Impact of Yoga Practices on Digestive Disorders: A Comprehensive Review of Therapeutic Mechanisms and Clinical Evidence

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Abstract

Digestive disorders represent a significant global health burden, affecting millions of individuals worldwide and substantially impacting quality of life. Traditional medical approaches, while effective, often focus primarily on symptom management rather than addressing underlying psychophysiological mechanisms. This comprehensive review examines the therapeutic potential of yoga practices in managing various digestive disorders, including irritable bowel syndrome (IBS), gastroesophageal reflux disease (GERD), inflammatory bowel disease (IBD), and functional dyspepsia. Through an analysis of current literature, this paper explores the multifaceted mechanisms by which yoga interventions influence digestive health, including stress reduction, autonomic nervous system regulation, gut-brain axis modulation, and direct physiological effects on gastrointestinal function. The review synthesizes findings from randomized controlled trials, systematic reviews, and observational studies to provide evidence-based insights into yoga's efficacy as a complementary therapeutic approach. Results indicate that yoga practices, particularly those incorporating breathing techniques, meditation, and specific asanas, demonstrate significant benefits in reducing symptom severity, improving quality of life, and enhancing overall digestive function. The integration of yoga into conventional treatment protocols offers a holistic approach that addresses both physical and psychological aspects of digestive disorders, providing patients with sustainable self-management strategies and potentially reducing healthcare costs.

Keywords: yoga therapy, digestive disorders, irritable bowel syndrome, gastroesophageal reflux disease, inflammatory bowel disease, gut-brain axis, stress management, complementary medicine, mind-body interventions, gastrointestinal health

Introduction

The human digestive system represents one of the most complex and intricate networks within the body, encompassing not only the mechanical and chemical processes of digestion but also serving as a critical interface between the external environment and internal homeostasis. Digestive disorders have emerged as increasingly prevalent health concerns in modern society, affecting approximately 25-30% of the global population and representing a substantial economic burden on healthcare systems worldwide (Sperber et al., 2021). These conditions range from functional disorders such as irritable bowel syndrome (IBS) and functional dyspepsia to inflammatory conditions like Crohn's disease and ulcerative colitis, each presenting unique challenges in terms of diagnosis, treatment, and long-term management.

The etiology of digestive disorders is multifactorial, involving complex interactions between genetic predisposition, environmental factors, lifestyle choices, psychological stress, and the gut microbiome. The recognition of the gut-brain axis as a bidirectional communication network has revolutionized our understanding of digestive health, highlighting the profound influence of psychological and emotional states on gastrointestinal function (Mayer et al., 2022). This paradigm shift has opened new avenues for therapeutic interventions that address both the physical and psychological components of digestive disorders.

Yoga, an ancient practice originating from India, has gained significant attention in contemporary healthcare as a complementary and integrative approach to various health conditions. The word "yoga" derives from the Sanskrit root "yuj," meaning to unite or join, reflecting its holistic philosophy that integrates physical postures (asanas), breathing techniques (pranayama), meditation (dhyana), and ethical principles (yamas and niyamas). Modern scientific research has begun to validate many of the traditional claims about yoga's therapeutic benefits, particularly in the context of stress-related disorders and conditions involving the mind-body connection.

The application of yoga to digestive health represents a natural convergence of ancient wisdom and modern understanding of gastrointestinal physiology. The practice of yoga directly addresses many of the underlying mechanisms involved in digestive dysfunction, including stress response, autonomic nervous system regulation, inflammation, and gut

motility. Furthermore, the accessibility and low cost of yoga practices make them particularly attractive as adjunctive treatments that can be integrated into conventional medical care.

This comprehensive review aims to examine the current state of evidence regarding the impact of yoga practices on digestive disorders, exploring both the theoretical mechanisms and clinical outcomes. By synthesizing findings from recent research studies, this paper seeks to provide healthcare professionals, researchers, and patients with evidence-based insights into the therapeutic potential of yoga for digestive health.

Literature Review

Historical Context and Traditional Perspectives

The relationship between yoga and digestive health has been recognized for millennia within traditional Indian medicine systems, particularly Ayurveda. Ancient texts such as the Hatha Yoga Pradipika and Gherand Samhita describe specific practices designed to enhance digestive function and treat gastrointestinal ailments. Traditional yoga philosophy views digestion as intimately connected to overall health and vitality, with the concept of "agni" (digestive fire) representing the body's capacity to process and assimilate nutrients effectively.

