



ISSN 2456-3110

Vol 8 · Issue 11

November 2023

Journal of  
**Ayurveda and Integrated  
Medical Sciences**

*www.jaims.in*

**JAIMS**

An International Journal for Researches in Ayurveda and Allied Sciences



**Maharshi Charaka**  
Ayurveda

**Indexed**

# A comprehensive review of Yoga's impact on Immunomodulatory Functions and Microbiome in Obesity

Anantha Krishna B S<sup>1</sup>, K. Krishna Sharma<sup>2</sup>

<sup>1</sup>Research Scholar, Department of Human Consciousness and Yogic Sciences, Mangalore University, Mangalagangothri, Mangaluru, Karnataka, India.

<sup>2</sup>Professor and Chairman, Department of Human Consciousness and Yogic Sciences, Mangalore University, Mangalagangothri, Mangaluru, Karnataka, India.

## ABSTRACT

The issue of food security is often viewed through the lens of scarcity, but an equally critical concern is the global rise of obesity resulting from excessive energy intake and insufficient expenditure. Affluent societies, driven by food trends favoring energy-dense, nutrient-poor diets coupled with sedentary lifestyles, grapple with the burgeoning problem of overweight and obesity. India, too, faces a surge in obesity, contributing to lifestyle-related and metabolic disorders. Multiple factors, including diet, genetics, environment, and notably, a lack of physical activity, contribute to this health crisis. Obesity, marked by low-grade inflammation, significantly impacts immune function. Research indicates alterations in the intestinal immune system, fostering a pro-inflammatory environment linked to metabolic disorders associated with obesity. True health encompasses physical, mental, and social well-being, transcending the mere absence of disease. Lifestyle elements like environment, sleep, diet, and exercise play pivotal roles in maintaining good health. Yoga, emerging as a prominent Complementary and Alternative Medicine (CAM) therapy, holds promise for enhancing physiological and psychological health. In addressing obesity and modulating immune functions, non-invasive, non-pharmaceutical interventions, like yoga, offer viable solutions. Studies attest to yoga's positive impact on inflammatory markers in the obese, yet a comprehensive understanding of its effects on immunomodulation and the gut microbiome in obesity within the context of Indian and *Yogic* systems warrants deeper exploration. Incorporating such holistic approaches into daily routines could provide effective strategies for combating obesity and promoting overall well-being.

**Key words:** Health, Immunomodulatory Function, Microbiome, Obesity, Yoga Therapy

## INTRODUCTION

Over one-third of the world's population is affected by overweight or obesity which is a complex multifactorial disease. In recent years the trend of prevalence of obesity has been increasing in developing countries.

### Address for correspondence:

Mr. Anantha Krishna B S

Research Scholar, Department of Human Consciousness and Yogic Sciences, Mangalore University, Mangalagangothri, Mangaluru, Karnataka, India.

E-mail: anukrishnabs@gmail.com

Submission Date: 15/09/2023 Accepted Date: 24/10/2023

### Access this article online

Quick Response Code



Website: [www.jaims.in](http://www.jaims.in)

DOI: [10.21760/jaims.8.11.12](https://doi.org/10.21760/jaims.8.11.12)

There has been an increase in obesity in India in recent years, the consequence of which is seen in lifestyle-related and metabolic disorders.<sup>[1]</sup> The sudden increase in obesity is associated with a significant health, social, and economic burden that disturbs health and social development. It's challenging for many developing countries like India to develop and implement effective obesity prevention and management methods to overcome this problem.

Obesity is defined as an excess of body weight, but this simple definition contradicts an etiologically complex phenotype associated with excess adiposity or body fat manifested metabolically.<sup>[2]</sup> It increases the risk of developing chronic diseases like diabetes, depression, and cardiovascular disease, and it can lead to mortality.

