

# A scientometric analysis of the relationship between functional dyspepsia and anxiety

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## ABSTRACT

**Aims:** Functional dyspepsia is a common disorder characterized by persistent or recurrent upper gastrointestinal tract symptoms without underlying disease or structural abnormalities that can have a significant impact on an individual's overall quality of life. Studies in the literature indicate that anxiety also plays an important role in the etiology of functional dyspepsia. Early diagnosis and treatment of the underlying anxiety disorder are important to relieve dyspeptic symptoms. In this study, the aim was to examine the studies related to functional dyspepsia and anxiety using the bibliometric method.

**Methods:** Clarivate Analytics' Web of Science database was used to search for articles and reviews on functional dyspepsia and anxiety between 1980 and 2022. VOSviewer, Tableau, and IBM SPSS Statistics were used for bibliometric network visualization and statistical analyses. A regression analysis using a nonlinear exponential model was used to forecast the number of publications in the next years. Keyword network visualization maps were used to identify recent trends and relationships.

**Results:** The Web of Science database included 560 articles and reviews about functional dyspepsia and anxiety between 1991 and 2023, with the top 5 research areas being Gastroenterology, Clinical Neurology, Neurosciences, Psychiatry, and General Internal Medicine. The collaborative clustering network map shows four distinct clusters based on total link strength scores, and the correlation between Gross Domestic Product (GDP) and the number of studies published suggests that countries with higher GDP tend to publish more studies. Since 2015, the amount of published materials on the topic has dramatically increased and is continuing to rise.

**Conclusion:** There has been an upward trend in publications about the relationship between functional dyspepsia and anxiety since the 2010s, with the top ten countries with the greatest number of publications being mostly wealthy nations. The most cited journal on the topic was the American Journal of Gastroenterology, with 1441 total citations. Our findings suggest that this is a rapidly evolving field with a broad range of research topics.

**Keywords:** Functional dyspepsia, anxiety, bibliometric analysis, dyspepsia

## INTRODUCTION

Functional dyspepsia is a disorder marked by recurrent or persistent regurgitation, upper abdominal distress or discomfort, bloating, nausea, and early satiety in the absence of underlying disease or structural abnormalities. It is a functional gastrointestinal condition characterized by symptoms that can significantly decrease an individual's quality of life due to its impact on gastrointestinal motility and sensitivity. It is a highly prevalent disorder that accounts for 5% of visits to primary care clinicians.<sup>1,2</sup> Around 10–20% of the general population is thought to have functional dyspepsia.<sup>3</sup> The pathophysiological mechanism of functional dyspepsia is unclear. However, it is thought to be a mix of variables, including abnormal stomach emptying, altered gastrointestinal motility,

visceral hypersensitivity, and psychological issues such as anxiety, stress, and depression. Functional dyspepsia, which manifests as gastric hypomotility and disorganized antral duodenal contractions, has been associated with gastrointestinal motor disorders.<sup>4</sup>

Anxiety is a mental health disorder characterized by feelings of worry, fear, or unease that can be mild or severe.<sup>5</sup> Anxiety disorders make up the majority of mental illnesses globally, with high comorbidity and morbidity.<sup>6</sup> The prevalence of anxiety disorders varies depending on the population studied and the diagnostic criteria used. Epidemiological studies show that anxiety disorders constitute the most frequent mental disorders in the community, with phobias being the most common.<sup>7</sup>

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There is a significant association between functional dyspepsia and anxiety.<sup>8-11</sup> Studies suggest that anxiety and depression play an important role in the etiopathogenesis of functional dyspepsia.<sup>8</sup> Patients with functional dyspepsia have a higher rate of anxiety disorder, depression, and somatoform disorder compared to the general population.<sup>10</sup> Anxiety is a significant predictor of healthcare utilization by patients with dyspepsia and irritable bowel syndrome.<sup>12</sup> Individuals with coexisting functional gastrointestinal disorders, particularly functional dyspepsia, exhibit a more intense symptom complex, lower health-related quality of life, higher somatization levels, and are more likely to suffer anxiety, depression, or sleeplessness than those without overlap.<sup>11,13</sup> Therefore, recognition of depression and anxiety is crucial to improve clinical outcomes in functional dyspepsia patients.<sup>9</sup>

A bibliometric analysis is a quantitative method used to evaluate and analyze scientific literature in a particular field.<sup>14-16</sup> It requires employing mathematical and statistical approaches to assess the external characteristics of literature in order to characterize, evaluate, and forecast research advancement in an area.<sup>17</sup> Bibliometric analysis is used to measure the productivity of researchers, groups, or institutions and to evaluate scientific production using various methods.<sup>18</sup> Bibliometric evaluation is an excellent method for assessing data characteristics and subject growth trends.<sup>17</sup> It is also used to explore research trends and characteristics of publications in a specific area. Following the studies on a particular topic and divulging their findings by examining these publications according to different features is the basis of bibliometric analysis. Bibliometric analysis is an advanced and efficient statistical technique that assesses secondary data acquired from digital databases from a quantifiable and objective standpoint and provides researchers with an overview of a particular research domain, such as gastroenterology, psychiatry and surgery.<sup>19-21</sup>

In this study, our purpose was to conduct a bibliometric analysis of the academic literature on functional dyspepsia and anxiety. Specifically, we sought to identify patterns in research, such as the number and types of studies conducted, frequently cited authors and publications, and common research themes and methodologies. By analyzing the bibliographic data, we aimed to gain insights into the current state of knowledge in the field, identify knowledge gaps, and suggest potential areas for future research. The findings from this study can be useful for researchers and clinicians to develop more effective diagnostic and treatment strategies for patients with functional dyspepsia and anxiety.