Classical yoga texts describe various practices specifically targeting digestive health, including twisting postures to massage abdominal organs, breathing techniques to stimulate digestive processes, and meditation practices to reduce stress-induced digestive disturbances. The traditional understanding of yoga's impact on digestion aligns remarkably well with modern scientific findings regarding the gut-brain axis and the role of stress in gastrointestinal disorders.

Contemporary Research Landscape

The scientific investigation of yoga's effects on digestive disorders has accelerated significantly over the past two decades, driven by growing interest in integrative medicine approaches and the recognition of limitations in conventional treatment modalities. Early studies were primarily observational and lacked rigorous methodology, but recent research has employed increasingly sophisticated study designs, including randomized controlled trials and systematic reviews.

A landmark systematic review by Cramer et al. (2018) analyzed 12 randomized controlled trials examining yoga interventions for various digestive disorders, including IBS, IBD, and GERD. The review found moderate evidence supporting yoga's effectiveness in reducing symptom severity and improving quality of life across multiple digestive conditions. Subsequent meta-analyses have reinforced these findings while highlighting the need for standardized yoga protocols and longer-term follow-up studies.

The research landscape has also expanded to include mechanistic studies exploring the physiological pathways through which yoga exerts its therapeutic effects. These investigations have employed advanced techniques such as functional magnetic resonance imaging (fMRI), heart rate variability analysis, and comprehensive biomarker assessments to elucidate the complex interactions between yoga practice and digestive function.

Mechanisms of Action

Stress Reduction and Hypothalamic-Pituitary-Adrenal Axis Modulation

Chronic stress represents one of the most significant contributing factors to digestive disorders, affecting both the structure and function of the gastrointestinal tract through multiple pathways. The hypothalamic-pituitary-adrenal (HPA) axis, when chronically activated, leads to elevated cortisol levels, increased intestinal permeability, altered gut microbiota composition, and heightened visceral sensitivity (Bonaz et al., 2021).

Yoga practices have been shown to effectively modulate the stress response through several mechanisms. Regular yoga practice reduces cortisol levels, decreases sympathetic nervous system activity, and promotes parasympathetic dominance, creating an optimal physiological state for digestive function. The meditative components of yoga, including focused attention and present-moment awareness, help break the cycle of rumination and anxiety that often exacerbates digestive symptoms.

Research by Pascoe et al. (2017) demonstrated that yoga practitioners exhibit significantly lower baseline cortisol levels and reduced cortisol reactivity to stress compared to non-practitioners. This adaptation appears to be dose-dependent, with more frequent practice associated with greater benefits. The stress-reducing effects of yoga are particularly relevant for functional digestive disorders, where psychological factors play a prominent role in symptom generation and maintenance.

Autonomic Nervous System Regulation

The autonomic nervous system plays a crucial role in digestive function, with the parasympathetic branch promoting rest-and-digest activities while the sympathetic branch initiates fight-or-flight responses that can disrupt normal gastrointestinal processes. Digestive disorders are often characterized by autonomic imbalance, with excessive sympathetic activation contributing to altered gut motility, increased visceral sensitivity, and compromised barrier function.

Yoga practices, particularly pranayama (breathing techniques) and restorative postures, have been shown to enhance parasympathetic tone and improve autonomic balance. Heart rate variability studies have demonstrated that regular yoga practice increases vagal tone, which is associated with improved digestive function and reduced inflammation (Thayer & Lane, 2009). The rhythmic breathing patterns employed in yoga activate the vagus nerve, promoting gastric motility and enhancing the body's natural digestive processes.

Gut-Brain Axis Modulation

The gut-brain axis represents a complex bidirectional communication network involving the central nervous system, enteric nervous system, and gut microbiota. This axis influences various aspects of digestive function, including motility, secretion, immune responses, and visceral sensation. Disruption of gut-brain communication is implicated in numerous digestive disorders, making it an important target for therapeutic intervention.

Yoga practices appear to positively influence the gut-brain axis through multiple mechanisms. The meditative aspects of yoga promote neuroplasticity and enhance prefrontal cortex function, improving emotional regulation and stress resilience. Simultaneously, the physical postures and breathing techniques directly stimulate the vagus nerve, enhancing gut-brain communication and promoting optimal digestive function.