In recent years, numerous researchers have identified that rapid lifestyle changes are likely responsible for the increasing body weight in the population, leading

to obesity. The increase in body mass causes public health challenges, and the health condition of obese persons is worse than that of healthy persons. It has some physical health impacts like cancers, Type 2 Diabetes, Hypertension, Heart diseases, arthritis, etc. It has an increasing risk of mental health, causing the chances for mood disorder, and eating disorder, and directly or indirectly affects the quality of life. Obesity and its impacts have a different dimension, signifying its significant impact on health, and it needs to be considered one of the important public health priorities.<sup>[3]</sup>

The causes of overweight and obesity are very complex, but there are many suggested contributors, such as poor diet and consumption of fast food, increased eating frequency, a decrease in physical activity, and energy imbalance between calories consumed and calories expended. Obesity is a multifactorial disorder affected by genetics<sup>[4]</sup> and nongenetic factors. Recent research indicates that the intestinal microbiota plays a significant role in obesity.<sup>[5]</sup> The homeostasis of microbiota depends on various factors such as age, sex, diet, and environmental conditions.<sup>[6]</sup> In recent years, researchers have discovered that intestinal dysbiosis influences obesity, as the composition of intestinal microbiota plays a significant role in obesity, with storage and energy expenditure depending on microbiota composition.

The prevention or control of obesity is multifactorial. In this aspect, there are many non-invasive and non-pharmaceutical treatment options available that need to be implemented in daily life routines. Yoga is a cost-effective and straightforward therapeutic modality with scientifically proven impacts on obesity. Studies on yoga have shown beneficial effects on inflammatory markers in obese individuals.<sup>[7]</sup> However, a deeper understanding of the concept of Indian and Yogic systems on immunomodulatory function and the gut microbiome in the obese is needed.

## AIMS AND OBJECTIVES

This comprehensive review aims to explore the diverse outcomes of various Yoga practices on

immunomodulatory functions and the composition of the gut microbiome in the obese population. By comparing different types and intensities of Yoga interventions, the review aims to elucidate the nuanced impacts on immune response and microbiota. The analysis will also consider the quality of evidence and study methodologies employed in the existing literature to provide a well-rounded perspective on the relationship between Yoga, immunomodulation, gut microbiota, and obesity. This holistic approach intends to contribute valuable insights to the understanding of the potential therapeutic benefits of Yoga in addressing immunological and microbiological aspects of obesity.

## METHODOLOGY

We employed an exhaustive search strategy using databases like PubMed, Google Scholar, and Scopus. Keyword combinations focused on yoga, obesity, immunomodulation, and microbiome. This meticulous approach ensured a comprehensive collection of recent and pertinent studies on the interplay between *Yoga*, immunomodulation, and the microbiome in obesity.

### Existing strategies for Obesity Prevention

Obesity is a complex issue with multiple contributing factors, and thus, there is no one-size-fits-all solution. Preventing and controlling obesity requires a multifaceted approach involving collaboration between policymakers and individuals. This joint effort aims to cultivate a healthy lifestyle and promote behaviours that deter obesity and related noncommunicable diseases, all of which are preventable.

Prevention and control strategies encompass three primary areas: individual or community-based interventions, organization-based interventions, and environmental-based interventions.<sup>[8]</sup> In individual or community-based approaches, people can combat obesity by moderating high-energy food consumption, increasing the intake of low-energy foods, maintaining regular physical exercise, and adhering to a health-conscious lifestyle.

Organization-based interventions, typically implemented through healthcare systems, prioritize the dissemination of knowledge for prevention, early detection, and appropriate interventions to ensure individuals maintain optimal health. Environmental-based interventions encourage and facilitate healthy behaviours, such as walking and cycling, through well-designed models. Ultimately, much like other chronic conditions, obesity is preventable by embracing a healthy lifestyle that includes a balanced diet, regular physical activity, and adequate sleep.

### Physical activity and obesity

Reducing adipose tissue is a key method for weight reduction in individuals with obesity.<sup>[9]</sup> Two effective approaches exist for decreasing adipose tissue:

- **Dietary Modification:** Altering dietary habits to reduce calorie intake and promote weight loss.
- **Energy Expenditure Modification (Exercise):** Incorporating physical activity as a means to reduce fat mass, which offers benefits beyond weight loss. Fitness is linked to more favourable clinical outcomes, including reduced risk of metabolic diseases, cardiovascular diseases, Alzheimer's disease, inflammation, and other health conditions.

Physical activity not only aids in fat mass reduction but also increases total energy expenditure, contributing to energy balance and potential weight loss.<sup>[10]</sup> Regular physical activity can target fat accumulation around the waist and reduce overall body fat in obese individuals. Moreover, it can mitigate the risk of depression and anxiety in those with obesity. Physical exercise is recognized for its role in halting the progression of obesity and has a positive impact on addressing physiological imbalances, immunological dysfunctions, fuel metabolism, and antioxidant defense systems.

