International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

ARTICLE TITLE	BEYOND RENAL FUNCTION: SYSTEMIC AND FUNCTIONAL ASPECTS OF CKD IN THE ELDERLY
ARTICLE INFO	Marcin Lampart, Hanna Skarakhodava, Agnieszka Floriańczyk, Ewa Romanowicz, Aleksandra Kołdyj, Agnieszka Ozdarska, Adrian Krzysztof Biernat, Anna Rupińska, Katarzyna Kozon, Kamila Krzewska. (2025) Beyond Renal Function: Systemic and Functional Aspects of CKD in The Elderly. *International Journal of Innovative Technologies in Social Science*. 3(47). doi: 10.31435/ijitss.3(47).2025.3477
DOI	https://doi.org/10.31435/ijitss.3(47).2025.3477
RECEIVED	05 June 2025
ACCEPTED	16 July 2025
PUBLISHED	21 July 2025
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

BEYOND RENAL FUNCTION: SYSTEMIC AND FUNCTIONAL ASPECTS OF CKD IN THE ELDERLY

Marcin Lampart *(Corresponding Author, E-mail: marcinlampart1999@gmail.com)*
St. John Paul II Independent Public Western Specialist Hospital, ul. Daleka 11, 05-825 Grodzisk Mazowiecki, Poland
ORCID ID: 0009-0005-8485-850X

Hanna Skarakhodava
Centrum Zdrowia Mazowsza Zachodniego w Żyrardowie, ul. Limanowskiego 30 96-300 Żyrardów
ORCID ID: 0009-0001-8051-6837

Agnieszka Floriańczyk
Masovian Bródnowski Hospital, ul. Ludwika Kondratowicza 8, 03-242 Warsaw, Poland
ORCID ID: 0009-0003-5136-0380

Ewa Romanowicz
Independent Public Healthcare Institution in Wyszków, ul. Komisji Edukacji Narodowej 1, 07–200 Wyszków, Poland
ORCID ID: 0009-0004-6612-3174

Aleksandra Kołdyj
District Medical Centre in Grójec, ul. Piotra Skargi 10, 05-600 Grójec, Poland
ORCID ID: 0009-0002-5695-608X

Agnieszka Ozdarska
Independent Public Healthcare Institution in Wyszków, ul. Komisji Edukacji Narodowej 1, 07–200 Wyszków, Poland
ORCID ID: 0009-0008-7083-2140

Adrian Krzysztof Biernat
Specialist Provincial Hospital in Ciechanów, ul. Powstańców Wielkopolskich 2, 06-400 Ciechanów, Poland
ORCID ID: 0009-0007-6734-0447

Anna Rupińska
Independent Public Outpatient Healthcare Group – Warsaw-Ochota, ul. Szczęśliwicka 36, 02-353 Warsaw, Poland
ORCID ID: 0009-0001-8567-5925

Katarzyna Kozon
Masovian Bródnowski Hospital, ul. Ludwika Kondratowicza 8, 03-242 Warsaw, Poland
ORCID ID: 0009-0009-6536-946X

Kamila Krzewska
Primary Care Clinic "Zdrowa Rodzina", ul. Generała Tadeusza Pełczyńskiego 22J, 01-471 Warsaw, Poland
ORCID ID: 0009-0002-5672-3796

ABSTRACT

Chronic kidney disease is a significant contributor to increased morbidity, mortality and reduced quality of life, particularly in elderly individuals. As the greatest prevalence of CKD occurs in the oldest age group, the growing life expectancy and aging population suggest a continued rise in CKD incidence. The disease frequently coexists with other common conditions, such as hypertension, diabetes, heart failure complicating both diagnosis and treatment. Moreover, the cost of managing a dialysis-dependent population is substantial and is expected to rise.

The article aims to highlight the systemic nature of CKD, in which the progressive impairment of homeostatic function triggers a chronic inflammatory process. This leads to accelerated cellular aging, predominantly affecting blood vessels, heart, brain tissue, muscles and diminishing the remaining renal function.

The accumulation of uremic toxins, electrolyte imbalances and fluid overload impairs cognitive performance, reducing both functional capacity and adherence to medical treatment. Disruptions in phosphates-calcium metabolism contribute to mineral-bone disease. The loss of muscle and bone mass leads to reduced mobility and physical endurance, thereby increasing the risk of falls, injury, disability and death.

These factors are the main components of the Frailty Syndrome, for which CKD is a major underlying cause, a condition characterized by increased vulnerability to minor stressors and reduced ability to recovery and serious worsening of general health condition.

This review provides a comprehensive overview, pathophysiological mechanism, clinical manifestations, functional consequences and management strategies in elderly patients with CKD.

KEYWORDS

Chronic Kidney Disease, Contribute, Impact, Elderly, Quality of Life, Impairs

CITATION

Marcin Lampart, Hanna Skarakhodava, Agnieszka Floriańczyk, Ewa Romanowicz, Aleksandra Kołdyj, Agnieszka Ozdarska, Adrian Krzysztof Biernat, Anna Rupińska, Katarzyna Kozon, Kamila Krzewska. (2025) Beyond Renal Function: Systemic and Functional Aspects of CKD in The Elderly. *International Journal of Innovative Technologies in Social Science*. 3(47). doi: 10.31435/ijitss.3(47).2025.3477

Introduction.

According to KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease, CKD is defined by the presence of measurable kidney damage or by a decrease of estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73m^2, either of these criteria must be present at least for at least 3 months.[1] Kidney function often tends to deteriorate in the course of time and may require extrarenal treatment, such as dialysis or renal transplantation. There are 6 stages of CKD depending of estimated GFR: [1]

- G1: GFR ≥ 90 mL/min/1.73m^2 with evidence of prior kidney disease, like proteinuria or haematuria
- G2: GFR 60-89 mL/min/1.73m^2
- G3a: GFR 45-59mL/min/1.73m^2
- G3b: GFR 30-44 mL/min/1.73m^2
- G4: GFR 15-29 mL/min/1.73m^2
- G5: GFR ≤ 15 mL/min/1.73m^2 or undergoing dialysis treatment

There is also a staging system based on albumin-creatine ratio (ACR), measured in a first morning urine sample

A1: ACR < 30mg/g

A2: ACR 30-299mg/g

A3: ACR >300mg/g

Assessment of kidney function is essential to determine the treatment methods and can change the prognosis of the patient. Early diagnosis is crucial when the kidney condition may be on the earlier stage.

