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# Prevalence and Impact of Disorders of Gut-Brain Interaction in Indonesia: An Analysis from the Rome Foundation Global Epidemiology Study

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## ABSTRACT

**Background & Aims**: Disorders of gut-brain interaction (DGBI) significantly impact quality of life (QoL), healthcare utilization, and work productivity globally, yet data from Indonesia remain limited. This household face-to-face survey study aimed to investigate the prevalence and impact of DGBI on psychological distress, dietary habits, QoL, and healthcare utilization among the Indonesian population based on Rome IV criteria.
**Methods**: A total of 1,339 Indonesian participants from the Rome Foundation Global Epidemiology Study were included in the final analysis. The overall prevalence of DGBI diagnoses in Indonesia was examined, including age- and sex-specific prevalence rates. Additionally, the association of DGBI with psychological distress (somatization, anxiety, depression), QoL, healthcare utilization, and dietary patterns were assessed.
**Results**: In Indonesia, the overall prevalence of DGBI was 18.2% (95%CI: 16.2-20.4%). Based on anatomical sites, bowel disorders were most prevalent (13.2%; 95%CI: 11.5-15.1%), followed by gastroduodenal disorders (6.0%; 95%CI: 4.9-7.4%), anorectal disorders (2.0%; 95%CI: 1.4-2.9%), and esophageal disorders (1.9%; 95%CI: 1.2-2.7%). Participants with DGBI (n=244) exhibited significantly higher psychological distress, including increased somatization, anxiety, and depression, as well as lower QoL compared to those without DGBI (n=1,095). Additionally, individuals with DGBI demonstrated significantly higher healthcare utilization rates. Dietary patterns also differed markedly in DGBI participants, characterized by significantly higher consumption of milk and pasta and reduced intake of vegetables, legumes, and rice.
**Conclusions**: DGBI represents a significant health burden in Indonesia, substantially impacting psychological well-being, dietary behaviors, healthcare resource utilization, and overall QoL, consistent with global trends.

**Key words:** disorders of gut-brain interaction – epidemiology – Indonesia – healthcare utilization – psychosocial burden.

**Abbreviations**: DGBI: disorders of gut-brain interaction; FGID: functional gastrointestinal disorder; HRQoL: health-related quality of life; IBD: inflammatory bowel disease; IBS: irritable bowel syndrome; PHQ-12: Patient Health Questionnaire; PROMIS Global-10: Patient-Reported Outcomes Measurement Information System Global-10 Questionnaire; QoL: quality of life; RFGES: Rome Foundation Global Epidemiology Study; SSS: symptom severity scale.

## INTRODUCTION

Disorders of gut-brain interaction (DGBI), previously known as functional gastrointestinal disorders (FGIDs), encompass a spectrum of gastrointestinal conditions characterized by complex pathophysiological mechanisms. These mechanisms include alterations in gut motility, visceral hypersensitivity, immune and mucosal dysfunction, gut dysbiosis, and abnormal central nervous system processing [1]. DGBI are common globally and significantly impact individuals' health and well-being [2]. Patients with DGBI often experience symptoms influenced by a combination of biological, psychological, and social factors, leading to decreased quality of life (QoL), impaired work productivity, and increased healthcare utilization [3, 4].

Despite the global prevalence and recognized burden of DGBI, the specific prevalence and associated impacts of these disorders remain poorly characterized in Indonesia, the fourth most populous country worldwide. Existing research

on DGBI prevalence in Indonesia has primarily focused on pediatric populations [5], and most utilized the outdated Rome III criteria [6, 7]. Currently, the updated Rome IV criteria represent the standard diagnostic framework for accurately identifying and classifying DGBI.

The Rome Foundation Global Epidemiology Study (RFGES) provided a comprehensive, anonymous survey conducted across 33 countries, including Indonesia [8]. In seven of these countries, including Indonesia, data were gathered through rigorous household face-to-face surveys. Utilizing this robust methodology, the RFGES dataset offers a unique opportunity to determine the prevalence of DGBI among Indonesian adults according to the Rome IV criteria and assess its association on psychological well-being (including anxiety, depression, and somatization), as well as health-related QoL (HRQOL).

Therefore, the objectives of this study were to establish the prevalence of DGBI in the adult Indonesian population using the Rome IV criteria and to evaluate the influence of these disorders on psychological distress, non-gastrointestinal somatic symptoms, and overall HRQOL.

## METHODS

### Study Population and Design

This study represents a secondary analysis of data from the RFGES [2], focused explicitly on Indonesian household-based surveys evaluating DGBI [9]. To achieve a balanced and representative sample, recruitment followed predefined demographic criteria: female-to-male ratio of 1:1 with an equal urban-rural participant distribution, and age distribution stratified as 40% in subjects aged 18-39, 40% in those aged 40-64, and 20% in those aged 65 or above. Participants were recruited between 2017 and 2018 from urban (ten randomly selected areas in Petamburan District, Jakarta) and rural (ten randomly selected areas in Bogor, West Java) sites in Indonesia, ultimately reaching a 62.8% urban and 37.2% rural distribution [10]. Sampling points within each site were randomly selected based on local administrative data and the discretion of site investigators. Due to the known familial clustering of DGBI, only one adult per household was included.