## METHODS

Ethics committee approval is not required for this bibliometric study. This research was conducted in accordance with the World Medical Association Declaration of Helsinki's "Ethical Principles for Medical Research Involving Human Subjects."

Clarivate Analytics' Web of Science (WoS) database was used for the literature review. In WoS, the search terms "functional dyspepsia" and "anxiety\*" were used. Only the "topic" section of the studies was used for the publication search. Using this search technique, all articles and reviews on functional dyspepsia and anxiety or articles containing terms derived from these were found and retrieved from the WoS database. The search dates were determined to be between 1980 and 2022 (access date: 24.04.2023). Researchers can use these reproducibility codes to access comparable documents (search results may differ based on access dates): (("functional dyspepsia" (Topic) OR "functional dyspe\*" (Topic)) AND (("anxiety" (Topic) OR "anxi\*" (Topic))) Timespan: 1980-2022 (Indexes Scanned: SSCI, SCI-E, ESCI, A&HCI, BKCI-SSH, BKCI-S, CPCI-SSH, CPCI-S) (Article Types Scanned: Article, Review Article)). For bibliometric network visualization, VOSviewer software was used (Leiden University's Center for Science and Technology Studies, Version 1.6.19).<sup>22</sup> The Tableau Software for Windows (Version 2019.4.1.; Tableau Software LLC, Seattle, WA) software was used to create a globe map. The IBM SPSS Statistics for Windows program was used for statistical analyses (Version 26; IBM Corp., Armonk, N.Y., USA). Data normal distribution was evaluated with the Shapiro-Wilks test. In line with the data distribution, Spearman's correlation coefficient was used to assess the relationships between the number of articles published by world nations and multiple economic development indicators of world countries to see whether there is a relationship between economic power and the number of scientific publications (Gross Domestic Product (GDP), and GDP per capita, World Bank, 2021 data).<sup>23</sup> To predict the number of publications in the next years, a nonlinear regression analysis (exponential model) was used. In the regression analysis, the R square (R<sup>2</sup>) value was utilized to measure the model's effectiveness. Results were considered statistically significant if the p-value was less than 0.05.

## RESULTS

The Web of Science database included 560 articles and reviews regarding functional dyspepsia and anxiety published between 1980 and 2023. Of these publications, 494 were articles (88.21%), and 66 were reviews (11.79%). 98.04% (549) of these publications were in English, 1.25% (7) were in German, 0.36% (2) were in Turkish, 0.179% (1) were in Korean, and 0.179% (1) were in Polish. The average number of citations per article was

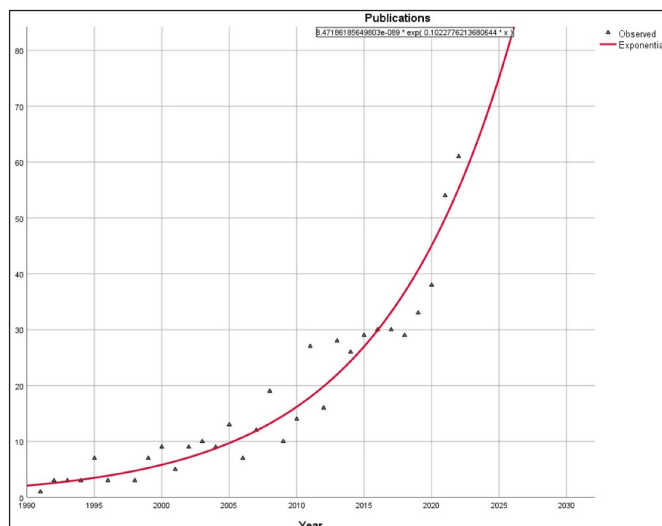
27.05, the total number of citations was 15147 (without self-citations: 13058), 72 publications were not cited, and the h-index of 560 articles was 60.

### Active Research Areas

The top 10 research areas about functional dyspepsia and anxiety were Gastroenterology (319, 56.96%), Clinical Neurology (75, 13.39%), Neurosciences (66, 11.79%), Psychiatry (61, 10.89%), Medicine General Internal (60, 10.71%), Pharmacology (43, 7.68%), Psychology (42, 7.49%), Medicine Research Experimental (20, 3.57%), Pediatrics (14, 2.50%), Nutrition (10, 1.79%).