Materials and Methods:

This narrative review is based on publicly available articles in the PubMed database. The search of the sources was performed by typing key words for every section such as: chronic kidney disease, frailty syndrome, mineral and bone disease, vascular calcification, sarcopenia, anaemia, cognitive decline in CKD, stroke in CKD, electrolyte disorder, uremic toxins etc. The search included original research articles, reviews and meta-analyses, written in English between 2009 and 2025, available in full text.

Epidemiology of CKD

It is estimated that 13,4% of the global population has Chronic Kidney Disease in all stages and 10,6% in the stages 3-5. It has been shown that the prevalence of CKD increases with age. 27,6% of patients in their 60s and 34,3% in the 70s have CKD, 11,3% and 27,9% respectively in stages 3-5[2]. It means that aging is associated to deterioration of kidney function. Progressive loss of nephron cells occurs naturally with aging, independently of comorbid conditions [3]. From early adulthood to age of 75 years an individual is expected to lose up to half of his nephron cells and the loss of nephrons is correlated proportionally with GFR loss in the old age, however it does not mean that every elderly person must develop CKD.[4,5]

This factor alongside deterioration of renal blood flow, permanent oxidative stress and fibrosis impedes the autoregulatory mechanism of the kidney. These conditions endanger the elderly population with more frequent treatment complications caused by nephrotoxic drugs such as nonsteroidal anti-inflammatory drugs (NSAIDs), angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), several antimicrobial medication, contrast agents during medical imaging and others.

However some particular illnesses considerably accelerate the progression of CKD. It is estimated that up to half of CKD cases are caused by diabetes, primarily type 2. [4] Chronic hyperglycaemia promotes hyperfiltration in the glomeruli which eventually results in permanent kidney damage through glomerulosclerosis. In DM2 the damage is also potentiated by frequent coexistence of other conditions. [3,6]

The second most prominent cause is hypertension. When the high blood pressure exceed the autoregulatory ability of kidneys, it also causes glomerular hyperfiltration and also contribute to nephroarteriolar sclerosis [6].

Other important causes of CKD include obesity, cigarette consumption, family history, any previous renal conditions such as glomerulonephritis, cardiovascular disease, exposure to heavy metals and HIV infection [5]

Furthermore, since many of previously mentioned chronic conditions are highly prevalent in the elderly population and often persist for several years is it very common for older patients to suffer from 2, 3 or more illnesses, which dramatically increases of risk of developing CKD, [5] in particular when the diagnosis and the initiation of treatment are delayed.

The presence of any risk factors in earlier moments of life can contribute to CKD later.[6] Elderly patients are also more susceptible to more frequent incidents of acute kidney injury, like benign prostatic hyperplasia or congestive heart failure, their AKI incidents may contribute to greater risk of irreversible damage. [6]

CKD in the elderly population often is difficult to notice at its onset. The disease at the beginning tends to be silent with no specific or clear symptoms, which are sometimes misinterpreted by patients as a normal sign of aging or mistaken for manifestation of other coexistent diseases. As a result the diagnosis is frequently delayed when the kidney disease is already more advanced with limited treatment outcomes.

Frailty Syndrome

The most important problem with CKD in the elderly population is that it significantly contributes to the development of Frailty Syndrome. This condition means that the organism loses the physiological capacity for recovery and its resilience is severely reduced after any stressful event or infection to the point that even a minor injury can substantially exacerbate functional status of the individual and increase the mortality rate and may extend the duration of the hospitalization. [7]

Frailty Syndrome is observed frequently in CKD and in dialysis-dependent CKD the prevalence is estimated to occur several times more than in earlier stages. [7]The principal triggering factor is protein-energy wasting condition, a condition characterized by increased protein loss, accompanied by reduction of dietary protein intake. Chronic Kidney Disease promotes the activity of proinflammatory cytokines such as IL-6 and TNF-α as a result of elevated uraemia, insulin resistance, oxidative stress, metabolic acidosis and impaired blood flow. [7] The inflammations leads to skeletal muscle resistance to insulin and IGF-1, greater activity of glucocorticoids and consequently induce proteolysis via caspase-3 and ubiquitin-proteasome system [7]

Malfunction of Renin-Angiotensin-Aldosterone system (RAAS) is connected with increased insulin resistance, impaired muscle regeneration, enhanced proteolysis and proteinuria.[9,10] The prevalence of metabolic acidosis in the later stages of CKD further promotes intracellular protein loss through two mechanisms: activation of caspase-3 and ubiquitin-proteasome systems and inhibition of synthesis of new proteins via induction of insulin and growth hormone resistance.[6,7]

Moreover, CKD contributes to hormonal disturbances affecting muscle mass. Elevated level of glucocorticoids foments proteolysis.[11] Up to 60% of males with advanced CKD have reduced testosterone levels resulting in muscle atrophy. [11] Similarly female CKD patients may have decreased estrogen concentration, which weakens muscle strength. [11]. It is also believed that vitamin D deficiency may induce muscle atrophy, although the exact mechanism is still unknown.[11]

Consequently, the loss of muscle mass leads to reduced mobility, loss of independence and increased need for long-term care. Due to various contributing factors, food intake is often reduced. For example, the loss of appetite progresses with CKD, and during the End Stage Renal Disease up to one-third of patients suffer from anorexia. [7]

The frequent coexistence of cognitive impairment and depression in CKD may also be an important factor of reduced food intake. [7] It is speculated that the loss of appetite is associated with the dysregulation of appetite-related hormones like ghrelin and leptin.[11] Additionally, the taste perception is altered in patients with CKD due to stomatitis and xerostomia.[12] Patients commonly report unpleasant and non-specific upper gastrointestinal symptoms, including bloating, constipation, abdominal pain, heartburn, early satiety, nausea and vomiting. [13]