### Study Questionnaire

Surveyors were trained to conduct face-to-face interviews under the supervision of the principal investigator (A.F.S.) and site coordinator (A.P.U.) in Indonesia, with methodological support from the RFGES team. Interviewers, fluent in *Bahasa Indonesia*, administered standardized questionnaires to participants, ensuring informed consent, addressing participants' questions, and verifying the completeness and accuracy of responses. To optimize participation, outreach strategies included health education booths, free medical screenings, and community engagement through local leaders and informational flyers.

The administered questionnaires were in Indonesian (*Bahasa Indonesia*) and provided to participants either via direct interviews or self-administered by subjects (for which the validity and completeness were checked by trained surveyors). The questionnaire included the full adult Rome IV Diagnostic Questionnaire [11], sociodemographic data, and questions on factors associated with the prevalence and severity of DGBI, such as living conditions, dietary habits, healthcare utilization, stress, concern about bowel function, anxiety, depression, and other psychosocial factors. Additional validated scales included the irritable bowel syndrome (IBS) symptom severity scale (IBS-SSS) [12], the Patient Health Questionnaire-12 (PHQ-12) [13], the Patient Health Questionnaire-4 (PHQ-4) for anxiety and depression screening [14], Food Frequency Questionnaire, and the Patient-Reported Outcomes Measurement Information System Global-10 Questionnaire (PROMIS Global-10) [15]. For PHQ-12 scores, menstrual symptom questions were excluded as they were sex- and age-specific. Scores ≥8 on the PHQ-12 indicated clinically relevant somatization [16], whereas PHQ-4 subscale scores ≥3 identified clinically relevant anxiety or depression.

### Diagnosis of DGBI

The diagnosis of DGBI was made based on the validated Rome IV Diagnostic Criteria through the 86-item adult questionnaire [11]. Participants were also further categorized based on overlapping DGBI diagnoses (1 DGBI diagnoses, 2 DGBI diagnoses and 3+ DGBI diagnoses). Additionally, to adjust for possible organic disorders, the subjects were queried regarding history of physician-confirmed diagnoses of gastrointestinal diseases [including IBS, reflux disease, functional dyspepsia, chronic constipation, chronic diarrhea, celiac disease, peptic ulcer disease, diverticulitis, inflammatory bowel disease (IBD), gastrointestinal malignancies] or prior bowel resection surgery. Participants who reported either organic gastrointestinal diseases or had undergone bowel resection or other abdominal surgery were kept in the denominator. However, participants with self-reported physician-confirmed organic gastrointestinal conditions, such as celiac disease, gastrointestinal cancer, or IBD, were excluded from all DGBI classifications despite being kept in the denominator. Those with peptic ulcer disease were excluded from the esophageal, gastroduodenal, and biliary DGBI categories but remained eligible for bowel and anorectal disorders. Conversely, participants with a history of diverticulitis or bowel resections were excluded from bowel and anorectal disorders but included in esophageal, gastroduodenal, or biliary diagnoses.

### Statistical Analysis

Descriptive statistics were presented as proportions (%) with corresponding 95% confidence intervals (95%CIs) for categorical variables and means with standard deviations (SD) or 95%CI for continuous variables. Age- and sex-specific prevalence rates were calculated and analyzed. Bivariate analyses (Pearson's chi-squared or Fisher's exact test for categorical variables and Student's t-test for continuous variables) were performed to identify associations between independent factors and DGBI. P-value less than 0.05 is considered statistically significant. Statistical analyses were performed using SPSS software v29.0 (IBM, Chicago, USA) and R statistical software v4.4.1 (R Foundation, Vienna, Austria).

## RESULTS

### Demographic Characteristics of Study Participants in Indonesia

The final analysis included 1,339 Indonesian individuals with complete data (51.1% female, mean age 45.9±16.5 years) (Table I). Most participants were married (78.6%), with religion belief of Islam (96.9%), and had an average education duration of 8.7±3.9 years. Approximately half (49.4%) resided in rural areas (villages with fewer than 2,500 inhabitants), with nearly universal access to healthcare services (99.6%). Healthcare-seeking behaviors varied: 25% reported visiting a physician a few times a year, 27.6% visited less than once annually, and 20.2% never visited a doctor.