### Development and Future Trends of Publication

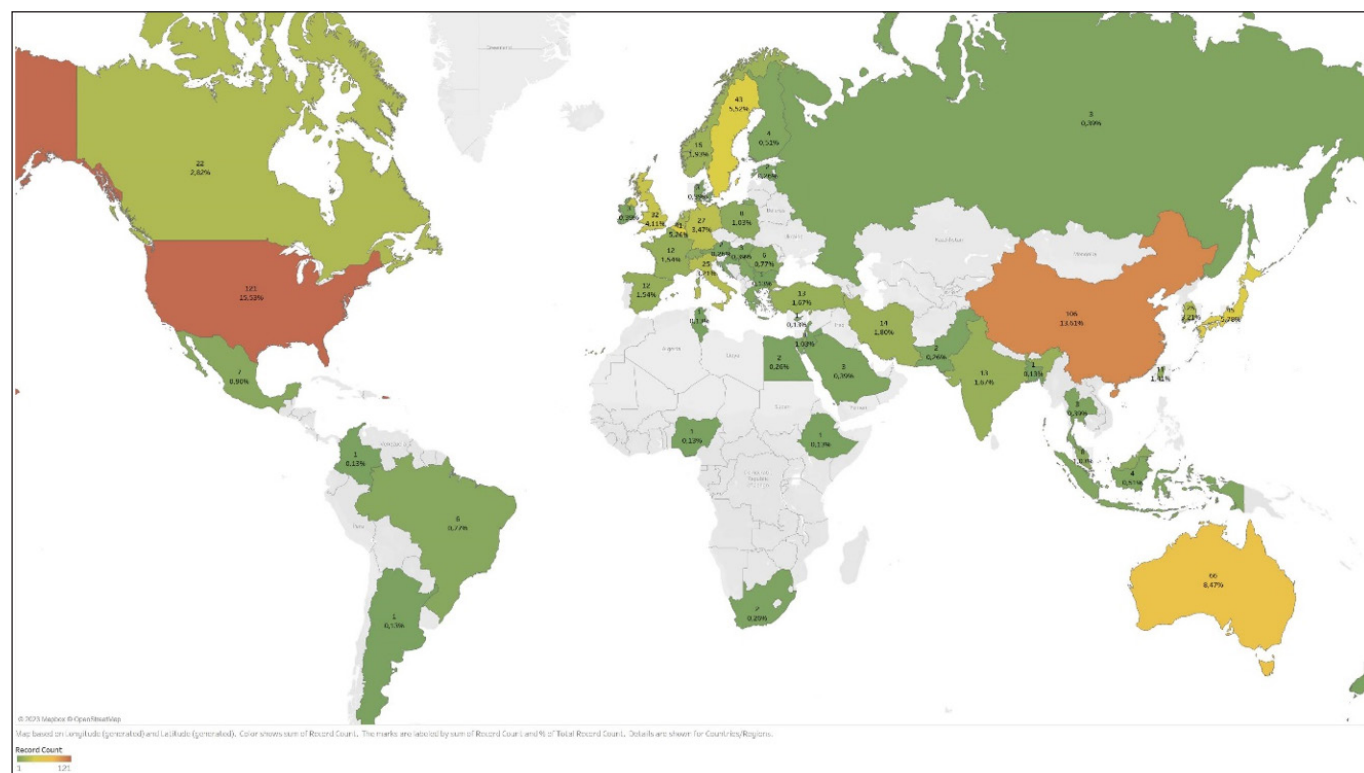
**Figure 1** depicts the yearly variation in the number of published papers. In addition, it presents the results of the non-linear exponential growth regression analysis conducted to predict the number of papers published in 2023 and beyond. The model demonstrated a statistically significant relationship with the data, with a degree of agreement of 90.4% ( $R^2=0.904$ ,  $p<0.001$ ). The model predicts that a total of 61 (95% CI (Confidence Interval): 31–122) articles will be published in 2023, 68 (95% CI: 34–136) new articles in 2024, and 75 (95% CI: 37–151) new articles in 2025 (**Figure 1**). These predictions suggest a gradual increase in the number of published articles over the next three years. It is expected that more than 100 articles will be published each year starting in 2028 (projected 104, 95% CI: 49–189). However, it is important to note that unforeseen factors could impact these projections.



**Figure 1** Distribution of functional dyspepsia and anxiety publications by year and projection of articles in the following years using the exponential growth model

### Active Countries

A total of fifty-eight countries had publications about functional dyspepsia and anxiety. The countries that produced the most research publications on anxiety and functional dyspepsia were the United States of America (USA) (121, 21.61%), the People's Republic of China (PRC) (106, 18.93%), Australia (66, 11.79%), Japan (45, 8.04%), Sweden (43, 7.68%), Belgium (41, 7.32%), England (32, 5.71%), Germany (27, 4.82%), Italy (25, 4.46%), and South Korea (25, 4.46%) (**Figure 2**). The total link strength scores of 27 countries that published at least five articles on functional dyspepsia and anxiety and had international associations among



