Dietary Management and Physical Activity for Glycemic Control and Cardiovascular Risk Reduction in Older Adults with Type 2 Diabetes: A Narrative Review

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Abstract

Type 2 diabetes in older adults presents challenges related to multimorbidity, frailty, sarcopenia, and hypoglycemia. To synthesize evidence on dietary management and physical activity for glycemic control, cardiovascular risk, and physical function in older adults with type 2 diabetes. This targeted narrative review integrates 40 journal publications with DOIs, encompassing national observational studies, clinical trials, meta-analyses, and clinical consensus statements. Trial evidence supports aerobic, resistance, and combined exercise for glycemic improvement. Dietary quality and structured nutrition therapy may improve glycemic and cardiometabolic markers. Indonesian observational findings are mixed and should not be interpreted causally. Functional outcomes are particularly relevant in older populations; improved risk markers do not necessarily establish fewer major cardiovascular events. Lifestyle interventions should be individualized, preserve nutritional adequacy and muscle function, and complement appropriate pharmacological and cardiovascular risk management.

Keywords: *Type 2 Diabetes, Older Adults, Dietary Management, Physical Activity, Glycemic Control.*

A. INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder involving insulin resistance and declining pancreatic beta-cell function. In older adults, treatment assessment cannot rely solely on glucose or HbA1c levels because loss of muscle mass, nutritional status, cognitive impairment, multimorbidity, and the ability to manage self-care all influence the benefits and risks of interventions.

The American Diabetes Association (ADA) 2026 Standards of Care emphasize a comprehensive assessment of functional status and overall health when setting glycemic targets (American Diabetes Association Professional Practice Committee, 2026). Dietary management and physical activity are foundational to T2DM care, but a uniform intervention may not be appropriate for every older adult. Excessive energy restriction may accelerate muscle loss, while exercise that does not account for balance impairment, neuropathy, or medications associated with hypoglycemia may create safety risks. Nutrition-therapy and hyperglycemia-management consensus statements emphasize individualized approaches that consider patient preferences and capabilities (Davies et al., 2022; Evert et al., 2019).

Studies in Indonesia have reported varying associations between dietary

adherence, diet quality, physical activity, and blood glucose levels. Some studies found significant associations (Dewi et al., 2026; Elya & Nurdin, 2024; Nurayati & Adriani, 2017; Permatasari et al., 2015; Ratu et al., 2024), whereas others did not (Briawan et al., 2021; Petrus et al., 2023). This heterogeneity makes it important to consider differences in study design and outcomes. Meanwhile, international meta-analyses and clinical trials indicate that exercise can improve HbA1c, although improvements in risk markers do not necessarily translate into fewer major cardiovascular events, as illustrated by the Look AHEAD trial (Church et al., 2010; Feng et al., 2025; Look AHEAD Research Group, 2013; Sigal et al., 2007; Umpierre et al., 2011; Zhan et al., 2026).

This narrative review critically synthesizes evidence on the relationship of dietary management and physical activity with glycemic control, cardiovascular risk factors and events, and physical function in older adults with T2DM. Particular attention is paid to differences between evidence specific to older adults and findings from general adult populations, as well as to safe and realistic implementation in Indonesian healthcare settings.

B. METHOD

This article uses a narrative review approach with thematic and critical synthesis, rather than a systematic review or a new meta-analysis. The initial corpus comprised 19 references from an earlier manuscript, followed by the addition of 21 relevant journal publications with DOIs, focusing on exercise trials, dietary interventions, physical function, and cardiovascular outcomes. The source literature included Indonesian studies and international publications used as contextual evidence or comparators. Additional publications and bibliographic information were identified through online searches in October 2026; the review does not claim to have searched all available databases comprehensively.

Search concepts included "type 2 diabetes," "older adults," "elderly," "dietary management," "nutrition therapy," "aerobic exercise," "resistance training," "HbA1c," "frailty," "sarcopenia," and "cardiovascular outcomes." Articles were selected according to their substantive relevance to the review question, with studies specifically involving older adults given greater interpretive weight than studies of general adult populations. Observational findings were treated as associations, while causal effects were discussed primarily on the basis of clinical trials and trial syntheses. Overlap between primary trials and meta-analyses was considered to avoid repeatedly counting the same findings as independent evidence. No PRISMA flow figures or formal risk-of-bias assessment are claimed.

