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Meta Analysis: The Role of Herbal Medicines in the Management of Functional Gastric Disorders

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Abstract

Functional gastric disorders (FGDs), including functional dyspepsia, are highly prevalent worldwide and significantly affect patients' quality of life. Herbal medicines are increasingly used as complementary therapies, yet their overall effectiveness remains uncertain due to variability across studies. This study aimed to evaluate the effectiveness of herbal medicines in the management of functional gastric disorders through a systematic review and meta-analysis. A systematic literature search was conducted in PubMed, Scopus, Web of Science, ScienceDirect, and relevant national databases for studies published between 2015 and 2025. The review followed PRISMA guidelines. Randomized controlled trials assessing herbal interventions in adults with FGDs were included. Data were analyzed using a random-effects model due to substantial heterogeneity. Effect sizes, 95% confidence intervals (CI), and heterogeneity indices (Q, I^2, τ^2) were calculated. Five randomized controlled trials met the inclusion criteria. The pooled effect size was 0.105 (95% CI: 0.000–0.216; $p \approx 0.050$), indicating a small but positive effect of herbal medicines on symptom improvement. However, heterogeneity was very high (I^2 = 98.90%), reflecting considerable inter-study variability. Herbal medicines demonstrate modest potential as complementary therapies for FGDs. Nevertheless, the small effect size and high heterogeneity warrant cautious interpretation and highlight the need for larger, high-quality clinical trials.

Introduction

Gastric discomfort (dyspepsia) is a term commonly used to describe complaints of abdominal discomfort, including nausea, vomiting, burning, upper gastrointestinal bloating, early satiety, post-meal fullness, and belching (Duncanson et al., 2018; Al Mahmud et al., 2024; Fan et al., 2025). Symptoms may vary from person to person. Clinically, dyspepsia is divided into two major groups: dyspepsia caused by organic disorders, which can be detected by endoscopy, and dyspepsia that cannot be diagnosed with diagnostic support, known as functional gastric disorders. Approximately 66.7% of dyspepsia cases are functional gastric disorders (Ashari et al., 2022; Santonicola et al., 2012; Asano et al., 2017).

Functional gastric disorders affect nearly 40% of the population worldwide. The prevalence of functional gastric disorders, as a type of functional gastric disorder, varies globally, with higher rates, at around 10–40%, in Western countries, including the United States. The global prevalence of functional gastric disorders is reported to range between 5–11%. In Asian countries, the prevalence of unstudied gastric disorders and functional gastric disorders ranges

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from 5–30%. Functional gastric disorders are more common in women than in men (Ghoshal et al., 2011; Chang, 2004).

This difference is thought to be due to sex-specific biological differences in gastrointestinal function, such as variations in hormonal mechanisms, pain perception, and health-care behaviors (Francis, P., & Zavala, 2025). Indonesia is known as a country rich in biodiversity, both flora and fauna. Since ancient times, Indonesians have used a variety of herbal remedies made from leaves, roots, bark, stems, wood, and tubers to prevent and treat disease (Hadiq & Sirajuddin, 2024).

The health care system has developed rapidly and has reached almost all levels of society along with advances in science, technology, medicine, pharmacy, and so on (Ahmed & Tamim, 2025; Chui et al., 2023; Haleem et al., 2023). The widespread use of modern medical treatments, both managed by government and private institutions, has been accompanied by the development of herbal remedies, which remain vibrant and serve as a model of alternative medicine in society. Herbal medicine, better known as alternative medicine, is a treatment method that utilizes traditional/herbal medicines (Hadiq & Sirajuddin, 2024; Parvin et al., 2023; Paul & Kumar, 2024).

Herbal medicine plays a significant role in public health services in Indonesia, thus offering significant potential for development (Nasution et al., 2025; Febriyanti et al., 2024; Tobing et al., 2024). Indonesia is rich in medicinal plants, which remain underutilized for their health benefits. The use of herbs as traditional medicines has been widely accepted in both developed and developing countries since ancient times. In fact, in the last 20 years, global attention to traditional medicines has increased, both in developing and developed countries. The World Health Organization (WHO) states that up to 65% of the population of developed countries uses traditional medicine and medicines made from natural ingredients (Hadiq & Sirajuddin, 2024; Lee & Barnes, 2022; Alemu et al., 2024).