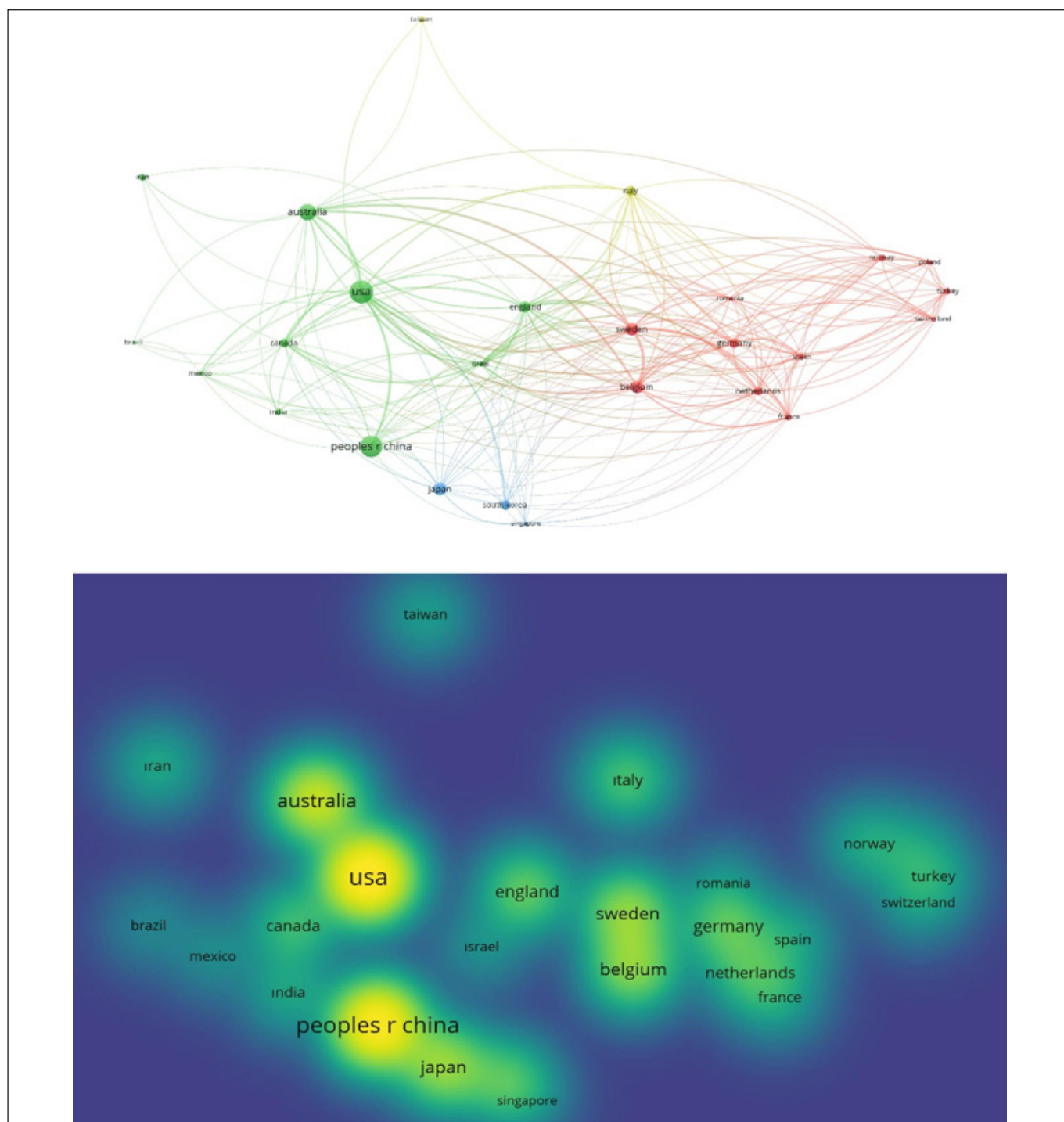
**Figure 2** Global distribution of publications on functional dyspepsia and anxiety



their authors were calculated. **Figure 3** displays the collaborative clustering network map using total link strength scores (Malaysia had no author connections to any other nation and was therefore omitted from the map). There were found to be four distinct clusters based on the data (Cluster 1: Belgium, France, Germany, the Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland, Turkey; Cluster 2: Australia, Brazil, Canada, England, India, Iran, Israel, Mexico, PRC, USA; Cluster 3: Japan, Singapore, South Korea; Cluster 4: Italy, Taiwan). The internal collaboration density map is also illustrated in **Figure 3**.

### Correlation Analysis of Publication Count and Gross Domestic Product

The GDP of a nation was significantly correlated with the number of studies that the country did on functional dyspepsia and anxiety ( $r=0.758$ ,  $p<0.001$ ). This was also true for the association between GDP per capita and the number of studies that the country published. ( $r=0.444$ ,  $p<0.001$ ). This suggests that countries with a higher GDP per capita tend to publish more studies, possibly due to having more resources and funding for research. However, correlation does not necessarily imply causation, and other factors may also be at play.



