SCOFF questionnaire, medical students with DGBI were almost three times more likely than those without DGBI to have an eating disorder (30% vs. 14%, p=0.002). They also had significantly worse mean somatization scores (6.3 vs. 3.5, p<0.001), more somatic sites affected (4.9 vs. 2.9, p<0.001), and worse mean anxiety (9.0 vs. 6.5, p<0.001) and depression (4.2 vs. 2.9, p<0.002) scores. Finally, those with DGBI reported significantly worse quality of life and higher levels of burnout, regarding both study disengagement and exhaustion, than those without DGBI.

Table 2. **Characteristics of Medical Students with and without Rome IV Disorders of Gut Brain Interaction (DGBI).**

Study Variables	Symptoms not compatible with a Rome IV DGBI (n=89)	Symptoms compatible with Rome IV DGBI (n=289)	p-value	Odds ratio (95% CI)
Demographics				
Mean age in years (SD)	20.6 (2.5)	20.8 (2.5)	0.69	--
Mean year of study (SD)	2.6 (1.5)	2.6 (1.5)	0.93	--
Pre-clinical	47 (53%)	167 (58%)	0.41	1.2 (0.8-2.0)
Female	54 (61%)	222 (77%)	0.003	2.1 (1.3-3.6)
Heterosexual	77 (87%)	201 (70%)	0.002	0.4 (0.2-0.7)
White	53 (60%)	212 (73%)	0.013	1.9 (1.1-3.1)
Drink Alcohol	66 (74%)	239 (83%)	0.074	1.7 (0.9-2.9)
Smoke Tobacco	5 (6%)	14 (5%)	0.78	0.9 (0.3-2.4)
Use Cannabis/ Marijuana	5 (6%)	17 (6%)	0.93	1.1 (0.4-2.9)
Use other illicit drugs	2 (2%)	16 (6%)	0.26	2.5 (0.6-11.3)
Past medical history				
Anxiety	11 (12%)	81 (28%)	0.003	2.8 (1.4-5.5)
Depression	9 (10%)	65 (23%)	0.01	2.6 (1.2-5.4)
Eating disorder	3 (3%)	18 (6%)	0.43	1.9 (0.5-6.6)
COVID-19 infection	45 (51%)	197 (68%)	0.002	2.1 (1.3-3.4)
Any abdominal surgery	7 (8%)	20 (7%)	0.76	0.9 (0.4-2.1)
Medication use				
Any GI medication	1 (1%)	42 (15%)	<0.001	15.0 (2.0-110.3)
Constipation	0 (0%)	9 (3%)	0.12	0.8 (0.7-0.8)
Diarrhea	0 (0%)	9 (3%)	0.12	0.8 (0.7-0.8)
Nausea	0 (0%)	7 (2%)	0.21	0.8 (0.7-0.8)
Antispasmodics	0 (0%)	9 (3%)	0.12	0.8 (0.7-0.8)
Stomach acid	1 (1%)	24 (8%)	0.02	8.0 (1.1-59.8)
Non-opioid painkillers	8 (9%)	87 (30%)	<0.001	4.4 (2.0-9.4)
Opioid painkillers	0 (0%)	3 (1%)	1	0.8 (0.7-0.8)
Anxiolytics/ antidepressants	6 (7%)	41 (14%)	0.06	2.3 (0.9-5.6)
Healthcare utilization				
Primary care	8 (9%)	66 (23%)	0.004	3.0 (1.4-6.5)
Gastroenterologist	5 (6%)	15 (5%)	0.79	0.9 (0.3-2.6)
Mental health	19 (21%)	98 (34%)	0.03	1.9 (1.1-3.3)
Burden				
Eating Disorder (SCOFF ≥2)	12 (14%)	87 (30%)	0.002	2.8 (1.4-5.3)
HADS-Anxiety ≥ 11	14 (16%)	101 (35%)	<0.001	2.9 (1.5-5.3)
HADS-Depression ≥ 11	3 (3%)	21 (7%)	0.19	2.2 (0.7-7.7)
Burden, Mean (SD)				
PHQ-12 score	3.5 (2.9)	6.3 (3.6)	<0.001	--
Number of PHQ-12 sites	2.9 (2.1)	4.9 (2.5)	<0.001	--
SF-8 PCS QOL	83.1 (1.45)	73.8 (18.5)	<0.001	--
SF-8 MCS QOL	72.1 (21.1)	61.9 (20.0)	<0.001	--
HADS-Anxiety score	6.5 (4.0)	9.0 (4.3)	<0.001	--
HADS-Depression score	2.9 (3.1)	4.2 (3.5)	<0.002	--
OLBI-Disengagement score	17.0 (4.0)	18.2 (4.0)	0.01	--
OLBI-Exhaustion score	19.3 (4.1)	21.5 (4.1)	<0.001	--

Legend: N (%) unless otherwise indicated.

