Commentary

iMedPub Journals
www.imedpub.com

British Biomedical Bulletin
ISSN 2347-5447

2025
Vol.13 No.1: 84

Emerging Biomarkers in Cardiometabolic Disorders: Bridging Mechanisms and Clinical Translation

Sarah Thopon*

Department of Biomedical Sciences, University of Oxford, Oxford, United Kingdom

Corresponding author: Sarah Thopon, Department of Biomedical Sciences, University of Oxford, Oxford, United Kingdom, E-mail: sarah.thopon@oac.uk

Received date: January 02, 2025, Manuscript No. ipbbb-25-20754; **Editor assigned date:** January 04, 2025, PreQC No. ipbbb-25-20754 (PQ); **Reviewed date:** January 18, 2025, QC No. ipbbb-25-20754; **Revised date:** January 24, 2025, Manuscript No. ipbbb-25-20754 (R); **Published date:** January 31, 2025, DOI: 10.36648/2347-5447.13.1.84

Citation: Thopon S (2025) Emerging Biomarkers in Cardiometabolic Disorders: Bridging Mechanisms and Clinical Translation. Br Biomed Bull Vol.13 No.1: 84.

Introduction

Cardiometabolic disorders, encompassing conditions such as obesity, type 2 diabetes mellitus, hypertension, dyslipidemia, and cardiovascular disease, represent one of the leading causes of morbidity and mortality worldwide. These disorders share overlapping pathophysiological mechanisms including insulin resistance, chronic inflammation, endothelial dysfunction, and altered lipid metabolism. Traditionally, clinical risk assessment has relied on conventional biomarkers such as fasting glucose, HbA1c, LDL cholesterol, and blood pressure. While invaluable, these markers often fail to capture early pathophysiological changes or predict disease trajectories with precision. Recent advances in molecular biology, high-throughput omics technologies, and systems biology approaches have facilitated the identification of emerging biomarkers that offer deeper mechanistic insights and hold promise for improving risk stratification, early diagnosis, and therapeutic monitoring. Bridging the gap between mechanistic understanding and clinical translation is now at the forefront of cardiometabolic research [1].

Description

One major category of emerging biomarkers includes inflammatory and immune mediators that reflect the chronic low-grade inflammation characteristic of cardiometabolic disorders. Circulating high-sensitivity C-reactive protein has long been recognized as a predictor of cardiovascular events, but newer markers such as interleukin-6, tumor necrosis factor-alpha, and monocyte chemoattractant protein-1 provide a more nuanced understanding of inflammatory pathways driving metabolic dysfunction. Adipokines, secreted by adipose tissue, are also gaining attention as integrative biomarkers. For instance, adiponectin exhibits anti-inflammatory and insulin-sensitizing properties, whereas leptin and resistin are linked to obesity-induced metabolic and vascular complications. Similarly, novel biomarkers such as omentin, visfatin, and chemerin are under investigation for their roles in linking adipose tissue biology to systemic cardiometabolic risk [2].

Another promising area of biomarker discovery involves endothelial and vascular function. Endothelial dysfunction is a hallmark of cardiometabolic diseases and precedes overt clinical manifestations. Circulating biomarkers such as asymmetric dimethylarginine, a competitive inhibitor of nitric oxide synthase, reflect impaired nitric oxide bioavailability and correlate with vascular dysfunction. Endothelial microparticles and circulating endothelial progenitor cells also serve as indicators of vascular injury and repair capacity. In addition, novel insights into the role of extracellular vesicles and exosomes in transporting proteins, lipids, and nucleic acids have revealed their potential as both biomarkers and mediators of cardiometabolic pathology. By providing real-time information on vascular health, these markers may allow clinicians to intervene earlier in disease progression, improving outcomes through precision medicine strategies [3].

Metabolic and lipidomic biomarkers represent another critical dimension in cardiometabolic research. Beyond traditional lipid profiles, advances in metabolomics have identified novel metabolites such as branched-chain amino acids, acylcarnitines, and ceramides as predictors of insulin resistance, diabetes onset, and cardiovascular risk. Elevated plasma ceramides, in particular, are associated with lipotoxicity, inflammation, and atherosclerosis progression, making them attractive candidates for clinical risk assessment. Additionally, gut microbiota-derived metabolites such as trimethylamine-N-oxide have emerged as biomarkers linking diet, microbial ecology, and cardiovascular risk. These discoveries emphasize the interconnectedness of metabolic pathways, microbial-host interactions, and cardiometabolic health, offering opportunities for more integrated diagnostic and therapeutic approaches. In recent years, genetic and epigenetic biomarkers have also gained momentum as tools for cardiometabolic disease prediction. Genome-wide association studies have identified multiple loci associated with obesity, T2DM, and CVD, including variants in genes such as FTO, TCF7L2, and PCSK9 The integration of genetic and epigenetic biomarkers into clinical practice could allow personalized risk prediction and therapeutic tailoring, though challenges remain in standardization and validation [4,5].

Conclusion

The landscape of biomarkers in cardiometabolic disorders is rapidly evolving, moving beyond conventional clinical measures toward multidimensional molecular signatures that capture the complexity of disease mechanisms. Emerging biomarkers encompassing inflammatory mediators, endothelial dysfunction markers, metabolites, lipids, and genetic/epigenetic regulators are not only enhancing mechanistic understanding but also paving the way for precision medicine in cardiometabolic health. Translating these discoveries into clinical practice requires rigorous validation, large-scale cohort studies, and integration with digital health technologies. Ultimately, the convergence of omics science, biomarker discovery, and clinical translation promises to transform the prevention, diagnosis, and management of cardiometabolic disorders, enabling earlier interventions, improved risk stratification, and more effective therapeutic strategies. By bridging mechanisms and clinical application, emerging biomarkers hold the potential to reduce the global burden of cardiometabolic disease and improve long-term health outcomes.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Larsson JMH, Karlsson H, Crespo JG, Johansson ME, Eklund L, et al. (2011). Altered O-glycosylation profile of MUC2 mucin occurs in active ulcerative colitis and is associated with increased inflammation. Inflamm Bowel Dis 17: 2299-2307.

2. Jian H, Liu Y, Wang X, Dong X, Zou X. (2023). Akkermansia muciniphila as a next-generation probiotic in modulating human metabolic homeostasis and disease progression: A role mediated by gut–liver–brain axes?. Int J Mol Sci 24: 3900.

3. Higarza, SG, Arboleya S, Arias JL, Gueimonde M, Arias N. (2021). Akkermansia muciniphila and environmental enrichment reverse cognitive impairment associated with high-fat high-cholesterol consumption in rats. Gut Microbes 13: 1880240.

4. Blüher, M. (2019). Obesity: Global epidemiology and pathogenesis. Nat Rev Endocrinol 15: 288-298.

5. Le Chatelier E, Nielsen T, Qin J, Prifti E, Hildebrand F, et al. (2013). Richness of human gut microbiome correlates with metabolic markers. Nature 500: 541-546.