The gut microbiome plays a crucial role in nutrient metabolism and energy expenditure.<sup>[11]</sup> Various treatment approaches for obesity have been observed to influence the diversity of the gut microbiome. Increased microbial diversity has been associated with

a potential preventive effect on long-term weight gain, especially in healthy individuals. Additionally, regarding inflammatory markers, gut bacteria can modulate inflammatory factors by affecting the secretion of inflammatory cytokines.<sup>[12]</sup> Elevated levels of interleukin (IL)-6, tumor necrosis factor (TNF), and C-reactive protein are biomarkers for inflammation and appear to be linked with obesity.<sup>[13]</sup> Numerous factors can modulate the activity and composition of the gut microbiota. Several studies have demonstrated that exercise can promote beneficial microbial alterations. Exercise exerts an anti-inflammatory influence on the gut, and various forms of physical activity can elicit distinct effects on the gut microbiome.

Physical activity stands as an established and effective approach in the battle against overweight and obesity. Yet, the optimal management of this condition lies in the synergy of dietary interventions and regular exercise. Exercise isn't just a fundamental component of weight management; it's a cornerstone of holistic well-being.

### A holistic approach to obesity

In the current scenario, the population is experiencing an increase in overweight and obesity. Pharmacological treatments can address weight gain resulting from metabolic and medical factors, but they often come with significant side effects.<sup>[14]</sup> In this context, there is a growing demand for complementary and alternative medicine (CAM) approaches. *Yoga* and yogic systems have emerged as prominent CAM therapies to address both physiological and psychological health challenges in the modern age. Therefore, before embracing *Yoga* and its systems as a therapeutic tool, it's crucial to comprehensively grasp their principles, methodologies, and their specific approach to various health conditions.

Obesity is characterized as a condition in Indian systems like *Yoga* and *Ayurveda*. Despite the differences in therapeutic approaches within the Indian system, a common thread is the integrated treatment concept, emphasizing the interconnectedness of the mind and body. Among the six ancient philosophies, *Yoga* holds a prominent

position due to its enduring presence in daily life since ancient times. References to various disorders, their symptoms, and practices for overcoming them can be found in the *Vedic* texts, *Upanishads*, *Vedangas*, *Ayurveda*, *Bhagavad Gita*, and *Yogic* texts, demonstrating the holistic understanding of health and disease.

In the *Taittiriya Upanishad*, the concept of "*Kosha*," which represents the sheaths of the body, explains how imbalances in the *Annamaya*, *Pranamaya*, and *Manomaya Kosha* can contribute to obesity. In the *Svetasvatara Upanishad*, when elucidating the qualities of a realized *Yogi*, as stated:

"*Laghutvamarogyamalolupatvam Varnaprasadam Svarasaushtavanca | Gandhah Shubho Mūtraparishamalpam Yogapravruttim Prathamam Vadanti*" || *Svetasvatara Upanishad* 2/13, which explains a *Yogi* will manifest lightness of the body (*Lagutvam*), good health (*Ārogyam*), a bright complexion (*Varnaaprasāda*), a sweet voice (*Svarasaushtava*), and a pleasant body fragrance (*Gandhah*). This verse emphasizes "*Laghutvam*" in terms of bodily lightness, implying that the practice of *Yoga* can help reduce excess weight to achieve this state of lightness. This signifies the profound understanding of the relationship between yoga and achieving a healthier, lighter body as mentioned in the *Upanishads*.

According to *Ayurveda*, all digestive and metabolic functions are governed by *Agni*, with the levels of *Mandagni*, *Jatharagni*, and *Dhatvagni* playing a pivotal role in disease causation. Specifically, the dysfunction of *Dhatvagni* is implicated in the onset of obesity. In *Yoga Vasista*, the source of *Vyadhi*, or disease, is attributed to a perturbed mind (*Adhi*). Obesity is classified under "*Samanya Adhija Vyadhi*," which arises due to day-to-day causes. According to *Yoga Vasistha*, dissatisfaction, and discontentment are the precursors of disease, with factors like excessive desires, consumption of unhealthy foods, residing in unsuitable environments, working at inappropriate times, engaging in unethical actions, associating with negative influences, and harboring ill thoughts about others

being contributory elements in the development of diseases.<sup>[15]</sup> This comprehensive perspective underscores the complex interplay of physical and mental factors in health and disease, as described in the ancient teachings of *Ayurveda* and *Yoga Vasista*.

