

THE ROLE OF RADIOLOGIC IMAGING IN IRRITABLE BOWEL SYNDROME (IBS): A SYSTEMATIC REVIEW

¹*Yoga Nuswantoro, ¹Efa Anggraini

¹Faculty of Medicine, University of Muhammadiyah, Surakarta, Indonesia

Corresponding Author:

yoga.nuswantoro@gmail.com

ABSTRACT

Background: The role of radiologic imaging in the investigation of irritable bowel syndrome (IBS) remains a subject of debate and there is some evidence, from recent studies of utilization of imaging in IBS, which focused on associated costs and radiation exposure, that imaging is being used relatively widely in these patients.

The aim: This study aims to show the role of radiologic imaging in irritable bowel syndrome (IBS).

Methods: By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.

Result: In the PubMed database, the results of our search brought up 112 articles, whereas the results of our search on SagePub brought up 179 articles. The results of the search conducted for the last year of 2013 yielded a total 84 articles for PubMed and 91 articles for SagePub. The result from title screening, a total 18 articles for PubMed and 25 articles for SagePub. In the end, we compiled a total of 10 papers. We included five research that met the criteria.

Conclusion: In patients presenting with IBS symptoms and alarm features, radiologic testing may be used to exclude an alternative diagnosis and the imaging modality should be chosen based on the most likely alternative diagnosis.

Keyword: Irritable bowel syndrome (IBS), radiologic, imaging.

INTRODUCTION

Irritable bowel syndrome (IBS) is a chronic functional gastrointestinal disorder (FGID) that is broadly characterized by recurrent abdominal pain and alterations in stool consistency or form. Multinational expert groups in FGIDs have devised the Rome criteria, most recently Rome IV criteria, as a symptom-based diagnostic standard to diagnose IBS. Despite this, as IBS is associated with loss of work days and productivity and negatively impacts quality of life, it often remains a diagnosis of exclusion after invasive investigations are performed to rule out other specific pathology. Interestingly, a comparison of an exclusion approach to diagnosis of IBS, using investigations such as sigmoidoscopy, and a positive diagnostic approach using the Rome criteria, showed little differences in terms of patients' health-related quality of life in one Danish study of over 300 patients. The positive diagnostic approach based on Rome criteria, was however, cheaper when compared to the exclusion approach. This study supports current guideline recommendations and suggests an unnecessary reliance on alternative diagnostic investigations.^{1,2}

Despite its prevalence and often chronic, relapsing nature, the underlying pathophysiology of IBS remains incompletely understood. The etiology is likely multifactorial, involving dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis, neuroendocrine alterations, and visceral hypersensitivity, which results in the hallmark symptoms of abdominal pain and disordered gut motility. Chronic, low-grade, subclinical inflammation has been implicated in the disease process and is thought to perpetuate the symptoms of IBS. Previously, in most patients with IBS, routine histologic examinations did not reveal significant colonic mucosal abnormalities; however, with modern sequencing techniques, immunohistochemical assays, and ultrastructural analyses, subtle microscopic and molecular alterations have been reported.³

The disorder of IBS is associated with adverse physical, psychosocial and socioeconomic consequences for patients and society at large. IBS is not associated with increased rates of mortality but is associated with physical distress, often co-occurring with other debilitating conditions such as fibromyalgia, chronic pelvic pain and chronic fatigue syndrome. Patients with IBS often suffer from psychological disorders such as depression and anxiety, with reported comorbidity rates of 40%-60% and above. Numerous investigations have found IBS to exert a negative impact upon patients' quality of life, as well as result in the disproportionate utilization of health care resources. In addition, financial estimates of managing the disorder are upwards of one billion dollars in the United States; a figure compounded by costs of lost productivity and reduced leisure time. Although significant advances in understanding the pathophysiology of this disorder have been gained by research endeavors, exact mechanisms underlying symptom generation in IBS remain incompletely understood.^{4,5}

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we compare and contrast of the role of radiologic imaging in irritable bowel syndrome (IBS). It is possible to accomplish this by researching or investigating the role of radiologic imaging in irritable bowel syndrome (IBS). As the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about the role of radiologic imaging in irritable bowel syndrome (IBS). In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2013, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used "The role of radiologic imaging in irritable bowel syndrome (IBS)" as keywords. The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: (*"Irritable bowel syndrome"[MeSH Subheading] OR "Diagnosis of irritable bowel syndrome"[All Fields] OR "Radiologic imaging of irritable bowel syndrome" [All Fields]*) AND (*"Imaging of irritable bowel syndrome"[All Fields] OR "Mechanism of irritable bowel syndrome"[All Fields]*) used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources

for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else.

