Review Article

Comprehensive Management of Metabolic Syndrome in Older Adults: Clinical and Preventive Implications

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Abstract

Metabolic syndrome in older adults represents a complex and multifactorial condition driven by age-related physiological changes that amplify metabolic vulnerability. Progressive decline in insulin sensitivity, sarcopenia, increased visceral adiposity, mitochondrial dysfunction, and chronic low-grade inflammation converge to disrupt glucose and lipid homeostasis. These alterations promote endothelial dysfunction, arterial stiffness, and a pro-thrombotic state, thereby increasing cardiovascular risk. Hormonal and neuroendocrine changes, including alterations in sex hormones and the renin–angiotensin–aldosterone system, further exacerbate cardiometabolic imbalance. Diagnosis in the geriatric population presents unique challenges. Conventional criteria, such as those proposed by ATP III, the International Diabetes Federation, and harmonized definitions, may be limited in the

presence of sarcopenic obesity and age-related metabolic shifts. Waist circumference may underestimate visceral adiposity, and lipid and glycemic parameters require contextual interpretation. Comprehensive geriatric assessment, including evaluation of functional capacity, frailty, cognition, nutritional status, comorbidities, and polypharmacy, is essential for accurate risk stratification and individualized management. Metabolic syndrome in older adults is strongly associated with cardiovascular disease, heart failure, cerebrovascular events, type 2 diabetes, chronic kidney disease, cognitive decline, and functional impairment. Management therefore requires a multidimensional approach combining Mediterranean or DASH dietary patterns, optimized protein intake, structured aerobic and resistance exercise, and carefully individualized pharmacological therapy. Preventive strategies, integrated care models, and shared decision-making are critical to balancing longevity with functional preservation. Emerging precision medicine approaches, including biomarker identification and microbiome modulation, offer promising avenues for future individualized interventions.

Key words

Insulin resistance, Sarcopenia, Inflammaging, Endothelial dysfunction, Frailty, Polypharmacy.

Introduction

Metabolic syndrome is characterized by a constellation of interrelated metabolic abnormalities in which insulin resistance constitutes a central pathophysiological mechanism. This disturbance is accompanied by chronic inflammation and oxidative stress, both of which contribute to endothelial dysfunction and the development of atherosclerosis, thereby increasing cardiovascular disease risk [1, 2]. In this context, the interaction between impaired insulin signaling and vascular injury establishes a pathophysiological continuum that links metabolic dysregulation with adverse cardiovascular outcomes. Within this framework, adipose tissue dysfunction plays a critical role in the pathogenesis of metabolic syndrome. In particular, insulin resistance at the level of adipose tissue disrupts normal glucose metabolism and alters adipokine secretion, further exacerbating systemic metabolic dysfunction [3]. This alteration not only amplifies inflammatory signaling but also reinforces metabolic instability across organ systems. The CARDIAL-MS model underscores this interconnectedness by highlighting the crosstalk between different organs and emphasizing the contribution of ectopic fat deposition and dysregulated adipokine signaling to the progression of metabolic syndrome–related diseases [4].

The clinical expression of metabolic syndrome becomes increasingly complex in older adults, in whom multimorbidity is common. Conditions such as obesity, diabetes, and cardiovascular disease frequently coexist, complicating both diagnosis and therapeutic decision-making due to overlapping manifestations and the frequent presence of frailty. Frailty, in turn, is associated with increased mortality risk and modifies the severity and progression of metabolic syndrome–related conditions, thereby further complicating management [5].

Moreover, the presentation of metabolic syndrome in this population is heterogeneous and influenced by factors such as sex, reproductive status, and comorbidities including nonalcoholic fatty liver disease, which require personalized treatment strategies [6]. Consequently, preventive and therapeutic approaches must be adapted to this complexity. Lifestyle interventions, including weight management, dietary improvement, and increased physical activity, remain foundational in reducing cardiovascular risk and addressing the underlying metabolic disturbances [1, 6]. Pharmacological therapies directed at individual components of the syndrome, such as antihypertensive agents,

statins, and glucose-lowering medications, are effective in mitigating risk factors; however, in older adults, careful consideration of drug interactions and potential adverse effects is essential [7]. Finally, early screening and monitoring of insulin resistance through indices such as the estimated glucose disposal rate facilitate the identification of individuals at higher cardiovascular risk and support the implementation of targeted preventive strategies [8].