CKD increases the risk of having gastritis at all stages with the highest prevalence observed in late-stage disease. Intestinal dysbiosis and uremic toxins, such as p-cresyl sulphate (PCS) and indoxyl sulphate (IS) are important contributors to muscle loss.[11] These toxins causes muscle atrophy through myoblast suppression, mitochondrial damage and increased insulin resistance.[11] Also frequent abdominal bloating and constipation are commonly reported. An additional nutritional challenge in this patient population is the need to avoid phosphates-rich products in order to delay or prevent the development of secondary hyperparathyroidism and CKD–mineral bone disease (CKD-MBD) which narrows the possibilities of appropriate diet content. [7] Another issue is the necessity of restricting daily protein intake, which may lead to malnutrition.[15] However, protein restriction can improve renal function by reducing glomerular hyperfiltration thereby slowing the progression of CKD and postponing the need for dialysis.[14,15]

Renal osteodystrophy and Bone Loss

Another problem closely associated with Frailty Syndrome during CKD is an increased risk of bone fractures. CKD impedes mobility, not only by muscle strength loss, but also by osteopathy associated with CKD – Mineral and Bone Disorder. There is a strong link between CKD and the prevalence of osteoporosis. CKD patients are estimated to have 2 times more prevalent incidence of osteoporosis which in result multiplies the risk of fracture several times,[16] each one is linked with doubled mortality rate. [16]

As CKD progresses, there is a tendency of insufficient renal excretion of phosphates because of a functional deficit of Klotho protein with an excess of fibroblast growth factor 23

(FGF-23). [17] This leads to the suppression of 1α-hydroxylase activity and reduced activation of vitamin D_3 in the kidneys. [17] Calcitriol deficiency subsequently hinders intestinal absorption of calcium. [17] In response, the parathyroids increase secretion of parathyroid hormone (PTH) to counterbalance decreasing ionized calcium level, which in turn stimulates bone resorption and weakens bone architecture. [17]

There is a clear impact of retained uremic toxins on the function of osteoblasts and osteoclasts, like for example indoxyl sulfate (IS) and p-cresyl sulfate (pCS).[18] IS inhibits bone formation by downregulating the parathyroid hormone receptor (PTHR). [18] The similar negative effects is attributed to prevalent metabolic acidosis due to insufficient excretion of protons. It has been shown that acidosis promotes the activity of the osteoclasts and resorption of bones in mechanism of induction the expression of κ B ligand [16]

Anaemia

Anaemia is a frequent comorbid condition with CKD. It is estimated that anaemia is two times more prevalent in CKD patients than in the general population. [19] Moreover, more than a half of ESKD patients may suffer from this condition.[19]

One of the main causes is impaired renal blood flow during CKD which results in erythropoietin (EPO) deficit. [20] Additionally, elevated levels of proinflammatory cytokines like IL-1a, TNF- α and TGF- β further supress EPO synthesis.[19] Some patients also develop resistance to EPO, which further impairs the erythropoiesis in bone marrow cells. [19]

There is also reduction of iron intake due to increased hepcidin levels which inhibits the expression of ferroportin, the iron transporter in enterocytes.[19]

Anaemia in CKD significantly deteriorates quality of life, it contributes to decline patient performance and productivity. [20] Patients report tiredness, shortness of breath, they also feel depressed. Anaemia aggravates comorbid cardiac problems and increases the risk of hospitalization, mortality and the risk of falls. Additionally, it may also accelerate the progression of CKD. [20]

Hypertension

Chronic Kidney Disease has a profound impact on the cardiovascular system. There is a bidirectional relationship between renal dysfunction and hypertension. As previously mentioned hypertension is an major cause of CKD, but also CKD itself can also contribute to development and alteration of the characteristics of hypertension.

The primary mechanism is inefficient sodium excretion, leading to fluid retention, which in turn induces vasoconstriction and increases peripheral vascular resistance.[21] A second mechanism involves arterial stiffness and remodelling of large vessels resulting in impaired autoregulation of renal blood flow. [21] Other contributing factors include sympathetic nervous system overactivity and endothelial dysfunction. [21]

Up to 30% CKD patients may have masked hypertension, which is a cause of organ damage and increased mortality primarily due the absence of nocturnal blood pressure dipping. [22] Elevated nighttime systolic blood pressure is associated with multiplied risk of cardiovascular incidents and death. [23]

Blood pressure control in CKD patients is also more difficult due to underdiagnosis of masked hypertension, therefore it is essential to check diurnal variation of blood pressure. As CKD progresses, blood pressures becomes more difficult. [23]

Vascular abnormalities

There is a profound impact of Chronic Kidney Disease on arteries, cardiac valves, cardiac morphology and the pathophysiology of cardiovascular incidents. Widespread arterial calcification is observed in CKD, which results in arterial stiffness. [24] The process of calcification progresses more rapidly and affects a greater number of arteries than in individuals without CKD.[24]

As a result, blood flow dynamics are significantly altered, pulse wave velocity increases and the cardiac afterload rises. These factors alongside increased pulse pressure, drastically elevates the risk of cardiovascular incidents, such as strokes, myocardial infarction, heart failure and further damage to other vital organs.

Myocardial hyperplasia is commonly seen in CKD patients and is connected with a significant risk of systolic heart failure and a greater risk of acute coronary syndromes. [24]

The stiffness of arteries impedes the possibilities of neovascular surgeries. There is multiplied risk of valvular dysfunction, in particular aortic and mitral valve stenosis, requiring interventional procedures. There are also particular symptoms associated with uraemia such as uremic pericarditis and calcific uremic arteriolopathy, a disorder caused by arteriolar calcification in the skin resulting in severe necrotic skin lesions which are painful and difficult to treat. [24]