Figure 2. **Venn Diagram Showing the Overlap Between Anatomical Regions in Those Medical Students with Disorders of Gut Brain Interaction (DGBI) (n=289).**

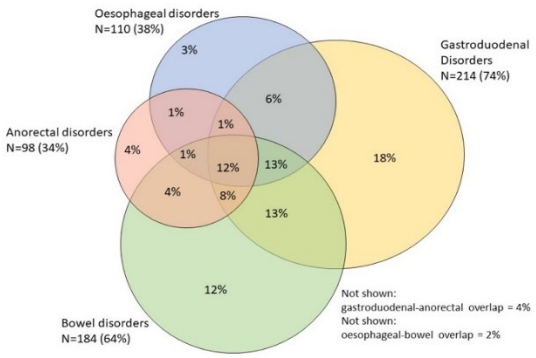


Table 3. **Relationship Between Psychological Distress and Number of Anatomical Sites Affected by DGBIs.**

Variable	Number of anatomical sites affected by DGBIs	
	Correlation	p value
SF-8 MCS QOL	-0.397	<0.001
SF-8 PCS QOL	-0.389	<0.001
OLBI-Disengagement score	0.245	<0.001
OLBI-Exhaustion score	0.314	<0.001
PHQ-12 somatic score	0.528	<0.001
Number of PHQ-12 sites	0.526	<0.001
HADS-Anxiety score	0.461	<0.001
HADS-Depression score	0.293	<0.001

Table 4. **Comparison Between Medical Students with and without Painful Disorders of Gut Brain Interaction (DGBI).**

Cohort with DGBI (n=289)	Non-painful DGBIs (n=142)	Painful DGBIs (n=147)	p-value	Odds ratio(95% CI)	
Demographics					
Mean age in years (SD)	20.5 (2.6)	21.0 (2.4)	0.06	--	
Mean year of study (SD)	2.4 (1.6)	2.8 (1.4)	0.05	--	
Pre-clinical	87 (61%)	80 (54%)	0.24	0.8 (0.5-1.2)	
Female	99 (70%)	123 (84%)	0.005	2.2 (1.3-3.9)	
Heterosexual	105 (74%)	96 (65%)	0.11	0.7 (0.4-1.1)	
White	96 (68%)	116 (79%)	0.03	2.8 (1.1-3.0)	
Past medical history					
Anxiety	23 (16%)	58 (40%)	<0.001	3.4 (1.9-5.9)	
Depression	15 (11%)	50 (34%)	<0.001	4.4 (2.3-8.2)	
Eating disorder	3 (2%)	15 (10%)	0.004	5.2 (1.5-18.6)	
COVID-19 Infection	95 (67%)	102 (69%)	0.65	1.1 (0.7-1.8)	
Any abdominal surgery	9 (6%)	11 (8%)	0.70	1.2 (0.5-3.0)	
Medication use					
Any I medication	12 (9%)	30 (20%)	0.004	2.8 (1.4-5.7)	
Constipation	4 (3%)	5 (3%)	1.00	1.2 (0.3-4.6)	
Diarrhea	3 (2%)	6 (4%)	0.50	2.0 (0.5-8.0)	
Nausea	2 (1%)	5 (3%)	0.45	2.5 (0.5-12.9)	
Antispasmodics	1 (1%)	8 (5%)	0.04	8.1 (1.0-65.7)	
Stomach acid	6 (4%)	18 (12%)	0.01	3.2 (1.2-8.2)	
Non-opioid painkillers	34 (24%)	53 (36%)	0.03	1.8 (1.1-3.0)	
Opioid painkillers	1 (1%)	2 (1%)	1.00	1.9 (0.2-21.7)	
Anxiolytic/antidepressants	10 (7%)	31 (21%)	<0.001	3.5 (1.7-7.5)	
Healthcare utilization at university					
Primary care	17 (12%)	49 (33%)	<0.001	3.7 (2.0-6.8)	
Gastroenterologist	4 (3%)	11 (8%)	0.07	2.8 (0.9-9.0)	
Mental health	30 (20%)	68 (46%)	<0.001	3.2 (1.9-5.4)	
Burden of DGBIs					
Eating Disorder (SCOFF ≥2)	33 (23%)	54 (37%)	0.01	1.9 (1.1-3.2)	
HADS-Anxiety ≥ 11	31 (22%)	70 (48%)	<0.001	3.3 (1.9-5.4)	
HADS-Depression ≥ 11	6 (4%)	15 (10%)	0.05	2.6 (1.0-6.8)	
Burden of DGBIs:				Number of painful DGBI sites	
Mean (SD)				Correlation	P value
PHQ-12 somatic score	4.9 (2.9)	7.5 (3.8)	<0.001	0.446	<0.001
Number of PHQ-12 sites	4.0 (2.2)	5.8 (2.5)	<0.001	0.432	<0.001
SF-8 PCS QOL	79.8 (14.6)	68.1 (20.0)	<0.001	-0.322	<0.001
SF-8 MCS QOL	69.1 (17.6)	55.0 (19.8)	<0.001	-0.348	<0.001
HADS-Anxiety score	7.7 (3.9)	10.3 (4.3)	<0.001	0.414	<0.001
HADS-Depression score	3.6 (3.1)	4.8 (3.7)	0.003	0.245	<0.001
OLBI-Disengagement score	17.6 (3.7)	18.8 (4.1)	0.01	0.184	0.002
OLBI-Exhaustion score	21.0 (4.1)	22.1 (4.0)	0.02	0.192	<0.001

Legend: N (%) unless otherwise indicated.

Multiple DGBI

Amongst those with at least one DGBI, almost 2-in-3 (63%) of individuals had multiple affected anatomical sites, and 12% had all 4 anatomical regions affected. The possible overlaps between anatomical regions are displayed **in** *Figure 2*, whilst *Table 3* demonstrates the correlation between increasing number of DGBIs and worsening quality of life (i.e., negative correlation), and greater burnout, somatization, anxiety, and depression scores (i.e., positive correlation).