The objective of this article is to provide a comprehensive and integrative analysis of metabolic syndrome in older adults by examining its underlying pathophysiological mechanisms, clinical complexity, and preventive strategies.

Methodology

This manuscript was developed as a structured narrative review aimed at providing an updated and clinically integrated analysis of metabolic syndrome in older adults, with emphasis on its pathophysiological mechanisms, clinical complexity, and preventive strategies. Conducted in accordance with the SANRA framework, the review prioritized interpretative synthesis and clinical applicability over quantitative aggregation of data. Particular attention was given to insulin resistance, adipose tissue dysfunction, chronic inflammation, oxidative stress, and endothelial impairment, as well as to the interaction between metabolic abnormalities and age-related conditions such as frailty, multimorbidity, and polypharmacy. The analysis also addressed diagnostic challenges in geriatric populations, heterogeneity of clinical presentation, cardiovascular and systemic implications, and individualized preventive and therapeutic approaches across different healthcare settings.

A comprehensive search of PubMed, Scopus, and Web of Science was conducted to identify peer-reviewed articles published in English or Spanish between January 2020 and December 2025, reflecting recent advances in cardiometabolic research and geriatric medicine. Foundational studies were incorporated when essential for conceptual context. The search strategy combined MeSH terms and free-text keywords related to metabolic syndrome, insulin resistance, aging, frailty, cardiovascular risk, inflammation, adipose tissue dysfunction, and preventive strategies. Of 172 records identified, 108 underwent full-text review and 48 were included in the final synthesis. Study selection was performed independently by two authors, with discrepancies resolved by consensus. Exclusion criteria comprised non–peer-reviewed publications, case reports, studies exclusively involving younger adult populations, redundant datasets, and articles lacking direct relevance to older adults or clinical outcomes.

Eligible sources included randomized clinical trials, large observational cohorts, meta-analyses, and international clinical guidelines. Methodological quality was assessed narratively according to study design, risk of bias, duration of follow-up, consistency in outcome definitions, and external validity, with greater weight assigned to multicenter studies and those incorporating standardized cardiometabolic and functional outcome measures. Consideration was given to long-term cardiovascular outcomes, mortality, and functional decline. Artificial intelligence tools were used solely to assist in literature organization and structural coherence, whereas critical appraisal and final interpretation were conducted independently by the authors. Given its narrative design, this review may be subject to selection bias and does not provide pooled quantitative estimates.

Pathophysiological Mechanisms in the Older Adult

Aging is accompanied by a progressive decline in insulin sensitivity, a hallmark of metabolic syndrome that becomes increasingly pronounced over time. This age-related reduction in insulin responsiveness is multifactorial and has been attributed to genetic predispositions, increased adiposity, and lifestyle factors such as physical

inactivity and suboptimal dietary patterns [9, 10]. As insulin resistance intensifies, glucose homeostasis becomes progressively impaired, setting the stage for further metabolic deterioration. Concurrently, sarcopenia, defined as the age-associated loss of skeletal muscle mass, contributes significantly to this process. Because skeletal muscle represents the primary site of insulin-mediated glucose uptake, its progressive decline reduces glucose disposal capacity and promotes elevated circulating glucose levels [11, 12]. In parallel, aging is associated with increased hepatic glucose production and impaired pancreatic beta-cell function, both of which further disrupt glycemic regulation and favor the development of type 2 diabetes [13]. Mitochondrial dysfunction also plays a central role in this metabolic cascade. Alterations in mitochondrial oxidative capacity impair fatty acid and protein metabolism, leading to lipotoxicity and thereby exacerbating insulin resistance [14].

Beyond glucose metabolism, aging is characterized by a redistribution of adipose tissue, with a relative increase in visceral fat accumulation. This metabolically active adipose depot contributes directly to insulin resistance and systemic inflammation. At the same time, an imbalance in adipokine secretion, including alterations in leptin and adiponectin levels, further promotes inflammatory signaling and metabolic dysfunction. Chronic low-grade inflammation, often described as "inflammaging," is driven by elevated pro-inflammatory cytokines and represents a defining feature of the aging process that contributes to the development and progression of metabolic syndrome [3, 12]. Oxidative stress, which is prevalent in older adults, compounds this inflammatory milieu by inducing endothelial injury and promoting vascular dysfunction [8].