**Figure 3.** Network visualization, cluster and density map on worldwide cooperation on functional dyspepsia and anxiety

### Active Authors

The top ten most active and productive writers with the most papers on functional dyspepsia and anxiety were Talley NJ (50, 8.93%), Tack J (25, 4.46%), Van Oudenhove L (22, 3.93%), Zeng F (19, 3.39%), Jones MP (17, 3.04%), Holtmann G (15, 2.68%), Liang FR (14, 2.50%), Miwa H (12, 2.14%), Qin W (12, 2.14%), and Walker MM (12, 2.14%). These influential authors have made significant contributions to the research on functional dyspepsia and anxiety, and their work has helped advance our understanding of the relationship between these conditions.

### Active Institutions

From 1991 and 2023, the top ten institutions that produced the most articles on functional dyspepsia and anxiety were the Catholic University of Leuven (37, 6.61%), University of Newcastle (32, 5.71%), Mayo Clinic (29, 5.18%), University Hospital of Leuven (23, 4.11%), Chengdu University of Traditional Chinese Medicine (21, 3.75%), Karolinska Institutet (20, 3.57%), Macquarie University (20, 3.57%), University of Sydney (19, 3.39%), University of Bergen (14, 2.50%), Xidian University (14, 2.50%). It is interesting to note that the Catholic University of Leuven and the University Hospital of Leuven, both located in Belgium, are among the top four institutions producing articles on functional dyspepsia and anxiety. Additionally, it is worth mentioning that two Chinese universities, Chengdu University of Traditional Chinese Medicine and Xidian University, also made it to the top ten list.

### Active Journals

Multiple years of research on functional dyspepsia and anxiety have resulted in the publication of 560 articles in 205 medical journals. This indicates the growing interest and importance of these subjects within the medical community. The top five active journals in this field are Neurogastroenterology and Motility (Publisher: Wiley) (51, 9.11%), Clinical Gastroenterology and Hepatology (23, 4.11%), Digestive Diseases and Sciences (20, 3.57%), Journal of Neurogastroenterology and Motility (Publisher: The Korean Society of Neurogastroenterology and Motility) (20, 3.57%), and Alimentary Pharmacology and Therapeutics (19, 3.39%). These journals have published more than 20% of the total articles on functional dyspepsia and anxiety. **Table 1** lists the top 30 journals that published four or more articles, along with the total amount of citations received and the average amount of citations per article.

**Table 1** The top 30 most active journals with articles on the relationship between functional dyspepsia and anxiety

Journals	RC	C	AC
Neurogastroenterology and Motility	51	805	110.27
Clinical Gastroenterology and Hepatology	23	933	111.79
Journal of Neurogastroenterology and Motility	20	541	64.32
Digestive Diseases and Sciences	20	357	24.77
Alimentary Pharmacology & Therapeutics	19	1026	90.82
Journal of Gastroenterology and Hepatology	19	336	43.27
World Journal of Gastroenterology	17	374	38.35
American Journal of Gastroenterology	15	1441	84.7
Scandinavian Journal of Gastroenterology	14	455	20.85
Psychosomatic Medicine	12	1082	54.93
PLoS One	11	247	27.67
Journal of Psychosomatic Research	11	530	26.37
Gastroenterology	10	890	72.35
Gut	10	950	86.22
Journal of Digestive Diseases	8	125	17.83
European Journal of Gastroenterology & Hepatology	8	225	14.96
Journal of Gastroenterology	7	346	36.88
BMC Gastroenterology	7	124	12.57
Medicine	6	25	5.15
Frontiers in Psychiatry	6	56	12.95
Psychotherapy and Psychosomatics	6	272	14.09
Digestion	5	186	17.6
Trials	5	29	4.27
Indian Journal of Gastroenterology	5	41	10.45
Gastroenterology Research and Practice	5	77	7.36
Journal of Clinical Gastroenterology	5	108	6.55
Clinical and Translational Gastroenterology	4	57	9.23
Journal of Pediatric Gastroenterology and Nutrition	4	241	15.35
Evidence-Based Complementary and Alternative Medicine	4	61	7.16
Frontiers in Neuroscience	4	7	3.5

(RC: Record Count, C: Number of Citations, AC: Average Citation per Manuscript)

### Citation Analysis

**Table 2** shows the 20 papers with the most citations out of the 560 publications published between 1991 and 2022. In the last column of **Table 2**, the yearly average number of citations is shown.

## Co-citation Analysis

There were 17,747 research papers in the references section of the 560 papers that were included in the analysis. The top ten publications with the most co-citations (more than 20) were Tack J (2006, Number of co-citations (NC):132), Zigmond AS (1983, NC:99), Aro P (2009, NC:77), Stanghellini V (2016, NC:63), Drossman DA (2006, NC:62), Koloski NA (2012, NC:56), Talley NJ (1999, NC:53), Van Oudenhove L (2008, NC:48), Tack J (2001, NC:47), Drossman DA (1993, NC:44).