Comparison of Painful vs. Non-Painful DGBI

Table 4 compares the painful DGBI cohort against those with non-painful DGBI. We defined painful DGBI as having pain at least one day per week from any anatomical GI region; this case definition was met by 51% (n=147/289) of those with DGBI. Amongst those with painful DGBI, 58% (n=85) had one painful anatomical site, 27% (n=39) had two, 14% (n=20) had three and 2% (n=3) had painful DGBI across all 4 anatomical sites.

Individuals with painful DGBIs, and in particular those with multiple painful sites, were significantly more likely to have higher levels of anxiety, depression, somatization, eating disorders, burnout, and reduced quality of life. They also reported significantly higher use of anti-spasmodic medications, acid suppressive drugs and non-opioid pain killers. While those with painful DGBI were significantly more likely to seek a healthcare provider, this was still relatively infrequent with 33% having seen a primary care provider, 46% a mental health specialist, and only 8% having seen a gastroenterologist.

Discussion

To our knowledge, this is the first study to examine the prevalence and burden of DGBI amongst UK medical students. We found that 76% of UK medical students who completed this anonymous online survey had symptoms compatible with a Rome IV DGBI, which is much higher than the reported prevalence of 37% amongst the UK general adult population.[2] Furthermore, almost two-thirds of medical students with DGBI had multiple affected anatomical sites, and over half experienced painful gastrointestinal symptoms at least once per week. The presence of DGBI was associated with psychological distress, somatic symptom reporting, eating disorders, burnout, and reduced quality of life, yet medical students infrequently seek help for their symptoms, even when painful.

The general health burden of DGBI as seen in medical students aligns with that reported for the general population, although it appears to be of a greater severity. For example, over 50% of medical students with DGBI experience frequent painful symptoms - which in itself correlated with increased physical and mental distress – in comparison to 26% of UK adults with DGBI having painful DGBI.[14] Many of the risk factors for painful DGBI (e.g. female sex, gastroenteritis, abuse, stress, poor sleep, obesity, psychological disorders, and somatic symptoms) were explored and apparent within our medical student cohort.[15] Protective factors against painful DGBI in adults include social support and optimism,[15] yet rates of healthcare utilization or support for DGBI symptoms were low amongst medical students. For instance, less than a quarter of those with DGBI, and only a third of those with painful DGBI, had consulted a primary care provider regarding their GI symptoms. This supports previous findings that medical students have low rates of healthcare consultation for DGBI symptoms[16-18] although reasons for this remain unclear. Possible fear of repercussions regarding training progression and general stigma surrounding ill-health can prevent medical students from seeking help for their physical and mental health.[19,20] DGBI are also under-taught within medical education which might lead to a lack of awareness of these disorders amongst medical students.[21]

A high proportion of medical students with DGBI had associated psychological distress, burnout (i.e., study exhaustion and disengagement) and eating disorders. These factors have been reported in DGBI within the general population, but are arguably more prevalent within medical students given the extensive demands placed upon them from a relatively young age.[5,6] Medicine has traditionally been considered as a highly demanding and stressful course, with a competitive admission process followed by frequent and rigorous examinations over a 5 to 6 year period.[5,6] Moreover, students face additional pressures to conduct research, publish in scientific journals, teach, build management and leadership skills and win prizes in order to choose the specialty of their choice. Additional stressors over this time-period include relationships, financial difficulties and housing issues, all of which have been heightened by the COVID-19 pandemic.[5,6] Hence, it is not surprising that high levels of psychiatric illness, burnout and substance use are being reported by medical students across the globe.[5,6] A recent study found that 29% of medical students respondents were given a mental health diagnosis whilst at medical school, and 82% could be classified as 'disengaged' and 85% 'exhausted' using the Oldenburg Burnout Scale.[22] In England and Wales, over 80% of medical students have high levels of burnout,[22,23] whilst a global systematic review and meta-analysis reported that medical students have a higher burden of burnout than age-matched peers.[24] An association between burnout and IBS has been reported,[25,26] which our study builds upon by highlighting the relationship between burnout and overall DGBI amongst medical students. Similarly, there is association between eating disorders and DGBI,[4] and a global systematic review found medical students have higher rates of eating disorders than the general adult population.[27] In summary, the combination of DGBI and its associated health impairment may lead to reduced academic performance, increased dropout, and potential long-term consequences for patient safety. Medical schools should therefore become familiar with the high prevalence and burden of DGBI, openly raise awareness of these conditions, and sign-post students to seek help via appropriate channels. Future research studies should investigate interventions suggested for DGBI but specifically within medical students (e.g., diet, lifestyle, exercise, antispasmodics, psychological support etc.). Hopefully, these measures will not just positively impact upon medical students as they progress to doctors, but also for patients and the healthcare system.

