

Impact of Yoga for gut-brain axis on adolescents

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Abstract

Adolescence is a crucial stage of human development characterized by significant physical, psychological, and lifestyle changes that can directly influence gastrointestinal health. In recent years, digestive problems such as constipation, abdominal pain, bloating, and irregular bowel habits have become increasingly common among adolescents due to sedentary lifestyles, excessive screen time, academic pressure, poor dietary patterns, and stress also. These issues not only affect physical health but also impact mental well-being and overall quality of life. The present study investigates the effectiveness of yoga as a holistic and non-pharmacological intervention for improving intestinal health among adolescents.

A diverse environment of microorganisms in the gut, holding most of our bacterial microorganisms. The gut environment has a symbiotic association with the surrounding organism, and an equilibrium and variety of bacteria support health of an individual. When variety of gut bacteria reduces, results in gastrointestinal and mental distress. This path of interaction is identified as the microbiome–gut– brain axis. Strategies such as probiotic supplementation that influence microbiome also improve both gut and mind illnesses. Current evidence recommends that Yogic practices like Dhauti, Vasti improves the variety of microbiome, which may be positively affects both the gut and mind. The purpose of this article is to elucidate the pathway of the microbiome–gut–brain axis and suggests the role of specific Yogic practice on gut microbiome.

Keywords: Gut, Brain, Adolescents, Shatkarma, Pranayama, Om Chanting

Introduction:

Adolescent depression, affecting ~13% of youths aged 10–19, is characterized by distorted cognitive patterns and impaired social functioning (Thapa et al. 2021), (Tian P et al. 2022). Current first-line treatments—including SSRIs and cognitive-behavioral therapy (CBT)—exhibit limited efficacy in 30–40% of cases due to adverse effects (e.g., emotional blunting),

(Nikolova VL et al. 2025, Zhou M et al. 2023), underscoring the urgent need for therapies targeting alternative pathways like the gut-brain axis (GBA) (Freimer D et al. 2022), (Schaub AC et al. 2022).

Adolescence represents a formative stage of human development marked by rapid physical growth, hormonal changes, and increasing psychological demands. During this period, lifestyle factors such as irregular eating habits, lack of physical activity, academic stress, and excessive screen exposure often contribute to the emergence of gastrointestinal problems. Digestive disorders, including constipation, abdominal discomfort, bloating, and irregular bowel movements, are increasingly observed among adolescents and may adversely affect their physical health, emotional stability, and academic performance.

The gastrointestinal system plays a vital role in nutrient absorption, immunity, and overall well-being. Disruptions in intestinal health during adolescence can lead to chronic digestive issues later in life if not addressed early. Conventional medical treatments often focus on symptom management, while preventive and holistic approaches receive comparatively less attention. In this context, yoga has emerged as a promising complementary practice that integrates physical postures, breathing techniques, and mental relaxation to promote systemic balance.

Yoga is known to influence the digestive system by improving gut motility, stimulating abdominal organs, reducing stress, and enhancing mind-body awareness. Several studies suggest that regular yogic practices can positively impact gastrointestinal functioning and stress-related digestive disorders. However, research focusing specifically on the adolescent population remains limited.

The bacterial community of gut is sustained by the symbiotic association among infective and non-infective bacteria and their balanced ratio. Considerable shifts to the bacterial communities due to nutritional changes, and antibiotics may disturb equilibrium, or generate oxidative stress and have health issues (Lozupone et al., 2012). Gut microbiome disturbance may result in the growth of numerous ailments or disorders like type 2 diabetes (Proctor et al., 2017; Li et al., 2015), irritable bowel syndrome (Dinan & Cryan, 2013), cardiac diseases (Li et al., 2015), allergies, temper ailments (Burokas et al., 2017), and intestinal inflammation (Peters et al., 2001).