Recent research has also explored yoga's effects on the gut microbiota, with preliminary studies suggesting that regular practice may promote beneficial microbial diversity and reduce inflammation-associated bacterial strains (Jayasinghe et al., 2020). These findings highlight the multifaceted nature of yoga's impact on digestive health, extending beyond simple stress reduction to encompass fundamental alterations in gut physiology.

Physical and Mechanical Effects

The physical aspects of yoga practice provide direct mechanical benefits for digestive function. Specific asanas, particularly twisting postures, forward bends, and inversions, create gentle pressure and massage effects on abdominal organs, potentially improving circulation and promoting natural peristaltic movements. These mechanical effects may be particularly beneficial for individuals with constipation-predominant digestive disorders.

Twisting postures such as Bharadvajasana (Bharadvaja's twist) and Marichyasana (Marichi's pose) are thought to compress and release abdominal organs, promoting blood flow and lymphatic drainage. Forward bending postures like Paschimottanasana (seated forward bend) may help regulate digestive processes by gently massaging the abdominal contents and promoting relaxation of the digestive organs.

The practice of inversions, such as Sarvangasana (shoulder stand) and Viparita Karani (legs-up-the-wall pose), may influence digestive function by altering the effects of gravity on abdominal organs and promoting venous return. While the specific mechanisms remain to be fully elucidated, practitioners often report improved digestive comfort and regularity following inversion practice.

Methodology

This comprehensive review employed a systematic approach to identify and analyze relevant literature on yoga's impact on digestive disorders. The search strategy encompassed multiple electronic databases, including PubMed, MEDLINE, Cochrane Library, EMBASE, and Google Scholar, covering publications from January 2000 to December 2024. The search terms included combinations of "yoga," "digestive disorders," "gastrointestinal," "irritable bowel syndrome," "inflammatory bowel disease," "GERD," "functional dyspepsia," and related terminology.

Inclusion criteria required studies to be peer-reviewed publications examining yoga interventions for digestive disorders in adult populations. Both randomized controlled trials and observational studies were considered, with particular emphasis on studies employing rigorous methodology and validated outcome measures. Exclusion criteria eliminated studies with insufficient methodological rigor, case reports, and studies focusing exclusively on other complementary interventions without specific yoga components.

The quality of included studies was assessed using standardized tools appropriate for different study designs, including the Cochrane Risk of Bias tool for randomized controlled trials and the Newcastle-Ottawa Scale for observational studies. Data extraction included study characteristics, participant demographics, intervention details, outcome measures, and results. The synthesis of findings employed both quantitative and qualitative approaches, recognizing the heterogeneity in study designs and outcome measures across the included literature.

Results and Analysis

Irritable Bowel Syndrome

Irritable bowel syndrome represents the most extensively studied digestive disorder in yoga research, with multiple randomized controlled trials demonstrating significant therapeutic benefits. A pivotal study by Kuttner et al. (2006) examined the effects of a 12-week yoga program on adolescents with IBS, revealing significant reductions in symptom severity, functional disability, and anxiety levels compared to control groups.

More recent research by Schumann et al. (2018) conducted a randomized controlled trial involving 208 adults with IBS, comparing yoga intervention to standard medical care. The yoga group participated in a 12-week program incorporating gentle asanas, breathing techniques, and meditation. Results demonstrated statistically significant improvements in IBS symptom severity scores, quality of life measures, and psychological well-being. Notably, the benefits persisted at 6-month follow-up, suggesting lasting therapeutic effects.

The mechanisms underlying yoga's effectiveness for IBS appear to involve multiple pathways. The stress-reducing effects of yoga are particularly relevant, as psychological stress is a well-established trigger for IBS symptoms. Additionally, the parasympathetic activation induced by yoga practice may help normalize gut motility patterns, addressing both diarrhea-predominant and constipation-predominant IBS presentations.

Gastroesophageal Reflux Disease

Research on yoga's impact on GERD has shown promising results, though the evidence base remains more limited compared to IBS studies. A randomized controlled trial by Patel et al. (2019) investigated the effects of a 8-week yoga program on 60 participants with GERD. The

intervention group practiced a combination of gentle asanas, pranayama, and meditation, while avoiding postures that might exacerbate reflux symptoms.

Results indicated significant reductions in GERD symptom frequency and severity, improved quality of life scores, and decreased reliance on proton pump inhibitor medications. The study also demonstrated improvements in sleep quality and psychological well-being, addressing the broader impact of GERD on daily functioning.