**Table I.** Demographic characteristics of Indonesian participants categorized by presence or absence of disorders of gut-brain interactions (DGBI)

| Variables | | Indonesia (N = 1339) | DGBI (N = 244) | No DGBI (N=1095) |
|---|---|---|---|---|
| Mean age (years) | 45.9±16.5 | 49.4±17.1 | 45.1±16.3 | |
| Age groups, n (%) | 18-39 | 526 (39.3) | 77 (31.6) | 449 (41.0) |
| | 40-64 | 545 (40.7) | 104 (42.6) | 441 (40.3) |
| | >65 | 268 (20.0) | 63 (25.8) | 205 (18.7) |
| Gender, n (%) | Male | 655 (48.9) | 94 (38.5) | 561 (51.2) |
| | Female | 684 (51.1) | 150 (61.5) | 534 (48.8) |
| Mean education (years; n=1,291) | | 8.7±3.9 | 7.8±3.7 | 8.9±3.4 |
| Marital status (n=1,320), n (%) | Single | 137 (10.4) | 17 (7.1) | 120 (11.1) |
| | Married/Cohabiting | 1037 (78.6) | 176 (73.0) | 861 (79.8) |
| | Divorced | 9 (0.7) | 6 (2.5) | 3 (2.8) |
| | Widow/Widower | 130 (9.9) | 40 (16.6) | 90 (8.3) |
| | Co-habiting | 7 (0.5) | 2 (0.8) | 5 (4.6) |
| Residence area (n=1,317), n (%) | City (>50,000 inhabitants) | 520 (39.5) | 115 (47.7) | 405 (37.6) |
| | Town (2,500 to 50,000 inhabitants) | 145 (11.0) | 22 (9.1) | 123 (11.4) |
| | Village or small town (<2,500 inhabitants) | 650 (49.4) | 104 (43.2) | 546 (50.7) |
| | Countryside that is not part of any city, town or village | 2 (0.1) | 0 (0) | 2 (0.2) |
| Religion, n (%) | Islam | 1,297 (96.9) | 237 (97.1) | 1,060 (96.8) |
| | Protestanism | 15 (1.1) | 3 (1.2) | 12 (1.1) |
| | Catholicism | 6 (0.5) | 3 (1.2) | 3 (0.3) |
| | Buddhism | 3 (0.2) | 0 (0) | 3 (0.3) |
| | Hinduism | 2 (0.1) | 1 (0.4) | 1 (0.1) |
| | Others | 16 (1.2) | 0 (0) | 16 (1.5) |
| How often do you go to a doctor for your health? | Once a month or more | 156 (11.7) | 54 (22.1) | 102 (9.4) |
| | A few times a year | 334 (25.0) | 88 (36.1) | 246 (22.6) |
| | Once a year | 206 (15.4) | 26 (10.7) | 180 (16.5) |
| | Less than once a year | 368 (27.6) | 61 (25.0) | 307 (28.2) |
| | Never | 270 (20.2) | 15 (6.2) | 255 (23.4) |
| Would you be able to visit a doctor if you really needed to do so? n (%) | Yes, but it would be difficult | 4 (0.3) | 1 (0.4) | 3 (0.3) |
| | Yes, easily | 1328 (99.6) | 242 (99.2) | 1086 (81.5) |
| | No | 1 (0.1) | 1 (0.4) | 0 (0) |
| Previous surgeries, n (%) | Gallbladder removed | 3 (0.2) | 0 (0) | 3 (0.3) |
| | Appendix removed | 18 (1.3) | 4 (1.6) | 14 (1.3) |
| | Uterus removed | 4 (0.3) | 0 (0) | 4 (0.4) |
| | Part of intestine removed | 1 (0.1) | 0 (0) | 1 (0.1) |
| | Other pelvic/abdominal surgery | 17 (1.3) | 2 (0.8) | 15 (1.4) |
| | Any of the above surgeries | 38 (2.8) | 6 (2.5) | 32 (2.9) |

| **Table I** (continued) | | | | |
|---|---|---|---|---|
| Medications, n (%) | To reduce constipation | 52 (5.1) | 41 (21.2) | 11 (1.3) |
| | To reduce diarrhea | 39 (3.9) | 27 (14.9) | 12 (1.5) |
| | To reduce nausea | 85 (8.4) | 38 (21.1) | 47 (5.7) |
| | To reduce stomach acid | 124 (12.2) | 60 (31.9) | 64 (7.7) |
| | To reduce pain (prescribed by a doctor) | 166 (16.4) | 43 (24.7) | 123 (14.7) |
| | To reduce pain (not prescribed by a doctor) | 207 (20.2) | 44 (24.3) | 163 (19.4) |
| | To reduce gas or bloating | 75 (7.5) | 31 (17.8) | 44 (5.4) |
| | To reduce anxiety | 4 (0.4) | 2 (1.2) | 2 (0.2) |
| | To improve depression | 1 (0.1) | 1 (0.6) | 0 (0) |
| | To improve sleeping | 4 (0.4) | 2 (1.2) | 2 (0.2) |
| | Any of the above medications | 505 (37.7) | 159 (65.2) | 346 (31.6) |

Data are presented as mean ± standard deviation or n (%). DGBI: disorders of gut-brain interaction.

Participants with any DGBI (n=244) were older (49.4±17.1 vs. 45.1±16.3 years), predominantly female (61.5% vs. 48.8%), and had less educational duration compared to those without DGBI (7.8±3.7 vs. 8.9±3.4 years). Medication use was also consistently higher in those with DGBI compared to those without DGBI (overall medications: 65.2% vs. 31.6%), particularly medications to reduce stomach acid (31.9%) and pain relief medications (24.7%).