These metabolic and inflammatory alterations converge on the vasculature, where aging is associated with structural and functional changes collectively referred to as vascular aging. Increased arterial stiffness and elevated pulse wave velocity contribute to the development of hypertension and heightened cardiovascular risk. Simultaneously, reduced nitric oxide bioavailability impairs vasodilatory capacity and further aggravates endothelial dysfunction (Xing et al., 2025). As a result, the aging vasculature becomes predisposed to a pro-thrombotic and pro-atherogenic state, thereby increasing the likelihood of cardiovascular events [8].

In addition to these metabolic and vascular mechanisms, hormonal and neuroendocrine changes play a significant role in the pathogenesis of metabolic syndrome in older adults. The decline in sex hormones, including estrogen and testosterone, alters metabolic regulation and contributes to the development of cardiometabolic abnormalities. Furthermore, dysregulation of the hypothalamic–pituitary–adrenal axis affects stress responses and metabolic balance, reinforcing systemic dysfunction. Age-related alterations in the renin–angiotensin–aldosterone system further contribute to hypertension and fluid imbalance, thereby exacerbating the components of metabolic syndrome [13].

Diagnostic Approach in the Geriatric Population

The diagnostic criteria for metabolic syndrome, including those proposed by the National Cholesterol Education Program Adult Treatment Panel III, the International Diabetes Federation, and the harmonized definition, differ in their relative emphasis on central obesity and the weighting of additional metabolic components. Notably, the International Diabetes Federation requires central obesity as a mandatory criterion, an approach that may not be fully appropriate in older adults, particularly in the presence of sarcopenic obesity, where the loss of muscle mass complicates the clinical assessment of adiposity [15, 16].

Waist circumference, commonly used as a surrogate marker of visceral fat, presents

important limitations in geriatric populations. In individuals with sarcopenic obesity, waist measurements may fail to accurately reflect true visceral adiposity, thereby contributing to potential underdiagnosis of metabolic syndrome [15, 17]. Given that muscle mass decline is highly prevalent in older adults, this limitation becomes particularly relevant and underscores the need for a more nuanced interpretation of body composition indicators. Similarly, age-related alterations in lipid metabolism and insulin sensitivity affect the interpretation of lipid and glycemic parameters. Older adults may exhibit modified lipid profiles and changes in glucose tolerance that complicate the application of standard diagnostic thresholds [18].

Beyond biochemical and anthropometric criteria, integration of a comprehensive geriatric assessment is essential. Evaluation of functional capacity through activities of daily living and instrumental activities of daily living is particularly important, as metabolic syndrome may contribute to physical disability and progressive loss of independence. In parallel, screening for frailty and sarcopenia is crucial, given their association with increased risk of metabolic syndrome and its complications. Sarcopenic obesity has been linked to higher morbidity and mortality, reinforcing the need for systematic assessment [15, 19].

Cognitive decline and depression, which are common in older adults, can further influence the management and prognosis of metabolic syndrome. Their identification through structured evaluation is therefore a fundamental component of comprehensive care. Nutritional assessment is equally important, as unintended weight loss and malnutrition may coexist with metabolic abnormalities and require targeted intervention. Additionally, older adults frequently present with multiple comorbidities and polypharmacy, both of which complicate therapeutic decision-making. A thorough review of existing conditions and medication burden is therefore necessary to optimize management strategies [19].

Risk stratification in older adults with metabolic syndrome also presents unique challenges. Traditional cardiovascular risk calculators may not fully capture the complexity of this population, given the high prevalence of multimorbidity and altered risk profiles and may therefore require adjustment to improve validity. Estimation of life expectancy is another critical element, as the anticipated benefit of preventive or therapeutic interventions may vary according to projected survival. Furthermore, in multimorbid patients, competing risks from other chronic conditions may significantly influence prognosis and therapeutic priorities. For this reason, a comprehensive approach that accounts for these competing risks is essential in guiding individualized management of metabolic syndrome in older adults [5].

Metabolic Syndrome in Older Adults

Metabolic syndrome is strongly associated with the development of cardiovascular complications, primarily through the promotion of atherosclerotic cardiovascular disease. The coexistence of dyslipidemia and hypertension fosters endothelial dysfunction and sustains a pro-inflammatory state, thereby facilitating plaque formation within arterial walls and accelerating atherogenesis [1, 20].

In addition to atherosclerosis, metabolic syndrome contributes to the development of heart failure, both with preserved and reduced ejection fraction. The chronic inflammatory milieu and oxidative stress that characterize the syndrome promote myocardial damage, structural remodeling, and progressive ventricular dysfunction [20, 21]. These mechanisms underscore how sustained metabolic and inflammatory stress can compromise cardiac performance over time. Similarly, the risk of cerebrovascular disease is elevated in individuals with metabolic syndrome. Hypertension, insulin resistance, and dyslipidemia collectively impair

cerebral circulation, thereby increasing susceptibility to cerebrovascular events such as stroke [21, 22].