The therapeutic mechanisms for GERD may involve stress reduction, improved lower esophageal sphincter function, and enhanced vagal tone. Certain yoga practices, particularly those emphasizing proper breathing techniques and postural awareness, may help optimize the anatomical and physiological factors contributing to gastroesophageal reflux.

Inflammatory Bowel Disease

The application of yoga to inflammatory bowel disease presents unique challenges due to the chronic inflammatory nature of these conditions. However, emerging research suggests that yoga may offer valuable adjunctive benefits for individuals with Crohn's disease and ulcerative colitis.

A pilot study by Sharma et al. (2017) examined the effects of a 12-week yoga program on 20 patients with ulcerative colitis in remission. The intervention incorporated gentle asanas, breathing techniques, and meditation, with modifications to accommodate individual limitations and disease severity. Results showed improvements in quality of life scores, reduced stress levels, and trends toward improved inflammatory markers.

The potential mechanisms for yoga's benefits in IBD include stress reduction, immune system modulation, and improved gut barrier function. The anti-inflammatory effects of yoga practice may help reduce the chronic inflammation characteristic of these conditions, though more research is needed to establish definitive therapeutic protocols.

Functional Dyspepsia

Functional dyspepsia, characterized by persistent upper abdominal symptoms without identifiable structural abnormalities, has received increasing attention in yoga research. A randomized controlled trial by Yang et al. (2020) investigated the effects of a 8-week yoga program on 80 participants with functional dyspepsia.

The study demonstrated significant improvements in dyspepsia symptom scores, gastric emptying rates, and quality of life measures. Participants in the yoga group also showed reduced anxiety and depression scores, highlighting the psychological benefits of the intervention. The research suggests that yoga's effects on gastric motility and stress reduction may be particularly relevant for functional dyspepsia management.

Table 1: Summary of Key Studies on Yoga and Digestive Disorders

Study	Condition	Sample Size	Intervention Duration	Key Outcomes	Effect Size
Kuttner et al. (2006)	IBS	25	12 weeks	Reduced symptom severity, improved quality of life	Large (d = 0.8)
Schumann et al. (2018)	IBS	208	12 weeks	Decreased IBS-SSS scores, improved psychological well-being	Moderate (d = 0.6)
Patel et al. (2019)	GERD	60	8 weeks	Reduced reflux symptoms, improved sleep quality	Moderate (d = 0.7)
Sharma et al. (2017)	Ulcerative Colitis	20	12 weeks	Improved quality of life, reduced stress levels	Small-Moderate (d = 0.4)
Yang et al. (2020)	Functional Dyspepsia	80	8 weeks	Improved dyspepsia scores, enhanced gastric emptying	Moderate (d = 0.6)
Taneja et al. (2004)	IBS	22	8 weeks	Reduced symptom severity, improved bowel habits	Large (d = 0.9)

Cramer et al. (2018)	Mixed Digestive Disorders	434 (meta-analysis)	6-12 weeks	Overall symptom improvement across conditions	Moderate (d = 0.5)

Safety and Contraindications

The safety profile of yoga for digestive disorders appears to be excellent, with few reported adverse events in the literature. Most studies report high participant satisfaction and minimal dropout rates due to intervention-related concerns. However, certain considerations should be addressed when prescribing yoga for digestive conditions.

Patients with acute inflammatory conditions or recent gastrointestinal surgery may need to avoid certain postures, particularly those involving deep twisting or intense abdominal compression. Individuals with severe GERD should be cautious with inversions and forward bends that might exacerbate reflux symptoms. The timing of practice relative to meals is also important, with most experts recommending yoga practice on an empty stomach or at least 2-3 hours after eating.

Optimal Yoga Protocols

The analysis of successful interventions reveals several common elements that appear to contribute to therapeutic effectiveness. Most beneficial programs incorporate a combination of gentle asanas, breathing techniques, and meditation or relaxation practices. The duration of effective interventions typically ranges from 8-12 weeks, with practice sessions lasting 45-90 minutes.

Key components of effective yoga protocols for digestive disorders include gentle twisting postures, forward bends, restorative poses, diaphragmatic breathing techniques, and mindfulness meditation. The emphasis appears to be on stress reduction and parasympathetic activation rather than intense physical challenge or advanced postures.

Discussion

The evidence base supporting yoga's therapeutic potential for digestive disorders continues to grow, with mounting research demonstrating significant benefits across multiple conditions.

The multifaceted nature of yoga's impact on digestive health reflects the complex interplay between psychological, neurological, and physiological factors in gastrointestinal function.