**Prevalence of DGBI in Indonesia**

Of the 1339 Indonesian participants, 244 (18.2%; 95%CI: 16.2-20.4%) satisfied the ROME IV criteria for at least one DGBI diagnoses (any DGBI; Table II). Bowel disorders were most prevalent (13.2%; 95%CI: 11.5-15.1%), followed by gastroduodenal disorders (6.0%; 95%CI: 4.9-7.4%), anorectal disorders (2.0%; 95%CI: 1.4-2.9%) and esophageal disorders (1.9%; 95%CI: 1.2-2.7%).

**Table II.** Prevalence of disorders of gut-brain interactions among Indonesian survey participants stratified by gender and age group

| Disorders of gut-brain interactions | Overall prevalence (n=1,339) | Gender | | Age group (years) | | |
|---|---|---|---|---|---|---|
| | | Female (n=684) | Male (n=655) | 18-39 (n=526) | 40-64 (n=545) | 65+ (n=268) |
| Any DGBI | 18.2 (16.2-20.4) | 21.9 (19.0-25.1) | 14.4 (11.8-17.2) | 14.6 (11.8-17.9) | 19.1 (16.0-22.5) | 23.5 (18.7-28.9) |
| 1 DGBI diagnoses | 14.2 (12.4-16.1) | 17.4 (14.7-20.4) | 10.8 (8.6-13.4) | 11.6 (9.1-14.5) | 15.4 (12.6-18.6) | 16.8 (12.7-21.6) |
| 2 DGBI diagnoses | 3.3 (2.4-4.3) | 3.7 (2.4-5.3) | 2.9 (1.8-4.4) | 2.5 (1.4-4.1) | 2.8 (1.6-4.4) | 6.0 (3.6-9.3) |
| 3+ DGBI diagnoses | 0.7 (0.4-1.3) | 0.9 (0.4-1.8) | 0.6 (0.2-1.4) | 0.6 (0.2-1.5) | 0.9 (0.4-2.0) | 0.7 (0.2-2.4) |
| Any esophageal disorders | 1.9 (1.2-2.7) | 2.0 (1.2-3.3) | 1.7 (0.9-2.9) | 1.3 (0.6-2.6) | 2.0 (1.1-3.5) | 2.6 (1.2-5.1) |
| Functional heartburn | 0.2 (0.1-0.6) | 0.3 (0.1-0.9) | 0.2 (0.0-0.7) | 0.2 (0.0-0.9) | 0.4 (0.1-1.2) | 0 |
| Functional chest pain | 0.3 (0.1-0.7) | 0.3 (0.1-0.9) | 0.3 (0.1-1.0) | 0.4 (0.1-1.2) | 0.4 (0.1-1.2) | 0 |
| Reflux hypersensitivity | 0.2 (0.1-0.6) | 0.1 (0.0-0.7) | 0.3 (0.1-1.0) | 0.6 (0.2-1.5) | 0 | 0 |
| Globus | 0.1 (0.0-0.3) | 0.1 (0.0-0.7) | 0 | 0.2 (0.0-0.9) | 0 | 0 |
| Functional dysphagia | 1.3 (0.8-2.0) | 1.3 (0.7-2.4) | 1.2 (0.6-2.3) | 0.4 (0.1-1.2) | 1.5 (0.7-2.8) | 2.6 (1.2-5.1) |
| Any gastroduodenal disorders | 6.0 (4.9-7.4) | 7.3 (5.5-9.4) | 4.7 (3.3-6.6) | 4.2 (2.7-6.2) | 6.8 (4.9-9.1) | 8.2 (5.4-11.9) |
| Functional dyspepsia | 4.3 (3.3-5.4) | 5.0 (3.5-6.8) | 3.5 (2.3-5.1) | 3.4 (2.1-5.2) | 4.0 (2.6-5.9) | 6.3 (3.9-9.7) |
| EPS | 1.4 (0.9-2.2) | 1.2 (0.6-2.2) | 1.7 (0.9-2.9) | 0.8 (0.3-1.8) | 1.7 (0.8-3.0) | 2.2 (0.9-4.6) |
| PDS | 3.2 (2.4-4.3) | 3.9 (2.7-5.6) | 2.4 (1.5-3.8) | 2.9 (1.7-4.5) | 2.8 (1.6-4.4) | 4.9 (2.7-7.9) |
| Belching disorder | 0.6 (0.3-1.1) | 0.7 (0.3-1.6) | 0.5 (0.1-1.2) | 0.6 (0.2-1.5) | 0.7 (0.2-1.7) | 0.4 (0.0-1.7) |
| Rumination syndrome | 1.3 (0.8-2.0) | 1.6 (0.9-2.8) | 0.9 (0.4-1.9) | 1.0 (0.4-2.1) | 1.7 (0.8-3.0) | 1.1 (0.3-3.0) |
| Chronic nausea vomiting syndrome | 0.7 (0.3-1.2) | 0.4 (0.1-1.2) | 0.9 (0.4-1.9) | 0.2 (0.0-0.9) | 0.7 (0.2-1.7) | 1.5 (0.5-3.5) |
| Cyclic vomiting syndrome | 0.1 (0.0-0.5) | 0.3 (0.1-0.9) | 0 | 0 | 0.4 (0.1-1.2) | 0 |
| Cannabis hyperemesis syndrome | 0 | 0 | 0 | 0 | 0 | 0 |
| Any biliary disorders | 0 | 0 | 0 | 0 | 0 | 0 |
| Functional biliary pain | 0 | 0 | 0 | 0 | 0 | 0 |
| Any bowel disorders | 13.2 (11.5-15.1) | 16.2 (13.6-19.1) | 10.1 (7.9-12.6) | 11.4 (8.9-14.3) | 13.4 (10.7-16.4) | 16.4 (12.4-21.2) |
| Rome-IV IBS | 2.6 (1.9-3.6) | 3.5 (2.3-5.1) | 1.7 (0.9-2.9) | 4.8 (3.2-6.8) | 1.7 (0.8-3.0) | 0.4 (0.0-1.7) |