In *Hatha Yoga* texts, especially in *Hatha Yoga Pradipika*, concepts related to lightness, health, and improvement of digestion, which can be correlated with obesity, are elaborated. The concept of *Asana*, as highlighted in the text, is stated as

"*Haṭhasya Prathamāṅgatvādāsanam Pūrvamucyate | Kuryāttadāsanam Proktam Sthairyamārogyam Cāṅgalāghavam*" || *Haṭhayogapradīpikā* 1-17 ||

*Āsana* or Posture (*Āsanam*) is described in the first place as it is the first limb or step. Therefore, *Āsana* (*Āsana*), which gives steadiness and firmness (*Sthairyam*), health (*Ārogyam*) and bodily lightness (*Lāghavam*), should be performed.

In many references in *Hatha Yoga* texts, it is explained that the practice of *Yoga* results in a beautiful bodily appearance, thinness, tranquility, and purity in one's countenance. This includes the manifestation of inner sound, clear eyes, good health, victory over semen or ova, the kindling of the digestive fire, and purification of the subtle channels, which can be correlated with overcoming the symptoms of obesity.

The study of *Yogic* effects on obesity and immunomodulatory functions, along with these classical references, can highlight the benefits of *Yoga* practice on obesity and immune functions. This can be correlated with the gut microbiome. A Narrative Review of *Yoga* Intervention Clinical Trials, including weight-related outcomes, indicates that therapeutic yoga programs are often effective for weight loss and improved body composition.<sup>[16]</sup> Key factors like practice frequency, longer intervention duration, *Yogic* dietary components, and residential and home practice suggest *Yoga* as a viable intervention for weight maintenance, obesity prevention, and reducing the risk of obesity-related diseases. *Yoga* may reduce pro-inflammatory markers, particularly IL-1beta, and show indications of decreasing IL-6 and TNF-alpha,



making it a potential complementary intervention for inflammatory-related diseases.<sup>[17]</sup>

Amid rising health awareness, exercise gains prominence. While *Yoga* is often misunderstood as mere physical activity, a comparative review highlights its unique aspects, emphasizing breath control, mindfulness, and posture maintenance. It positions *Yoga* interventions as equivalent or superior to physical exercise across various physiological outcomes.<sup>[18]</sup>

### Future directions

Backed by both classical wisdom and scientific evidence, yoga emerges as a personalized holistic strategy to enhance immune function and positively influence the gut microbiome in individuals with obesity, consequently fostering overall health. Adopting a holistic paradigm, *Yoga* proves advantageous in enhancing both physiological and psychological functions, thereby promoting psychophysiological well-being. Research examining the relationship between *Yoga*, the gut microbiota's composition in obesity, and its immune modulatory effects provides scientific validation for the positive impact of *Yoga*, aligning with insights from classical references.

### CONCLUSION

In conclusion, the amalgamation of classical wisdom and scientific findings in *Yogic* studies sheds light on its diverse physiological and psychological impacts, addressing various disorders. However, certain limitations, such as understanding *Yogic* concepts, study design, subject homogeneity, and follow-up, need consideration. Future research should delve into the mechanisms of *Yoga* on body composition and explore the efficacy of specific *Yoga* types for various disorders. Public awareness is crucial for utilizing *Yoga* as a complementary therapeutic tool. Despite increased awareness, a disparity exists between *Yoga* practice and evaluation. As per *Patanjali's* philosophy of "*Heyam Dukham Anagatam*" (prevent future suffering), *Yoga's* positive impact on physical, psychological, and spiritual aspects promotes

homeostasis, aligning with the holistic health concept of complete well-being in the Indian system of medicine. This integration achieves a state of "*Sama Dasha Sama Agnischa Sama Dhatu Mala Kriyaaha*" - balanced bodily energies, optimal digestion, harmonious tissue formation, and efficient excretory functions - resulting in overall health.

### ACKNOWLEDGMENT

The corresponding author is a recipient of the Indian Council of Social Science Research Doctoral Fellowship. His article is largely an outcome of his doctoral work sponsored by ICSSR. However, the responsibility for the facts stated, opinions expressed and the conclusions drawn is entirely that of the author.