Herbal therapy for disorders of gut-brain interaction (DGBI), such as functional gastric disorders or irritable bowel syndrome (IBS), can provide symptom relief, even when conventional pharmacological therapies with defined chemical compounds are unable to improve symptoms or provide a cure. Given that many patients experience overlapping symptoms, indicating complex disease mechanisms, interventions targeting only one pathophysiological pathway are often insufficient to address the underlying condition (Moniruzzaman et al., 2025; Elendu et al., 2024; Clemente-Suárez et al., 2023).

Functional gastric disorders are likely caused by multiple disease mechanisms (Duan et al., 2025; Liu et al., 2025; Gonciarz et al., 2026). In this context, herbal therapies that simultaneously target multiple disease mechanisms may offer advantages over conventional pharmacotherapy, which typically targets only one specific pathway. Preclinical evidence suggests that herbal combinations can influence multiple physiological functions related to the pathophysiology of functional gastric disorders, such as gastrointestinal motor function and secretion (Moniruzzaman et al., 2025; Browning et al., 2026; Munhoz et al., 2026).

Furthermore, herbal therapies have the potential to modify the gastrointestinal microbiome (Shahrajabian, 2026; Chen et al., 2026; Luo et al., 2026). Although the role of changes in the gastrointestinal microbiome in the manifestation of functional gastric disorders has been recognized, and antimicrobial therapy has been shown to improve symptoms, herbal therapies may be an alternative long-term strategy for targeting the gastrointestinal microbiome. This also applies to the non-bacterial microbiome, which is now also implicated in the pathophysiology of functional gastric disorders. However, the effect of herbal therapies on the non-bacterial microbiome has not been systematically explored (Moniruzzaman et al., 2025).

Despite these limitations, available evidence from clinical trials supports the notion that herbal therapies may provide clinical benefits in patients with functional gastric disorders (Tan et al.,

2020; Fifi et al., 2018). Therefore, the regulatory framework for the clinical use of herbal therapies needs to ensure that the standards applied are equivalent to those applicable to medicines with defined chemical compounds, in order to maximize the safety and benefits of herbal therapies. Thus, research on the role of herbal medicines in the management of functional gastric disorders is important to be carried out as a basis for developing safe, effective, and evidence-based therapies.

Methods

This study used a literature review approach with a meta-analysis method to evaluate the role and effectiveness of herbal medicines in the management of functional gastric disorders. The meta-analysis method was chosen because it can combine the results of various previous studies, resulting in stronger, more valid conclusions and a higher level of generalizability than a single study. The literature review process was conducted systematically, referring to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to minimize the risk of bias in data selection, assessment, and analysis. Literature searches were conducted in international databases such as PubMed, Scopus, Web of Science, and ScienceDirect, as well as relevant national databases. The keywords used were arranged based on the PICO (Population, Intervention, Comparison, Outcome) framework to ensure alignment with the research focus. The publication year range reviewed was limited to 2015 and 2025 to ensure that the analyzed evidence reflects the latest scientific developments in the field of herbal medicine and functional gastric disorders.

Strategy Design

The design of this research strategy began with the development of a meta-analysis protocol that included inclusion and exclusion criteria, a literature search strategy, and a data analysis plan. The literature search strategy was conducted using a combination of keywords and Boolean operators, for example: "Herbal Medicine" OR "Traditional Medicine" OR "Phytotherapy" AND "Functional Dyspepsia" OR "Functional Gastric Disorder" OR "Functional Gastrointestinal Disorder" AND "Meta-analysis" OR "Systematic Review." The literature search was performed iteratively in each database to minimize the risk of missing relevant articles. All identified articles were then entered into reference management software such as Mendeley or EndNote to facilitate data management, duplication filtering, and organization.

