ACADEMIC SCIENCE PRESS

INTERNATIONAL JOURNAL OF MODERN MEDICINE AND NATURAL SCIENCES
ISSN: 3143-6153

Modern Approaches to Metabolic Syndrome

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ARTICLE INFO

Keywords:
metabolic syndrome,
insulin resistance,
abdominal obesity,
GLP-1 receptor agonists,
SGLT2 inhibitors,
cardiometabolic risk,
individualized therapy.

Vol. 01, **No**. 04, 2026

https://doi.org/10.5281/zenodo.23063114

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ABSTRACT

Metabolic syndrome is a multifactorial pathological condition characterized by abdominal obesity, insulin resistance, arterial hypertension, and disorders of lipid metabolism. The aim of this article is to analyze modern approaches used in the diagnosis and treatment of metabolic syndrome. The study reviewed international scientific sources, clinical trials, and meta-analyses published in recent years. The findings demonstrated that modern pharmacological agents such as Semaglutide, Tirzepatide, and Empagliflozin, as well as individualized lifestyle modification strategies, are effective in improving metabolic parameters. Contemporary approaches are expanding the possibilities for the comprehensive and individualized management of metabolic syndrome.

Introduction

Metabolic syndrome is one of the most pressing issues in modern medicine and public health, characterized by the coexistence of abdominal obesity, insulin resistance, arterial hypertension, dyslipidemia, and disorders of carbohydrate metabolism. The clinical significance of this syndrome is determined by its substantial contribution to the increased risk of developing Type 2 Diabetes, Atherosclerosis, chronic kidney disease, and metabolic dysfunction-associated liver diseases.

According to the World Health Organization and other international epidemiological observations, the growing prevalence of obesity and metabolic disorders has made metabolic syndrome one of the most widespread pathological conditions worldwide. In particular, sedentary lifestyle, high-calorie nutrition, chronic stress, and disruption of sleep rhythm are considered the major modifiable risk factors contributing to disease development.

An increase in visceral adipose tissue, chronic low-grade inflammation, oxidative stress, and impaired insulin signaling play key roles in the pathogenesis of metabolic syndrome. Recent scientific studies indicate that metabolic syndrome should no longer be regarded solely as an endocrine disorder, but rather as a cardiometabolic condition involving multiple organ systems.

Currently, alongside lifestyle modification, modern pharmacological agents such as Semaglutide, Tirzepatide, and Empagliflozin, as well as gut microbiota-targeted therapies and individualized diagnostic approaches, are being extensively investigated in the management of metabolic syndrome.

The aim of this study is to analyze contemporary scientific approaches used in the diagnosis and treatment of metabolic syndrome and to evaluate their clinical effectiveness.

Materials and Methods.

In this study, a scientific literature review was conducted to evaluate modern approaches to the diagnosis and treatment of metabolic syndrome. The research materials included clinical studies, systematic reviews, and meta-analyses published between 2020 and 2026 in international scientific databases, including PubMed, Scopus, and Web of Science.

During the literature selection process, keywords such as “metabolic syndrome,” “insulin resistance,” “GLP-1 receptor agonists,” “SGLT2 inhibitors,” and “cardiometabolic risk” were used. The selected scientific sources were analyzed using analytical, comparative, and systematic approaches. Throughout the study, metabolic parameters, the effectiveness of pharmacotherapy, and their impact on cardiometabolic risk factors were evaluated.

Results.

In 2021, multicenter clinical studies conducted in the United States and Europe investigated the effects of Semaglutide on the components of metabolic syndrome. In the STEP clinical program, patients receiving semaglutide demonstrated an average body weight reduction of 10–15% after 68 weeks of treatment, along with significant improvements in fasting glucose, arterial blood pressure, and triglyceride levels. Additionally, a mean reduction of 4–5 mmHg in systolic blood pressure was reported.

In 2022, the impact of Tirzepatide on metabolic syndrome was evaluated within the framework of the international SURPASS program. During a 40–52-week follow-up period, a significant decrease was observed in the proportion of patients meeting the diagnostic criteria for metabolic syndrome. In certain groups, the prevalence of metabolic syndrome declined from an initial 83–88% to 51–60%. Furthermore, marked clinical improvements were noted in insulin sensitivity, body weight, and waist circumference.

In 2023, the international SELECT trial investigated the cardiovascular effects of semaglutide in more than 17,000 patients. The findings demonstrated that in patients with overweight and metabolic abnormalities, the risk of cardiovascular complications, including myocardial infarction and stroke, decreased by approximately 20%. These results indicated that GLP-1 receptor agonists provide not only weight reduction but also cardioprotective effects in the management of metabolic syndrome.

Meta-analyses conducted between 2023 and 2024 compared semaglutide with other GLP-1 receptor agonists. An analysis involving 3,760 patients revealed that semaglutide reduced HbA1c levels by an average of 0.44% and body weight by 2.5 kg more than other agents, demonstrating its superiority in metabolic control.

In 2024, the STEP-HFpEF trial involving patients with heart failure and obesity showed that individuals treated with semaglutide experienced improved functional status, increased physical activity, and an approximate 13% reduction in body weight. These findings further emphasized the importance of managing metabolic syndrome as a multisystem cardiometabolic condition.

In recent years, particularly during 2024–2026, studies involving artificial intelligence, genetic markers, and gut microbiota have expanded considerably in order to improve early detection and individualized treatment of metabolic syndrome. These approaches are expected to provide an important foundation for personalized therapy in the future.

Conclusion.

According to the analysis of scientific literature, modern approaches to the diagnosis and treatment of metabolic syndrome are developing significantly. Current studies demonstrate the necessity of considering this syndrome as a multisystem cardiometabolic condition. In the future, individualized diagnostics and personalized therapy based on artificial intelligence, genomics, and biomarkers are expected to play an important role in the early detection of metabolic syndrome and in reducing its complications.

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