Irritable bowel syndrome (IBS) is a recurrent condition characterized by abdominal pain accompanied by diarrhea, gas and bloating. It is estimated that IBS affects 8% to 14% of the population and is the most common of all gastrointestinal ailments (Spollett GR. Pract 1989). Among pediatric samples, data indicate that IBS is experienced by approximately 17% of high school children and 8% of middle school children abdominal pain and irritable bowel syndrome in adolescents (J Pediatr 1996): A community-based study. (Hyams JS, Burke G et, al 1996). Children with this recurring syndrome frequently experience interference with day-to-day activities, such as missed school, withdrawal from physical activities, mood

disturbances (eg, anxiety and depression) and disruptions in peer relationships (Walker LS, Garber J. 1993).

Therefore, the present study aims to examine the role of yoga in improving intestinal health among adolescents. By exploring the effects of a structured yoga intervention on digestive functioning and overall well-being, this study seeks to contribute to the growing body of evidence supporting yoga as an effective, non-pharmacological approach for promoting intestinal health during adolescence.

Gut-Brain Axis

The gut and brain communicate constantly through a network of nerves, hormones, and biochemical signals. The vagus nerve, in particular, carries messages both ways: stress in the brain can disrupt digestion, while digestive issues can trigger anxiety or low mood.

- Stress increases cortisol, which slows digestion and can cause bloating or constipation.
- Poor gut health disrupts serotonin production (90% of serotonin is produced in the gut), affecting mood and emotional stability.
- Imbalances in gut bacteria can influence everything from immunity to sleep.

Together, these factors explain why your mood and digestion are often so closely linked.

How Yoga Supports the Gut-Brain Axis?

The junction of the gut-brain-microbiome axis is the vagus nerve. It is common for patients with both gastrointestinal and psychological illnesses to have defective vagus nerve activation. (Gershon, 2005; Rottenberg, 2007). Exercise in many forms, such as Yoga and aerobic training, has been demonstrated to increase parasympathetic tone (Vempati & Telles, 2002). Yoga has been shown in meta-analytical research to be an effective way to enhance GI and psychological health (Cramer et al., 2013; Schumann et al., 2016). Changes in the gut microbiome impact vagal transmission from the gut to the brain (Perez-Burgos et al., 2013). Consequently, it makes sense to speculate that whatever effects Yoga might have on the variety of gut microbes might be established by influencing vagal communication between the gut and brain. Regrettably, there isn't any empirical data available at this time to support this conclusion.

Mind structure and function are enhanced by yogic breathing exercises (S. Colcombe & Kramer, 2003; Kramer et al., 2005) and stops age-related brain deterioration (S. J. Colcombe et al., 2006) by controlling BDNF (Brain-derived neurotrophic factor). Apart from regulating mood disorders, learning, and memory, BDNF is also responsible for the existence of striatal neurons in the brain (Molteni et al., 2004; Rasmussen et al., 2009). According to Linnarsson et al., (Linnarsson et al., 1997) BDNF is well known for its protective function in the adult brain because cells die when this protein is deleted genetically. Reduced levels of BDNF in

the hippocampus have also been connected to gut inflammatory diseases like IBS (irritable bowel syndrome) and IBD as well as anxiety and sadness (Proctor et al., 2017; Sarkar et al., 2016).

Yoga works holistically by targeting both the nervous system and digestion.

- Movement stimulates the digestive organs, easing bloating and improving metabolism.
- Breathwork regulates the vagus nerve, calming the brain and improving gut function.
- Relaxation practices reduce cortisol, allowing the body to return to “rest and digest” mode.
- Mindfulness in yoga increases awareness of stress triggers, helping prevent digestive flare-ups linked to anxiety.

This combination makes yoga a powerful tool for restoring gut-brain harmony.

SATKARMA:

The Shatkarma have been known in India for over 4,000 years, described in the *Hatha Yogic* texts such as Hatha Yoga Pradipika, Gheranda Samhita and Hatharatnavali. The Hatha Yoga tradition of Yoga describes six purifying techniques that are known to balance a person's constitution. In the twenty-first century, there is once more a need to bring the original meaning and experience of the Shatkarma practices into common language, but most practitioners still don't explore the depth and spirit of the practices. A thorough literature regarding the scientific evidence for Shatkriya does not exist. The scant data on Shatkriya implies that practices are understudied. However, these methods are beneficial in a number of physiological and therapeutic areas. Research has shown that the practice of dhauti can improve digestive issues and respiratory functioning. The first Shatkarma practice is ‘Dhauti’. “Dhauti” extracts poisonous substances from the body and purifies the gastrointestinal tract. The second Shatkarma practice is ‘Vasti’. Vasti is of two type Jal Vasti or Sushak/Sthal vasti as described in Hatha yogic text. But Sushak/Sthal vasti is unexplored or not in practice due to its difficult procedure. Both ‘Dhauti’ Vatsara and Bahiskrit as well ‘Vasti’ play vital role in maintaining homeostasis in the body through maintaining the ecosystem of GI.