C. RESULTS AND DISCUSSION

The 40 publications included Indonesian observational studies, exercise trials specifically involving older adults, meta-analyses of different exercise modalities, dietary trials, cardiovascular cohort studies, and clinical guidelines and consensus statements. Many Indonesian studies included adults across a broad age range and

therefore cannot be directly generalized to frail older adults. International studies provide more controlled evidence, although their populations are also often not restricted to people aged 60 years or older.

In Indonesian observational studies, associations between dietary adherence or physical activity and glucose or HbA1c were inconsistent. Elya and Nurdin (2024) found an association between dietary adherence and fasting glucose, but not across all behavioral indicators; Ratu et al. (2024) reported an association between activity and HbA1c, whereas Petrus et al. (2023) found no significant association in a small sample. Differences in exposure measurement, sample size, medication use, and cross-sectional design limit causal conclusions.

By contrast, intervention studies strengthen the evidence for structured exercise. Trials specifically involving older adults by Castaneda et al. (2002) and Dunstan et al. (2002) showed benefits of resistance training for glycemic control and muscle composition or strength. Meta-analyses in older populations also support resistance or combined exercise, although the optimal dose and superiority of one modality for every patient remain uncertain (Feng et al., 2025; Zhan et al., 2026). Nutrition therapy and Mediterranean-style dietary studies suggest improvements in glycemic indicators and some risk factors, but many dietary studies included general adult populations rather than older adults specifically (Esposito et al., 2009; Salas-Salvadó et al., 2019; Schwingshackl et al., 2018; Zheng et al., 2024).

Cardiovascular outcomes highlight an important distinction between risk factors and clinical events. In the Look AHEAD trial, intensive lifestyle intervention did not significantly reduce the composite of major cardiovascular events, despite improving several metabolic parameters (Look AHEAD Research Group, 2013). Subsequent analyses, however, reported benefits for mobility and aspects of physical function (Gregg et al., 2018; Houston et al., 2018). Therefore, neutral findings for cardiovascular events do not eliminate other potential benefits of lifestyle modification.

Table 1 summarizes selected publications that most directly address the objectives of this review. Other publications support the interpretation in the Discussion and the clinical recommendations.

Table 1. Summary of Selected Publications Addressing Dietary Management and Physical Activity in Older Adults with Type 2 Diabetes

Study	Design / Population	Relevant Findings and Interpretive Limitations
Elya & Nurdin (2024)	Cross-sectional; Indonesia	Dietary adherence was associated with glucose levels; association does not establish causality.
Ratu et al. (2024)	Observational; T2DM	Physical activity was associated with HbA1c; not all dietary indicators were

		significant.
Mahmudiono et al. (2021)	Cross-sectional; ages 55–90	Self-efficacy was associated with activity duration; this was not an intervention trial.
Zhan et al. (2026)	Network meta-analysis; older adults	Structured exercise benefited HbA1c; rankings of exercise modalities are not definitive.
Feng et al. (2025)	Meta-analysis; older adults	Resistance exercise supported improvements in HbA1c and muscle strength.
Zheng et al. (2024)	Diet meta-analysis; adults	The Mediterranean diet improved some markers; applicability specifically to older adults is limited.
Look AHEAD Research Group (2013)	RCT; adults with T2DM	No significant reduction in MACE was demonstrated, although other metabolic benefits remained.
Sigal et al. (2007)	RCT; adults with T2DM	Aerobic and resistance training were beneficial; combined training may provide greater benefits.
Castaneda et al. (2002)	RCT; older adults with T2DM	Resistance training improved glycemic control.
Dunstan et al. (2002)	Controlled trial; ages 60–80	Resistance training combined with weight management supported HbA1c and lean-mass outcomes.
Houston et al. (2018)	Look AHEAD analysis	Physical function remains an important clinical outcome in addition to cardiovascular events.
Gregg et al. (2018)	Look AHEAD analysis	Assessed disability-free life expectancy; this is not equivalent to evidence of reduced MACE.

