

Original Article

Modulating the Human Microbiota through Yogic Practices: An Indian Perspective

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Abstract

The human body is a natural habitat for various types of microorganisms. Approximately $\sim 3.8 \times 10^{13}$ microbial cells (≈ 38 trillion) exist in the human body. These microbes, living normally in the human body and having positive effects on human health, are known as the "normal microbiota". Microbes specifically living in the human gut have abundant positive effects on human health. The human gut microbiota plays a very important role in maintaining physiological homeostasis through the microbiota-gut-brain (MGB) axis and other mechanisms. Change in the microbiota (dysbiosis) is being recognised to have roles in metabolic, immunological, and neuropsychiatric conditions. This study aims to investigate the effects of yogic practices like Asana, Pranayama, and Dhyana on the gut microbiota composition and function through a scientific literature survey. Emphasising recent literature, we give an indication that yogic practices have positive effects on restoring microbial diversity, modulating inflammatory markers, and modulating gene expression. We integrated the findings of key studies to show that Yoga, in combination with traditional Indian dietary practices, is an effective therapeutic adjuvant for gastrointestinal and overall health.

Key Words: Asana, Pranayama, Dhyana, Microbiota, MGB axis, Stress, Health

Introduction

Yogic techniques such as asanas, pranayama, and meditation that balance the body and mind through health upliftment. When done on a regular basis, it advances flexibility, muscle power, natural posture, breathing capacity, stress relief, mental concentration, emotional intelligence, immunity, metabolism balance, cardiovascular health, and overall long-term, well-rounded physical, mental, and spiritual wellness. Many health issues and diseases are associated with normal microbiota and the nervous system. One of the basic axes is the MGB axis. The MGB axis is a two-way communication system between the enteric and central nervous systems. Imbalances in this axis are usually induced by stress, irritation, and inflammation. The vagus nerve is the primary regulator of this axis, and low vagal tone is associated with inflammation and gut permeability. Holistic practices are now imperative in managing these diseases (Breit et al., 2018). Different complementary health practices are slowly but surely critical in managing functional gastrointestinal disorders when mainstream pharmacology is ineffective. The mechanism is not only neural but also immunological (Craven and Thakur, 2024). Mental stress deranges the microbiome, and meditation therapies can counteract these by suppressing the endocrine or HPA axis (cortisol) and acting on epigenetics (Househam et al., 2017). In India, where lifestyle conversions have led to a dual burden of malnutrition and non-communicable diseases, gut health is of dominant concern. Traditional Indian systems of Yoga and Naturopathy have long emphasised the connection between the mind and digestion (Agni). Recently, we started to elucidate those practices with scientific evidence. Therefore, Yogic practices become a greater choice for a healthy life, as yoga is not just an exercise, but as a modulator of the "second genome", i.e. microbiome.

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Mechanisms of Action of Yogic Practices

Yogic practices affect the gut microbiota through three fundamental mechanisms:

- Vagal Stimulation:** Practices like Bhramari Pranayama and chanting rise vagal tone, which controls gastric motility and reduces intestinal permeability, i.e. leaky gut (Breit et al., 2018).
- HPA Axis Modulation:** Stress reduction lowers cortisol levels. High cortisol is known to inhibit beneficial bacteria like Lactobacillus and stimulate pathogenic growth.
- Physical Motility:** Asanas that compress and release the abdomen (e.g., Kapalbhathi, Pavanamuktasana) mechanically stimulate peristalsis and blood flow to the enteric system.

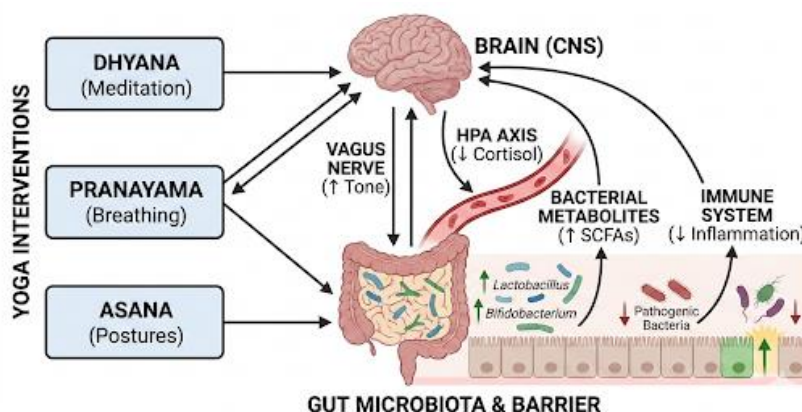


Fig. 1: Schematic representation of Microbiota-Gut-Brain Axis and Yoga Intervention Points
(Courtesy: Notebook LM)