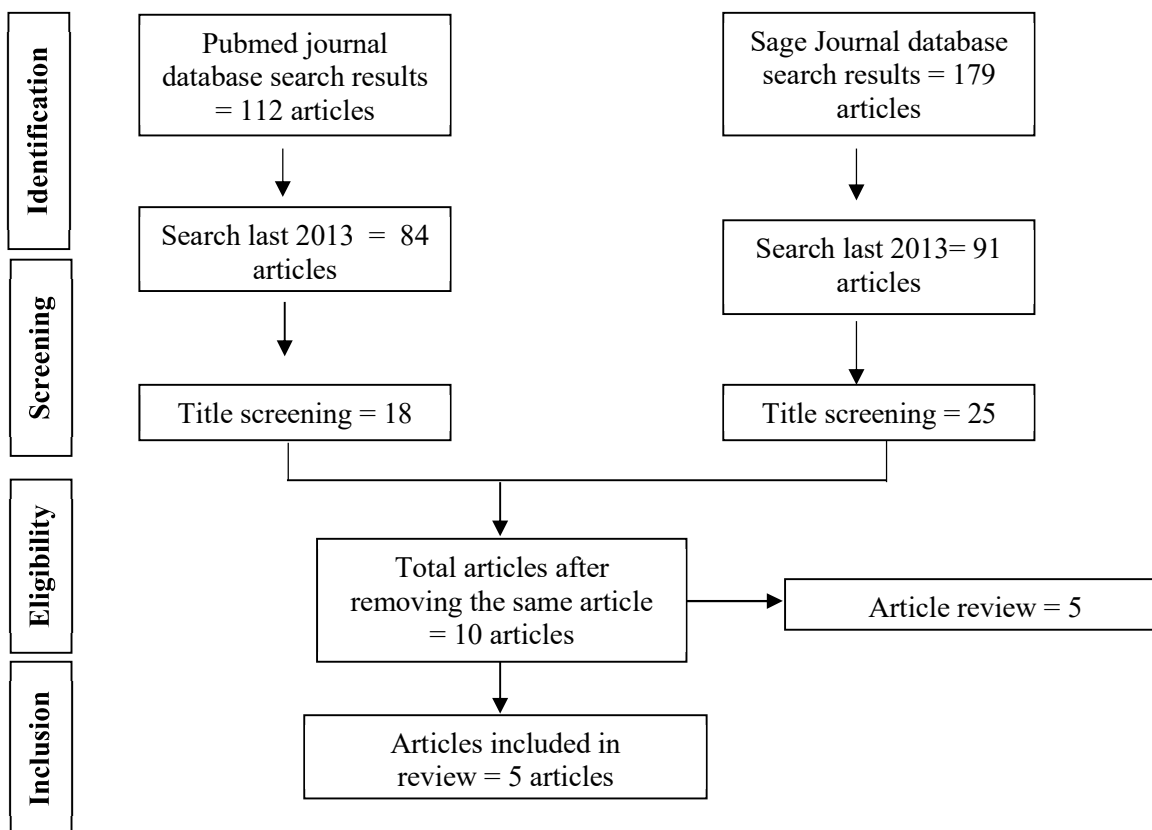


Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. In order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

In the PubMed database, the results of our search brought up 112 articles, whereas the results of our search on SagePub brought up 179 articles. The results of the search conducted for the last year of 2013 yielded a total 84 articles for PubMed and 91 articles for SagePub. The result from title screening, a total 18 articles for PubMed and 25 articles for SagePub. In the end, we compiled a total of 10 papers. We included five research that met the criteria.