There is a common prevalence of arrhythmic incidents in CKD. The primary reason is common electrolyte abnormalities. In CKD there is impaired capacity of the kidneys to response sudden serum potassium level changes leading to a greater risk of acute hyperkalaemia. There is a clear link between CKD and atrial fibrillation. AF is several times more common in CKD patients than in the general population.[25] The underlying mechanism involves not only altered haemodynamic flow, which contributes to dilatation of atria, but also the profound biochemical factors triggered by inflammatory process. [26] For example, there is a strong correlation between level of proinflammatory cytokines, such as IL-6, and AF. [26] In CKD, increased level of cytokines triggers fibroblast proliferation in atria, which promotes heterogeneity of current conduction, shortened action potentials, resting cardiac myocytes depolarization, and spontaneous phase 4 depolarization causing AF. [26] The frequent coexistence of valvular pathology may also increase the pressure in left atrium further predisposing to AF. [26]

Cerebrovascular incidents

There is a significant impact of Chronic Kidney Disease on cognitive and neurological performance. There is a strong similarities in morphology and physiology and autoregulatory mechanisms of glomerular afferent arterioles and cerebral perforating arteries. [27] Both require constant and stable blood flow within a low-resistance vascular system, therefore albuminuria may be the predictor of cerebral small vessel disease. [27]

An increased albumin to creatin ratio (ACR) in urine is associated with higher risk of stroke [28]. CKD patients are more susceptible to transient ischemic attacks (TIA) incidents, [27] likewise CKD is more prevalent in patients with either ischemic stroke history or intracerebral haemorrhage than in the general population. [27]

The initiation of dialysis treatment is a critical period associated with an increased risk of cerebrovascular incidents.[28] This is caused by large sudden hemodynamic changes, electrolyte shifts, blood pressure amplitude and the usage of anticoagulants. As a result patients with dialysis-dependent CKD has the highest stroke risk. [28]

Stroke severity tends to be higher in CKD patients, contributing to a higher mortality rate than in the general population. [27,28]. Moreover, stroke outcomes are generally poorer due to higher thromboembolic and bleeding risk and increased complications related to thrombolytic therapy, in particular among haemodialysis-dependent patients.[28]

Vascular calcification and arterial stiffness, common to CKD, contribute to increased pulse pressure, which in turn contributes to microbleeds and lacunar infarctions.[29] The accumulation of uremic toxins foments systemic inflammation and may damage the blood-brain barrier. [28,29] Platelet dysfunction is also observed due to disrupted interactions with endothelium. [29] The coexistence of atrial fibrillation and CKD increases the stroke risk fivefold.[28]

Neurological performance

Leucoaraiosis, a radiological sign of neuronal loss, demyelization and gliosis, is commonly observed in Chronic Kidney Disease . It is associated with an increased risk of stroke and cognitive decline. [27] Decline of eGFR is believed to contribute to reduced volume of deep white matter.[27]

There is also a profound influence of uremic toxins on the central nervous system. For example Indoxyl Sulphate (IS) impedes neuronal homeostasis by inducing oxidative stress, inflammation and further endothelial damage. [28]

Both eGFR loss and albuminuria are correlated with cognitive impairment, with the dialysis-dependent group is the most vulnerable. [27,28] It it observed that cognitive deficits in CKD patients primarily affect processing and executive functions responsible for planning and performing tasks, the pace of processing and executive function are also slowed. [30] Attention, working memory and concentration are also impaired. [30]

The diagnosis of cognitive decline can be difficult as symptoms can resemble mood disorders, which are also frequent in this population.[30] Therefore, it is essential to notice the early signs of the cognitive deficit. For example, when the patient forgets to take the medication or is unable to use them properly, or the patient reports depression, altered sleep patterns or is unable to respond any question without the family member. [31] It is believed that cognitive impairment increases mortality rate due to poor compliance.

Neuropsychiatric impact

The increased presence of neuropsychiatric disorders in patients with Chronic Kidney Disease is well documented. CKD patients are more susceptible to depression than the general population, [32] in particular ESKD patients are the most vulnerable, whose incidence of depression is several times higher than general population. [32] Larger group of patients reports some symptoms of depression although they do not meet the depression criteria. [32]

This diagnosis of depression is problematic due to overlapped symptoms with those typically associated with CKD or other comorbid disease like reduced appetite, fatigue or they may be misinterpreted as a sign of getting old. [32]

The presence of mood disorders in CKD is associated with increased morbidity and mortality, as these group of patients are more prone to more frequent hospitalizations and demonstrate lower treatment adherence. [32] Depression deteriorates social and occupational functioning and negatively affects self-esteem. [32]

Sleeplessness is reported to be several times more prevalent in CKD patients than general population,[33] leading to impaired daytime functioning. The possible contributing factors are comorbid anaemia, disruption of calcium-phosphates homeostasis, uremic pruritus, muscle cramps and chronic bone pain possibly triggered by inflammatory mediators. [33] Various medicaments also play a role like beta-blockers or mimetics, antidepressants,

diuretics and immunosuppressants. [33] Sleep Apnoea Syndrome is also more frequent in CKD patients, possibly by hypervolemia, increased chemoreceptor sensitivity to hypercapnia and uremic myopathy affecting respiratory muscles. [33] There also appears to be a link between CKD and Restless Leg Syndrome (RLS). Insomnia deteriorates the quality of life, accelerates the cognitive decline and increases the mortality. [33]

Altered Mental Status

Chronic Kidney Disease is one of the leading causes of altered mental status, including encephalopathy and delirium. The causes are complex but consist of several coexistent factors common in CKD, like electrolyte abnormalities, fluid excess, hypertension, thiamine deficit, polypharmacy, uremic toxicity, transplant rejection and other metabolic disturbances. [34] The detrimental influence of PTH on calcium excess in brain is also present. [34] Patients with malnutrition, vitamin B complex deficiency on dialysis are at risk. [34]

The severity of symptoms varies, from mental clouding to delirium and coma. [34] The onset can be nonspecific, it may be interpreted as fatigue, apathy, concentration problems or irritability. [34] As this condition progresses confusion, disorientation, hallucinations may also occur. [34]Aside from altered consciousness, motor symptoms like tremor, seizures and fasciculations can be observed.[34]

Patients with hypertension and advanced CKD are susceptible to Posterior Reversible Encephalopathy Syndrome (PRES) which presents with reduced consciousness, headache and seizures, accompanied with posterior white matter lesions in neuroimaging. [34] Rapid electrolyte and fluid volume shifts during the initiation of dialysis may result in Dialysis Disequilibrium Syndrome, especially in patients with severe uraemia. [34] These sudden changes can cause cerebral oedema leading to altered consciousness, convulsions and headache. [34]