BASTI:

The **Gheranda Samhita** describes **Ṣaṭkarma (six purification practices)** as the first stage of yoga for purification of the body before higher practices like Pranayama and meditation. In **Gheranda Samhita Saraswati, N. (2004)**. Basti is described as a yogic cleansing technique that purifies the **lower abdomen and intestines**, removing accumulated impurities and balancing bodily humors. Sanskrit reference (**GS 1.12–1.13**) Basti may act as a colon purification technique with systemic physiological benefits.

The **Hatha Yoga Pradipika** Digambar ji, S., & Kokaje, M. L. (Eds.). (1998). also lists Basti among the six cleansing practices. It states that Basti Eliminates disorders of Vata, Pitta, and Kapha, improves digestive fire (Agni), Produces a light and healthy body. The text emphasizes that mastery of abdominal muscles and control of Apana Vayu is necessary.

DHAUTI:

Dhauti refers to internal cleansing practices of the digestive tract **Saraswati, N. (2004)**. Dhauti benefits the human body in Removes mucus and toxins, improves digestion, promotes health and longevity. The text states that Dhauti removes Kapha, bile, and impurities accumulated in the stomach and digestive tract.

Dhauti (vomiting cleansing) removes kapha and pitta disorders and helps cure diseases such as cough, asthma, and spleen problems (Hatha Yoga Pradipika 2. 24). Hatha Yoga Pradipika **Digambarji, S., & Kokaje, M. L. (Eds.). (1998)**.

PRANAYAMA:

Pranayama is a yogic breathing technique. The word pranayama combines 'prana' and 'ayama.' Prana means 'vital energy' or 'life force.' 'Ayama' is defined as 'extension' or 'expansion.' So, the meaning of pranayama is 'extension or expansion of the dimension of prana.' Pranayama is a set of yogic breathing techniques that aim to act directly and intentionally regulating (stop/control) one or more parameters of respiration (e.g., frequency, deepness, inspiration/expiration ratio). Slow breathing increases cortical and subcortical activity. These modifications may correlate with the following psychological output: increased comfort, relaxation, pleasantness, vigor, and alertness and reduced symptoms of arousal, anxiety, depression, anger, and confusion. Two hypothetical mechanisms may analyze these slow breathing-related changes i. voluntary regulation of internal bodily states by interoceptors and ii. role of mechanoreceptors within the nasal vault in modulating olfactory bulb activity, which activates the entire cortical areas **Zaccaro A et al. (2018)**

In the **Gheranda Samhita** Prāṇāyāma is introduced after the purification practices, indicating that a cleansed body is necessary for effective breath control. In Gheranda Samhita, Pranayama is described after purification practices because cleansing prepares the body for breath control. Pranayama is defined as the regulation of inhalation, retention, and exhalation of breath. **Saraswati, N. (2004)**.

OM CHANTING:

Om is the matrix of all mantras. The Om Mantra is described as Pranav in Patanjali Yogsutra. Its Japa (constant repetition), with bhavnam is the way [should be done] or is advised at the beginning of Yoga sutras. Its Japa results in overcoming the obstacles of the mind before doing yoga and turning inward consciousness. The Upanishads are full of references regarding the 'Om' mantra. Om is composed of three sounds, A, U and M, with a deep breath.