There are limitations to this study. First, the cross-sectional study design identifying an association between DGBI and other co-morbidities does not infer causality. Second, it was conducted at only one university, and may not be representative of medical students at other UK institutions. Moving forward, it raises interest to conduct further studies of DGBI in medical students elsewhere, but also among junior doctors in whom a high prevalence of stress and burnout, leading to career disengagement and reduced patient quality of care, is

increasingly being recognised.[28] Third, there was no comparative control group, either from another course within the university or the general population. However, the prevalence of DGBI within medical students reported in this UK study, and that from India, far exceed those reported within their respective general populations.[2,29] The study from India also reported DGBI to be significantly more common in medical students than its humanities students.[29] Fourth, the low response rate of 23% (n=378/1621) may mean that the reported prevalence of DGBI as 76% (n=289/378) is not reflective of the prevalence of DGBI amongst the entire cohort of medical students at the university. However, we aimed to reduce potential selection bias by promoting the study as an evaluation of physical and mental health, as opposed to specifically mentioning gastrointestinal symptoms. Nevertheless, the results could be extrapolated to calculate the minimum possible prevalence of DGBI for the entire population of medical students at the university, i.e., if all the non-responders were presumed to lack any symptoms compatible with DGBI, the minimum prevalence of DGBI in this cohort would be 18% (n=289/1621). This equates to almost 1-in-5 medical students and still suggests a high prevalence. Fifth, the predominance responders to the survey were female (73%), although the female to male ratio in the medical school is almost 1:1, again adding to potential selection bias. Sixth, we did not use the Rome IV diagnostic questionnaire in its entirety, as it encompasses 86 questions with a complex scoring algorithm, but rather selected 17 pertinent questions that captured the spectrum of gastrointestinal symptoms followed by using clinically relevant frequency cut-offs to determine the presence of DGBI and painful DGBI. Further, the Rome diagnostic criteria require symptoms to be active over the last 3 months but to have started at least 6 months prior. The latter we did not enquire for and might therefore have over-estimated the prevalence of Rome IV DGBI, although the frequent presence of symptoms, particularly those that are painful, is nevertheless of concern. Seventh, the use of an anonymous study questionnaire meant that results could not be corroborated through clinical notes, nor could investigations be done. As such, some of the reported symptoms may have been due to underlying organic disease, although this is unlikely in individuals of a relatively young age reporting chronic symptoms. Finally, the most common DGBI in this study was functional nausea and vomiting disorders, with a prevalence of 37%, which is much higher than the global prevalence of around 1.0% in the 18-39 age group.[2] This marked difference may be due to a high rate of alcohol use in the study population, with 78% of medical students drinking alcohol, although we did not quantify individuals' drinking habits. Previous research suggests that UK medical students have high rates of alcohol misuse.[30] Therefore, for some individuals in this study, the symptoms of functional nausea and vomiting disorders may have instead been caused by alcohol consumption.

In conclusion, DGBI are common and burdensome among UK medical students, yet they infrequently seek help for their symptoms, even when painful. Increased awareness of DGBI amongst medical students may lead to improved support, health status, and study engagement.

Summary – Accelerating Translation

Disorders of gut-brain interaction (DGBI) are chronic gastrointestinal symptoms that occur in the absence of organic disease. In this UK based study, the prevalence of symptoms compatible with DGBI amongst medical students at Sheffield University was 76% of whom two-of-three had multiple affected anatomical sites. Approximately 50% of medical students reported experiencing pain from a GI region at least once per week. The presence of DGBI (in particular, multiple painful DGBI) was associated with anxiety, depression, somatization, eating disorders, reduced quality of life, and burnout through study disengagement and exhaustion. Medical students with DGBI had low healthcare utilization relative to their symptom burden. Our findings will help increase awareness of DGBI amongst medical students and may lead to improved support, health status, and study engagement.

References

1. Drossman DA, Hasler WL. Rome IV—Functional GI Disorders: Disorders of Gut-Brain Interaction. Gastroenterology. 2016;150(6):1257-61.
2. Sperber AD, Bangdiwala SI, Drossman DA, Ghoshal UC, Simren M, Tack J, et al. Worldwide Prevalence and Burden of Functional Gastrointestinal Disorders, Resultsof Rome Foundation Global Study. Gastroenterology. 2021;160(1):99-114.e3.
3. Aziz I, Palsson OS, Törnblom H, Sperber AD, Whitehead WE, Simrén M. The prevalence and impact of overlapping Rome IV-diagnosed functional gastrointestinal disorders on somatization, quality of life, and healthcare utilization: A cross-sectional general populationstudy in threecountries. Am J Gastroenterol. 2018;113(1):86-96.
4. Staller K, Abber SR, Burton Murray H. The intersection between eating disorders and gastrointestinal disorders: a narrative review and practical guide. Lancet Gastroentero lHepatol. 2023;8(6):565-78.
5. Molodynski A, Lewis T, Kadhum M, Farrell SM, LemtiriChelieh M, Falcão De Almeida T, et al. Cultural variations in wellbeing, burnout and substance use amongst medical students in twelve countries. Int Rev Psychiatry. 2021;33(1-2):37-42.
6. Kadhum M, Ayinde OO, Wilkes C, Chumakov E, Dahanayake D, Ashrafi A, et al. Wellbeing, burnout and substance use amongst medical students: A summary of results from nine countries. Int J Soc Psychiatry. 2022;68(6):1218-22.
7. Palsson OS, Whitehead WE, Van Tilburg MAL, Chang L, Chey W, Crowell MD, et al. Development and Validation of the Rome IV Diagnostic Questionnaire for Adults. Gastroenterology. 2016;150(6):1481-91.
8. Morgan JF, Reid F, Lacey JH. The SCOFF Questionnaire: Assessmentof a New Screening Tool for Eating Disorders. BMJ. 1999;319(7223):1467-8.
9. Hill LS, Reid F, Morgan JF, Lacey JH. SCOFF, the development of an eating disorder screening questionnaire. Int J Eat Disord. 2010;43(4):344-51.
10. Spiller RC, Humes DJ, Campbell E, Hastings M, Neal KR, Dukes GE, et al. The Patient Health Questionnaire 12 Somatic Symptom scale as a predictor ofsymptomseverity and consultingbehaviour in patientswith irritable bowelsyndrome and symptomatic diverticular disease. Aliment Pharmacol Ther. 2010;32(6):811-20.
11. Zigmond AS, Snaith RP. The Hospital Anxiety and DepressionScale. Acta Psychiatr Scand. 1983;67(6):361-70.