**Table II** (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| IBS-C | 0.3 (0.1-0.7) | 0.4 (0.1-1.2) | 0.2 (0.0-0.7) | 0.4 (0.1-1.2) | 0.4 (0.1-1.2) | 0 |
| IBS-D | 1.6 (1.1-2.4) | 1.9 (1.1-3.1) | 1.4 (0.7-2.5) | 3.2 (2.0-5.0) | 0.9 (0.4-2.0) | 0 |
| IBS-M | 0.2 (0.1-0.6) | 0.4 (0.1-1.2) | 0 | 0.2 (0.0-0.9) | 0.2 (0.0-0.9) | 0.4 (0.0-1.7) |
| IBS-U | 0.4 (0.2-0.9) | 0.7 (0.3-1.6) | 0.2 (0.0-0.7) | 1.0 (0.4-2.1) | 0.2 (0.0-0.9) | 0 |
| Functional constipation | 3.3 (2.4-4.3) | 4.2 (2.9-5.9) | 2.3 (1.3-3.7) | 1.3 (0.6-2.6) | 4.0 (2.6-5.9) | 5.6 (3.3-8.8) |
| Opioid-induced constipation | 1.3 (0.8-2.0) | 1.3 (0.7-2.4) | 1.2 (0.6-2.3) | 1.0 (0.4-2.1) | 1.3 (0.6-2.5) | 1.9 (0.7-4.0) |
| Functional diarrhea | 1.7 (1.1-2.5) | 1.8 (1.0-3.0) | 1.7 (0.9-2.9) | 1.0 (0.4-2.1) | 1.1 (0.5-2.3) | 4.5 (2.5-7.5) |
| Functional bloating/distention | 1.2 (0.7-1.9) | 1.2 (0.6-2.2) | 1.2 (0.6-2.3) | 0.8 (0.3-1.8) | 1.5 (0.7-2.8) | 1.5 (0.5-3.5) |
| Unspecified functional bowel disorder | 3.2 (2.4-4.3) | 4.4 (3.0-6.1) | 2.0 (1.1-3.3) | 2.5 (1.4-4.1) | 4.0 (2.6-5.9) | 3.0 (1.4-5.6) |
| Central nervous system disorders of gastrointestinal pain | 0 | 0 | 0 | 0 | 0 | 0 |
| Centrally mediated abdominal pain syndrome | 0 | 0 | 0 | 0 | 0 | 0 |
| Any anorectal disorders | 2.0 (1.4-2.9) | 1.9 (1.1-3.1) | 2.1 (1.2-3.5) | 1.5 (0.7-2.8) | 1.7 (0.8-3.0) | 3.7 (1.9-6.5) |
| Fecal incontinence | 0.3 (0.1-0.7) | 0.1 (0.0-0.7) | 0.5 (0.1-1.2) | 0.2 (0.0-0.9) | 0 | 1.1 (0.3-3.0) |
| Levator ani syndrome | 0.4 (0.2-0.9) | 0.4 (0.1-1.2) | 0.5 (0.1-1.2) | 0.4 (0.1-1.2) | 0.2 (0.0-0.9) | 1.1 (0.3-3.0) |
| Proctalgia fugax | 1.3 (0.8-2.1) | 1.3 (0.7-2.4) | 1.4 (0.7-2.5) | 1.1 (0.5-2.3) | 1.5 (0.7-2.8) | 1.5 (0.5-3.5) |

IBS: irritable bowel syndrome; IBS-C: IBS with constipation; IBS-D: IBS with diarrhea; IBS-M: IBS-mixed; IBS-U: IBS unsubtyped; DGBI: disorders of gut-brain interactions; EPS: epigastric pain syndrome; PDS: postprandial distress syndrome.