The findings indicate that management of T2DM in older adults should begin with an understanding of physiological changes associated with aging. Declines in muscle mass and strength can worsen insulin resistance and reduce activity, while multimorbidity and polypharmacy increase vulnerability to hypoglycemia and treatment-related adverse effects. Accordingly, successful lifestyle intervention should not be judged solely by how low HbA1c can be reduced, but also by whether

function, nutritional status, safety, and quality of life are preserved (American Diabetes Association Professional Practice Committee, 2026; Cruz-Jentoft et al., 2019; Davies et al., 2022).

The inconsistent findings of Indonesian dietary studies do not necessarily represent a fundamental contradiction. Adherence to meal timing, overall dietary quality, glycemic index or load, and intake of particular food groups are distinct constructs. Elya and Nurdin (2024) reported an association between adherence and blood glucose; Briawan et al. (2021) found no association with an overall diet-quality score; and Permatasari et al. (2015) observed associations between carbohydrate-related indicators, meal timing, and HbA1c. Differences in parameters and assessment periods make these results difficult to compare directly. Fasting glucose may be affected by short-term conditions, whereas HbA1c reflects glycemic exposure over several months.

Intervention evidence supports selecting dietary patterns according to composition quality, energy needs, and sustainability. Meta-analyses by Zheng et al. (2024) and Schwingshackl et al. (2018) indicate that several dietary approaches can improve glycemic control, although the magnitude of benefit depends on the comparator diet and participant characteristics. Esposito et al. (2009) evaluated a Mediterranean-style diet and the need for antihyperglycemic medication in newly diagnosed T2DM, but their population was not specifically representative of frail older adults. Principles such as consuming vegetables, legumes, unsaturated-fat sources, and fiber-rich carbohydrates can be adapted to local foods without reproducing a traditional Mediterranean menu in full (Evert et al., 2019; Salas-Salvadó et al., 2019).

In older adults, calorie restriction must be balanced against the risk of muscle loss. Villareal et al. (2017) studied older adults with obesity and demonstrated the importance of combining diet with exercise to preserve function during weight loss, although the study did not specifically involve people with T2DM. The sarcopenia consensus identifies muscle strength as a core assessment component (Cruz-Jentoft et al., 2019). Older adults with T2DM who have frailty, low body weight, swallowing difficulties, poor appetite, or risk of malnutrition therefore require a different approach from older adults with obesity and preserved function. For the former group, maintaining adequate energy and protein intake may be more important than pursuing aggressive weight loss (American Diabetes Association Professional Practice Committee, 2026; Evert et al., 2019).

Physical activity has a strong biological basis for increasing muscle glucose uptake, improving insulin sensitivity, and maintaining functional capacity. Early evidence from Boulé et al. (2001) and Thomas et al. (2006), followed by the meta-analysis by Umpierre et al. (2011), showed that structured exercise can reduce HbA1c even when weight loss is modest. Randomized trials by Sigal et al. (2007) and Church et al. (2010) support benefits from both aerobic and resistance training and suggest potential advantages of combining them. Much of this evidence comes from adults generally, so application to older adults should account for baseline fitness, mobility,

and comorbidities.

Resistance training deserves particular attention in older adults because muscle tissue is central to glucose metabolism and functional independence. Studies by Castaneda et al. (2002) and Dunstan et al. (2002) provide direct evidence that progressive resistance training can improve glycemic control in older adults with T2DM. Tessier et al. (2000) also evaluated aerobic exercise in older patients, while Ishiguro et al. (2016) assessed resistance-training protocols in a synthesis of T2DM studies. Recent meta-analyses in older populations reinforce these benefits, although average estimates do not necessarily predict the magnitude of change in an individual patient (Feng et al., 2025; Zhan et al., 2026).

Combined exercise may offer simultaneous benefits for aerobic capacity, muscle strength, and the ability to perform daily activities. However, the "best exercise" should not be determined solely by rankings from a network meta-analysis; indirect comparisons and variation in exercise dose limit certainty about the superiority of any one modality (Zhan et al., 2026). Older adults who are inactive should begin at a safe intensity and progress gradually. Accessible daily activities, such as walking and standing after prolonged sitting, may provide a starting point, although the study by Dunstan et al. (2012) on interrupting sitting assessed acute glucose responses in adults and did not demonstrate reductions in clinical events. Exercise recommendations should be adapted to musculoskeletal limitations, balance, neuropathy, and fall risk (Colberg et al., 2016).