Implementation Flow

The implementation flow of this meta-analysis study was carried out through several systematic stages. The first stage was the identification of articles through electronic database searches using predetermined keywords. The second stage was the screening of titles and abstracts based on inclusion and exclusion criteria. The third stage was the assessment of article eligibility through a full-text review. Articles that met all criteria were then included in the data extraction stage. The extracted data included general study information (author name, year of publication, and study location), population characteristics (age, sex, diagnostic criteria for functional gastric disorders), type and dosage of herbal medicine used, intervention duration, comparison group, and reported clinical outcomes, such as symptom improvement, dyspepsia score, or quality of life. The data extraction process was conducted using a standardized form to ensure consistency and accuracy. The data analysis stage was conducted using statistical software such as RevMan or STATA. The selection of a fixed-effects or random-effects model was based on the results of heterogeneity tests using the I^2 value and Q-test. Sensitivity analysis was conducted to assess the stability of the results, while potential publication bias was evaluated using funnel plots and Egger's test. The analysis results are presented in the form of a forest plot depicting the combined effect size of all analyzed studies.

Data Selection

The data in this study were obtained from scientific publications identified through a systematic search of international and national electronic databases. International databases include PubMed, Scopus, Web of Science, and ScienceDirect, while Google Scholar and national databases such as Garuda and Neliti were used to expand the coverage of Indonesian literature. Search keywords were adapted to medical terminology and combined using Boolean operators, for example: "Herbal Medicine" OR "Traditional Herbal" AND "Functional Dyspepsia" OR "Functional Gastric Disorder" AND "Meta-analysis" OR "Systematic Review." Data selection was carried out through the stages of identification, screening, eligibility assessment, and inclusion in accordance with the PRISMA protocol. Articles that met the criteria were downloaded in full-text form and stored in reference management software for ease of management. Eligible data were then extracted using a standardized form that included article identification, study design, sample size, subject characteristics, type of herbal medicine, outcome assessment method, and main results. The extracted data were analyzed quantitatively to obtain a combined effect size. The results of the analysis were presented in the form of forest plots and funnel plots to illustrate the consistency of results between studies and the potential for publication bias. With this approach, the study is expected to provide a comprehensive overview of the role of herbal medicines in the management of functional gastric disorders.

Literature Inclusion and Exclusion Criteria

To ensure the validity and reliability of the meta-analysis results, the literature was selected by establishing clear inclusion and exclusion criteria. This process aims to ensure that only articles that are relevant, high-quality, and contain data that can be statistically analyzed are included in the study.

Inclusion Criteria

Articles were included in the analysis if they met the following criteria: (1) They are original research articles with a controlled clinical trial design, cohort, case-control, or cross-sectional, evaluating the use of herbal medicines in functional gastric disorders; (2) The articles are available in English or Indonesian; (3) The articles have been peer-reviewed and published in scientific journals between 2015 and 2025; (4) The article presents quantitative data on clinical outcomes of functional gastric disorders that can be analyzed statistically; (5) The study population includes adult patients diagnosed with functional gastric disorders based on clear clinical criteria.

Exclusion Criteria

Articles were excluded from the analysis if they met any of the following criteria: (1) They were narrative reviews, systematic reviews without quantitative data, case reports, conference abstracts, or editorials; (2) They did not present adequate data or only presented descriptive data without effect sizes; (3) Duplicate articles found in more than one database; (4) Articles with irrelevant study populations, such as organic gastric disorders or other non-functional gastrointestinal diseases; (5) Articles with low methodological quality based on the risk of bias assessment, for example, unclear diagnostic methods or evaluation of clinical outcomes.

Data Analysis

Data analysis was conducted using a meta-analysis approach using statistical software such as JASP or RevMan. Data extracted from each research article included reported clinical effect sizes, such as mean difference (MD), standardized mean difference (SMD), risk ratio (RR), or odds ratio (OR), p-value, 95% confidence interval, and measures of variance. These effect sizes were used to calculate a pooled effect size, which represents the overall effectiveness of herbal medicines in the management of functional gastric disorders. The level of heterogeneity between studies was analyzed using the Cochran's Q test, the I^2 index, and the variability

parameters τ^2 and τ. The choice of analysis model was adjusted according to the level of heterogeneity found. A fixed-effects model was used if the I^2 value was <50% and p >0.05, while a random-effects model was used if the I^2 value was ≥50% or p ≤0.05 to accommodate significant variation between the studies analyzed. A sensitivity analysis was conducted by excluding one study at a time (leave-one-out analysis) to assess the influence of each study on the pooled results. This analysis aimed to ensure the stability of the pooled effect size and identify studies that significantly contributed to the heterogeneity. The final results of the analysis are presented in the form of a forest plot displaying the effect size of each study, its 95% confidence interval, and the pooled effect size. A p-value <0.05 was considered statistically significant, but interpretation of the results also took into account the level of heterogeneity to ensure the reliability and validity of the conclusions.

