

REVIEW ARTICLE

**HOLISTIC MANAGEMENT OF CHRONIC KIDNEY DISEASE:
THE ROLE OF MEDICAL NUTRITION THERAPY AND
LIFESTYLE INTERVENTIONS – A NARRATIVE REVIEW**

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Abstract:

Background:

Chronic Kidney Disease (CKD) is a progressive condition affecting nearly 10% of the global population and is strongly associated with diabetes, hypertension, obesity, and cardiovascular morbidity. Traditional management emphasizes pharmacological therapy and renal replacement strategies, but growing evidence highlights the complementary role of Medical Nutrition Therapy (MNT) and lifestyle interventions in slowing disease progression and improving quality of life.

Methods:

This narrative review was conducted following the Narrative Review Checklist. Studies published between 2015 and 2025 were identified through PubMed and Scopus using MeSH terms related to CKD, medical nutrition therapy, diet therapy, lifestyle, and exercise. Eligible studies included original research and case reports involving human subjects, published in English. Animal studies, reviews, conference abstracts, and editorials were excluded. Data extracted included study design, population, intervention, duration, and key outcomes.

Results:

Evidence from randomized controlled trials and cohort studies demonstrates that MNT significantly improves renal and metabolic outcomes. Protein-restricted diets, particularly when supplemented with ketoanalogues, delay progression and reduce dialysis initiation. Individualized nutrition education and structured renal diets improve eGFR, blood pressure, and metabolic markers. Plant-forward dietary approaches such as the Mediterranean and New Nordic Renal diets reduce proteinuria, phosphorus excretion, and cardiovascular risk factors. Sodium restriction supported by behavioral counselling or web-based coaching improves adherence and blood pressure control, though long-term sustainability remains a

challenge. Digital health interventions, including mobile applications and mHealth campaigns, enhance dietary adherence, reduce interdialytic weight gain, and improve quality of life. Exercise interventions consistently enhance fitness and functional capacity, with modest renal benefits, highlighting their value as adjunctive therapy.

Discussion:

Collectively, the evidence affirms MNT as a cornerstone of holistic CKD management, with stronger and more consistent effects on renal and cardiovascular outcomes than lifestyle interventions alone. While exercise, smoking cessation, and weight control remain valuable adjuncts, the integration of structured dietary therapy with behavioral support and digital health platforms offers the greatest promise for long-term benefit.

Conclusion:

MNT is a highly effective and essential strategy for managing CKD, outperforming isolated lifestyle measures in terms of renal, cardiovascular, and metabolic outcomes. Its incorporation into routine care—supported by patient education, counseling, and technology-driven tools—can delay disease progression, reduce complications, and improve quality of life. Future research should focus on long-term adherence strategies and cost-effective, scalable models of nutrition-centered CKD care.

Keywords: Chronic Kidney Disease (CKD), Medical Nutrition, Holistic Management.

Introduction:

Chronic kidney disease (CKD) is a progressive clinical syndrome marked by a persistent reduction in kidney function, typically defined by a decreased glomerular filtration rate (GFR) or evidence of kidney damage for more than three months. It represents a growing global health burden, affecting approximately 9–13% of the world's population, with significant variation across regions due to differences in healthcare systems, socioeconomic status, and lifestyle factors (1,2). The disease trajectory often leads to end-stage renal disease (ESRD), requiring dialysis or transplantation, and is strongly associated with increased cardiovascular morbidity and premature mortality (3).

CKD does not occur in isolation; it is intricately linked with metabolic disorders such as diabetes mellitus, hypertension, and obesity, all of which act as both causes and consequences of renal impairment (4). The bidirectional relationship between CKD and these comorbidities complicates management and underscores the necessity of a comprehensive, multidisciplinary approach rather than a purely pharmacological or renal replacement therapy-driven model (5).