It encompasses the sound of syllables that have an eternal purpose. When we chant 'AUM', a vibration sound is felt through our vocal cord, which clears and opens up the sinuses touching our front teeth gently, will now start to feel the top of our head. 'Om' and its effect on the Nervous System is the endeavour of this review work. Research shows that Om chanting stimulates the Vagus Nerve through its auricular branches, sharpening the brain. The studies show that chanting Om can reduce activities of limbic brain regions, amygdala, hippocampus, parahippocampal gyrus, insula, orbitofrontal and anterior cingulate cortices and thalamus. These are the portion of the brain associated with stress and emotions. When the 'A' sound starts, it generates a vibration in the abdomen. This strengthens the spinal cord.

'OM' (or AUM) is of supreme importance as it is believed to be the primordial sound of the universe and a symbol for cosmic consciousness. OM chanting has been a part of meditation practice for a long time due to its effectiveness in enhancing mental clarity, emotional stability, and inner peace. According to regular practitioners of OM chanting, its benefits include improved well-being, stress reduction, and increased focus. It is used for both personal spirituality and holistic health. However, the basis for such benefits in the neurophysiological sense is poorly understood, creating a gap between ancient wisdom and modern science. **Kirti S Bongarge et al. (2022).**

OM (AUM) is considered the primordial sound of the universe in Indian spiritual traditions. It is regarded as the cosmic vibration from which creation originates. OM chanting is a traditional yogic practice that represents universal consciousness and promotes physical relaxation, mental clarity, emotional balance, and meditative depth. In classical texts such as the Mandukya Upanishad, OM represents the entire universe and the nature of consciousness. Chanting OM with contemplation helps remove obstacles and leads to deeper meditation.

The Mind-Body Connection in Ancient and Modern Medicine:

The concept of an intimate link between the mind and physical well-being, particularly digestive health, is not a recent discovery of modern science. It is a cornerstone of Ayurveda, a 5,000-year-old holistic healing system from India that views the mind (*Manas*) and body (*Sharira*) as intrinsically interconnected. According to Ayurvedic philosophy, health is an equilibrium of the body's primary energies or *doshas* (Vata, Pitta, and Kapha) and is maintained by a balanced state of mind, known as Manasik Swasthya. A central tenet of Ayurvedic physiology is the concept of Agni, the digestive fire. Agni is considered the source of all energy and intelligence in the body, responsible for the digestion, metabolism, and assimilation of food at every cellular level. When Agni is strong, food is properly digested, tissues are nourished, and the body and mind remain in a state of health. Conversely, an imbalanced Agni leads to the accumulation of Ama, or toxins, which are considered precursors to various diseases.

Remarkably, classical Ayurvedic texts, such as the Charaka Samhita, explicitly describe how psychological factors can directly disrupt this digestive fire. The texts state that negative

emotions and mental states, including anxiety (Chinta), grief (Shoka), fear (Bhaya), and anger (Krodha), can impair digestion and assimilation, even when food is consumed in the right quantity. This ancient understanding of the influence of the mind on digestion provides a compelling historical and philosophical parallel to modern research on the GBA and its dysregulation by psychological stress. It establishes a conceptual framework where the mind's state is not just a consequence of a physical ailment but a central factor in its pathogenesis. This congruence of ancient wisdom and modern scientific inquiry offers a valuable, integrated paradigm for exploring health and disease.

Adolescence

Adolescence is a developmental stage characterized by significant emotional, social, and cognitive changes, which can be accompanied by heightened levels of stress, anxiety, and mood disturbances (Steinberg, 2014). The Child and Adolescent Mindfulness Measure (CAMM) was developed by **Greco, L., Baer, R. A., and Smith, G. T. (2011)**.

Objectives:

Irritable bowel syndrome (IBS) is a common condition associated with recurrent abdominal pain and altered bowel habits. IBS is particularly pernicious to youth, who may withdraw from life tasks due to pain, diarrhea, and/or fear of symptoms. Emotional stress exacerbates, IBS symptoms, and mind-body interventions may be beneficial.