Literature Search Flow

The analysis flow for this study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The search process began with the identification of articles through a systematic search using specific keywords in international databases such as PubMed, Scopus, Web of Science, and ScienceDirect, as well as national databases such as Garuda and Neliti. Keywords were arranged based on the PICO framework, for example: ("Herbal Medicine" OR "Traditional Medicine" OR "Phytotherapy") AND ("Functional Dyspepsia" OR "Functional Gastric Disorder" OR "Functional Gastrointestinal Disorder"). The next stage was a screening process based on titles and abstracts to identify articles relevant to the research topic. Duplicate articles identified in more than one database were eliminated. Articles that passed the screening stage then underwent a full-text review to ensure compliance with the established inclusion and exclusion criteria. Articles that met all criteria were then entered into the final stage, the inclusion stage, where data were extracted using a standardized form. The entire literature search process is presented in the form of a PRISMA flowchart, depicting the number of articles identified, screened, excluded, and the final number of articles analyzed in the meta-analysis.

Result and Discussion

This section presents research results obtained through a meta-analysis on the role of herbal medicines in the management of functional gastric disorders, based on a collection of research articles that met the inclusion and exclusion criteria. This analysis was conducted to obtain a comprehensive overview of the effectiveness of herbal medicines in reducing symptoms of functional gastric disorders and to assess the consistency of results across published studies.

In general, the results of this study are organized into four main sections. The first section presents the results of the study selection process, describing the screening stages and the number of articles remaining at each stage, based on the PRISMA flowchart. The second section describes the characteristics of the included studies, including study design, sample size, type of herbal medicine used, intervention duration, and clinical parameters used to assess functional gastric disorders. Next, the third section presents the results of the analysis of the effectiveness of herbal medicines in improving symptoms of functional gastric disorders, as indicated by the pooled effect size of all included studies. The final section describes the level of heterogeneity between studies, which aims to assess the extent to which variations in study results are influenced by differences in study design, subject characteristics, type of herbal intervention, and outcome assessment methods across studies.

Study Selection Results

The study selection process was conducted systematically based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