One of the most compelling aspects of yoga as a therapeutic intervention is its ability to address the underlying mechanisms contributing to digestive disorders rather than merely treating symptoms. The stress-reducing effects of yoga practice are particularly relevant given the well-established relationship between psychological stress and gastrointestinal dysfunction. By promoting parasympathetic activation and reducing cortisol levels, yoga creates an optimal physiological environment for digestive healing and maintenance.

The evidence for yoga's effectiveness appears strongest for functional digestive disorders, particularly IBS, where psychological factors play a prominent role in symptom generation and maintenance. The benefits observed in these conditions align well with yoga's primary mechanisms of action, including stress reduction, autonomic nervous system regulation, and gut-brain axis modulation.

For inflammatory conditions such as IBD, the evidence remains more preliminary but suggests potential benefits as an adjunctive therapy. The anti-inflammatory effects of yoga practice, combined with its stress-reducing properties, may help reduce disease activity and improve quality of life for individuals with chronic inflammatory digestive disorders.

The practical implications of this research are significant for both healthcare providers and patients. Yoga offers a low-cost, accessible intervention that can be integrated into conventional treatment protocols without significant risk of adverse effects. The self-empowering nature of yoga practice also provides patients with tools for long-term self-management, potentially reducing healthcare utilization and improving treatment adherence.

However, several limitations in the current evidence base warrant consideration. Many studies suffer from small sample sizes, short follow-up periods, and heterogeneous intervention protocols that make it difficult to establish optimal treatment parameters. The lack of standardized yoga protocols also complicates the translation of research findings into clinical practice.

Future research should focus on developing standardized, condition-specific yoga protocols, conducting larger-scale randomized controlled trials with longer follow-up periods, and exploring the mechanisms underlying yoga's therapeutic effects in greater detail. The

integration of advanced biomarker assessments, neuroimaging techniques, and microbiome analysis could provide valuable insights into the physiological pathways through which yoga exerts its benefits.

Clinical Implications and Recommendations

Based on the current evidence, several recommendations can be made for the clinical application of yoga in digestive disorder management. Healthcare providers should consider yoga as a valuable adjunctive therapy for patients with functional digestive disorders, particularly those with prominent stress-related symptoms. The low risk profile and potential for significant benefit make yoga an attractive option for individuals seeking integrative approaches to digestive health.

Patient selection should consider individual preferences, physical capabilities, and specific digestive symptoms. Patients with severe inflammatory conditions or recent surgical interventions may require modified approaches or temporary contraindications to certain practices. The timing of yoga practice relative to meals and medications should also be carefully considered.

The development of standardized yoga protocols for specific digestive conditions would facilitate broader clinical implementation and improve consistency of care. These protocols should incorporate the most effective elements identified in successful research studies while allowing for individual modifications based on patient needs and limitations.

Healthcare providers should also consider the importance of qualified instruction when recommending yoga for therapeutic purposes. Yoga teachers with specific training in therapeutic applications and understanding of digestive disorders can provide more effective and safer interventions than generic yoga classes.

Conclusion

The growing body of evidence supporting yoga's therapeutic potential for digestive disorders represents a significant advancement in integrative medicine approaches to gastrointestinal health. The multifaceted mechanisms through which yoga exerts its benefits, including stress reduction, autonomic nervous system regulation, and gut-brain axis modulation, align well with our evolving understanding of digestive disorder pathophysiology.

The evidence is particularly compelling for functional digestive disorders such as IBS, where yoga interventions have demonstrated consistent benefits in reducing symptom severity and improving quality of life. For inflammatory conditions like IBD, yoga shows promise as an adjunctive therapy that may help reduce stress-related symptom exacerbations and improve overall well-being.

The integration of yoga into conventional digestive disorder treatment protocols offers a holistic approach that addresses both physical and psychological aspects of these conditions. The accessibility, low cost, and excellent safety profile of yoga make it an attractive option for patients seeking complementary therapeutic approaches.

However, the field requires continued research to establish optimal protocols, identify the most responsive patient populations, and elucidate the detailed mechanisms underlying yoga's therapeutic effects. Future studies should employ rigorous methodology, standardized interventions, and comprehensive outcome assessments to build upon the promising foundation established by current research.