## Trending Topics

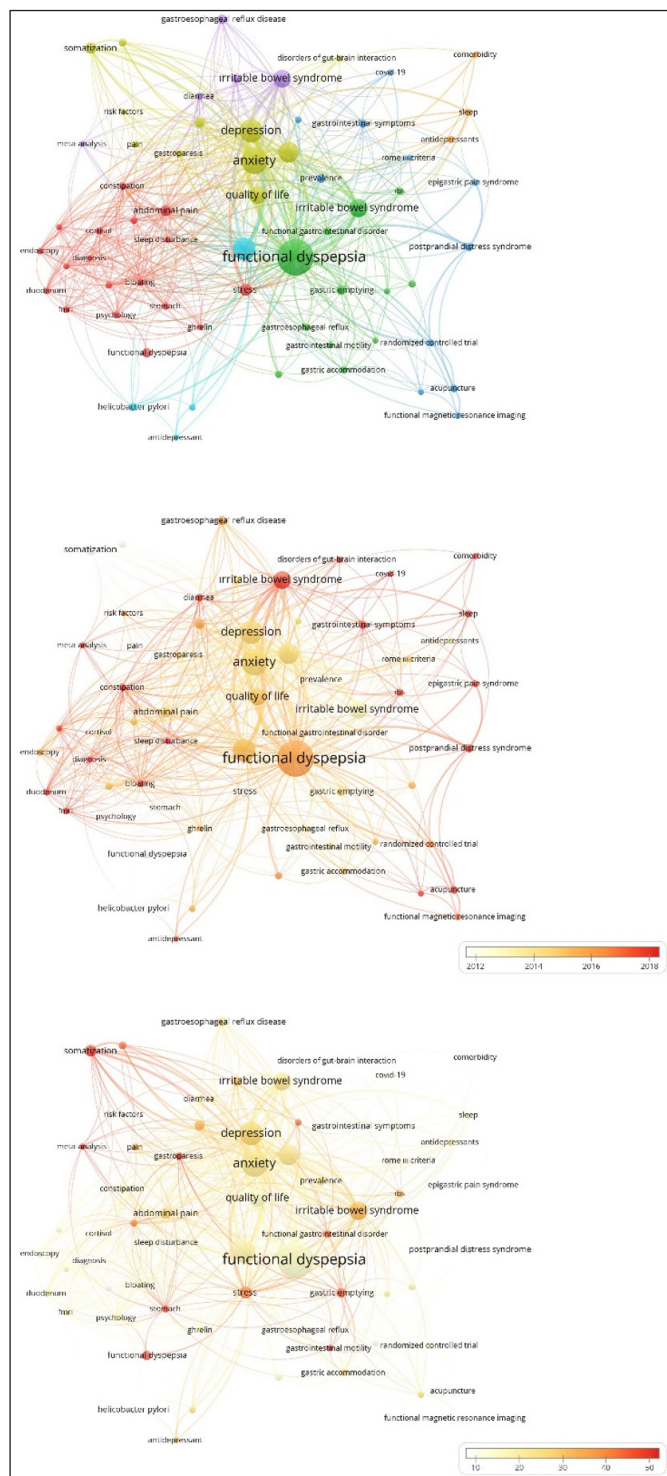
3433 distinct keywords were mentioned in the 560 papers on anxiety and functional dyspepsia. **Figure 4** depicts the cluster network visualization for 64 terms that occurred in at least five distinct publications. For those 64 terms, **Figure 4** also shows a network map for trend visualization and a network map for citation visualization.