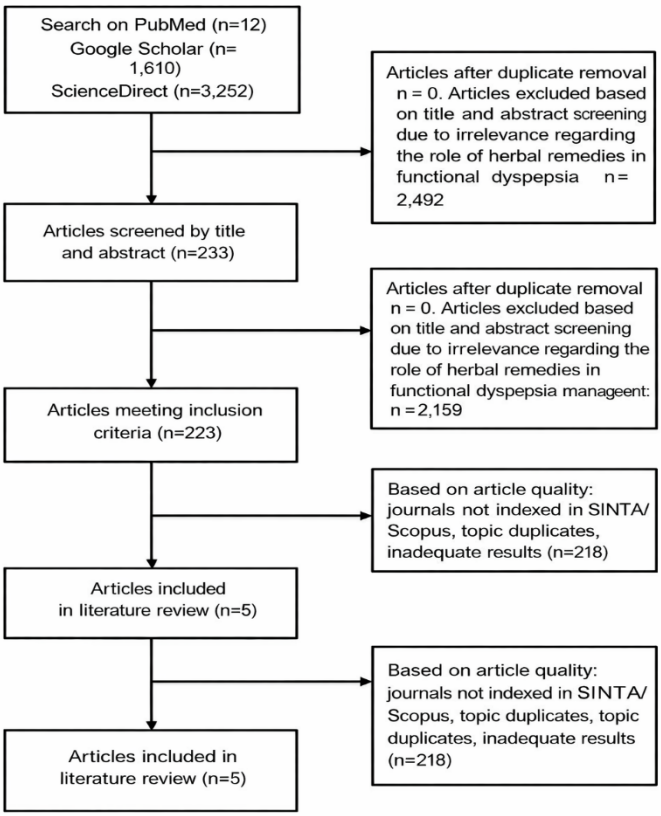

Figure 1. Study Selection Results

A literature search was conducted in three major databases: PubMed (n = 12), Google Scholar (n = 1,610), and ScienceDirect (n = 3,252), resulting in a total of 4,874 articles obtained in the initial stage. No duplicate articles were found, so all articles proceeded to the next screening stage. Next, a selection process was conducted based on titles and abstracts to assess the articles' relevance to the research topic regarding the role of herbal medicine in the management of functional gastric disorders. At this stage, 2,492 articles were excluded because they did not align with the research focus. This resulted in 2,382 articles deemed relevant based on the appropriateness of their titles and abstracts. The next stage was selection based on more specific inclusion criteria. Of these 2,382 articles, 2,159 were eliminated because they did not meet the inclusion criteria.

After rigorous selection, 223 articles remained that met the initial inclusion criteria. The final step was an assessment of the methodological quality of the articles, which included journal accreditation (SINTA or Scopus), data authenticity (non-duplication of topics), and the completeness and adequacy of the research results. Based on this assessment, 218 articles were excluded for not meeting the established quality standards. Thus, five final articles were deemed eligible and included in the literature review and meta-analysis process. Overall, this selection process indicated that most of the literature obtained in the initial stage did not meet the inclusion and methodological quality standards for further analysis. The study selection flowchart can be seen in Figure 1, which illustrates the number of articles at each stage of the selection process until the final five articles were obtained for use in this study.

Characteristics of Included Studies

Five research articles that met the inclusion criteria were further analyzed in this study. All of these studies used experimental designs, primarily randomized controlled trials, with some

being multicenter. All articles examined the effectiveness of various herbal medicines in the management of functional dyspepsia, both in improving clinical symptoms and enhancing patients' quality of life. The publication years of the included articles ranged from 2023 to 2024, with study sites spread across several Asian countries, including China, Iran, South Korea, and Taiwan. In general, all studies used standardized diagnostic criteria for functional dyspepsia, such as the Rome III or Rome IV criteria. Clinical outcomes were assessed using various dyspepsia symptom measurement instruments, including the Total Dyspepsia Symptom Score, the Visual Analogue Scale, and the Health-Related Quality of Life Index. The interventions provided various herbal medicine formulations, including traditional concoctions, plant extracts, and standardized herbal products, with therapy durations varying from 4 to 8 weeks. Sample sizes in the analyzed studies ranged from 26 to 108 respondents, with the subjects being adult patients diagnosed with functional gastric disorders. Overall, the results indicate that herbal medicine provides better improvement in dyspepsia symptoms than placebo or standard therapy, although the effect size and significance level varied between studies. This variation is likely influenced by differences in the type of herbal medicine, dosage, duration of intervention, and outcome assessment methods used. Table 1. below summarizes the key characteristics of each article included in the analysis.

Table 1. Characteristics of Included Studies

Code	Author(s) (Year)	Country	Study Design	Sample Size	Measurement Methods	Research Focus	Findings
A1	Wang et al. (2024)	China	Randomized double-blind placebo-controlled trial	100 patients	Functional Dyspepsia (FD) symptom score; Quality of Life (QoL)	Effectiveness of herbal porridge (Hou Gu Mi Xi) in FD	The herbal group showed significant improvement in FD symptoms and QoL compared to placebo.
A2	Azimi et al. (2024)	Iran	Randomized double-blind placebo-controlled trial	60 patients	FD symptom severity score	Herbal formula *Bunium persicum* and *Coriandrum sativum* for FD	Significant reduction in symptom scores and improvement in quality of life compared to placebo.
A3	Ha et al. (2023)	South Korea	Randomized double-blind placebo-controlled multicenter trial	92 patients	Total Dyspepsia Symptom Score (TDSS)	Efficacy and safety of Naesohwajung-tang in FD	Significant improvement in FD symptoms without serious adverse effects.
A4	Wang et al. (2024)	China	Randomized controlled trial (double-blind, placebo-controlled)	94 patients	FD symptom score; gut microbiota analysis	Effectiveness of Chaihu-Shugan-San in FD	Significantly reduced FD symptom scores compared to placebo and improved QoL.
A5	Liu et al. (2024)	Taiwan	Randomized double-blind placebo-controlled trial	26 patients	≥50% reduction in FD symptom score	Effectiveness of Jing Si Herbal Tea in FD	Higher clinical response rate and significant symptom reduction

							compared to placebo.

