



LETTER TO THE EDITOR

Digital technologies in the management of metabolic syndrome: a physiopathological and translational perspective

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Metabolic syndrome (MetS) is a chronic health issue, affecting millions of people worldwide (Zahedani et al. 2023). It is characterized by insulin resistance, central obesity, dyslipidaemia, and hypertension. Beyond its association with type 2 diabetes mellitus (T2DM) and other metabolic disorders, MetS is closely linked to cardiovascular diseases (CVDs), including heart failure, coronary artery disease, and stroke, which are major contributors to global morbidity and mortality (Alharbi et al. 2024). Modern lifestyles, particularly increased fast food intake and sedentary behavior, further accelerate the prevalence of MetS (Choubey et al. 2024). Managing MetS requires monitoring multiple indicators such as waist circumference (WC), blood pressure (BP), lipid levels, fasting blood sugar (FBS), and patient history. However, comprehensive evaluations are often difficult due to physicians' time constraints, particularly in densely populated or resource-poor settings (Liu et al. 2025). These difficulties have fueled interest in digital health interventions as innovative strategies for the prevention and management of MetS and its associated CVD risks (Theodore Armand et al. 2024).

Digital healthcare uses information and communication technologies to enhance healthcare delivery, improve outcomes, and promote patient self-management. Evidence increasingly shows that it is effective in controlling MetS-related risk factors, including diabetes and obesity (Alharbi et al. 2024, Lee et al. 2024). Tools such as wearable devices, telemedicine, mobile apps, and artificial intelligence (AI) provide prompt feedback, educational materials, individualized counselling, diet and activity tracking, and real-time monitoring. These features help patients make informed decisions and pursue health goals (Lee et al. 2024). By integrating wearable data with lifestyle metrics, healthcare professionals can have a thorough grasp of a patient's lifestyle and provide better customized health recommendations (Cahyaningrum & Tanggono 2025). Telemonitoring allows remote assessment of

health metrics, optimizing medication management and follow-up care. Web-based platforms further empower patients through providing social support, education, virtual coaching, and personalized guidance, promoting patient motivation and engagement. With ongoing advances in AI and improved user-friendly designs, these tools increasingly help individuals integrate lifestyle changes, such as improved diets, into their daily routines and maintain these changes over time (Cahyaningrum & Tanggono 2025, Hillary et al. 2024).

Although digital tools are increasingly used in healthcare, their true impact on individuals with MetS is still under investigation. Recent studies, however, point to promising clinical benefits. For example, a meta-analysis showed that lifestyle interventions delivered via digital platforms significantly reduced body weight, body mass index (BMI), and WC compared to usual care (Choubey et al. 2024). Another study found reductions in WC and BP among participants with one or two MetS risk factors, while those with three risk factors achieved improvements in weight, BMI and FBS in addition to WC and BP. Continuous glucose monitoring further enhanced glycemic control (Borges et al. 2024). Additionally, a scoping review found that chatbot-based interventions improved user engagement by providing empathetic responses, enhancing social presence, and increasing trust. Speech-based and augmented reality-enabled chatbots achieved even greater user participation and engagement than text-only interactions (Chew 2022).

In conclusion, digital health interventions are cost-effective, scalable, and effective in promoting weight loss and improving other MetS-related risk factors. They support goal-setting, progress tracking, and adherence to therapy, while promoting accessibility and user engagement. However, barriers remain, particularly regarding data privacy, security, regulation, and user compliance. Trust in data protection and adequate training for healthcare professionals are essential for effective integration. Despite these challenges, digital health interventions hold strong promise in reducing the global burden of MetS.

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