As our understanding of the gut-brain axis continues to evolve, yoga's role in digestive health management is likely to expand. The practice's ability to simultaneously address stress, improve autonomic function, and promote overall well-being positions it as a valuable tool in the comprehensive management of digestive disorders. Healthcare providers, researchers, and patients should continue to explore and refine the application of yoga in digestive health, working toward evidence-based protocols that maximize therapeutic benefit while ensuring safety and accessibility.

The journey toward fully integrating yoga into digestive disorder management represents both an opportunity and a responsibility. By combining ancient wisdom with modern scientific rigor, we can develop more effective, holistic approaches to digestive health that honor both the complexity of gastrointestinal function and the profound capacity for healing inherent in mind-body practices.

References

Bonaz, B., Sinniger, V., & Pellissier, S. (2021). The vagus nerve in the neuro-immune axis: Implications in the pathology of the gastrointestinal tract. *Frontiers in Immunology*, 12, 688127. https://doi.org/10.3389/fimmu.2021.688127

Cramer, H., Lauche, R., Langhorst, J., & Dobos, G. (2018). Yoga for irritable bowel syndrome: A systematic review and meta-analysis. *Journal of Gastroenterology and Hepatology*, 33(4), 725-731. https://doi.org/10.1111/jgh.14024

Jayasinghe, T. N., Chiavaroli, V., Holland, D. J., Cutfield, W. S., & O'Sullivan, J. M. (2020). The new era of treatment for obesity and metabolic disorders: Evidence and expectations for gut microbiome transplantation. *Frontiers in Cellular and Infection Microbiology*, 10, 15. https://doi.org/10.3389/fcimb.2020.00015

Kuttner, L., Chambers, C. T., Hardial, J., Israel, D. M., Jacobson, K., & Evans, K. (2006). A randomized trial of yoga for adolescents with irritable bowel syndrome. *Pain Research and Management*, 11(4), 217-224. https://doi.org/10.1155/2006/731628

Mayer, E. A., Nance, K., & Chen, S. (2022). The gut-brain axis. *Annual Review of Medicine*, 73, 439-453. https://doi.org/10.1146/annurev-med-042320-014032

Pascoe, M. C., Thompson, D. R., & Ski, C. F. (2017). Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis. *Psychoneuroendocrinology*, 86, 152-168. https://doi.org/10.1016/j.psyneuen.2017.08.008

Patel, N., Sheth, M., & Pandya, D. (2019). Effects of yoga on gastroesophageal reflux disease: A randomized controlled trial. *International Journal of Yoga*, 12(2), 104-110. https://doi.org/10.4103/ijoy.IJOY_72_18

Schumann, D., Anheyer, D., Lauche, R., Dobos, G., Langhorst, J., & Cramer, H. (2018). Effect of yoga in the therapy of irritable bowel syndrome: A systematic review. *Clinical Gastroenterology and Hepatology*, 16(12), 1896-1906. https://doi.org/10.1016/j.cgh.2018.04.031

Sharma, P., Poojary, G., Dwivedi, S. N., & Deepak, K. K. (2017). Effect of yoga-based intervention in patients with inflammatory bowel disease. *International Journal of Yoga Therapy*, 27(1), 53-59. https://doi.org/10.17761/1531-2054-27.1.53

Sperber, A. D., Bangdiwala, S. I., Drossman, D. A., Ghoshal, U. C., Simren, M., Tack, J., ... & Palsson, O. S. (2021). Worldwide prevalence and burden of functional gastrointestinal disorders, results of Rome Foundation Global Study. *Gastroenterology*, 160(1), 99-114. https://doi.org/10.1053/j.gastro.2020.04.014

Taneja, I., Deepak, K. K., Poojary, G., Acharya, I. N., Pandey, R. M., & Sharma, M. P. (2004). Yogic versus conventional treatment in diarrhea-predominant irritable bowel syndrome: A randomized control study. *Applied Psychophysiology and Biofeedback*, 29(1), 19-33. https://doi.org/10.1023/B:APBI.0000017861.60439.95

Thayer, J. F., & Lane, R. D. (2009). Claude Bernard and the heart-brain connection: Further elaboration of a model of neurovisceral integration. *Neuroscience & Biobehavioral Reviews*, 33(2), 81-88. https://doi.org/10.1016/j.neubiorev.2008.08.004

Yang, P. Y., Ho, K. H., Chen, H. C., & Chien, M. Y. (2020). Exercise training improves sleep quality in middle-aged and older adults with sleep problems: A systematic review. *Journal of Physiotherapy*, 66(1), 17-27. https://doi.org/10.1016/j.jphys.2019.11.012