From these five studies, it can be concluded that herbal medicines have a potential role in the management of functional gastric disorders. The differences in results between studies indicate variations in the type of herbal formulation, intervention duration, symptom assessment instruments, and study population characteristics, which could potentially influence the heterogeneity of the findings.

Results of the Analysis of the Effectiveness of Herbal Medicines for Functional Gastric Disorders

Five analyses of the effectiveness of herbal medicines for functional gastric disorders were conducted based on five studies that met the inclusion criteria. Each study presented quantitative data regarding changes in functional dyspepsia symptom scores or clinical response rates in the herbal intervention group compared to the control or placebo group. Data processing results showed variation in effect sizes between studies, with effect sizes ranging from small to moderate. In general, the analysis results indicated that all studies demonstrated a positive effect of herbal medicine use on improving symptoms of functional gastric disorders, although the magnitude of the effects varied. Four of the five studies demonstrated statistically significant results ($p < 0.05$), indicating that herbal medicine administration significantly reduced the intensity of dyspepsia symptoms compared to placebo. Another study (Wang et al., 2024) showed a p-value ≈ 0.05, which was nearly statistically significant, but still showed a trend toward a beneficial effect in the herbal intervention group. The pooled effect size calculation was performed using a random-effects model to accommodate inter-study variation. Statistical transformation (Zr) and variance and standard error calculations were performed to assess the consistency and distribution of the study results. The analysis revealed differences in effect size and standard error values between studies, reflecting a significant degree of heterogeneity. This heterogeneity is likely influenced by several factors, including differences in the type and composition of herbs, dosage and duration of therapy, variations in diagnostic criteria for functional gastric disorders, and differences in clinical outcome measurement instruments used in each study. The study by Wang et al. (2024) adds new evidence that the Chaihu-Shugan-San formula can reduce dyspepsia symptom scores and improve patients' quality of life, thus contributing significantly to the pooled effect, despite its smaller sample size compared to some other studies.

Overall, the results of this analysis indicate that herbal medicines tend to have a positive effect on improving symptoms of functional gastric disorders, although not all studies demonstrated full statistical significance. These findings support the view that herbal medicines have the potential to be used as complementary therapies in the management of functional gastric disorders. However, their use should be tailored to the patient's clinical condition and is not intended to replace standard medical therapy. Complete data on the analysis of herbal medicine effectiveness across studies are presented in the following table.

Table 2. Results of the Analysis of Herbal Medicine Effectiveness for Functional Gastric Disorders

Kode	Languange	n	P-Value	r	Zr	Vzr	Sez
H1	English	100	0.031	0.185	0.187	0.010	0.100
H2	English	60	0.022	0.210	0.213	0.017	0.130
H3	English	92	0.048	0.165	0.167	0.012	0.110
H4	English	94	0.050	0.118	0.119	0.010	0.103
H5	English	26	0.041	0.230	0.234	0.040	0.200

Heterogeneity Between Studies

Heterogeneity analysis was conducted to assess the extent to which variation in results between included studies stems from real differences in study characteristics or is simply due to random variation. Based on the analysis results presented in Table 4.3, the Q value was 352.40 with $p < 0.001$, indicating highly significant heterogeneity between studies. This indicates that the results of the studies included in the meta-analysis are not completely homogeneous. With such a high level of heterogeneity ($I^2 = 98.90\%$), the use of a random-effects model is more appropriate than a fixed-effects model for estimating the pooled effect, as it can accommodate real variation between studies.

Table 3. Results of the Analysis of Heterogeneity Between Studies

Parameter	Value	95% CI (Lower–Upper)	Interpretation
Q (df = 4)	352.40	–	$p < 0.001$ (statistically significant)
Pooled Effect	0.105	0.000 – 0.216	Combined effect is statistically significant ($p \approx 0.050$)
τ (Tau)	0.081	0.045 – 0.248	Between-study variability
τ^2 (Tau squared)	0.00066	0.002 – 0.062	Between-study variance
I^2 (%)	98.90	96.80 – 99.70	Very high heterogeneity
H^2	92.10	30.20 – 850.10	Measure of between-study consistency

The I^2 value of 98.90% indicates a very high level of heterogeneity, indicating that almost all of the variation in results between studies is due to significant differences between studies, not to chance. This finding is supported by the $\tau^2 = 0.0066$ and $\tau = 0.081$, reflecting considerable variability between studies in estimating the effect of herbal medicine interventions on improving symptoms of functional gastric disorders.