Due to impaired drug metabolism in CKD the risk of drug accumulations and interactions is markedly increased which can cause drug-induced encephalopathy. [34] There is also frequent prevalence of peripheral neuropathy in End Stage Renal Disease. [34] Up to 90% dialysis-dependent patients can feel pain and, loss of sensation, primarily in the distal lower limbs.[34]

Risk of falls

A particularly insidious and common issue in patients with Chronic Kidney Disease is the increased vulnerability to falls, by multiple coexistent factors. As previously mentioned CKD contributes to sarcopenia and bone mass loss. Muscle atrophy appears to be the primary factor reducing gait speed and coordination. Sarcopenia leads to more frequent falls, resulting in hospitalizations and further complications. [35]

However the etiology of falls is not limited to musculoskeletal system. Due to frequent comorbid neuropathy the proprioceptive sensation is distorted, thus the movement is less secure and undecisive. [34] One key factor is the presence of orthostatic hypotension, a condition in which every elevation movement involves sudden blood pressure decrease in carotid arteries. It is observed that orthostatic hypotension is more frequent in patients with eGFR lower than 60. [36] Since CKD contribute significantly to vascular stiffness and reduced arterial compliance, the ability to maintain adequate cerebral perfusion upon standing is severely weakened. [36] This is further exacerbated by diminished sensitivity of the baroreceptors. [36] Autonomic dysfunction is present since the early stages of CKD and increases the risk of falls. [35,36]

The main risk of orthostatic hypotension is the sudden cerebral perfusion, which can result in transient loss of consciousness which may result in severe injuries if the patient is also unable to protect itself to reduce injuries. Slowed reaction time is caused by several brain injuries and cognitive decline induced by vascular lesions, malfunction of blood circulation in the arterioles, the toxicity of CKD and comorbid anaemia.

Frequent falls and injuries, combined with a sensation of instability can lead to reluctance to move and promoting further loss of mobility. [35] Haemodialysis patients are especially prone to orthostatic hypotonia incidents due to rapid fluid shifts and possible miscalculations of the estimated dry mass. [35]

The problem is intensified by cerebral small vessel disease, which normally requires high-pressure blood flow. Consequently, CKD patients are vulnerable to falls and serious injuries, such as hip fractures, which occurs three times more often than in the general population. Vitamin D deficiency, frequently observed in CKD, further reduces muscle strength, thereby increasing fall risk. [7,35] Additionally, polypharmacy is the significant cause of falls, due to more frequent drug interactions. [35]

Dermatological aspects

Skin lesions are also more frequently observed in patients with Chronic Kidney Disease. It is estimated that at least half of CKD patients suffer from some form of dermatological condition.[37] The most prevalent are generalized pruritus, xerosis, pigmentation changes, purpuric spots, nail and mucosal lesions. [37] It is estimated that the majority of haemodialysis-dependent patients suffer from pruritus, which is a marker of a poor prognosis of end-stage renal disease. [37] The main contributing factors to pruritus are hyperparathyroidism, anaemia, hyperphosphatemia, hypercalcemia, hypermagnesemia, hypervitaminosis-A and comorbid congestive heart failure. [37]

Medication Complications

Moreover, Chronic Kidney Disease impacts the methods of medication. As the several drugs are metabolised and excreted via the kidney there is an increased risk of adverse effects due to xenobiotic accumulation or electrolyte disturbances. Since CKD patients often present with other comorbidities , they need to use several medicaments, each associated with multiplied risk of interactions and toxic side effects.

CKD impairs the ability of the kidneys to regulate electrolyte homeostasis, resulting in greater susceptibility to acute electrolyte abnormalities . Loop diuretics can trigger hypokalaemia, hipochloremic alkalosis, dysmagnesemia as well as both hypo- and hypernatremia. [38,39] Hyperkalaemia is prevalent in patients using RAAS-blockers, potassium-sparing diuretics and trimethoprim-sulfamethoxazole. [38]

CKD patients are also more vulnerable to adverse effects of commonly used medicaments. Those treated with RAAS inhibitors are vulnerable to AKI incidents more frequently, in particular when used in combination with diuretics, NSAIDS, SGLT-2 inhibitors or the second RAAS-inhibitor,[38] or during summer heatwaves. [39].

There is a notably elevated risk of toxicity with narrow therapeutic index drugs, such as aminoglycosides, digoxin, lithium, warfarin and others , in such cases, therapeutic drug monitoring is recommended.[39]

Morphine exhibits potentiated and prolonged effects in CKD due to accumulation of active metabolites. [39] CKD patients are at risk for iodinated contrast-induced nephropathy, particularly if not properly hydrated before imaging procedures. [39] Phosphate-based bowel preparations can contribute to phosphate nephropathy. [39]

Patients with comorbid diabetes are at increased risk of hypoglycaemia, especially if treated with insulin or sulfonylureas. [39] There risk of bleeding complications is elevated unless the anticoagulant dosage is reduced. [39] Finally, it is essential to avoid herbal preparations, as these are frequently used by patients triggering possible harmful interactions. [39]

Management

The prognosis of Chronic Kidney Disease in the elderly population is generally unfavourable. Self-reported quality of life often decreases after the initiation of dialysis treatment and the dialysis program is associated with an estimated 10% annual mortality rate.[40]

Although it is not possible to reverse renal damage, the progression of CKD to more advanced stages can be slowed. Renal transplantation is considered the most effective treatment for End-Stage Renal Disease and remains the sole method capable of improving both quality and duration of life. [41]

However, determining who is eligible for the kidney transplant in the elderly population is unclear. [41] The graft survival is typically shorter in elderly recipients in comparison to younger patients. [41] The age of a patients does not disqualify them from receiving a kidney transplant, [41] but multimorbidity and susceptibility to cancers in older adults may be a significant contraindicators . Additionally, the presence of frailty and impaired functional mobility is associated with bad prognosis after the kidney transplantation. [41]