Based on the number of DGBI diagnoses, the prevalence of having only one DGBI diagnoses was 14.2% (95%CI: 12.4-16.1%), and having overlapping DGBI diagnoses of two and three or greater were 3.3% (95%CI: 2.4-4.3%) and 0.7% (95%CI: 0.4-1.3%), respectively.

Functional constipation was the predominant bowel disorder (3.3%), followed by IBS (2.6%), with the diarrhea-predominant subtype being the most frequent. Among gastroduodenal disorders, functional dyspepsia (4.3%) and rumination syndrome (1.3%) were most prevalent. Proctalgia fugax was the leading anorectal disorder (1.3%), and functional dysphagia was the most common esophageal disorder (1.3%).

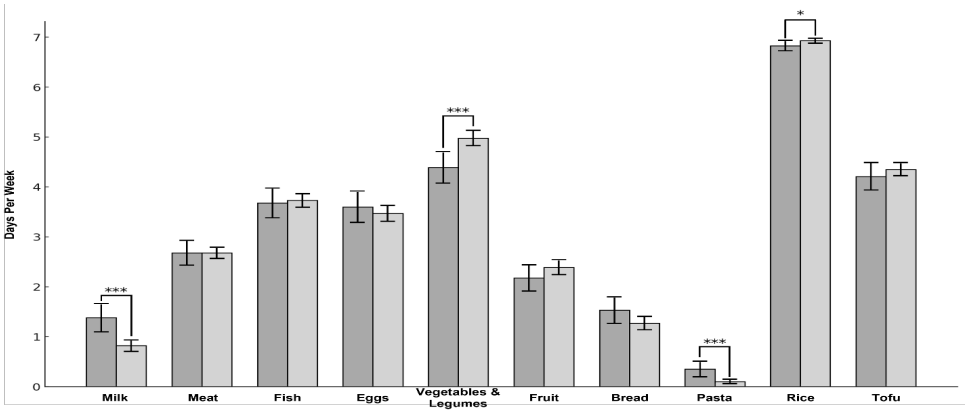
Overall, DGBI prevalence was higher among females compared to males (21.9% vs. 14.4%; Table II), particularly gastroduodenal disorders (7.3% vs. 4.7%) and bowel disorders (16.2% vs. 10.1%). In contrast, esophageal disorders (2.0% vs. 1.7%) and anorectal disorders (2.1% vs. 1.9%) were similar in prevalence among both sexes. As for the age groups, individuals aged 65 years and older exhibited the highest prevalence of any DGBI diagnosis. IBS was predominant among younger adults aged 18-39 (4.8%), whereas functional dyspepsia was highest in older age groups (aged 40-64: 4.0%; and 65+: 6.3%).

### The Psychological Impact of DGBI in Indonesia

Participants with DGBI exhibited higher scores of PHQ-12 (somatization) and PHQ-4 (including anxiety and depression subscore) compared to those without DGBI (4.3±2.8 vs. 2.6±2.0; p<0.001 and 1.0±1.5 vs. 0.6±1.2; p<0.001; respectively; Table III). There were significantly more somatization and depression cases among those with DGBI, but not for anxiety. Furthermore, overall physical and mental quality-of-life scores were significantly lower in participants with DGBI (15.5±2.5 vs. 16.7±2.1; p<0.001 and 13.8±2.5 vs. 14.4±2.6; p<0.001, respectively).

### Relationship of Diet and DGBI in Indonesia

Dietary habits were generally similar between participants with and without DGBI, with a few notable exceptions (Fig. 1).




**Fig, 1.** Frequency of food consumption (days per week) in participants with any DGBI (dark gray bars) compared to those without DGBI (light gray bars). Error bars represent 95% confidence intervals. $^{*}$p <0.05; $^{***}$p <0.001.

**Table III.** Psychosocial burden and healthcare utilization among individuals with and without disorders of gut-brain interaction (DGBI)