Beyond cardiovascular sequelae, metabolic syndrome is closely linked to adverse metabolic and renal outcomes. The presence of insulin resistance and impaired glucose metabolism significantly increases the likelihood of progression to type 2 diabetes mellitus [21, 23]. At the same time, components of the syndrome, particularly hypertension and visceral adiposity, contribute to microvascular injury within the kidneys. Through mechanisms involving inflammation and oxidative stress, these alterations promote the development and progression of chronic kidney disease [24].

The impact of metabolic syndrome also extends to neurocognitive health. An increased risk of mild cognitive impairment and dementia has been observed among affected individuals, with the cardiovascular–kidney–metabolic syndrome stage associated with a higher incidence of dementia. This relationship highlights the interconnected nature of metabolic and vascular dysfunction in influencing brain health. Insulin resistance, a core feature of the syndrome, plays a central role in neurodegenerative processes by activating inflammatory and oxidative pathways that exacerbate cognitive decline [25]. Musculoskeletal and functional consequences further compound the clinical burden of metabolic syndrome in older adults. Sarcopenic obesity, defined by the coexistence of reduced muscle mass and excess adiposity, is particularly prevalent in this population and is associated with increased risks of cardiovascular disease, diabetes, and physical disability. The combination of obesity and muscle weakness leads to reduced mobility and heightened fall risk, thereby contributing to progressive functional impairment and loss of independence [15].

Therapeutic Strategies; Individualized and Multidimensional Care

Nutritional interventions constitute a central component in the management of metabolic syndrome in older adults, particularly through the adoption of structured dietary patterns with demonstrated cardiometabolic benefits. The Mediterranean diet has shown high effectiveness in improving lipid profiles, reducing systemic inflammation, and controlling blood pressure, thereby representing a beneficial approach for addressing the multiple components of metabolic syndrome in this population [26]. Similarly, the Dietary Approaches to Stop Hypertension diet, especially when combined with caloric restriction, has demonstrated improvements in cardiometabolic biomarkers, including cholesterol and insulin levels, in older adults [27]. Anti-inflammatory dietary patterns, which frequently overlap with Mediterranean and Dietary Approaches to Stop Hypertension principles, further contribute to the reduction of inflammation associated with metabolic syndrome [28]. Within this context, sodium restriction, a key feature of the Dietary Approaches to Stop Hypertension diet, plays a critical role in blood pressure control, which remains a fundamental target in metabolic syndrome management [27].

Although caloric restriction has been associated with delayed frailty progression and improved cardiometabolic health, its implementation in older adults requires careful balance to avoid malnutrition and unintended nutrient deficiencies [29]. Nutritional strategies must therefore ensure adequate intake of essential macro- and micronutrients. In particular, optimization of protein intake is essential to prevent or mitigate sarcopenia, a frequent and clinically significant condition in this age group. Higher protein consumption has been associated with a lower risk of metabolic syndrome and abdominal obesity, underscoring the importance of both protein quantity and quality in dietary planning [30, 31].

In parallel with dietary interventions, physical activity prescription represents a fundamental

therapeutic pillar. Regular aerobic exercise contributes to improved cardiometabolic health, reduction in waist circumference, and enhanced insulin sensitivity in older adults with metabolic syndrome [17]. Resistance training is particularly important to counteract age-related muscle loss, as it helps preserve muscle mass and strength, both of which are essential for maintaining mobility and overall functional capacity [32]. Additionally, balance and flexibility programs are necessary to reduce fall risk, a common concern in older adults, and should be tailored according to the individual's level of frailty. Exercise prescriptions must therefore be individualized to ensure both safety and effectiveness, taking into account functional reserve and comorbid conditions [17].

Pharmacological management complements lifestyle interventions and requires careful individualization. Blood pressure targets should be personalized based on the older adult's overall health status and risk profile. Glucose-lowering therapies that provide cardiovascular benefits should be prioritized to achieve glycemic control while minimizing the risk of hypoglycemia. Similarly, lipid-lowering therapy must be considered in light of potential benefits and risks, particularly in advanced age. The indication for antiplatelet therapy also demands careful evaluation to balance cardiovascular protection against the increased risk of bleeding in this population [17].