### REFERENCES

1. Venkatrao M, Nagarathna R, Majumdar V, Patil SS, Rathi S, Nagendra H. Prevalence of Obesity in India and Its Neurological Implications: A Multifactor Analysis of a Nationwide Cross-Sectional Study. *Ann Neurosci*. 2020;27:153. <https://doi.org/10.1177/0972753120987465>.
2. Panuganti KK, Nguyen M, Kshirsagar RK, Doerr C. Obesity (Nursing). *StatPearls*. 2021.
3. Tiwari A, Balasundaram P. Public Health Considerations Regarding Obesity. *StatPearls*. 2023.
4. Thaker VV. Genetic and Epigenetic Causes of Obesity. *Adolesc Med State Art Rev*. 2017;28:379. <https://doi.org/10.1542/9781581109405-genetic>.
5. Geng J, Ni Q, Sun W, Li L, Feng X. The links between gut microbiota and obesity and obesity-related diseases. *Biomedicine & Pharmacotherapy*. 2022;147:112678. <https://doi.org/10.1016/J.BIOPHA.2022.112678>.
6. Hasan N, Yang H. Factors affecting the composition of the gut microbiota, and its modulation. *PeerJ*. 2019;7. <https://doi.org/10.7717/PEERJ.7502>.
7. Esteveo C. The role of yoga in inflammatory markers. *Brain Behav Immun Health*. 2022;20:100421. <https://doi.org/10.1016/J.BBIH.2022.100421>.
8. Making I of M (US) C on an EF for OPD, Kumanyika SK, Parker L, Sim LJ. Obesity Prevention Strategies in Concept and Practice. 2010.

9. Niemi GM, Rewane A, Algotar AM. Exercise and Fitness Effect On Obesity. StatPearls. 2023.
10. Cox CE. Role of Physical Activity for Weight Loss and Weight Maintenance. Diabetes Spectr. 2017;30:157. <https://doi.org/10.2337/DS17-0013>.
11. Montenegro J, Armet AM, Willing BP, Deehan EC, Fassini PG, Mota JF, et al. Exploring the Influence of Gut Microbiome on Energy Metabolism in Humans. Advances in Nutrition. 2023;14:840–57. <https://doi.org/10.1016/J.ADVNUT.2023.03.015>.
12. Schirmer M, Smeekens SP, Vlamakis H, Jaeger M, Oosting M, Franzosa EA, et al. Linking the Human Gut Microbiome to Inflammatory Cytokine Production Capacity. Cell. 2016;167:1125. <https://doi.org/10.1016/J.CELL.2016.10.020>.
13. Bentham J, Di Cesare M, Bilano V, Bixby H, Zhou B, Stevens GA, et al. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. The Lancet. 2017;390:2627–42. [https://doi.org/10.1016/S0140-6736\(17\)32129-3](https://doi.org/10.1016/S0140-6736(17)32129-3).
14. MacDaniels JS, Schwartz TL. Effectiveness, tolerability and practical application of the newer generation anti-obesity medications. Drugs Context. 2016;5. <https://doi.org/10.7573/dic.212291>.
15. Arya RP. Yoga-Vasistha of Valmiki (4 Volumes). 2005th ed. Parimal Publication Pvt. Ltd; 2005.
16. Rioux Grace J, Ritenbaugh C. Narrative Review of Yoga Intervention Clinical Trials Including Weight-Related Outcomes. Alternative Therapies in Health and Medicine. 2013;19:32-46.
17. Falkenberg RI, Eising C, Peters ML. Yoga and immune system functioning: a systematic review of randomized controlled trials. J Behav Med. 2018;41:467–82. <https://doi.org/10.1007/s10865-018-9914-y>.
18. Govindaraj R, Karmani S, Varambally S, Gangadhar BN. Yoga and physical exercise – a review and comparison. International Review of Psychiatry. 2016;28:242–53. <https://doi.org/10.3109/09540261.2016.1160878>.

**How to cite this article:** Anantha Krishna B S, K. Krishna Sharma. A comprehensive review of Yoga's impact on Immunomodulatory Functions and Microbiome in Obesity. J Ayurveda Integr Med Sci 2023;11:87-92. <http://dx.doi.org/10.21760/jaims.8.11.12>

**Source of Support:** Nil, **Conflict of Interest:** None declared.

\*\*\*\*\*