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

Anantha Krishna B S¹, K. Krishna Sharma²

¹Research Scholar, Department of Human Consciousness and Yogic Sciences, Mangalore University, Mangalagangothri, Mangaluru, Karnataka, India.
²Professor 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. There has been an increase in obesity in India in recent years, the consequence of which is seen in lifestyle-related and metabolic disorders.[2] 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.[2] 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.[3]

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[4] and non-genetic factors. Recent research indicates that the intestinal microbiota plays a significant role in obesity.[5] The homeostasis of microbiota depends on various factors such as age, sex, diet, and environmental conditions.[6] 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.[7] 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 non-communicable 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.[8] 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. 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. 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. 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. 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. 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.

**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. 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
Anantha Krishna B S et al. Yoga's impact on Immunomodulatory Functions and Microbiome in Obesity

ISSN: 2456-3110

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 Taittariya 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:

“Laghutvam varogyamalolupatvam Varnaprasādām Svarasauśhtavānca | Gandhah Shubho Mūtraripishamalpam Yogapraruttim Prathamam Vadanti” || Svetasvatara Upanisad 2/13, which explains a Yogi will manifest lightness of the body (Lagutvam), good health (Ārogyam), a bright complexion (Varnaaprasāda), a sweet voice (Svarasauśhtava), 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 Dhathvagni playing a pivotal role in disease causation. Specifically, the dysfunction of Dhathvagni is implicated in the onset of obesity. In Yoga Vasista, the source of Vyadhī, or disease, is attributed to a perturbed mind (Adhi). Obesity is classified under "Samanya Adhija Vyadhī," 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. 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 Āsana, as highlighted in the text, is stated as

"ḥathasya Prathamāntvādāsanaṁ Pūrvamucyate/ Kuryāttadāsanaṁ Proktam Sthairyamārogyaṁ Cāṅgalāghavam” || Hathayogapradīpikā 1-17 ||

Āsana or Posture (Āsānam) is described in the first place as it is the first limb or step. Therefore, Āsana (Āsana), which gives steadiness and firmness (Sthairya), health (Ārogya) 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. 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.\textsuperscript{[17]}

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

\textbf{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, \textit{Yoga} proves advantageous in enhancing both physiological and psychological functions, thereby promoting psychophysiological well-being. Research examining the relationship between \textit{Yoga}, the gut microbiota's composition in obesity, and its immune modulatory effects provides scientific validation for the positive impact of \textit{Yoga}, aligning with insights from classical references.

\textbf{CONCLUSION}

In conclusion, the amalgamation of classical wisdom and scientific findings in \textit{Yogic} studies sheds light on its diverse physiological and psychological impacts, addressing various disorders. However, certain limitations, such as understanding \textit{Yogic} concepts, study design, subject homogeneity, and follow-up, need consideration. Future research should delve into the mechanisms of \textit{Yoga} on body composition and explore the efficacy of specific \textit{Yoga} types for various disorders. Public awareness is crucial for utilizing \textit{Yoga} as a complementary therapeutic tool. Despite increased awareness, a disparity exists between \textit{Yoga} practice and evaluation. As per \textit{Patanjali}'s philosophy of "\textit{Heyam Dukham Anagatam}" (prevent future suffering), \textit{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 "\textit{Sama Dosha Sama Agnisha Sama Dhatu Mala Kriyaaha}" - balanced bodily energies, optimal digestion, harmonious tissue formation, and efficient excretory functions - resulting in overall health.

\textbf{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.

\textbf{REFERENCES}


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