Traditionally, CKD management has emphasized medical therapy, blood pressure control, and slowing disease progression using renin–angiotensin–aldosterone system (RAAS) inhibitors and other pharmacological agents. While these remain indispensable, there is growing recognition that medical nutrition therapy (MNT) and lifestyle interventions are equally vital in addressing both renal outcomes and overall health (6,7). Nutritional management in CKD encompasses several strategies, including

individualized protein regulation, sodium and phosphorus restriction, maintenance of optimal caloric intake, and correction of vitamin and mineral imbalances. Evidence indicates that appropriate dietary modifications can reduce uremic toxin production, improve metabolic balance, and delay the need for dialysis (8,9).

Beyond diet, lifestyle interventions play a complementary role. Regular physical activity has been shown to enhance cardiorespiratory fitness, improve muscle mass, and reduce fatigue in CKD patients, thereby contributing to better quality of life (10). Smoking cessation, stress management, and maintaining a healthy body weight further reduce the risk of cardiovascular complications, which remain the leading cause of death in CKD (11,12). Importantly, exercise and lifestyle modification also contribute to psychological well-being, helping patients cope with the chronic nature of the disease (13). Recent guidelines and expert consensus increasingly advocate for an integrative, patient-centered model of care that combines pharmacological treatment with nutrition and lifestyle strategies (14). Such an approach not only targets renal outcomes but also addresses the systemic metabolic disturbances that drive disease progression. By adopting a holistic management framework, clinicians can optimize clinical outcomes, slow CKD progression, and enhance patients' functional capacity and quality of life. This narrative review will explore current evidence on the role of medical nutrition therapy and lifestyle interventions in the holistic management of chronic kidney disease, highlighting mechanisms, benefits, and future directions for research and clinical practice.

Methodology

This narrative review was conducted following the Narrative review checklist guidelines to ensure transparent and comprehensive reporting of the search, screening, and selection process. The review synthesizes evidence from original research articles and case reports on CKD, published over the past 15 years [2010 to 2025]. The scientific studies were included - Articles published in peer-reviewed journals indexed in PubMed or Scopus, Studies involving human subjects only, Original research articles and case reports, Studies with Medical Subject Headings [MeSH] Chronic Kidney Disease, renal Insufficiency, Chronic, Medical Nutrition Therapy, Diet Therapy, Nutritional Physiological Phenomena, Life Style, Exercise Therapy, Weight Reduction Programs, Cardiovascular Diseases / prevention & control, Quality of Life Articles published in English. The studies which were executed on Animal, Review articles, editorials, conference abstracts, and commentaries and not available in full text.

Data Extraction

From each included study, the following data were extracted: Study design, Number and participants, Type and duration of study, Key findings and conclusion.

Results:

Sr.	Title	Authors	Methodology	Conclusion
1	Ketoanalogue-Supplemented Vegetarian Very Low-Protein Diet and CKD Progression [15]	Garneata L <i>et al.</i> , 2016.	Nondiabetic CKD (eGFR<30) run-in on LPD then randomized to very-low-protein vegetarian diet (0.3 g/kg) + ketoanalogues vs continue LPD (0.6 g/kg) for 15 months; primary endpoint = RRT initiation or >50% eGFR drop.	sVLPD + ketoanalogues was associated with slower decline in renal function and delayed dialysis in selected, adherent patients (suggests benefit of tightly supervised protein-restriction + supplements).
2	Sodium Restriction in Patients With CKD: A Randomized Controlled Trial of Self-management Support [16]	Meuleman Y <i>et al.</i> , 2017.	CKD outpatients randomized to self-management support for sodium restriction (intervention) vs usual care; assessed urinary sodium and BP.	Self-management support reduced sodium intake and improved BP in the short term—shows sodium-focused behavioral support can be effective.
3	A Self-management Approach for Dietary Sodium Restriction in Patients With CKD: A Randomized Controlled Trial [[17]	Humalda JK <i>et al.</i> , 2020.	Multicentre RCT (n≈99) comparing web-based e-coaching + group meetings vs routine care for sodium reduction; 3-month intervention + 6-month maintenance; primary = sodium excretion.	e-coaching reduced sodium excretion at 3 months and transiently lowered SBP; effect attenuated during maintenance — digital self-management helps short-term adherence but sustaining change is challenging.
4	Diet therapy along with nutrition education can improve renal function in people with stages 3–4 CKD who do not have diabetes: a randomized controlled trial [18]	Hamidianshirazi M <i>et al.</i> , 2023.	120 patients (stages 3–4, non-diabetic) randomized: intensive individualized renal diet (0.75 g/kg/d, energy 30–35 kcal/kg, Na-restriction) + counselling vs routine care for 24 weeks; primary = change in eGFR.	The nutrition intervention group had a significant increase in eGFR, lower serum creatinine and improved BP compared with control — indicates individualized MNT + education can improve short-term kidney function markers and BP.
5	Health effects of the New Nordic Renal Diet in patients with stage 3–4 CKD, compared with habitual diet: A randomized trial [19]	Hansen NM <i>et al.</i> , 2023.	26-week randomized trial (N=60) comparing New Nordic Renal Diet (plant-forward, lower protein/phosphorus/sodium) with habitual diet; food deliveries + recipes, monthly visits, 24-h urine and labs.	NNRD reduced 24-h urine phosphorus, proteinuria, systolic BP and body weight (mainly abdominal fat) but no eGFR change over 26 weeks — supports whole-diet (plant-forward) approach for metabolic improvements and lower phosphorus burden.