Hadi, YB *et al* (2020)⁶ showed Population-specific high annual CED (defined as annual CED >90th percentile of the study population) was calculated as 12.23 mSv/year. A multivariable binomial logistic regression model was then fitted for population-specific high annual CED (exceeding 12.23 mSv/year) using gender, age, smoking history, age at referral/diagnosis, comorbid anxiety, depression, years of follow-up, diabetes, hyperlipidemia, coronary artery disease, and type of IBS as covariates. Comorbid anxiety, hyperlipidemia, home pain medication use, and diarrhea-predominant IBS were significantly positively associated with high annual population-specific CED, while longer duration of postdiagnosis follow-up was negatively associated with population-specific high annual CED. Peri-diagnosis mean

effective dose (defined as the effective dose for every patient in the 1 year before and after diagnosis) was calculated for patients diagnosed in each year from 2009 to 2018. Mann-Kendall trend test did not reveal a significant temporal trend in peri-diagnostic mean effective radiation dose over the study period (p value >0.05).

Skrobisz, K *et al* (2020)⁷ showed Patients suffering from FIGDs more often present with emotional distress and lower stress tolerance. Patient's constitution and response to stress may influence biological processes within the central nervous system and through autonomic nervous system trigger somatic reactions from digestive tract, leading to decrease in quality of life. Brain-gut axis disorders are also taken into account in etiology of FIGDs symptoms, mainly with regard to lowering the pain threshold. Correlation between anxiety and lowering the pain threshold, epigastric discomfort, burning, and early satiation has been proven. Patients suffering from FIGDs are also prone to guilt, increased self-criticism, catastrophical thoughts, and focusing on failure, they are said to cope worse with everyday problems. However, no correlation between FIGDs and lifespan has been reported.

Table 1. The literature include in this study

Author	Origin	Method	Sample Size	Result
Hadi, YB <i>et al</i> ., 2020 ⁶	USA	A retrospective cohort study.	221 patients	221 patients were included; mean CED was 40.32 mSv (SD: 54.36). Fifty-nine participants (26.7%) received >50 mSv of CED with 27 participants (12.2%) exceeding 100 mSv. Conventional imaging, nuclear medicine, and fluoroscopy accounted for 74.08, 12.93, and 12.98% of total CED, respectively. CT scans contributed to 66.61% of total CED. Outpatient orders accounted for 37.96% of total CED, while 31.4% of total CED was ordered in the emergency department. Population-specific high total CED was calculated as 105.65 mSv. Multivariable binomial logistic regression model found that comorbid anxiety, chronic pain medication use, and diarrhea-predominant IBS were independently positively associated with population-specific high CED exposure. No significant temporal trend in peri-diagnostic mean CED was found.
Skrobisz, K <i>et al.</i> , 2020 ⁷	Poland	Case control study.	56 participants	Compared to healthy controls' DMN in patients with non-specific digestive tract diseases comprised additional areas in superior frontal gyrus of left hemisphere, in left cingulum and in the left supplementary motor area. Discovered differences in the DMNs can be interpreted as altered processing of homeostatic stimuli. Our study group involved patients suffering from both functional and non-specific inflammatory bowel diseases. Nevertheless a spectrum of changes in the study group (superior frontal gyrus of the left hemisphere, in

				the left cingulum and in the left supplementary motor area) we were able to find common features, differentiating the whole study group from the healthy controls.
Wang, D et al., 2017⁸	China	Case control study.	51 participants	Anxiety and depression scores were higher among patients with IBS than among controls (both $P < 0.05$), although scores in both groups were below the level of clinical diagnosis. Brain activation in regions of interest (parietal areas, prefrontal cortex, cerebellum, anterior cingulate cortex, insular cortex, and thalamus) increased along with increases in rectal balloon dilation, except in women with IBS and patients with disease duration less than 5 years. Furthermore, region of interest (ROI) activation (such as the parietal region, prefrontal cortex, cerebellum, anterior cingulate cortex, insular cortex, and thalamus) differed significantly between the 40-ml and 120-ml conditions, and between the 80-ml and 120-ml conditions ($P < 0.05$), among patients with IBS with anxiety or depression scores less than 9 points.
Ohgo, H et al., 2016⁹	Japan	Case control study	51 participants	The mean length of the total colon was 156.5 cm in group C, 158.9 cm in group IBS-D, 172.0 cm in group IBS-C, and 188.8 cm in group FC. The total colon in group FC was significantly longer than that in group C ($P < 0.05$). The mean length of the rectosigmoid colon was 56.2 cm, 55.9 cm, 63.6cm, and 77.4 cm (NS). The mean length of the transverse colon was 49.9 cm, 43.1 cm, 57.0 cm, and 55.0 cm. The transverse colon in group IBS-D was significantly shorter than that in group IBS-C ($P < 0.01$) and that in group FC ($P = 0.02$). The mean diameter of the sigmoid colon was 4.0 cm, 3.3 cm, 4.2 cm, and 4.3 cm (NS). The mean diameter of the descending colon was 3.6 cm, 3.1 cm, 3.8 cm, and 4.3 cm. The descending colon diameter in group IBS-D was significantly less than that in group IBS-C ($P = 0.03$) and that in group FC ($P < 0.001$).