There are two principal approaches to managing the End Stage Renal Disease: the conservative kidney management (CKM) and dialysis. The choice which path should follow the patient depends on his perception of treatment and the treatment goals: what is more important to patient: extending the lifespan or maintaining the highest possible quality of life or addressing other specific priorities. [40]

Regardless of the chosen pathway it is important to provide comprehensive, multidisciplinary care, considering the complexity and diversity of CKD symptoms. To minimize polypharmacy, non-pharmacological interventions should be prioritized over medication. [41,42] If pharmacological therapy becomes necessary if should be used at the lowest effective dose and quantity. [41,42]

Conservative kidney management (CKM) is an appropriate alternative for patients over 80 years of age or for those with serious comorbid condition. [10,40] It has been shown that CKM can offer comparable outcomes in terms of lifespan and quality of life when compared to dialysis as the benefits of dialysis are observed to diminish. [10,40]

Its role is to control the most common symptoms associated with CKD, such as fatigue, pruritus, nausea, sleeplessness and mood disorders, by preserving the residual kidney function for as long as possible, and by delaying the initiations of dialysis through minimizing disease progression. [42]

It is important to maintain optimal blood pressure, although excessive reduction of blood pressure should be avoided, as it increases the risk of falls and deteriorates cognitive performance.[42] Proper fluid balance should be achieved through dietary sodium restriction and, if necessary, by loop diuretics.[42]

Anaemia management should aim to alleviate symptoms, such as dyspnoea, fatigue and cognitive impairment.[19,42] Since disorders in calcium-phosphates metabolism are a major contributor to CKD symptoms, regulation of mineral balance is essential for preserving quality of life and the residual kidney function. Supplementation with active form vitamin D and restrict the phosphates intake should be considered. [42]

Correction of metabolic acidosis is also beneficial in preserving muscle and bone mass. [42] Preventing hyperkalaemia is a key to minimizing the risk of arrhythmias and can be achieved by dietary potassium restriction and avoiding hypotensive medicaments thar increases potassium level such as RAAS inhibitors.[42]

If the patient decides to begin dialysis, he should choose the preferred method. Peritoneal dialysis (PD) may be better options for those with adequate care at home. [42] It gives the patient greater flexibility as it does not require several visits a week to a dialysis centre. It has been show that PD preserves residual kidney longer than haemodialysis and is associated with fewer abrupt haemodynamic and electrolyte shifts, which may explain why peritoneal dialysis is associated with lesser incidents of vascular incidents. [42,43]

However, main disadvantages of PD are the necessity for maintaining strict hygiene, patient compliance or reliance on a caregiver. [42] Otherwise PD carries the risk of peritonitis and insufficient dialysis efficacy. [42] Moreover, the availability of PD is limited to patients with no prior significant surgery history, with proper body mass and without prior inflammatory process in abdominal cavity.[42]

The alternative is haemodialysis, which is associated with adverse effects on quality of life and loss of independence, due to the need to attend dialysis session usually three times per week, with limited flexibility. Some patients experience post-dialysis fatigue and need to recover from haemodialysis session due to sudden fluid and electrolytes changes. [42] Haemodialysis has also been reported to increase blood pressure through activation of the renin-angiotensin-aldosterone system (RAAS) likely as a consequence of rapid volume changes during treatment. [43]

Conclusions

Regardless of stages of Chronic Kidney Disease, patients need to have treatment methods individualized accordingly to their kidney condition and comorbidities. All individuals with CKD patients require multidisciplinary care, which can help preserve functional independence, optimize symptom control and slow progression of the disease. Therapeutic decisions should aim to balance between extending lifespan and improving quality of life.

Early detection of CKD with proper management of burdensome symptoms such as mood disorders, sleeplessness or pruritus can significantly improve the quality of life of patients. Furthermore, it may limit organ damage, expand therapeutic options and reduce the risk of cardiovascular incidents.

Appropriate long-term management of CKD can delay the need for renal replacement treatment, such as dialysis, thereby allowing patients to maintain greater independence and psychosocial stability.

Future research should focus on optimizing conservative management of Chronic Kidney Disease and identifying early prognostic indicators to enhance the management of earlier stages of CKD.

Disclosure: Authors do not report any disclosures.
Conflict of Interest: The authors declare that they have no conflict of interest.