6	Chronic Kidney Disease Awareness Campaign and Mobile Health Education to Improve Knowledge, Quality of Life, and Motivation for a Healthy Lifestyle: A Randomized Controlled Trial [20]	Sarker MHR <i>et al.</i> , 2022.	Community RCT (Bangladesh) comparing CKD awareness campaign + mHealth education vs standard care in CKD stages 1–3 over 6 months; outcomes included knowledge, QOL, motivation for lifestyle change.	The combined campaign + mHealth significantly improved CKD knowledge, quality of life and motivation for healthy lifestyle behaviors — educational/lifestyle support via mHealth is feasible and effective in low-resource settings.
7	Randomized controlled trial of exercise in CKD — the RENEXC study [21]	Hellberg M <i>et al.</i> , 2019.	12-month, home-based RCT (n≈151, CKD stages 3–5) randomizing to endurance + balance vs endurance + strength training; measured physical performance, mGFR and albuminuria.	Both programs improved physical performance; the strength group showed decreased albuminuria while measured GFR declined similarly in both groups — exercise (aerobic + resistance) improves function and may favorably affect some renal risk markers.
8	Comparing mHealth app use and face-to-face training on dietary & fluid adherence in haemodialysis patients: a randomized clinical trial (Di Care app) [22]	Torabikhah M <i>et al.</i> , 2023.	Single-blinded RCT in HD patients (n=70) randomized to Di Care mHealth app vs face-to-face education (same materials) for 1 month; outcomes: interdialytic weight gain (IDWG) and labs (K, P, TG, albumin, ferritin).	Both approaches improved adherence; mHealth produced larger reductions in IDWG and some lab markers (K, P, TG) than face-to-face — suggests mobile education/apps can effectively support dietary/fluid adherence in dialysis populations.
9	Adherence to the Mediterranean diet is associated with renal function among healthy adults: the ATTICA study [23]	Chrysohoou C <i>et al.</i> , 2010.	Cross-sectional analysis of the ATTICA cohort (n≈3,042 adults); assessed MedDietScore and serum urea/creatinine plus estimated creatinine clearance.	Greater adherence to a Mediterranean dietary pattern was independently associated with lower urea/creatinine and higher estimated creatinine clearance — supports protective association between Mediterranean-style diets and renal function.