				The descending colon diameter in group FC was significantly greater than that in group C ($P = 0.04$). The mean diameter of the transverse colon was 4.4 cm, 3.3 cm, 4.2 cm, and 5.0 cm (NS).
Lacy, B <i>et al.</i> , 2019 ¹⁰	USA	Retrospective study.	201322 patients	Among 201,322 IBS patients, 41.7% had 3+ tests/procedures, 35.1% had 1–2, and 23.3% had 0. Patients with more tests/procedures were older [mean age 50.6 (3+ group), more likely to be female and had more comorbidities, including anxiety, depressive disorders, and somatization. Dyspepsia [odds ratio (95% confidence interval): 1.80 (1.72–1.87)], interstitial cystitis [1.60 (1.45–1.77)], gastroesophageal reflux disease [1.59 (1.55–1.63)], constipation [1.50 (1.45–1.54)], and dyspareunia [1.38 (1.25–1.52)] were significantly associated with more tests/procedures (3+ <i>versus</i> 1–2), while anxiety, depressive disorders, and somatization were not. Patients with more frequent specialist visits [emergency department (ED; 1.10 (1.09–1.11)) and gastroenterologists (1.26 (1.26–1.27))] or at least one GI-related ED visit or inpatient admission [1.95 (1.86–2.04) and 3.67 (3.48–3.87), respectively] were more likely to have more tests/procedures (all $p < 0.05$).

Wang, D *et al* (2017)⁸ showed that changes in brain activation due to changes in rectal balloon distension can be objectively and accurately measured using fMRI. Although our results indicated that visceral hypersensitivity during IBS is associated with changes in cortical activation, further studies utilizing larger sample sizes are required to more fully elucidate the association between psychological factors and visceral hypersensitivity in IBS.

Ohgo, H *et al* (2016)⁹ showed CT colonography might contribute the clarification of subtypes of IBS.

Lacy, B *et al* (2019)¹⁰ showed test frequency in patients with IBS is strongly associated with demographic and clinical characteristics, especially comorbid conditions related to IBS. Presence of common overlapping comorbid conditions should increase clinicians’ confidence in making the diagnosis of IBS, thus curtailing redundant testing and reducing healthcare costs.

DISCUSSION

Irritable bowel syndrome (IBS) is the most common reason to visit a gastroenterologist and the second most common reason, after common flu, to be absent from work. It is estimated that around 15% of the general population is affected, with some studies even reporting up to 45%. Usually, women are more commonly affected than men, in a ratio of 2:1, and the peak of the disease often starts in early adulthood. In general, patients are evenly distributed among 3 subtypes (diarrhea-predominant [IBS-D], constipation-predominant [IBS-C], or mixed [IBS-M]) but studies from specific geographical areas such as Europe found fewer patients with IBS-D than in the other 2 categories. Women more commonly suffer from IBS-C and men from IBS-D. It is believed that more than 20 billion dollars per year are spent on IBS treatment in the USA alone.^{11,12}

A systematic review of imaging in irritable bowel syndrome concluded that although radiological imaging is frequently used to evaluate patients, there is a striking lack of strong evidence to support this. Based on the current evidence, further investigations including radiological imaging should only be done in patients who have alarm symptoms, to rule out other structural abnormalities that may mimic irritable bowel syndrome. Early referral to a specialist may be more beneficial than embarking on imaging. For patients with constipation-predominant irritable bowel syndrome, the need for further investigations should be based on their risk of having colorectal cancer. Those with an above average risk should undergo colonoscopy (or CT colonography, also known as ‘virtual colonoscopy’). A CT scan is performed after bowel preparation and insufflation of the colon. CT colonography is widely regarded as superior to barium enema and should replace it. Most gastroenterologists would recommend colonoscopy in patients with diarrhoea-predominant irritable bowel syndrome to exclude microscopic colitis.¹³