**Table 2** The top 20 most cited articles on functional dyspepsia and anxiety according to total citations

No	Article	Author Journal	PY	TC	AC
1	Medically unexplained physical symptoms, anxiety, and depression: A meta-analytic review	Henningsen, P et al. Psychosomatic Medicine	2003	578	27.52
2	The brain-gut pathway in functional gastrointestinal disorders is bidirectional: a 12-year prospective population-based study	Koloski, NA et al. Gut	2012	331	27.58
3	Epidemiology and health care seeking in the functional GI disorders: A population-based study	Koloski, NA et al. American Journal of Gastroenterology	2002	242	11
4	Psychosocial factors are linked to functional gastrointestinal disorders: A population based nested case-control study	Locke, GR et al. American Journal of Gastroenterology	2004	213	10.65
5	Clinical Features of Idiopathic Gastroparesis Vary With Sex, Body Mass, Symptom Onset, Delay in Gastric Emptying, and Gastroparesis Severity	Parkman, HP et al. Gastroenterology	2011	204	15.69
6	Role of stress in functional gastrointestinal disorders - Evidence for stress-induced alterations in gastrointestinal motility and sensitivity	Monnikes, H et al. Digestive Diseases	2001	202	8.78
7	Somatic comorbidities of irritable bowel syndrome: A systematic analysis	Riedl, A et al. Journal of Psychosomatic Research	2008	182	11.38
8	Anxiety Is Associated With Uninvestigated and Functional Dyspepsia (Rome III Criteria) in a Swedish Population-Based Study	Aro, P et al. Gastroenterology	2009	177	11.8
9	Reliability and validity of the Gastrointestinal Symptom Rating Scale (GSRS) and Quality of Life in Reflux and Dyspepsia (QOLRAD) questionnaire in dyspepsia: A six-country study	Kulich, KR et al. Health and Quality of Life Outcomes	2008	175	10.94
10	Evidence that independent gut-to-brain and brain-to-gut pathways operate in the irritable bowel syndrome and functional dyspepsia: a 1-year population-based prospective study	Koloski, NA et al. Alimentary Pharmacology & Therapeutics	2016	160	20
11	Chronic abdominal pain in children: A technical report of the American Academy of Pediatrics and the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition	Di Lorenzo, C et al. Journal of Pediatric Gastroenterology and Nutrition	2005	157	8.26
12	Characteristics of Patients With Chronic Unexplained Nausea and Vomiting and Normal Gastric Emptying	Pasricha, PJ et al. Clinical Gastroenterology and Hepatology	2011	147	11.31
13	Predictors of health care seeking for irritable bowel syndrome and nonulcer dyspepsia: A critical review of the literature on symptom and psychosocial factors	Koloski, NA et al. American Journal of Gastroenterology	2001	147	6.39
14	Functional dyspepsia impairs quality of life in the adult population	Aro, P et al. Alimentary Pharmacology & Therapeutics	2011	139	10.69
15	Determinants of symptoms in functional dyspepsia: gastric sensorimotor function, psychosocial factors or somatisation?	Van Oudenhove, L et al. Gut	2008	136	8.5
16	Visceral hypersensitivity is associated with GI symptom severity in functional GI disorders: consistent findings from five different patient cohorts	Simren, M et al. Gut	2018	135	22.5
17	Multicenter, Randomized, Placebo-Controlled Trial of Amitriptyline in Children With Functional Gastrointestinal Disorders	Saps, M et al. Gastroenterology	2009	134	8.93
18	Eight year prognosis of postinfectious irritable bowel syndrome following waterborne bacterial dysentery	Marshall, JK et al. Gut	2010	133	9.5
19	Sleep disturbances in clinic patients with functional bowel disorders	Fass, R et al. American Journal of Gastroenterology	2000	126	5.25
20	Validity of a new quality of life scale for functional dyspepsia: a United States multicenter trial of the Nepean Dyspepsia Index	Talley, NJ et al. American Journal of Gastroenterology	1999	125	5

(PY: Publication year, TC: Total citation count, AC: Average citations per year)





**Figure 4** Keyword cluster analysis, keyword trend, and citation network visualization map of functional dyspepsia and anxiety

**DISCUSSION**

Functional dyspepsia is a major healthcare issue, particularly in modern times and in developed countries. It has a significant impact on the quality of life of patients.<sup>24-26</sup> Studies have reported that patients with functional dyspepsia have a reduced quality of life compared to healthy controls or the general population.<sup>24</sup> Dyspepsia is associated with increased rates of absence, decreased work efficiency, and increased use of medical

and prescription drugs. Patients with functional dyspepsia also experience worse mental and physical quality of life.<sup>27</sup> The presence of other functional gastrointestinal disorders increases the burden of functional dyspepsia.<sup>27</sup>

Like functional dyspepsia, anxiety disorders also have significant economic costs and burdens, both in terms of direct medical treatment and indirect costs, such as lost productivity and reduced quality of life.<sup>28-29</sup> It is estimated that anxiety disorders impact 26.9 million people in the United States at some time in their life.<sup>28</sup> According to large population-based surveys, up to 33.7% of the general population of the world will experience an anxiety disorder at some point in their lifetime.<sup>30</sup> Over 6% of men and 13% of women have suffered from an anxiety disorder within the previous six months, according to a study conducted in the United States.<sup>29</sup>

Anxiety and functional dyspepsia are strongly connected.<sup>8,9</sup> Studies suggest that psychological factors, such as anxiety and depression, play an important role in the etiology of functional dyspepsia.<sup>8</sup> Cognitive-behavioral therapy (CBT) has been shown to be effective in reducing symptoms of functional dyspepsia in several studies. A randomized controlled trial found that CBT significantly reduced the severity of functional dyspepsia symptoms, including abdominal pain, bloating, and nausea, compared to a control group.<sup>31,32</sup> Another study conducted in China found that CBT improved the quality of life of functional dyspepsia patients and reduced anxiety and depression symptoms.<sup>3</sup> A systematic review and meta-analysis of randomized controlled trials also found that CBT was effective in reducing functional dyspepsia symptoms and improving quality of life.<sup>34</sup> Therefore, recognition and treatment of depression and anxiety are crucial to improving clinical outcomes in functional dyspepsia patients.<sup>9</sup>

There has been an upward trend in publications about the relationship between functional dyspepsia and anxiety since the 2010s. Even in the era of the COVID-19 pandemic, research on this topic continued without slowing. The evaluation of regression analysis suggests that the amount of research will keep increasing exponentially in the coming years. When analyzing the proportion of articles by country, the top ten countries with the greatest number of publications on the relationship between functional dyspepsia and anxiety were mostly wealthy nations. The correlation analysis reveals a significant relationship between article productivity and economic development variables, suggesting that a country's degree of economic development influences the number of articles published on functional dyspepsia. However, it is important to note that this does not necessarily mean that functional dyspepsia and anxiety are more prevalent

in wealthier nations, but rather that these countries may have more resources and funding available for research and publication. There was a significant correlation between GDP and GDP per capita and the number of publications regarding functional dyspepsia, although the association is significantly stronger with GDP than with GDP per capita, suggesting that national income is more important than individual income.