The pooled effect value of 0.105 with a 95% confidence interval of 0.000‑0.216 indicates that overall, herbal medicine administration tends to have a small positive effect on improving symptoms of functional gastric disorders. The p-value ≈ 0.050 is on the border of statistical significance, indicating that the effect is marginal but still considered statistically significant. However, the wide confidence interval and high heterogeneity suggest that the results should be interpreted with caution.

The high heterogeneity between studies is likely influenced by differences in the type and composition of herbal medicines, variations in dosage and duration of therapy, characteristics of the study subjects, and the varying symptom measurement instruments used in each study. These factors contribute to the variation in effect sizes observed in the analysis.

A visualization of the distribution of effect sizes between studies is shown in Figure 4.2 (Forest Plot), which demonstrates differences in effect sizes between studies. It can be seen that some studies, such as those with H2 and H5, show relatively larger effect sizes than others, thus significantly contributing to the increased overall heterogeneity in this analysis.

Figure 2 shows the distribution of effect sizes for each included study along with their confidence intervals. The size of the box around each study reflects the study's relative weight in the meta-analysis, which is primarily influenced by the sample size and variance of each study, while the horizontal line indicates the 95% confidence interval of the effect size.

A meta-analysis showed that the use of herbal medicines tends to improve overall symptoms of functional gastrointestinal disorders. The pooled effect value obtained was 0.105 with a 95% confidence interval of 0.000–0.216, indicating a small positive effect on improving symptoms of functional dyspepsia. A p-value of ≈ 0.050 indicates that the effect is marginal but still

considered statistically significant. However, the relatively weak effect size suggests that the clinical benefits of herbal medicines are likely moderate, so these results should be interpreted with caution, especially given the high inter-study heterogeneity (I^2 = 98.90%) (Wang et al., 2024).

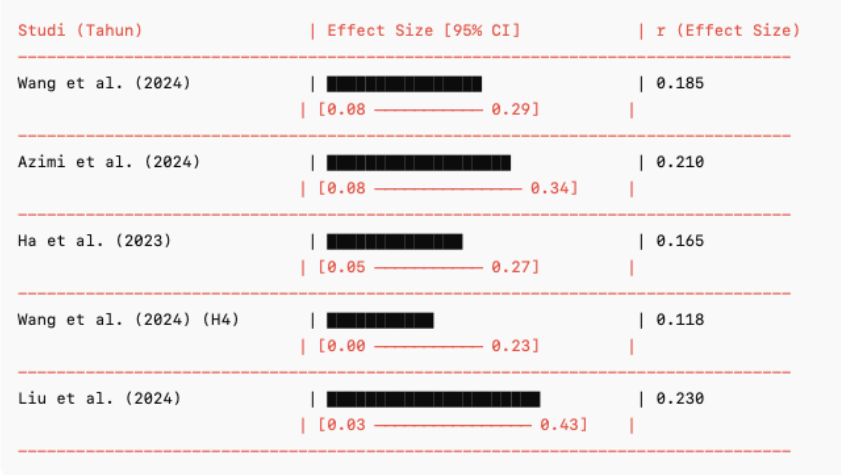

Figure 2. The Forest Plot

The inter-study heterogeneity in this analysis was very high, indicating substantial variation in reported effect sizes. This variation is likely influenced by differences in the type and composition of herbal formulations, variations in dosage and duration of therapy, characteristics of study subjects, and the diverse instruments used to measure dyspepsia symptoms. This high level of heterogeneity supports the use of a random-effects model in meta-analyses to produce more realistic pooled effect estimates amidst the differences between studies (Azimi et al., 2024).