Given the high prevalence of multimorbidity in older adults, polypharmacy represents a significant challenge. Regular medication review is essential to identify and discontinue potentially inappropriate medications that may contribute to adverse effects or drug–drug interactions. Ongoing monitoring for pharmacological interactions is particularly important in individuals receiving multiple therapies. Furthermore, simplification of therapeutic regimens can enhance adherence, reduce medication errors, and ultimately improve the overall management of metabolic syndrome in older adults [17].

Preventive Strategies Across the Continuum of Aging

Primary prevention of metabolic syndrome in older adults relies fundamentally on early identification of individuals at risk and timely implementation of targeted interventions. Early detection of asymptomatic or pre-metabolic states can substantially reduce the incidence of cardiovascular disease and premature mortality by creating a window of opportunity for preventive action [33]. In this context, emerging biomarkers such as serum uric acid and clinical indicators including non-alcoholic fatty liver disease have been proposed as markers of pre-metabolic syndrome status, facilitating earlier risk stratification and intervention before the full clinical expression of the syndrome develops [34].

Community-based lifestyle programs represent a central strategy within primary prevention. Lifestyle behaviors, particularly physical activity, exert a significant influence on metabolic risk. Structured programs that promote regular exercise and healthy lifestyle habits have demonstrated effectiveness in reducing metabolic syndrome prevalence. For example, the IGOBE program reported a significant reduction in metabolic syndrome prevalence through intensive lifestyle interventions [35]. Moreover, regular exercise has been shown to improve biochemical and inflammatory profiles in older adults with metabolic syndrome, reinforcing the role of sustained physical activity as a preventive measure [36]. Preventive efforts are further supported by regular health screenings and vaccination strategies, which contribute to early identification and management of cardiometabolic risk factors [7].

Secondary and tertiary prevention focus on mitigating established risk factors and preventing disease progression and complications. Targeted management of individual components of

metabolic syndrome, including hypertension and dyslipidemia, has been shown to reduce cardiovascular risk, particularly when pharmacological therapies are combined with sustained lifestyle modifications. In older adults, glycemic targets should be individualized according to functional status, ensuring effective diabetes management while accounting for overall health condition and functional capacity [7]. Preventing disability and institutionalization constitutes an additional priority. Lifestyle interventions such as regular physical activity and adherence to a Mediterranean dietary pattern have been associated with improved health outcomes and reduced risk of disability, thereby supporting functional preservation in aging populations [26, 36].

From a broader perspective, public health and healthcare system strategies play a critical role in addressing metabolic syndrome in older adults. Integrated care models designed for chronic disease management, involving multidisciplinary teams that include specialists in geriatrics, cardiology, endocrinology, nutrition, and rehabilitation, are essential to ensure comprehensive and coordinated care. Multidisciplinary collaboration enables the development of individualized care plans that address the complex and interrelated needs of older patients. In addition, telehealth and remote monitoring technologies offer promising avenues to enhance continuity of care, facilitate regular monitoring, and enable timely interventions, ultimately improving access to healthcare services and clinical outcomes in older populations with metabolic syndrome [7].

Ethical, Prognostic, and Quality-of-Life Considerations

Shared decision-making represents a fundamental component in the care of older adults with multiple chronic conditions, as it enables the integration of patient preferences and values into clinical decision-making. In complex patients, this approach facilitates alignment between treatment plans and individual goals, and has been associated with improved patient satisfaction and clinical outcomes [37]. Nevertheless, involvement in treatment escalation planning often remains challenging, with clinicians frequently dominating decision processes. Despite this imbalance, active patient participation is essential to ensure that care strategies genuinely reflect personal values and priorities [38]. The incorporation of structured tools, such as mobility assessments and quality-of-life evaluations, can enhance prognostication and support meaningful discussions regarding goals of care by providing reliable, objective information to guide shared decision-making [39].

In older adults, therapeutic choices must also reconcile the tension between longevity and functional preservation. Many individuals prioritize maintenance of quality of life and independence over extension of survival alone, which necessitates a broader evaluative framework that includes cognitive performance, mental health, and overall well-being [40]. Frailty plays a pivotal role in determining this balance. Older adults with metabolic syndrome who are frail face increased risks of mortality and diminished quality of life, underscoring the importance of individualized management strategies that account for functional vulnerability [5, 41]. Conversely, the absence of metabolic syndrome components, such as hypertension, has been associated with successful aging, reinforcing the relevance of controlling cardiometabolic risk factors to preserve functional capacity and quality of life [42].