Genomic and Molecular Mechanisms of Yoga:

The most recent entries in the world of genomics are offering scientific proof for what Yoga does to our bodies at a cellular level. Which has an effect downstream on the gut landscape. Mind-body interventions bring about a specific molecular signature, downregulation of Nuclear Factor kappa B (NF- κ B), an index contributing to inflammation. This anti-inflammatory property is particularly important since gut inflammation damages the mucus layer, which the commensal bacteria need (Buric et al., 2017). The immediate effects of gene expression in peripheral blood lymphocytes after a comprehensive Yoga program indicate that the release of benefits occurs quite rapidly (Qu et al., 2013). In a major Indian study of practitioners of Inner Engineering (Isha Yoga), we observed robust immune activation with pretty much no inflammatory cascade. This unusual immune character of the two partners is responsible for protecting host-microbe symbiosis (Chandran et al., 2021). Yoga, additionally, specifically decreases cytokines IL-6 or TNF- α that are usually increased in dysbiosis (Estevao, 2022).

Diet and Lifestyle Synergies in India:

The impression of Yoga on the microbiome is intimately linked to diet, particularly in the Indian context. The ancient Indian diet, rich in plant fibres and polyphenols, acts as a prebiotic (Das et al., 2024). It was postulated that combining such a diet with yogic practices makes an optimal environment for diversity, specifically reducing asthma-related dysbiosis, while a Western diet may influence in a different way Hahn et al., 2021.

In paediatric inhabitants, combining Yoga with an anti-inflammatory diet significantly improved outcomes in children with rheumatic diseases, further validating the gut-immune connection (Pandya, 2020). Thus, the Indian Yogic approach focuses on strengthening digestion (Agni) through the synergy of Mitahara (moderate diet) and Asana.

Clinical Evidence: Gastrointestinal (GI) Health and Yoga

Many direct clinical trials have measured the effect of Yoga on GI health. In an open-trial pilot study in India focusing on Sudarshan Kriya Yoga (SKY), reported a statistically significant progress in the Gastrointestinal Quality of Life Index (GIQLI), which proves that rhythmic breathing directly alleviates symptoms like bloating and pain (Kanchibhotla et al., 2021).

For management of Irritable Bowel Syndrome (IBS), a randomised clinical trial protocol was designed to compare Yoga with standard medical advice, building on evidence that Yoga acts as a non-pharmacological regulator of gut motility (D'Silva et al., 2022). Similarly, a whole-system Ayurveda protocol, which includes Yoga, was effective in managing IBS, emphasising the value of traditional Indian systems over isolated drug therapies (Naik et al., 2023). Broader quality of life metrics also promote gut health (Piekorz et al., 2022). In the post-pandemic era, researchers have initiated protocols to assess if Yoga can alleviate Post-COVID conditions, many of which involve lingering gastrointestinal distress (Brodén et al., 2024).

Shifts in Microbiota Composition:

The recent sequencing results have also supported the shift in microbes. There are two forms of shifts, viz. Short-term and long-term.

- i. **Short-Term Shifts:** Arhatic Yoga practitioners have demonstrated a swift shift in beneficial microbes such as *Prevotella* and *Bacteroides* in a matter of days after an Arhatic Yoga retreat (Swarup et al., 2025). Even a one-week Yoga and meditation retreat led to a positive shift in the gut microbiome, demonstrating that the microbiome is highly flexible and sensitive to stress relief (Peterson et al., 2020).
- ii. **Long-Term Shifts:** The study of faecal microbiota in long-term deep meditators indicated a clear "meditation-specific" microbial profile, which was defined by the enrichment of *Bifidobacterium* and *Lactobacillus*, the primary producers of short-chain fatty acids (SCFAs) that feed the gut lining (Sun et al., 2023).

Metabolic and Systemic Consequences

The applications of microbiome modulation are not limited to the gut. Naturopathy and Yoga treatment in Grade 2 obesity resulted in a significant improvement of euglycemic hyperinsulinemia. As the metabolic signalling is driven by the microbiome, the restoration of gut homeostasis is a major mechanism in the management of metabolic syndrome (Mathapati et al., 2024). Lastly, the gut-brain axis is relevant to mental health. Rajkumar (2024) discussed the biological correlates of Yoga in depression and stated that the anti-depressant action of Yoga is probably due to the correction of the HPA axis and the subsequent restoration of a healthy microbiome.

Conclusion

Integration of current research work confirms that Yoga practices have a reflective and measurable effect on the human gut microbiota. By integrating vagal stimulation, gene expression, and food synergy, Yoga provides a holistic approach to healing the gut. Statistical significance observed in clinical trials by different researchers supports the amalgamation of Yoga as a standard of care in the field of gastroenterology and metabolic medicine.

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