| Variables | No DGBI (N = 1095) | Any DGBI (N = 244) | p | 1 DGBI (N = 190) | 2 DGBI (N = 44) | 3+ DGBI* (N = 10) |
|---|---|---|---|---|---|---|
| **12-item PHQ-15 score (N= 730, 161)** | 2.6±2.0 | 4.3±2.8 | **<0.001** | 3.9±2.8 (N = 120) | 4.9±2.5 (N = 32) | 6.9±2.1 (N = 9) |
| **Somatization cases (N= 730, 161)** | 12 (1.6) | 20 (12.4) | **<0.001** | 10 (8.3) (N = 120) | 6 (18.8) (N = 32) | 4 (44.4) (N = 9) |
| **PHQ-4 score (N = 1090, 243)** | 0.6±1.2 | 1.0±1.5 | **<0.001** | 0.9±1.5 (N = 189) | 1.3±1.6 (N = 44) | 2.2±1.8 (N = 10) |
| **PHQ-4 Anxiety (N = 1092, 244)** | 0.3±0.7 | 0.5±0.8 | **0.002** | 0.4±0.8 (N = 190) | 0.6±0.9 (N = 44) | 1.3±1.0 (N = 10) |
| **Anxiety cases (N = 1092, 244)** | 13 (1.2) | 6 (2.5) | 0.225 | 3 (1.6) (N = 190) | 2 (4.5) (N = 44) | 1 (10.0) (N = 10) |
| **PHQ-4 Depression (N = 1093, 243)** | 0.3±0.6 | 0.5±0.8 | **<0.001** | 0.5±0.8 (N = 189) | 0.7±0.9 (N = 44) | 0.9±1.0 (N = 10) |
| **Depression cases (N = 1093, 243)** | 10 (0.9) | 7 (2.9) | **0.031** | 4 (2.1) (N = 189) | 2 (4.5) (N = 44) | 1 (10.0) (N = 10) |
| **PROMIS-10 physical (N = 1069, 238)** | 16.7±2.1 | 15.5±2.5 | **<0.001** | 15.8±2.5 (N = 186) | 14.5±2.1 (N = 42) | 13.2±2.4 (N = 10) |
| **PROMIS-10 mental (N = 1089, 241)** | 14.4±2.6 | 13.8±2.5 | **<0.001** | 14.1±2.5 (N = 188) | 12.7±2.1 (N = 43) | 11.8±1.9 (N = 10) |
| **How often do you go to a doctor for your health? (n=1,090, 244)** | | | | | | |
| **Once a month or more** | 102 (9.4) | 54 (22.1) | **<0.001** | 33 (17.4) | 18 (40.9) | 3 (30.0) |
| **A few times a year** | 246 (22.6) | 88 (36.1) | | 70 (36.8) | 14 (31.8) | 4 (40.0) |
| **Once a year** | 180 (16.5) | 26 (10.7) | | 25 (13.2) | 1 (2.3) | 0 (0) |
| **Less than once a year** | 307 (28.2) | 61 (25.0) | | 48 (25.3) | 10 (22.7) | 3 (30.0) |
| **Never** | 255 (23.4) | 15 (6.1) | | 14 (7.4) | 1 (2.3) | 0 (0) |
| **Ever visited a doctor because of a bowel problem? (N = 1,092, 244)** | 62 (5.7) | 44 (18.0) | **<0.001** | 34 (17.9) | 8 (18.2) | 2 (20.0) |
| **How concerned are you about your bowel functioning (n=1,088, 243)** | | | | | | |
| **Not at all** | 1,029 (94.6) | 156 (64.2) | **<0.001** | 120 (63.5) | 29 (65.9) | 7 (70.0) |
| **Somewhat** | 56 (5.1) | 82 (33.7) | | 66 (34.9) | 13 (29.6) | 3 (30.0) |
| **Very concerned** | 3 (0.3) | 5 (2.1) | | 3 (1.6) | 2 (4.5) | 0 (0) |
| **Are you embarrassed to discuss your bowel functioning with others (family, friends)? (N = 1094, 243)** | | | | | | |
| **Not at all** | 1074 (98.2) | 178 (73.3) | **<0.001** | 131 (69.3) | 38 (86.4) | 9 (90.0) |
| **Somewhat** | 18 (1.6) | 61 (25.1) | | 54 (28.6) | 6 (13.6) | 1 (10.0) |
| **Very embarrassed** | 2 (0.2) | 4 (1.6) | | 4 (2.1) | 0 (0) | 0 (0) |
| **Does stress, pressure or tension affect your bowel functioning? (N = 1095, 243)** | | | | | | |
| **Not at all** | 1076 (98.3) | 172 (70.8) | **<0.001** | 126 (66.7) | 37 (84.1) | 9 (90.0) |
| **Somewhat** | 17 (1.5) | 59 (24.3) | | 51 (27.0) | 7 (15.9) | 1 (10.0) |
| **Greatly affects it** | 2 (0.2) | 12 (4.9) | | 12 (6.3) | 0 (0) | 0 (0) |

**Notes** *Only 1 participant had 4 DGBI diagnoses; DGBI: disorders of gut-brain interaction; PHQ-12: Patient Health Questionnaire; PROMIS Global-10: Patient-Reported Outcomes Measurement Information System Global-10 Questionnaire.

Individuals with DGBI consumed significantly more milk products (0.8±1.7 days per week vs. 1.4±2.1 days per week; p<0.001) and pasta (0.1±0.6 days per week vs. 0.4±1.1 days per week; p<0.001) compared to those without DGBI. Conversely, the consumption of vegetables and legumes (5.0±2.4 days per week vs. 4.4±2.4 days per week; p<0.001) and rice (6.9±0.6 days per week vs. 6.8±0.7 days per week; p=0.034) was significantly lower in those with DGBI.

### Healthcare Utilization

Participants with DGBI reported a higher frequency of doctor visits for any health issue than those without DGBI (Table III). Those with overlapping (2 or 3 and greater) DGBI diagnoses had slightly more frequent doctor visits compared to those with only a single DGBI diagnosis. Individuals with DGBI often expressed greater concerns about their bowel function and experienced more embarrassment discussing these issues with family and friends. Additionally, their bowel function was significantly impacted by stress, pressure, and tension (p<0.001).