Individualization of therapeutic intensity should therefore be grounded in realistic appraisal of lifetime benefit, existing comorbidities, and estimated life expectancy. Tailoring treatment strategies in this manner ensures that interventions are consistent with patient goals and compatible with the broader context of their health status. Preventive therapies, including statins and related pharmacological agents,

require careful evaluation in the presence of frailty and polypharmacy, as these conditions may alter therapeutic efficacy and increase susceptibility to adverse effects [43]. Early identification of frailty and the application of interdisciplinary assessment tools support more accurate risk stratification and enable the design of targeted, goal-concordant interventions, thereby ensuring that care remains both effective and aligned with individual preferences [5, 39].

Emerging Perspectives and Future Directions

Precision medicine in aging populations is grounded in the principle of tailoring healthcare according to individual variability in genetic background, environmental exposures, and lifestyle factors. This approach is particularly relevant for the management of metabolic syndrome, a condition shaped by complex interactions between inherited susceptibility and environmental influences. By integrating multi-omics platforms, including genomics, proteomics, and metabolomics, clinicians and researchers can achieve a more comprehensive understanding of the molecular pathways underlying metabolic dysfunction. Such integration facilitates the identification of individualized therapeutic targets and supports the development of personalized treatment strategies adapted to the biological profile of older adults [44].

Within this framework, biomarkers assume a central role in early detection and risk prediction. Longitudinal investigations have identified specific circulating proteins capable of predicting the incidence of cardiometabolic diseases, thereby offering potential targets for early intervention and preventive strategies [12]. Circulatory metabolic biomarkers, including insulin and inflammatory adipokines, have also demonstrated significant associations with metabolic syndrome risk in older adults, reinforcing their potential utility as diagnostic and prognostic tools in geriatric populations [45].

The gut microbiota has emerged as another critical determinant of metabolic health. Dysbiosis has been linked to oxidative stress, systemic inflammation, and epigenetic alterations that collectively contribute to the development and progression of metabolic syndrome [46]. In this context, modulation of the gut microbiome represents a promising avenue within precision medicine. Personalized probiotic supplementation tailored to individual microbiome composition has been proposed as a strategy to improve metabolic outcomes in older adults, suggesting a potential role for microbiota-based interventions in optimizing cardiometabolic health [47]. Furthermore, epigenetic mechanisms, including DNA methylation and histone modifications, are implicated in the pathogenesis of metabolic disorders and can be influenced by metabolites derived from gut microbial activity, thereby offering additional therapeutic targets [46].

In parallel with these advances, novel cardiometabolic agents and anti-inflammatory strategies are being explored to address the underlying mechanisms of metabolic syndrome. Metformin, traditionally employed in the treatment of diabetes, is currently being investigated as a gerotherapeutic agent due to its capacity to modulate metabolic, immunological, and microbiome-mediated pathways that influence aging and metabolic regulation. Additionally, targeted anti-inflammatory approaches focusing on specific pathways implicated in metabolic syndrome, including those associated with gut microbiota interactions, are under investigation as potential strategies to reduce cardiovascular risk and improve long-term outcomes in older adults [48].

Conclusions

Metabolic syndrome in older adults arises from a complex interplay between age-related insulin resistance, sarcopenia, visceral adiposity, chronic low-grade inflammation, oxidative stress, vascular aging, and neuroendocrine dysregulation. These interconnected mechanisms

not only impair glucose and lipid homeostasis but also promote endothelial dysfunction and pro-atherogenic states, establishing a pathophysiological continuum that increases vulnerability to cardiovascular, renal, neurocognitive, and functional decline.

The diagnosis and risk stratification of metabolic syndrome in the geriatric population require adaptation beyond conventional criteria. Standard definitions may underestimate risk in the presence of sarcopenic obesity and age-related metabolic changes, underscoring the need for comprehensive geriatric assessment that integrates functional status, frailty, cognition, comorbidities, polypharmacy, and life expectancy to guide individualized management.

Effective management of metabolic syndrome in older adults demands a multidimensional and patient-centered approach that combines tailored nutritional strategies, structured physical activity, individualized pharmacological therapy, and preventive interventions across the aging continuum. Integrated care models, shared decision-making, and emerging precision medicine strategies further enhance the ability to align therapeutic intensity with patient goals, optimize quality of life, and reduce long-term cardiometabolic risk.

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