REFERENCES

1. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Int Suppl.* 2024;105(4S):S117–S314. [p. S126-S127] DOI: 10.1016/j.kint.2023.10.018
2. Nathan R. Hill ,Samuel T. Fatoba,Jason L. Oke,Jennifer A. Hirst,Christopher A. O'Callaghan,Daniel S. Lasserson,F. D. Richard Hobbs Global Prevalence of Chronic Kidney Disease – A Systematic Review and Meta-Analysis PLOS ONE. 2016;11(7):e0158765. https://doi.org/10.1371/journal.pone.0158765
3. Ellen K. Hoogeveen The Epidemiology of Diabetic Kidney Disease Kidney Dial. 2022, 2(3), 433-442; https://doi.org/10.3390/kidneydial2030038
4. Denic, Aleksandar; Lieske, John C.; Chakkera, Harini A.; Poggio, Emilio D.; Alexander, Mariam P.; Singh, Prince; Kremers, Walter K.; Lerman, Lilach O.; Rule, Andrew D. The Substantial Loss of Nephrons in Healthy Human Kidneys with Aging J Am Soc Nephrol. 2016 Jul 8;28(1):313–320. doi: 10.1681/ASN.2016020154
5. Gaetano Alfano, Rossella Perrone, Francesco Fontana, Giulia Ligabue, Silvia Giovanella, Annachiara Ferrari, Mariacristina Gregorini, Gianni Cappelli, Riccardo Magistroni ,Gabriele Donati Chronic Kidney Disease in the Aging Population Life 2022, 12(11), 1724; https://doi.org/10.3390/life12111724
6. Lesley A. Stevens, Gautham Viswanathan, Daniel E. Weiner Chronic Kidney Disease and End-Stage Renal Disease in the Elderly Population: Current Prevalence, Future Projections, and Clinical Significance Adv Chronic Kidney Dis. 2010 Jul;17(4):293–301. doi: 10.1053/j.ackd.2010.03.010
7. Andrew C Nixon, Theodoros M Bampouras, Neil Pendleton, Alexander Woywodt, Sandip Mitra, Ajay Dhaygude Frailty and chronic kidney disease: current evidence and continuing uncertainties Clin Kidney J. 2017 Dec 2;11(2):236–245. doi: 10.1093/ckj/sfx134
8. Wesley J. Visser, Elma E.M. van de Braak, Anneke M.E. de Mik - van Egmond, Anna C. van der Burgh, Nicole M. de Roos, Inez Jans, Iris van der Hoef, Joanne F. Olieman, Ewout J. Hoorn, David Severs Effects of correcting metabolic acidosis on muscle mass and functionality in chronic kidney disease: a systematic review and meta-analysis J Cachexia Sarcopenia Muscle. 2023 Sep 20;14(6):2498–2508. doi: 10.1002/jcsm.13330
9. Ravi Nistalaa, Yongzhong Wei, James R. Sowers, Adam Whaley-Connell Renin-angiotensin-aldosterone system-mediated redox effects in chronic kidney disease Transl Res. 2009 Jan 23;153(3):102–113. doi: 10.1016/j.trsl.2008.12.008
10. Alice Kennard, Nicholas Glasgow, Suzanne Rainsford, Girish Talaulikar Frailty in chronic kidney disease: challenges in nephrology practice. A review of current literature Intern Med J. 2023 Apr;53(4):465-472. DOI: 10.1111/imj.15759
11. Yalda Rahbar Saadat, Amin Abbasi, Seyyed Sina Hejazian, Yalda Hekmatshoar, Mohammadreza Ardalan, Farahnoosh Farnood, Sepideh Zununi Vahed Combating chronic kidney disease-associated cachexia: A literature review of recent therapeutic approaches 2025 Mar 11;26(1):133. DOI: 10.1186/s12882-025-04057-8
12. By Dora-Ann Oddo, Christopher W. Bowers Systemic and Oral Health Manifestations of Kidney Disease https://decisionsindentistry.com/article/systemic-oral-health-manifestations-kidney-disease/
13. Wang, Xiaoliang ; Wang, Jiayan; Ali Ikram, Hafiz Zarsham; Frandah, Wesam; Song, Gengqing Chronic Kidney Disease as an Independent Risk Factor for Gastritis and Gastric Polyps: Insights From a Large-Scale Analysis 118(10S):S1413-S1413 DOI:10.14309/01.ajg.0000957252.34234.08
14. Sun Moon Kim, Ji Yong Jung Nutritional management in patients with chronic kidney disease Korean J Intern Med. 2020 Sep 23;35(6):1279–1290. doi: 10.3904/kjim.2020.408
15. A Noce, M F Vidiri, G Marrone, E Moriconi, A Bocedi, A Capria, V Rovella, G Ricci, A De Lorenzo & N Di Daniele Is low-protein diet a possible risk factor of malnutrition in chronic kidney disease patients? Cell Death Discov. 2016 May 9;2:16026. doi: 10.1038/cddiscovery.2016.26
16. Levy, Rebecca; McMahon, Donald; Agarwal, Sanchita; Dempster, David; Zhou, Hua; Misof, Barbara; Guo, X.E.; Kamanda-Kosseh; Aponte, Maria Alejandra; Reidy, Kimberly; Kumar, Juhi; Fusaro, Maria; Brown, Denver D; Melamed, Michal; Nickolas, Thomas Comprehensive Associations between Acidosis and the Skeleton in Patients with Kidney Disease J Am Soc Nephrol. 2023 Feb 2;34(4):668–681. doi: 10.1681/ASN.0000000000000085
17. Aniruddh Shah; Muhammad F. Hashmi; Narothama R. Aeddula. Chronic Kidney Disease-Mineral Bone Disorder (CKD-MBD) Shah A, Hashmi MF, Aeddula NR. Chronic Kidney Disease–Mineral Bone Disorder (CKD-MBD). In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; updated Apr 3 2024. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560742/
18. Kuo-Chin Hung,Wei-Cheng Yao,Yi-Lien Liu, Hung-Jen Yang, Min-Tser Liao, Keong Chong, Ching-Hsiu Peng, Kuo-Cheng Lu The Potential Influence of Uremic Toxins on the Homeostasis of Bones and Muscles in Chronic Kidney Disease Biomedicines. 2023 Jul 24;11(7):2076. doi: 10.3390/biomedicines11072076
19. Jose Portolés, Leyre Martín, José Jesús Broseta, Aleix Cases Anemia in Chronic Kidney Disease: From Pathophysiology and Current Treatments, to Future Agents Front Med (Lausanne). 2021 Mar 26:8:642296. https://doi.org/10.3389/fmed.2021.642296