## DISCUSSION

This is the first population-based study in Indonesia utilizing the Rome IV diagnostic criteria to determine the

prevalence of DGBI and their impact on psychological burden, QoL, and dietary intake. The observed prevalence of DGBI in Indonesia was 18.2%, significantly lower than the global average of 40% but similar to other household countries, including Malaysia [17], which document a prevalence of around 20% [10]. Most individuals diagnosed with DGBI were aged between 40 and 64 years and predominantly female. This demographic profile aligns closely with other regional studies but differs notably from an internet-based survey reporting younger affected populations aged 18-39 years [2]. In terms of specific DGBI diagnoses, bowel disorders were most prevalent among Indonesians, followed by gastroduodenal and anorectal disorders, mirroring findings from other international and regional studies [10].

Those with DGBI demonstrated elevated levels of anxiety, depression, and somatization, consistent with reports from the RFGES conducted in Europe and elsewhere [18, 19]. The exact mechanisms linking psychological disturbances and DGBI remain unclear, however, likely involving multifactorial influences. Female predominance in DGBI-related psychological dysfunction has been reported previously and attributed to age and possibly female sex hormones which ultimately increased visceral perception and subsequently resulted in higher somatic symptom severity among women [20]. Another plausible mechanism, although not studied here, includes altered interactions between gut microbiota metabolites, such as peptidoglycans and lipopolysaccharides, and the central nervous system [16]. Interestingly, previous studies have implied that increasing penetration of the Western diet, which is higher in fat content, into Asian lifestyles may be linked to changes in the gut microbiome [21]. These dietary shifts, which differ significantly from traditional Asian diets in terms of fiber and fat content, could potentially contribute to gastrointestinal symptoms and psychological effects such as anxiety and depression [22].

Dietary factors also emerged as significant modifiers of gut microbiota and symptom severity in DGBI. Indonesian participants with DGBI exhibited significantly higher consumption of milk products and pasta but a lower intake of vegetables, legumes, and rice. Prior studies have indicated that certain dietary components, notably specific carbohydrates, proteins, and fats, can exacerbate gastrointestinal symptoms [23-25]. Dietary interventions, including eliminating dairy and gluten, have demonstrated efficacy in symptom management [26]. Notably, the observed differences in dairy and pasta consumption between Indonesian and Malaysian populations highlight the need for further research exploring baseline dietary habits, socioeconomic determinants of food access, and the specific types of dairy products consumed. For example, fermented dairy products like yogurt have previously demonstrated beneficial impacts on gut microbiota and symptom reduction in patients with DGBI and IBD [27].

Indonesia's recent introduction of the universal health coverage program in 2014 has improved health equity and service access [28], as shown in our data, more than 99% of Indonesians have easy access to visit a doctor for any health problem. Despite this, only a minority (18%) of individuals with DGBI in this studied population sought formal medical consultation specifically for bowel issues. This could be because many still preferred informal or traditional health providers, such as practitioners utilizing biologically based therapies, acupuncture, and mind-body practices. This preference is often culturally driven, with traditional healers perceived as more approachable and culturally familiar [29]. Additionally, stigma or embarrassment associated with discussing bowel problems may further reduce formal medical consultations, highlighting a critical cultural barrier to healthcare utilization.

Several limitations of this study must be acknowledged. Indonesia's diverse ethnicities and cultural practices, with subtle differences throughout the country's different regions, present inherent challenges in data collection and may limit the generalizability of findings. Of note, data were collected from Java island and may not fully represent other regions in Indonesia, especially since Indonesia is a diverse and large country. In addition, due to incompleteness of data, the total subjects included in this analysis were less than the original target of at least 2000 participants [10]. However, these data are still particularly important to understand better and build ground foundation for further research and awareness in DGBI, especially within the Indonesian population. Furthermore, the cross-sectional nature of the study restricts the ability to infer causality or establish temporal relationships between DGBI and associated psychological and somatic symptoms. Prospective longitudinal studies are needed to explore these dynamics further, including long-term cultural and geographic influences on symptom manifestation and healthcare-seeking behaviors.

## CONCLUSIONS

This pioneering RFGES-based investigation provides comprehensive insights into the epidemiology and impact of DGBI in Indonesia. Our findings highlight significant psychological burdens, increased healthcare utilization, dietary implications, and diminished quality of life associated with DGBI, emphasizing parallels and distinct variations compared to global and regional populations.

**Conflicts of interest:** None to declare.

**Authors' contribution**: D.M.S., A.P.U., K.Y.C., O.S.P., A.D.S., S.I.B., Y.Y.L., and A.F.S. conceived and designed the study. All the authors analyzed and interpreted the data. D.M.S., A.P.U., L.A., J.W., N.H.H. and A.F.S drafted the manuscript. O.S.P., A.D.S., S.I.B., and Y.Y.L. revised the manuscript. A.F.S. supervised the study. All the authors read and approved the final version of the manuscript.

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