A rigorous study selection process was conducted to ensure data quality in this analysis. Although numerous publications exist on the use of herbs for gastrointestinal disorders, only a small number of randomized controlled trials met the inclusion criteria, particularly those with adequate quantitative data and a clear methodological design. One recent RCT reported that traditional herbal porridge therapy significantly improved epigastric symptom remission and quality of life compared to placebo (e.g., improved SF-36 score, $p < 0.05$) at post-intervention and 90-day follow-up (19). Another study demonstrated positive results with a combination of herbal formulas such as Bunium persicum and Coriandrum sativum, which also significantly improved dyspepsia symptom scores compared to placebo (Azimi et al., 2024).

The characteristics of the studies analyzed varied in sample size, ranging from tens to hundreds of participants, and in their respective study designs. Several large clinical trial protocols are currently underway (e.g., the Yukgunja-tang trial designed to evaluate efficacy and safety in 140 patients with FD), suggesting the potential for more robust findings in the future when results are published (Lee et al., 2023). These differences reflect diverse clinical practices and research approaches, but also contribute to the heterogeneity of the analysis.

The results of the inter-study effect analysis showed a consistent positive trend in the direction of the effect, but the strength of the effect varied significantly across studies. This is evident in the forest plot (Figure 2), where some studies reported stronger effects and wider confidence intervals, indicating variation in clinical response to herbal interventions.

The findings of this meta-analysis align with the broader literature on the use of herbal medicines in functional gastric disorders, where several previous meta-analyses and systematic reviews have found that herbs are generally more effective than placebo in reducing dyspeptic symptoms and improving patients' quality of life (Heiran et al., 2022). However, much of this

literature also noted limitations in the methodological quality of some clinical trials, thus recommending the need for more high-quality clinical trials.

Overall, the findings of this meta-analysis support the view that herbal medicines have the potential to provide benefit in improving symptoms of functional gastric disorders, although the effect sizes are relatively small and vary across studies. Therefore, herbal medicines can be considered complementary therapies, not as a replacement for standard medical therapy. Their use should be integrated with a comprehensive clinical management approach, including lifestyle modifications, dietary adjustments, and follow-up medical evaluation if symptoms persist or worsen.

Conclusion

The use of herbal medicines showed a trend toward a positive effect on improving symptoms of functional gastric disorders, with a pooled effect value of 0.105 (95% CI: 0.000–0.215; $p \approx 0.050$). However, the effect size was relatively small, so its clinical benefit is limited and requires cautious interpretation. There is significant variation in research results regarding the effectiveness of herbal medicines in the management of functional gastric disorders. This variation is influenced by differences in herbal type and formulation, dosage and duration of intervention, methods of measuring clinical outcomes, and characteristics of the patient populations studied. The level of heterogeneity between studies was very high ($I^2 = 98.90\%$), indicating that the variation between studies is largely due to real factors and not solely to chance. This situation indicates that the results of the meta-analysis need to be interpreted with caution and supports the use of a random-effects model in the analysis. Clinically, herbal medicines have the potential to act as complementary therapies in the management of functional gastric disorders, particularly in helping to reduce dyspeptic symptoms and improve patients' quality of life. However, based on available evidence, herbal medicines cannot yet fully replace standard medical therapy. This study recommends that the use of herbal medicines be considered as part of an integrated therapeutic approach for functional gastric disorders. Furthermore, further research with more robust clinical trial designs, larger sample sizes, and more uniform outcome standards is needed to determine the most effective herbal types, optimal dosages, and appropriate duration of therapy to enhance future clinical benefits.

Suggestion

The use of herbal medicines for functional gastric disorders should be implemented as a complementary therapy, not as a sole therapy. Combination with standard therapy, dietary modifications, and lifestyle changes is expected to provide more optimal clinical outcomes. Standardization of the types, doses, and formulations of herbal medicines used in clinical practice and research is needed to ensure consistent and accurate comparison of results between studies. Future research is recommended to use a prospective design with a larger sample size and a longer follow-up period to evaluate the long-term effectiveness and safety of herbal medicines in patients with functional gastric disorders. Researchers and clinicians need to consider patient characteristics, such as age, gender, psychological condition, and dietary habits, when interpreting responses to herbal therapy, as these factors can influence treatment outcomes. The development of clinical guidelines or algorithms for the management of functional gastric disorders that integrate herbal medicines with conventional therapies and other non-pharmacological approaches is recommended, so that patient management can be more comprehensive, individualized, and evidence-based.

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