10	The association between a Mediterranean-style diet and kidney function in the Northern Manhattan Study cohort [24]	Khatri M <i>et al.</i> , 2014.	Prospective cohort study in the Northern Manhattan Study; dietary score related to incidence of reduced eGFR and rapid eGFR decline.	Higher adherence to a Mediterranean-style diet was associated with lower incidence of CKD (eGFR <60) and less rapid kidney function decline — supports whole-diet approaches for kidney preservation.
11	Can renal nutrition education improve adherence to a low-protein diet in patients with stages 3–5 CKD? [25]	Paes-Barreto JG <i>et al.</i> , 2013.	RCT in CKD stages 3–5; standard counselling vs. intensive renal nutrition education for 4 months; outcomes: protein intake and adherence.	Intensive nutrition education led to greater reduction in protein intake and improved adherence — highlights value of structured MNT and education in CKD.
12	Protein Diet Restriction Slows Chronic Kidney Disease Progression in Non-Diabetic and in Type-1 Diabetic Patients, but Not in Type-2 Diabetic Patients: A Meta-Analysis of RCTs [26]	Rughooputh MS <i>et al.</i> , 2015.	Meta-analysis of RCTs on protein restriction vs. usual intake; subgroup analyses by diabetes type; outcomes: GFR change/decline.	Protein restriction slowed renal decline in non-diabetic and type-1 diabetic CKD patients, but not in type-2 diabetic patients — benefit appears patient-specific.
13	Effects of exercise in the whole spectrum of chronic kidney disease: a systematic review [27]	Barcellos FC <i>et al.</i> , 2015.	Systematic review of trials assessing exercise across CKD stages; outcomes: fitness, strength, QoL, inflammatory/nutritional markers, renal endpoints.	Aerobic exercise consistently improved fitness, strength and QoL (especially in dialysis patients); evidence for renal outcomes in early CKD limited — exercise is safe and beneficial for holistic CKD care.
14	Exercise training in CKD: efficacy, adherence and safety [28]	Howden EJ <i>et al.</i> , 2015.	Evaluation of supervised + home-based exercise program in CKD vs usual care; assessed fitness, adherence and safety.	Combined supervised/home-based exercise improved fitness, showed good adherence, and had few adverse events — supports exercise prescriptions as feasible in CKD care.

Evidence from recent randomized controlled trials strongly supports the beneficial role of Medical Nutrition Therapy (MNT) in the holistic management of chronic kidney disease. Dietary interventions aimed at optimizing protein intake, reducing sodium and phosphorus burden, and improving overall dietary quality have shown consistent improvements in renal and metabolic outcomes. Garneata *et al.* [15] demonstrated that a supervised vegetarian very-low-protein diet supplemented with ketoanalogues significantly delayed disease progression and reduced the need for renal replacement therapy, confirming that carefully monitored protein restriction can slow CKD progression. In alignment with this, Hamidianshirazi *et al.* [16] reported that individualized renal diets combined with intensive nutrition education in stage 3–4 CKD patients led to significant improvements in eGFR, serum creatinine, and blood pressure compared with routine care, highlighting the value of personalized nutrition counselling. Likewise, Hansen *et al.* [17] found that the New Nordic Renal Diet, a plant-based and nutrient-restricted approach, reduced proteinuria, phosphorus excretion, body weight, and systolic blood pressure, further emphasizing the metabolic and cardiovascular advantages of structured dietary modification.

Targeted MNT focusing on sodium restriction has also proven effective. Meuleman *et al.* [18] showed that self-management support led to lower sodium intake and improved blood pressure, while Humalda *et al.* [19] demonstrated that web-based e-coaching reduced urinary sodium excretion and systolic blood pressure during the intervention period. These findings reinforce that sodium-focused nutrition therapy, supported by behavioral strategies, can produce meaningful improvements in cardiovascular and renal risk profiles.

Technology-driven nutrition support has further expanded the reach of MNT. Torabikhah *et al.* [20] found that a mobile health application promoting dietary and fluid adherence in hemodialysis patients outperformed face-to-face education by reducing interdialytic weight gain and improving laboratory markers such as serum potassium, phosphorus, and triglycerides. Similarly, Sarker *et al.* [21] reported that mHealth education combined with community campaigns improved CKD knowledge, quality of life, and motivation for adopting healthy dietary habits.

Taken together, these trials confirm that MNT—delivered through individualized counselling, structured dietary modifications, behavioral self-management strategies, or technology-assisted platforms—offers clear benefits in CKD care. Improvements in renal function markers, blood pressure control, metabolic outcomes, and patient adherence strongly position MNT as a cornerstone of holistic CKD management.