12. Ware JE, Kosinski M, Dewey JE, Gandek B. How to score and interpret single-item health status measures: a manual for users of the SF-8 health survey. Lincoln, RI: Quality Metric Incorporated. 2001;15(10):5.
13. Demerouti E, Bakker AB. The Oldenburg Burnout Inventory: A good alternative to measure burnout and engagement. Handbook of stress and burnout in health care. 2008;65(7):1-25.
14. Luo Y, Camey SA, Bangdiwala SI, Palsson OS, Sperber AD, Keefer LA. Global patterns of prescription pain medication usage in disorders of gut–braininteractions. Neurogastroenterol Motil. 2023;35(1):e14457.
15. Zia JK, Lenhart A, Yang PL, Heitkemper MM, Baker J, Keefer L, et al. Risk Factors for Abdominal Pain-Related Disorders of Gut-Brain Interaction in Adults and Children: A Systematic Review. Gastroenterology. 2022;163(4):995-1023.e3.
16. Tan Y-M, Goh KL, Muhidayah R, Ooi CL, Salem O. Prevalence of irritable bowel syndrome in young adult Malaysians: A survey among medical students. J Gastroenterol Hepatol. 2003;18(12):1412-6.
17. Gallas S, Knaz H, Methnani J, Maatallah Kanzali M, Koukane A, Bedoui MH, et al. Prevalence and risk factors of functional gastrointestinal disorders in early period medical students: a pilot study in Tunisia. Libyan J Med. 2022;17(1).
18. Jafri W, Yakoob J, Jafri N, Islam M, Ali QM. Frequency of irritable bowel syndrome in college students. J Ayub Med Coll Abbottabad. 2005;17(4):9.
19. Shahaf-Oren B, Madan I, Henderson C. "A lot of medical students, their biggest fear is failing at being seen to be a functional human": disclosure and help-seeking decisions by medical students with health problems. BMC Med Educ. 2021;21(1):1-599.
20. Menon V, Sarkar S, Kumar S. A cross-sectional analysis of barriers to health-care seeking among medical students across training period. J Ment Health Hum Be. 2017;22(2):97-103.
21. Simons J, Shajee U, Palsson O, Simren M, Sperber AD, Törnblom H, et al. Disorders of gut-brain interaction: Highly prevalent and burdensome yet under-taught within medical education. United European Gastroenterol J. 2022;10(7):736-44.
22. Farrell SM, Kadhum M, Lewis T, Singh G, Penzenstadler L, Molodynski A. Wellbeing and burnout amongst medical students in England. Int Rev Psychiatry. 2019;31(7-8):579-83.
23. Farrell SM, Molodynski A, Cohen D, Grant AJ, Rees S, Wullshleger A, et al. Wellbeing and burnout among medical students in Wales. Int Rev Psychiatry. 2019;31(7-8):613-8.
24. Erschens R, Keifenheim KE, Herrmann-Werner A, Loda T, Schwille-Kiuntke J, Bugaj TJ, et al. Professional burnout among medical students: Systematic literature review and meta-analysis. Med Teach. 2019;41(2):172-83.
25. Hod K, Melamed S, Dekel R, Maharshak N, Sperber AD. Burnout, butnotjobstrain, isassociatedwith irritable bowelsyndrome in workingadults. J Psychosom Res. 2020;134:110121-.
26. Patacchioli FR, Angelucci L, Dell'Erba G, Monnazzi P, Leri O. Actual stress, psychopathology and salivary cortisol levels in the irritable bowelsyndrome (IBS). J Endocrinol Invest. 2001;24(3):173-7.
27. Jahrami H, Sater M, Abdulla A, FarisMeA-I, AlAnsari A. Eatingdisordersriskamong medical students: a global systematicreview and meta-analysis. Eat Weight Disord. 2019;24(3):397-410.
28. Hodkinson A, Zhou A, Johnson J, Geraghty K, Riley R, Zhou A, et al. Associations of physician burnout with career engagement and quality of patient care: systematic review and meta-analysis. BMJ. 2022;378:e070442.
29. Goyal O, Nohria S, Dhaliwal AS, Goyal P, Soni RK, Chhina RS, et al. Prevalence, overlap, and risk factors for Rome IV functional gastrointestinal disorders among college students in northern India. Indian J Gastroenterol. 2021;40(2):144-53.
30. Bogowicz P, Ferguson J, Gilvarry E, Kamali F, Kaner E, Newbury-Birch D. Alcohol and other substance use among medical and law students at a UK university: a cross-sectional questionnaire survey. Postgrad Med J. 2018;94(1109):131-6.

Acknowledgments

None.

Conflict of Interest Statement & Funding

The Authors have no funding, financial relationships or conflicts of interest to disclose.