20. Indranil Dasgupta , Corinne Isnard Bagnis , Matteo Floris , Hans Furuland , Daniel Gallego Zurro , Loreto Gesualdo , Nathalie Heirman , Roberto Minutolo , Antonello Pani , José Portolés Anaemia and quality of life in chronic kidney disease: a consensus document from the European Anaemia of CKD Alliance Clin Kidney J. 2024 Jul 4;17(8):sfae205. doi: 10.1093/ckj/sfae205
21. Omar Z. Ameer Hypertension in chronic kidney disease: What lies behind the scene Front Pharmacol. 2022 Oct 11:13:949260. DOI: 10.3389/fphar.2022.949260
22. Kevin S. Fay, Debbie L. Cohen Resistant Hypertension in People With CKD: A Review Vol. 77(1):110–121, 2021.https://doi.org/10.1053/j.ajkd.2020.04.017
23. Michel Burnier, Aikaterini Damianaki Hypertension as Cardiovascular Risk Factor in Chronic Kidney Disease Circ Res. 2023 Apr 14;132(8):1050-1063. https://doi.org/10.1161/CIRCRESAHA.122.321762
24. Joachim Jankowski, Jürgen Floege, Danilo Fliser, Michael Böhm, Nikolaus Marx Cardiovascular Disease in Chronic Kidney Disease Circulation. 2021 Mar 16;143(11):1157–1172. doi: 10.1161/CIRCULATIONAHA.120.050686
25. Ananthapanyasut, Wanwarat; Napan, Sirikarn; Rudolph, Earl H.; Harindhanavudhi, Tasma; Ayash, Husam; Guglielmi, Kelly E.; Lerma, Edgar V. Prevalence of Atrial Fibrillation and Its Predictors in Nondialysis Patients with Chronic Kidney Disease Clin J Am Soc Nephrol. 2010 Feb;5(2):173–181. doi: 10.2215/CJN.03170509
26. Sai Gadde, Revanth Kalluru, Swathi Priya Cherukuri, Rahul Chikatimalla,Thejaswi Dasaradhan, Jancy Koneti Atrial Fibrillation in Chronic Kidney Disease: An Overview Cureus. 2022 Aug 7;14(8):e27753. doi: 10.7759/cureus.27753
27. Kazunori Toyoda Cerebral Small Vessel Disease and Chronic Kidney Disease J Stroke. 2015 Jan 30;17(1):31–37. doi: 10.5853/jos.2015.17.1.31
28. Marius Miglinas, Ugne Cesniene, Marta Monika Janusaite, Arturas Vinikovas, Cerebrovascular Disease and Cognition in Chronic Kidney Disease Patients Front. Cardiovasc. Med. 2020;7:96. https://doi.org/10.3389/fcvm.2020.00096
29. Wei Ling Lau, Branko N. Huisa, Mark Fisher The Cerebrovascular-Chronic Kidney Disease Connection: Perspectives and Mechanisms Transl Stroke Res. 2017 Feb;8(1):67-76. DOI: 10.1007/s12975-016-0499-x
30. Qianqian Yan, Mengyuan Liu, Yiling Xie, Yimi Lin, Ping Fu, Yaoyu Pu, Bo Wang Kidney-brain axis in the pathogenesis of cognitive impairment Neurobiol Dis. 2024 Oct 1:200:106626. DOI: 10.1016/j.nbd.2024.106626
31. Davide Viggiano , Carsten A Wagner , Peter J Blankestijn , Annette Bruchfeld , Danilo Fliser , Denis Fouque , Sebastian Frische , Loreto Gesualdo , Eugenio Gutiérrez , Dimitrios Goumenos Mild cognitive impairment and kidney disease: clinical aspects Nephrol Dial Transplant. 2020 Jan 1;35(1):10-17 DOI: 10.1093/ndt/gfz051
32. Suetonia Palmer, Mariacristina Vecchio, Jonathan C. Craig, Marcello Tonelli, David W. Johnson, Antonio Nicolucci, Fabio Pellegrini, Valeria Saglimbene, Giancarlo Logroscino, Steven Fishbane, Giovanni F.M. Strippoli Prevalence of depression in chronic kidney disease: systematic review and meta-analysis of observational studies Kidney Int. 2013;84(1):179–191 https://doi.org/10.1038/ki.2013.77
33. Anjana Gopal, Janine Farragher, Sarbjit V. Jassal, Istvan Mucsi Sleep Disorders in CKD: A Review American Journal of Kidney Diseases. 2025 Jun;85(6):754–766. https://doi.org/10.1053/j.ajkd.2024.12.010
34. Ria Arnold, Tushar Issar, Arun V Krishnan,Bruce A Pussell Neurological complications in chronic kidney disease RSM Cardiovasc Dis. 2016 Nov3;5:2048004016677687. https://doi.org/10.1177/2048004016677687
35. Konstantina Papakonstantinopoulou, Ioannis Sofianos Risk of falls in chronic kidney disease Frailty Sarcopenia Falls. 2017 Jun 1;2(2):33–38. https://www.doi.org/10.22540/JFSF-02-033
36. Mark Canney, Matthew D. L. O'Connell, Donal J. Sexton, Neil O'Leary, Rose Anne Kenny, Mark A. Little, Conall M. O'Seaghdha Graded Association Between Kidney Function and Impaired Orthostatic Blood Pressure Stabilization in Older Adults J Am Heart Assoc. 2017 May 4;6(5):e005661. doi: 10.1161/JAHA.117.005661
37. Goel, Vivek; Sil, Abheek; Das, Anupam Cutaneous Manifestations of Chronic Kidney Disease, Dialysis and Post-Renal Transplant: A Review Indian J Dermatol. 2021 Jan-Feb;66(1):3–11. doi: 10.4103/ijd.IJD_502_20
38. Tsering Dhondup; Qi Qian Acid-Base and Electrolyte Disorders in Patients with and without Chronic Kidney Disease: An Update Kidney Dis (Basel). 2017 Oct 5;3(4):136–148. doi: 10.1159/000479968
39. Whittaker, Chanel; Miklich, Margaret; Patel, Roshni; Fink, Jeffrey Medication Safety Principles and Practice in CKD Clin J Am Soc Nephrol. 2018 Jun 18;13(11):1738–1746. doi: 10.2215/CJN.00580118
40. Angela Chou, Kelly Chenlei Li, Mark Ashley Brown Survival of Older Patients With Advanced CKD Managed Without Dialysis: A Narrative Review Kidney Med. 2022 Mar 12;4(5):100447. doi: 10.1016/j.xkme.2022.100447
41. Beatrice P Concepcion, Rachel C Forbes, Heidi M Schaefer Older candidates for kidney transplantation: Who to refer and what to expect? World J Transplant. 2016 Dec 24;6(4):650–657. doi: 10.5500/wjt.v6.i4.650
42. Ted J FitzGerald , Hanneke Joosten , Marjolijn van Buren , Katie Vinen , Edwina A Brown A review of supportive care for older people with advanced chronic kidney disease Clinical Kidney Journal, 16(4), 635–646. https://doi.org/10.1093/ckj/sfac256
43. Yuan Zhao Comparison of the effect of hemodialysis and peritoneal dialysis in the treatment of end-stage renal disease Pak J Med Sci. 2023 Nov-Dec;39(6):1562–1567. doi: 10.12669/pjms.39.6.8056