Review of literature:

1. Pranayama:

After a review of various pranayama, a group of scientists reported that pranayama might modulate ventricular performance by decreasing sympathetic activity and increasing parasympathetic activity, strengthen cardiorespiratory coupling, enhance baroreflex sensitivity, and have a unique effect on the brain stem cardiorespiratory centre. Left uni nostril breathing is associated with the parasympathetic response by activating the right hemisphere. Right uni nostril breathing is associated with a sympathetic response by activating the left hemisphere. Dynamic and smooth, both nostril breathing may balance both hemispheres. However, they concluded that the mechanisms behind the effect of various pranayama still need to be improved. **Nivethitha L (2016)**.

2. Om Chanting:

Past studies have found that OM chanting increases alpha EEG levels, indicating a correlation with increased relaxation and reduced stress. **Das, I., & Anand, H. (2012)**. Moreover, theta power also increases in all brain areas following OM chanting, and this change is correlated with a state of relaxation. **Harne, B. P., & Hiwale, A. S. (2018)**.

OM chanting also influences cortical activity and emotional processing, beyond brain wave activity. Verbal chanting or simply listening to the sound of OM has been found to activate the same brain areas associated with attention and relaxation **Saini, M et al. (2024)**. Additionally, OM chanting has been shown to reduce an emotional response to negative stimuli, which may suggest its use as a means of emotional regulation. **Zhang, Z., Peng, Y., & Chen, T. (2022)**

This follows research on the effect of mindfulness and meditation in general. It has become a scientific area of interest due to its various effects on brain activity, cognition, and emotional well-being. Some studies suggest that the expertise of meditation is associated with specific patterns of functional connectivity in the brain. Studies demonstrate that expert meditators integrate larger-scale brain networks, including somato motor, attention, limbic and frontoparietal networks, and they have more ability to generate psychological distancing from thoughts and emotions than less experienced meditators. **Czajko et al (2024)**], **Rutjens et al. (2022)**. That might imply that, if you meditate over a long period of time, you can also get permanent changes in brain function.

It was found that mantra chanting, a special type of meditation, causes a significant change in brainwave activity. The second piece of research analyzed experienced OM mantra chanters and found that in chanting, there was an increase in the EEG frequency bands, Alpha (10%), Gamma (13%), Beta (23%), and Delta (16%), which represents a deeper state of relaxation and focus **Raghav, Y. Y., & Gulia, S. (2023)**.], **Bayan, T., & Deb, N. (2025)**.

The rhythmic breathing and vocalization involved in Om chanting increase blood flow to critical brain regions. This improved circulation enhances oxygenation a nutrient delivery, essential for optimal cognitive function and neural efficiency. **G. S., Kulkarni, D. D., & Pant, G. (2011)**

Conclusion:

Our study aimed to explore the intricate relationship between gut health and cognitive functioning in adolescents, providing a comprehensive analysis of how various factors associated with gut health influence cognitive performance. The findings from our study add to the growing body of literature on the gut-brain axis, highlighting significant associations between gut health and cognitive functions, particularly memory and processing speed. This discussion delves deeper into these findings, contextualizing them within existing literature and outlining potential implications for future research and practical applications.

Yoga may regulate a two-way relationship between the gut and the brain by balancing the diversity of gut microbiota. Yoga can be used as a therapy method for GI and psychiatric conditions. It is unknown at this time how Yoga affects the connection between the gut and the brain. This article's goals are to provide a quick overview of the many interactions that exist between the gut, brain, and microbiota as well as to elaborate on how Yoga may affect

these connections and establish equilibrium among gut microbiome and supports individuals' health.

All of the studies outlined above indicate that Yoga may regulate a two-way relationship between the gut and the brain by balancing the diversity of gut microbiota. Yoga can be used as a therapy method for GI and psychiatric conditions. It is unknown at this time how Yoga affects the connection between the gut and the brain. This article's goals are to provide a quick overview of the many interactions that exist between the gut, brain, and microbiota as well as to elaborate on how Yoga may affect these connections and establish equilibrium among gut microbiome and supports individuals' health.

Suggestions and Recommendations

These small adjustments, combined with yoga, create a foundation for better gut and mental health.

- Eat mindfully, avoiding rushed or distracted meals.
- Stay hydrated—dehydration slows both digestion and cognitive function.
- Replace late-night scrolling with a calming yoga or breathing routine.
- Practice gratitude or journaling to support a positive mindset alongside yoga.

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