Author Contributions

Conceptualization: LCB, IA. Data Curation: LCB, IA. Formal Analysis: LCB, IA. Investigation: LCB, IA. Methodology: LCB, IA. Supervision: IA. Writing - Original Draft: LCB, IA. Writing - Review Editing: LCB, IA.

Cite as

Brown LC, Aziz I. Prevalence and Burden of Disorders of Gut-Brain Interaction Among UK Medical Students. Int J Med Stud. 2024 Jan-Mar;12(1):43-52.

ISSN 2076-6327

This journal is published by Pitt Open Library Publishing

Supplementary Material

Supplementary Table 1. **Prevalence of Disorders of Gut Brain Interaction (DGBI) in Medical Students from Across the Globe.**

Authors	Country	Year of study	Number of participants	Criteria	Prevalence
Any DGBI					
Gallas *et al.*	Tunisia	2022	343	Rome III	54.2%
Goyal *et al.*	India	2021	425	Rome IV	34.4%
Any functional bowel disorder					
Chu *et al.*	China	2012	1071	Rome III	68.5%
Irritable Bowel Syndrome (IBS)					
Tan *et al.*	Malaysia	2003	533	Rome I	15.8%
Jafri *et al.*	Pakistan	2005	245	Rome II	26.0%
Okeke *et al.*	Nigeria	2005	330	Rome II	26.1%
Shen *et al.*	China	2009	313	Rome II	13.4%
Mansour-Ghanaei *et al.*	Iran	2009	422	Rome II	12.6%
Okami *et al.*	Japan	2011	1768	Rome II	35.5%
Dong *et al.*	China	2010	728	Rome III	9.3%
Jung *et al.*	Korea	2011	319	Rome III	29.2%
Wells *et al.*	Canada	2012	228	Rome III	20.6%
Naeem *et al.*	Pakistan	2012	360	Rome III	28.3%
Ibrahim *et al.*	Saudi Arabia	2013	597	Rome III	29%
Liu *et al.*	China	2014	767	Rome III	33.2%
Al Ghamdi *et al.*	Saudi Arabia	2015	167	Rome III	21.0%
Darweesh *et al.*	Egypt	2015	86	Rome III	22.1%
Costanian *et al.*	Lebanon	2015	431	Rome III	20.6%
Wang *et al.*	China	2016	1874	Rome III	31.9%
Perveen *et al.*	Bangladesh	2016	293	Rome III	4.8%
Husain *et al.*	Romania	2016	102	Rome III	24.5%
Alaqueel *et al.*	Saudi Arabia	2017	270	Rome III	21.1%
Pozos-Radillo *et al.*	Mexico	2018	561	Rome III	61.7%
Elhosseiny *et al.*	Egypt	2019	382	Rome III	31.7%
Shafique *et al.*	Pakistan	2021	370	Rome III	41.1%
Javed *et al.*	Pakistan	2022	305	Rome III	5.57%
Gallas *et al.*	Tunisia	2022	343[1]	Rome III	7.6%
El Sharawy *et al.*	Egypt	2022	182	Rome III	27.5%
Jadallah *et al.*	Jordan	2022	1094	Rome III	30.9%
Jia *et al.*	China	2022	2739	Rome III	12.23%
Goyal *et al.*	India	2021	1309	Rome III	9.5%
				Rome IV	6.2%
Hasosah *et al.*	Saudi Arabia	2017	179	Rome IV	13.2%
Sehonou and Dodo	Benin	2018	315	Rome IV	14%
Alshammari *et al.*	Saudi Arabia	2018	133	Rome IV	28.6%
Hakami *et al.*	Saudi Arabia	2019	252	Rome IV	7.9%
AlButaysh *et al.*	Saudi Arabia	2020	232	Rome IV	31.9%
Anthea *et al.*	Malta	2021	135	Rome IV	17.8%
Alreshidi *et al.*	Saudi Arabia	2022	301	Rome IV	20.9%
Gravina *et al.*	Italy	2023	161	Rome IV	21.1%
Tran *et al.*	Vietnam	2023	400	Rome IV	5.5%
Wani *et al.*	Saudi Arabi	2020	90	*Unknown*	42.2%
Functional Dyspepsia (FD)					
Basandra and Divyansh	India	2014	200	Rome III	18%
Shankar *et al.*	Pakistan	2020	221	Rome III	34.8%
Gallas *et al.*	Tunisia	2022	242	Rome III	6.7%
Javed *et al.*	Pakistan	2022	305	Rome III	0.66%
Goyal *et al.*	India	2021	1309	Rome IV	15.2%
Loor *et al.*	Romania	2021	150	Rome IV	18%
Tran *et al.*	Vietnam	2023	400	Rome IV	6.5%

Supplementary References

1. Gallas S, Knaz H, Methnani J, et al. Prevalence and risk factors of functional gastrointestinal disorders in early period medical students: a pilot study in Tunisia. *Libyan J Med.* 2022;17(1)doi:10.1080/19932820.2022.2082029
2. Goyal O, Nohria S, Dhaliwal AS, et al. Prevalence, overlap, and risk factors for Rome IV functional gastrointestinal disorders among college students in northern India. *Indian J Gastroenterol.* 2021;40(2):144-153. doi:10.1007/s12664-020-01106-y
3. Chu L, Zhou H, Lü B, Li M, Chen M-y. [An epidemiological study of functional bowel disorders in Zhejiang college students and its relationship with psychological factors]. *ZhonghuaNeiKe Za Zhi.* 2012/06// 2012;51(6):429-432.
4. Tan Y-M, Goh KL, Muhidayah R, Ooi CL, Salem O. Prevalence of irritable bowel syndrome in young adult Malaysians: A survey among medical students. *Journal of Gastroenterology and Hepatology.* 2003;18(12):1412-1416. doi:https://doi.org/10.1046/j.1440-1746.2003.03212.x

