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EDITORIAL

# New therapy for metabolic syndrome: Gut microbiome supplementation

Waseem Qureshi, Maqsood Ahmad Dar, Mohd Younis Rather

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**Waseem Qureshi,** Hospital Administration, Government Medical College, University of Kashmir, Jammu and Kashmir, Srinagar 190010, India

**Maqsood Ahmad Dar,** Department of Medicine, Government Medical College, University of Kashmir, Jammu and Kashmir, Srinagar 190010, India

**Mohd Younis Rather,** Multidisciplinary Research Unit, Government Medical College, University of Kashmir, Jammu and Kashmir, Srinagar 190010, India

**Corresponding author:** Waseem Qureshi, Doctor, FRCP, FRCPE, MBBS, MD, Chief Physician, Doctor, Professor, Superintendent, Hospital Administration, Government Medical College, University of Kashmir, Gole Market-10, Jammu and Kashmir, Srinagar 190010, India.
qureshiwaseem786@gmail.com

## Abstract

The gut microbiota is important in the development and progression of metabolic illnesses such type 2 diabetes, cardiovascular disease (CVD), and obesity. This diverse community of microorganisms controls a variety of physiological functions, including metabolism, inflammation, and immune response. Understanding these interactions has resulted in novel therapeutic options, including microbiome supplementation. The gut microbiome is extremely susceptible to dietary changes, which can alter its makeup and function, influencing metabolite synthesis that affects host health. Certain metabolites, such as butyrate and propionate, have been proven to protect against metabolic illnesses, whereas trimethylamine has been linked to CVD. Prebiotics, probiotics, synbiotics, and postbiotics are being investigated by researchers as ways to change the gut microbiome and boost metabolic health. Despite advances in therapy and lifestyle adjustments, the prevalence of metabolic syndrome is increasing, emphasizing the need for new medicines.

**Key Words:** Probiotics; Prebiotics; Synbiotics; Postbiotics; Microbiome; Type 2 diabetes mellitus; Cardiovascular disease; Obesity

**Core Tip:** The gut microbiota plays a crucial role in the onset and progression of metabolic conditions like type 2 diabetes, cardiovascular disease, and obesity. This diverse microbial community regulates various physiological functions, including metabolism, inflammation, and immune response. Understanding these interactions has led to innovative therapeutic approaches, such as microbiome supplementation. Dietary changes significantly impact the composition and function of the gut microbiome, influencing metabolite production that directly impacts host well-being. Certain metabolites like butyrate and propionate exhibit protective effects against metabolic disorders, while trimethylamine is associated with cardiovascular risk. Researchers explore prebiotics, probiotics, synbiotics, and postbiotics as potential avenues to modulate the gut microbiome and enhance metabolic health. Despite therapeutic advancements and lifestyle modifications, the prevalence of metabolic syndrome continues to rise, underscoring the urgent need for novel treatments.

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## INTRODUCTION

The complex relationship between the gut microbiome and metabolic health has received a lot of attention in recent years, revolutionizing our understanding of the pathogenesis and potential treatment options for metabolic disorders like type 2 diabetes, cardiovascular disease (CVD), and obesity. The gut microbiota, a varied population of bacteria living in the intestines, orchestrates a wide range of physiological processes such as metabolism, inflammatory regulation, and immune response. This symbiotic link between the host and its microbial residents has prompted research into new therapeutic techniques, with microbiome supplementation appearing as a viable option. Dietary composition has emerged as a critical modulator of gut microbiota composition and function, with research showing that dietary alterations, particularly between animal-based and plant-based diets, have a significant impact on the microbiome and subsequent host physiology. The gut microbiota has a substantial impact on metabolic processes such as glucose metabolism, lipid control, and insulin sensitivity by producing metabolites like short-chain fatty acids (SCFAs), bile acids, and other bioactive compounds. While some microbial metabolites, such as butyrate and propionate, have been shown to protect against metabolic illnesses, others, such as trimethylamine, have been linked to the development of ailments such as atherosclerosis and CVD. This delicate equilibrium emphasizes the need of regulating the gut flora to improve metabolic health. Researchers are looking into different ways to modify the gut microbiota, such as prebiotics, probiotics, synbiotics, and postbiotics. Prebiotics, such as inulin and fructooligosaccharides (FOS), preferentially increase the growth of beneficial bacteria, increasing SCFA synthesis and strengthening the gut barrier. Probiotics, on the other hand, bring helpful bacteria strains into the gut, whereas synbiotics mix prebiotics with probiotics to achieve synergistic results. Postbiotics, or metabolites created by probiotics, provide another option for intervention in metabolic syndrome. Recent research has presented persuasive evidence for gut microbiota supplementation's therapeutic potential in the management of metabolic syndrome. Supplementation with probiotics, prebiotics, or a combination of the two has been demonstrated to improve key metabolic indicators while also changing the gut microbial makeup. These findings demonstrate the potential of addressing the gut microbiome as a key role in metabolic homeostasis. However, while the findings are encouraging, more research is needed to understand the underlying biological mechanisms and long-term consequences of gut microbiota supplements. Personalized therapy techniques, taking into account individual differences in gut microbiota composition and metabolic phenotype, are critical for improving therapeutic outcomes. Collaboration across disciplines is critical for increasing our understanding and integrating results into clinical practice, ushering in a new era of precision medicine in metabolic health therapy. Despite positive results, difficulties remain, including the need for standardized methodology and large-scale trials to overcome inconsistent findings and fully realize the medicinal potential of microbiome supplements.