Based on international collaboration, the countries with the highest level of cooperation were the United States, Sweden, Belgium, England, and Australia. Clusters were generally formed based on the continent, with the exception of China (Cluster 1 was mostly comprised of European countries, Cluster 2 was mostly comprised of countries from America and the USA's close allies, and Cluster 3 was mostly comprised of Asian countries). Despite not working with any other nations, Malaysia also made a significant contribution to the research.

The journal with the most articles published to date on the topic was *Neurogastroenterology and Motility* (published by Wiley), followed by *Clinical Gastroenterology and Hepatology*, *Journal of Neurogastroenterology and Motility* (published by The Korean Society of Neurogastroenterology and Motility), *Digestive Diseases and Sciences*, *Alimentary Pharmacology & Therapeutics*, *Journal of Gastroenterology and Hepatology*, *World Journal of Gastroenterology*, and *American Journal of Gastroenterology*, respectively. When the journals were compared for the average number of citations per article per year, *Clinical Gastroenterology and Hepatology* had the lead with 111.79 average citations per article per year, followed closely by *Neurogastroenterology and Motility* with 110.27 average citations per article per year. The most cited journal on the topic of functional dyspepsia and anxiety was the *American Journal of Gastroenterology*, with 1441 total citations and an average number of citations per article per year of 84.7.

The most cited study was "Medically unexplained physical symptoms, anxiety, and depression: A meta-analytic review" published in *Psychosomatic Medicine* in 2003 by Henningsen P., and had 578 total citations and 27.52 citations per year.<sup>35</sup> The second most cited was "The brain-gut pathway in functional gastrointestinal disorders is bidirectional: a 12-year prospective population-based study" by Koloski NA., in 2012 in *Gut*, with 331 total citations and an average of 22.58 citations per year.<sup>36</sup> This was also the publication with the highest average citation count on this topic, owing its power to being a longitudinal study that followed a large population over 12 years, providing valuable insights into the bidirectional relationship between the brain and gut in functional gastrointestinal disorders.

The third was "Epidemiology and health care seeking in the functional GI disorders: A population-based study" also by Koloski NA., this time published in the *American Journal of Gastroenterology* in 2002 and having a total citation count of 242.<sup>37</sup>

The clustering analysis divided the keywords into seven different clusters. Functional dyspepsia, anxiety, depression, dyspepsia, functional gastrointestinal disorders, irritable bowel syndrome, quality of life, stress, somatization, and abdominal pain were the most frequently used keywords. After our search terms were removed from the list, the data showed that the terms frequently examined in recent years were gut-brain interaction, COVID-19, duodenum, proton pump inhibitors, and sleep disturbance. Gastric emptying, gastroparesis, somatization, gastrointestinal motility, and irritable bowel syndrome were the most frequently cited terms.

To our knowledge, there were no other bibliometric studies exploring the publications about the relationship between functional dyspepsia and anxiety. This suggests that our study fills a gap in the literature and provides valuable insights into the current state of research on functional dyspepsia and anxiety. This is the strongest aspect of this study. Additionally, another key strength of this article was that it covered the period from 1980 to 2023. Due to the inability to conduct citation and co-citation analyses in the PubMed and Scopus databases, they were excluded from the analysis. Because it incorporates citation analysis and indexes articles from higher-quality publications, WoS is preferred over competing databases. Usage of a reliable and comprehensive database such as WoS is another aspect of this study's strengths. Main limitation of this study was the reliance on a single database, even though it's a comprehensive one.

## CONCLUSION

Functional dyspepsia is a common functional gastrointestinal disorder characterized by persistent or recurrent upper gastrointestinal tract symptoms. It is suggested that anxiety contributes to the pathogenesis and maintenance of functional dyspepsia symptoms, as it is a prevalent comorbidity in functional dyspepsia patients. The relationship between functional dyspepsia and anxiety is an important research topic in both internal medicine and psychiatry. Reducing the effects of functional dyspepsia on the general population requires early diagnosis of anxiety, rehabilitation, and, most importantly, knowledge. Our findings suggest that this is a rapidly evolving field with a broad range of research topics. We believe this article will lead to more research and publications on this critical topic.



## ETHICAL DECLARATIONS

**Ethics Committee Approval:** Ethics committee approval is not required in this bibliometric study.

**Informed Consent:** Informed consent is not required.

**Referee Evaluation Process:** Externally peer reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Author Contributions:** All the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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