5. Jafri W, Yakoob J, Jafri N, Islam M, Ali QM. Frequency of irritable bowel syndrome in college students. *Journal of Ayub Medical College Abbottabad*. 2005;17(4):9.
6. Okeke EN, Agaba EI, Gwamzhi L, Achinge GI, Angbazo D, Malu AO. Prevalence of irritable bowel syndrome in a Nigerian student population. *Afr J Med Med Sci*. 2005/03// 2005;34(1):33-36.
7. Shen L, Kong H, Hou X. Prevalence of irritable bowel syndrome and its relationship with psychological stress status in Chinese university students. https://doi.org/10.1111/j.1440-1746.2009.05943.x. *Journal of Gastroenterology and Hepatology*. 2009/12/01 2009;24(12):1885-1890. doi:https://doi.org/10.1111/j.1440-1746.2009.05943.x
8. Mansour-Ghanaei F, Fallah M, Heidarzadeh A, et al. Prevalence and characteristics of irritable bowel syndrome (IBS) amongst medical students of Gilan Northern Province of Iran. *Middle East Journal of Digestive Diseases (MEJDD)*. 2009;1(2):100-105.
9. Okami Y, Kato T, Nin G, et al. Lifestyle and psychological factors related to irritable bowel syndrome in nursing and medical school students. *Journal of Gastroenterology*. 2011;46(12):1403-1410. doi:10.1007/s00535-011-0454-2
10. Dong Y-Y. Prevalence of irritable bowel syndrome in Chinese college and university students assessed using Rome III criteria. *World Journal of Gastroenterology*. 2010;16(33):4221. doi:10.3748/wjg.v16.i33.4221
11. Jung HJ, Park MI, Moon W, et al. Are Food Constituents Relevant to the Irritable Bowel Syndrome in Young Adults? - A Rome III Based Prevalence Study of the Korean Medical Students. *Journal of Neurogastroenterology and Motility*. 2011;17(3):294-299. doi:10.5056/jnm.2011.17.3.294
12. Wells M, Roth L, McWilliam M, Thompson K, Chande N. A Cross-Sectional Study of the Association between Overnight Call and Irritable Bowel Syndrome in Medical Students. *Canadian Journal of Gastroenterology*. 2012;26(5):281-284. doi:10.1155/2012/865915
13. Naeem SS, Siddiqui EU, Kazi AN, Memon AA, Khan ST, Ahmed B. Prevalence and factors associated with irritable bowel syndrome among medical students of Karachi, Pakistan: A cross-sectional study. *BMC Research Notes*. 2012;5(1):255. doi:10.1186/1756-0500-5-255
14. Ibrahim NKR, Battarjee WF, Almehmadi SA. Prevalence and predictors of irritable bowel syndrome among medical students and interns in King Abdulaziz University, Jeddah. *Libyan Journal of Medicine*. 2013;8(1):21287. doi:10.3402/ljm.v8i0.21287
15. Liu Y, Liu L, Yang Y, et al. A School-Based Study of Irritable Bowel Syndrome in Medical Students in Beijing, China: Prevalence and Some Related Factors. *Gastroenterology Research and Practice*. 2014;2014:1-8. doi:10.1155/2014/124261
16. Al Ghamdi S, AlOsamey F, AlHamdan A, et al. A study of impact and prevalence of irritable bowel syndrome among medical students. *International Journal of Medicine and Medical Sciences*. 2015;7(9):139-147.
17. Darweesh MM, Abd El Hameed MAM, Hassan YM, et al. The prevalence of irritable bowel syndrome among medical and non-medical Suez Canal University students. *Open Journal of Gastroenterology*. 2015;5(05):42.
18. Costanian C. Prevalence and factors associated with irritable bowel syndrome among university students in Lebanon: Findings from a cross-sectional study. *World Journal of Gastroenterology*. 2015;21(12):3628. doi:10.3748/wjg.v21.i12.3628
19. Wang Y, Jin F, Chi B, et al. Gender differences in irritable bowel syndrome among medical students at Inner Mongolia Medical University, China: a cross-sectional study. *Psychology, health & medicine*. 2016;21(8):964-974.
20. Perveen I, Parvin R, Saha M, Bari MS, Huda MN, Ghosh MK. Prevalence of irritable bowel syndrome (IBS), migraine and co-existing IBS-migraine in medical students. *Journal of Clinical and Diagnostic Research: JCDR*. 2016;10(11):OC09.
21. Husain M, Dumitrascu D, Chaudhry I. Irritable bowel syndrome (IBS) and stress; a study of international medical school students. *European Psychiatry*. 2016;33(S1):S633-S633.
22. Alaqeel MK, Alowaimer NA, Alonezan AF, Almegbel NY, Alaujan FY. Prevalence of irritable bowel syndrome and its association with anxiety among medical students at King Saud bin Abdulaziz University for health sciences in Riyadh. *Pak J Med Sci*. 2017;33(1):33-36. doi:10.12669/pjms.331.12572
23. Pozos-Radillo E, Preciado-Serrano L, Plascencia-Campos A, Morales-Fernández A, Valdez-López R. Predictive study of academic stress with the irritable bowel syndrome in medicine students at a public university in Mexico. *Libyan Journal of Medicine*. 2018;13(1)