## GUT MICROBIOME

The gut microbiome, comprising a diverse community of bacteria residing in the intestines, has emerged as a crucial player in the development and progression of metabolic disorders such as type 2 diabetes mellitus (T2DM), CVD, and obesity[1]. The gut microbiota, which contains billions of microorganisms, regulates a variety of physiological functions such as metabolism, inflammation, and immunological response. Understanding these intricate relationships has led to new paths for therapeutic approaches, with microbiome supplementation appearing as a promising option[2]. The gut microbiome is extremely sensitive to dietary composition, with research indicating that changing diets, such as animal-based *vs* plant-based diets can drastically alter the gut microbiota's composition and function. This, in turn, can alter the formation of metabolites that affect host physiology, such as SCFAs, bile acids, and other bioactive substances[3]. Certain metabolites produced by the gut microbiota, such as butyrate and propionate, have been proven in studies to protect against metabolic disorders such as type 2 diabetes and CVD. These metabolites promote colon health, increase insulin sensitivity, and regulate lipid metabolism. However, other metabolites, such as trimethylamine, can cause atherosclerosis,

thrombosis, and CVD, emphasizing the intricate interplay between the gut microbiota and metabolic health[4]. To modify the gut microbiome and promote metabolic health, researchers are investigating the use of prebiotics, probiotics, synbiotics, and postbiotics. Prebiotics such as inulin, lactulose, and FOS preferentially enhance the development of beneficial bacteria such as Bifidobacterium and Lactobacillus, resulting in the synthesis of SCFAs and increased gut barrier integrity[5]. Despite advancements in conventional treatments and lifestyle modifications, the prevalence of metabolic syndrome continues to rise, underscoring the urgent need for innovative therapeutic strategies. Recent research has shed light on the pivotal role of the gut microbiota in metabolic health, offering new avenues for intervention[6]. A compelling study published in the *World Journal of Diabetes* presents evidence for the therapeutic potential of gut microbiota supplementation in managing metabolic syndrome[7]. The supplementation with probiotics, prebiotics, or their combination led to significant improvements in key metabolic parameters, including glucose metabolism, lipid profile, and blood pressure. Moreover, analyses of gut microbiome composition revealed favorable changes following supplementation, characterized by an increase in beneficial microbial species and a reduction in pathogenic taxa. These findings have profound implications for the treatment of metabolic syndrome. Targeting the gut microbiome, a central player in metabolic equilibrium, through supplementation approaches offers a novel strategy to address the underlying mechanisms of metabolic dysfunction[8]. The observed enhancements in metabolic markers underscore the therapeutic potential of modulating gut microbiota composition in managing metabolic syndrome. Importantly, the safety and tolerability profile of gut microbiota supplementation suggests its potential as an adjunct or complementary therapy to existing interventions[9]. While the results of this study are promising, further research is warranted to elucidate the molecular mechanisms underlying gut microbiota supplementation in metabolic syndrome. Future investigations should explore the long-term effects of supplementation and potential synergies between probiotics and prebiotics. Additionally, personalized treatment approaches, considering individual variations in gut microbiome composition and metabolic phenotype, are essential for optimizing therapeutic outcomes. Collaborative efforts across diverse disciplines, including microbiology, endocrinology, and nutrition, are crucial for advancing our understanding of the gut microbiome-metabolic axis and translating these findings into clinical practice. Moving forward, continued research is essential to refine supplementation protocols, deepen our mechanistic understanding, and ultimately enhance outcomes for individuals with metabolic syndrome. This heralds a new era of precision medicine, where harnessing the power of the gut microbiota holds promise for personalized and effective metabolic health therapies. Furthermore, innovative therapies targeting gut microbiome-host interactions are being explored to attenuate the progression of T2DM and CVD. While microbiome supplementation has encouraging results, more study is needed to prove its clinical usefulness. Studies have occasionally produced contradictory or misleading results, emphasizing the need for more comprehensive and standardized methodologies to studying the gut microbiota. Furthermore, research on the benefits of certain strains of probiotics is limited, emphasizing the significance of strain-specific study[10].

## CONCLUSION

The rapidly expanding field of study into the gut microbiome's impact in metabolic health has revealed new pathways for therapeutic intervention and personalized treatment options. Researchers discovered intriguing opportunities for modifying the microbiome to optimize metabolic health after meticulously investigating the intricate links between food composition, gut microbiota composition and activity, and metabolic outcomes. The therapeutic potential of gut microbiota supplementation, which includes prebiotics, probiotics, synbiotics, and postbiotics, has been demonstrated by compelling evidence of changes in key metabolic parameters and beneficial modifications in gut microbial composition. These findings highlight the gut microbiome's critical involvement in metabolic homeostasis and its potential as a therapeutic target in metabolic syndrome and related illnesses. While the possibilities appear intriguing, more research is needed to understand the underlying mechanisms, optimize supplementation procedures, and assure long-term efficacy and safety. Addressing issues such as methodology standardization, investigating strain-specific effects, and incorporating personalized treatment techniques will be critical for progressing the discipline and converting research findings into clinical practice.

## FOOTNOTES

**Author contributions:** Qureshi W spearheaded the research and analysis, delving into the intricate relationship between metabolic syndrome and the gut microbiome, while also exploring emerging therapies; Dar MA and Rather MY provided invaluable insights from diverse perspectives, enriching the discourse with their expertise in biotechnology, microbiology, endocrinology, and therapeutic interventions. Together, our collaborative efforts synthesized complex scientific findings into a cohesive narrative, shedding light on the potential of gut microbiome supplementation as a novel therapeutic avenue for metabolic syndrome.

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**Country of origin:** India

**ORCID number:** Waseem Qureshi 0000-0002-0063-6557; Mohd Younis Rather 0000-0001-8928-6479.

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