Successful behavior change depends on more than the type of diet or exercise. Mahmudiono et al. (2021) found an association between self-efficacy and activity duration among older adults in Surabaya, while the meta-analysis by Alliston et al. (2024) indicated that self-management programs may support glycemic control. Repeated education, realistic shared goals, family support, and self-care monitoring may improve consistency. In Indonesian primary care, programs using locally available foods and activities that require no specialized facilities may be more acceptable, but their long-term effectiveness requires pragmatic studies with comparison groups.

An important question raised by this review is whether improved diet and physical activity actually reduce cardiovascular risk. Blood pressure, lipid levels, HbA1c, and body weight should be distinguished from clinical events such as myocardial infarction, stroke, cardiovascular death, and hospitalization. Meta-analyses of Mediterranean dietary patterns and the PREDIMED-Plus trial have reported improvements in several risk factors, but PREDIMED-Plus did not specifically recruit older adults with T2DM (Salas-Salvadó et al., 2019; Zheng et al., 2024). PREDIMED assessed primary prevention in a high-risk population and should not be treated as direct evidence for every older patient with T2DM (Estruch et al., 2018).

The Look AHEAD findings should be interpreted proportionately: although intensive diet and physical activity intervention improved several metabolic indicators, a significant reduction in major cardiovascular events was not

demonstrated for the trial's primary outcome (Look AHEAD Research Group, 2013). In contrast, cohort studies of a Mediterranean lifestyle have reported favorable associations with cardiovascular outcomes, but residual confounding cannot be excluded (Aznar de la Riera et al., 2026). Differences in design and population explain why these findings should be considered together without concluding either that lifestyle interventions certainly prevent cardiovascular disease or that they provide no benefit.

In addition to cardiovascular events, mobility and the ability to maintain independence are clinically important outcomes for older adults. Further analyses from Look AHEAD reported findings related to mobility, physical function, and disability-free life expectancy (Gregg et al., 2018; Houston et al., 2018). These outcomes broaden assessment of intervention benefits beyond HbA1c. For older adults with T2DM, reasonable goals therefore include safe glycemic control, prevention of hypoglycemia, preservation of muscle strength and mobility, and management of blood pressure and lipids according to each patient's clinical condition (American Diabetes Association Professional Practice Committee, 2026; Davies et al., 2022).

In clinical practice, dietary and physical-activity plans should take current medications into account. Insulin and sulfonylureas may cause hypoglycemia if eating patterns or exercise intensity change without appropriate monitoring. Assessment is also needed for patients with symptomatic heart disease, retinopathy that limits certain forms of exercise, neuropathy, or balance problems. Nutrition counseling should consider dental health, food access, reduced appetite, kidney function, and protein requirements. Lifestyle therapy remains complementary to, rather than an automatic substitute for, indicated pharmacological treatment (American Diabetes Association Professional Practice Committee, 2026; Colberg et al., 2016; Davies et al., 2022; Evert et al., 2019).

This review has several limitations. Targeted searching does not guarantee that all relevant evidence was identified; the included articles cover both general adult and older populations, observational and interventional designs, and secondary reviews that may overlap in their primary studies. Publication selection was not accompanied by formal risk-of-bias assessment or grading of certainty. Indonesian studies often use single-time-point measurements of diet and activity and rarely assess frailty, hypoglycemia, changes in muscle function, or cardiovascular events. Future research should include controlled trials in older adults, realistic dietary and exercise protocols, safety monitoring, assessment of concomitant therapies, and long-term follow-up.

D. CONCLUSION

Dietary management and physical activity are important components of care for older adults with T2DM. Experimental evidence supports aerobic, resistance, and combined exercise for glycemic control; resistance training also has particular relevance for maintaining muscle strength and functional capacity. High-quality,

individualized dietary planning may support HbA1c and some cardiometabolic risk factors, with special attention to adequate energy and protein intake. However, improvements in HbA1c, blood pressure, or lipid profiles cannot be equated directly with evidence of fewer major cardiovascular events. Interventions should be adapted to frailty, comorbidities, hypoglycemia risk, preferences, and physical capabilities, and integrated with medical treatment.

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