Discussion:

The evidence synthesized in this review highlights the pivotal role of Medical Nutrition Therapy (MNT) as a cornerstone in the holistic management of chronic kidney disease (CKD). Several randomized controlled trials have demonstrated that targeted dietary interventions can effectively improve renal outcomes, slow disease progression, and reduce cardiovascular risk factors. Garneata *et al.* [29] provided compelling evidence that a vegetarian very-low-protein diet supplemented with ketoanalogues delayed the need for dialysis, suggesting that strict protein restriction, when carefully supervised, can positively influence CKD trajectory. Likewise, Hamidianshirazi *et al.* [30] demonstrated that individualized nutrition education coupled with a renal-specific diet significantly improved eGFR, blood pressure, and serum creatinine levels, underscoring the added value of patient-

centered counseling. Complementing these findings, Hansen *et al.* [31] reported that the New Nordic Renal Diet—a plant-based, nutrient-restricted approach—successfully reduced proteinuria, phosphorus burden, and blood pressure, supporting the notion that whole-diet modifications can optimize metabolic and cardiovascular outcomes in CKD patients.

Sodium restriction, another central element of MNT, has also been validated in controlled trials. Meuleman *et al.* [32] demonstrated that self-management counseling reduced sodium intake and improved blood pressure, while Humalda *et al.* [33] found that web-based e-coaching interventions achieved short-term reductions in sodium excretion and systolic blood pressure. Although the durability of these effects remains limited, these studies reinforce that behavioral strategies can significantly enhance dietary adherence, at least in the short term. Sustaining these benefits, however, requires innovative and continuous patient support mechanisms.

The integration of digital health platforms into MNT represents a promising advancement. Mobile health applications, such as those evaluated by Torabikhah *et al.* [35], not only improved dietary and fluid adherence in hemodialysis patients but also reduced interdialytic weight gain and improved laboratory markers including serum potassium and phosphorus. Similarly, Sarker *et al.* [34] showed that combining community campaigns with mHealth education enhanced CKD awareness, quality of life, and motivation for lifestyle change. These findings highlight the scalability and accessibility of technology-driven MNT approaches, particularly in resource-constrained settings.

Overall, the evidence strongly favors MNT as an integral component of CKD care, with benefits extending beyond renal function to include cardiovascular and psychosocial outcomes. Future research should focus on long-term adherence strategies, the cost-effectiveness of technology-based interventions, and the synergistic effects of combining dietary therapy with other lifestyle modifications such as structured exercise. A multidimensional approach that integrates personalized nutrition, digital health tools, and behavioral support holds promise for achieving sustainable improvements in CKD outcomes.

Conclusion:

The accumulated evidence from recent randomized controlled trials highlights Medical Nutrition Therapy (MNT) as a highly effective and essential strategy for the holistic management of chronic kidney disease. Compared with other interventions such as general lifestyle advice, stand-alone behavioral counseling, or exercise programs, MNT demonstrates more consistent and clinically meaningful benefits across renal, cardiovascular, and metabolic outcomes. Carefully structured dietary interventions—including protein restriction with ketoanalogue supplementation, individualized renal diets, and plant-forward dietary approaches—have been shown to slow CKD progression, reduce proteinuria, improve blood pressure, and optimize biochemical parameters. Sodium-reduction strategies supported by nutritional counseling and self-management interventions have further demonstrated significant improvements in cardiovascular risk profiles.

Technology-driven platforms, particularly mobile health applications, have strengthened the impact of MNT by enhancing adherence and extending its accessibility, leading to measurable improvements in laboratory indices, fluid balance, and patient quality of life. These results affirm that MNT not only addresses the physiological aspects of CKD but also empowers patients through education, self-management, and behavioral change. While lifestyle interventions such as physical

activity remain important adjuncts, the direct influence of MNT on renal function and metabolic stability positions it as more effective and indispensable in CKD care.

In conclusion, MNT should be regarded as the cornerstone of CKD management, offering superior benefits compared with isolated lifestyle interventions. Its integration into patient care pathways—supported by education, behavioral strategies, and digital health solutions—represents the most effective approach to improving outcomes, delaying disease progression, and enhancing the quality of life in individuals living with CKD.

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