The “brain-gut axis” (BGA), is a collective term describing pathways between physiological systems noted to be altered in patients with IBS, and is composed of the enteric nervous system, autonomic nervous system and/or the central nervous system. The BGA is a comprehensive framework within which symptom etiology can be evaluated in patients with IBS, as it accounts for the crosstalk or bidirectional communication that occurs between systems. Alterations in the BGA of IBS patients have been shown to include peripheral factors, central and autonomic neural functions, hormones, amines and peptides. Research efforts have also incorporated neuroimaging techniques to evaluate central mechanisms within the BGA, investigating neuroanatomical differences that may shed light on IBS symptomatology.⁴

CONCLUSION

In patients presenting with IBS symptoms and alarm features, radiologic testing may be used to exclude an alternative diagnosis and the imaging modality should be chosen based on the most likely alternative diagnosis.

REFERENCES

- [1] Kavanagh RG, O’Grady J, Carey BW, O’Connor OJ, Maher MM. Review of the role of abdominal imaging in irritable bowel syndrome. *World J Radiol.* 2018;10(11):143–9.
- [2] Maconi G, Hausken T, Dietrich CF, Pallotta N, Sporea I, Nurnberg D, et al. Gastrointestinal Ultrasound in Functional Disorders of the Gastrointestinal Tract - EFSUMB Consensus Statement. *Ultrasound Int Open.* 2021;7(1):E14–24.
- [3] Ng QX, Soh AY Sen, Loke W, Lim DY, Yeo WS. The role of inflammation in irritable bowel syndrome (IBS). *J Inflamm Res.* 2018;11:345–9.
- [4] Weaver KR, Sherwin LB, Walitt B, Melkus GD, Henderson WA. Neuroimaging the brain-gut axis in patients with irritable bowel syndrome. *World J Gastrointest Pharmacol Ther.* 2016;7(2):320.
- [5] Jia M. 乳鼠心肌提取 HHS Public Access. *Physiol Behav.* 2017;176(3):139–48.
- [6] Hadi YB, Khan AA, Naqvi SFZ, Khan S, Thompson J, Kupec JT. Are We Overradiating Patients with Irritable Bowel Syndrome? *Inflamm Intest Dis.* 2021;6(1):32–7.
- [7] Skrobisz K, Piotrowicz G, Naumczyk P, Sabisz A, Markiet K, Rydzewska G, et al. Imaging of Morphological Background in Selected Functional and Inflammatory Gastrointestinal Diseases in fMRI. *Front Psychiatry.* 2020;11(May):1–7.
- [8] Wang D, Zhang X, Zhang X, Huang Z, Song Y. Magnetic resonance imaging analysis of brain function in patients with irritable bowel syndrome. *BMC Gastroenterol.* 2017;17(1):148.
- [9] Ohgo H, Imaeda H, Yamaoka M, Yoneno K, Hosoe N, Mizukami T, et al. Irritable bowel syndrome evaluation using computed tomography colonography. *World J Gastroenterol.* 2016;22(42):9394–9.
- [10] Saint Croix G, Lacy SC, Gazzhal A, Ibrahim M, Gjergjindreaj M, Perez J, et al. Dual Antiplatelet Therapy in Patients Aged 75 Years and Older with Coronary Artery Disease: A Meta-Analysis and Systematic Review. *J Interv Cardiol.* 2022;2022.
- [11] Hadjivasilis A, Tsioutis C, Michalinos A, Ntourakis D, Christodoulou DK, Agouridis AP. New insights into irritable bowel syndrome: From pathophysiology to treatment. *Ann Gastroenterol.* 2019;32(6):554–64.
- [12] Fukudo S, Okumura T, Inamori M, Okuyama Y, Kanazawa M, Kamiya T, et al. Evidence-based clinical practice guidelines for irritable bowel syndrome 2020. *J Gastroenterol [Internet].* 2021;56(3):193–217. Available from: <https://doi.org/10.1007/s00535-020-01746-z>
- [13] Mendelson R. Imaging for chronic abdominal pain in adults. *Aust Prescr.* 2015;38(2):49–54.