24. Elhosseiny D, Mahmoud NE, Manzour AF. Factors associated with irritable bowel syndrome among medical students in Ain Shams University. *Journal of the Egyptian Public Health Association*. 2019;94(1):1-9. doi:10.1186/s42506-019-0023-8
25. Shafique S, Faraz N, Wasti H, Surti A. Irritable bowel syndrome among medical students and its association with anxiety. *The Professional Medical Journal*. 2021;28(11):1561-1565. doi:10.29309/tpmj/2021
26. Javed M, Yadav T, Shakil J, Haider Zaidi ST, Zehra M. Prevalence of irritable bowel syndrome and functional dyspepsia and their relationship with generalized anxiety disorder among medical students in Karachi. *J Pak Med Assoc*. 2022;72(10):2132-2136. doi:10.47391/JPMA.4927
27. El Sharawy SM, Amer IF, Elkadeem MZ. Irritable bowel syndrome in Egyptian medical students, prevalence and associated factors: a cross-sectional study. *The Pan African medical journal*. 2022;41:311-311. doi:10.11604/pamj.2022.41.311.28228
28. Jadallah KA, Khatatbeh MM, Sarsak EW, Sweidan AN, Alzubi BF. Irritable bowel syndrome and its associated factors among Jordanian medical students: A cross-sectional study. *Medicine (Baltimore)*. 2022;101(33):e30134-e30134. doi:10.1097/MD.0000000000030134
29. Jia W, Liang H, Wang L, et al. Associations between Abnormal Eating Styles and Irritable Bowel Syndrome: A Cross-Sectional Study among Medical School Students. *Nutrients*. 2022;14(14):2828. doi:10.3390/nu14142828
30. Hasosah MY, Alamri SA, Al-Husayni FA, Aljedaani RM, Zwawy MA, Al-Zahrani AA. Prevalence of Irritable Bowel Syndrome among Medical Students and Interns in Jeddah, Saudi Arabia. *J Clin Med Case Stud| Volume*. 2017;2(4)
31. Sehonou J, Dodo LRS. Profilclinique et facteursassociés au syndrome de l'intestin irritable chez les étudiantsenmédecine à Cotonou, Bénin. *Pan African Medical Journal*. 2018;31(1)
32. Alshammari OM, Almuslam AS, Alrashidi AA, et al. Prevalence of Irritable Bowel Syndrome among Medical Students in Hail University, Saudi Arabia. *The Egyptian Journal of Hospital Medicine*. 2018;71(2):2581-2584.
33. Hakami RM, Elmakki E, Hasanain T, et al. Irritable Bowel Syndrome: assessment of prevalence and risk factors in Saudi University students using Rome IV Criteria. *Gastroenterology Insights*. 2019;10(1)doi:10.4081/gi.2019.8239
34. AlButaysh O, AlQuraini A, Almukhaitah A, Alahmdi Y, Alharbi F. Epidemiology of irritable bowel syndrome and its associated factors in Saudi undergraduate students. *Saudi J Gastroenterol*. 2020;26(2):89-93. doi:10.4103/sjg.SJG_459_19
35. Anthea P, Tiziana F, Francesca P, Pierre E. Prevalence, behaviours and burden of irritable bowel syndrome in medical students and junior doctors. *The Ulster Medical Journal*. 2021;90(1):16.
36. Alreshidi FF, Alsammari MA, Almallahi AE, et al. Prevalence of Irritable Bowel Syndrome IBS and Its Risk Factors among Medical Students in Hail University. *International Journal of Pharmaceutical Research and Allied Sciences*. 2022;11(2):45-51. doi:10.51847/VDfCLB5GFG
37. Gravina G, Pellegrino R, Romeo M, et al. The Burden of Irritable Bowel Syndrome in Medical and Nurse Italian University Student Population: The VANVITELLI-IBS Survey. *Reviews on Recent Clinical Trials*. 2023;
38. Tran TTT, Luu MN, Tran LL, Nguyen D, Quach DT, Hiyama T. Association of mental health conditions and functional gastrointestinal disorders among Vietnamese new-entry medical students. *PLOS ONE*. 2023;18(7):e0289123. doi:10.1371/journal.pone.0289123
39. Wani F, Almaeen A, Bandy A, et al. Prevalence and risk factors of IBS among medical and nonmedical students in the Jouf University. *Nigerian Journal of Clinical Practice*. 2020;23(4):555-560.
40. Basandra S, Divyansh D. Epidemiology of dyspepsia and irritable bowel syndrome (IBS) in medical students of Northern India. *J Clin Diagn Res*. 2014;8(12):JC13-JC16. doi:10.7860/JCDR/2014/10710.5318
41. Shankar P, Mandhan N, Hussain Zaidi SM, Choudhry MS, Kumar A. Relationship of functional dyspepsia with mental and physical stress. *Annals of Psychophysiology*. 2020;7(1):25-30. doi:10.29052/2412-3188.v7.i1.2020.25-30
42. Loor A, Dumitrascu D-L, Surdea-Blaga T, Leucuta D-C, David L. Helicobacter pylori infection and positive Rome IV criteria for functional dyspepsia in Romanian medical students. *Journal of medicine and life*. 2021;14(4):492-497. doi:10.25122/jml-2021-0163