RESEARCH PAPER

Effectiveness of a Controlled Renal Diet in Managing Hyperuricemia Among Patients with Chronic Kidney Disease

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ABSTRACT

Purpose: Chronic kidney disease (CKD) is frequently associated with nutritional abnormalities, including inadequate dietary intake, protein–energy wasting, anaemia, and hypoalbuminemia. Hyperuricemia is also common among patients with CKD, primarily due to impaired renal excretion of uric acid. The present study aims to assess dietary adequacy and its association with hyperuricemia among patients with CKD.

Methods: A cross-sectional observational study was conducted among 100 adults with CKD and hyperuricemia attending Apollo Hospitals Unit, International Hospital, Guwahati. Socio-demographic and clinical information were collected using a structured interview schedule. Nutritional status was assessed using body mass index (BMI) and Subjective Global Assessment (SGA), while dietary intake was assessed using a 24-hour dietary recall. Biochemical parameters were obtained from hospital laboratory records.

Results: Most participants were in CKD stages 3 (33%), 2 (29%), and 4 (25%), and diabetes mellitus was the predominant comorbidity (64%). Although 81.25% of participants had a normal BMI, SGA identified 40% as moderately malnourished. Mean energy intake was 27.5 kcal/kg body weight/day, corresponding to 86.4% of the recommended intake, while mean protein intake was 0.55 g/kg/day, equivalent to 78.6% of the recommended intake. Biochemical assessment revealed a high prevalence of anaemia and hypoalbuminemia, with mean haemoglobin and serum albumin concentrations of 10.07 ± 1.42 g/dL and 3.44 ± 0.58 g/dL, respectively. Serum creatinine was elevated in 99% of participants.

Conclusion: Patients with CKD and hyperuricemia showed a substantial burden of dietary inadequacy and malnutrition, which may remain undetected when BMI is used alone. Comprehensive nutritional assessment, including clinical assessment tools such as SGA, along with individualized renal dietary counselling, should be incorporated into the management of these patients.

Keywords: Chronic kidney disease, Hyperuricemia, Nutritional status, Protein-energy wasting,, Renal nutrition

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Introduction

Chronic kidney disease (CKD) is increasingly recognized as a major global public health problem, characterized by a progressive decline in renal function and structural kidney damage lasting more than three months. Epidemiological evidence suggests that approximately 10–15% of the adult population is affected by CKD, with rising prevalence due to ageing populations and increasing rates of metabolic disorders like diabetes and hypertension.[1,2] Beyond the need for renal replacement therapy, CKD is associated with multiple comorbidities, including cardiovascular disease, infections and nutritional abnormalities. Malnutrition, particularly protein–energy wasting, is a frequent and serious complication in CKD patients [3]. Hyperuricemia-defined as serum urate above 6.8 mg/dL-is increasingly recognized as a risk marker and amplifier of chronic kidney disease (CKD) progression and cardiovascular disease (CVD), rather than merely a precursor to gout[4]. Elevated uric acid may in turn damage the kidney through crystal-dependent and crystal-independent mechanisms. Hyperuricemia is therefore both a consequence and a possible driver of CKD progression, in addition to its links with gout and cardiovascular disease [5].

Malnutrition in CKD is multifactorial and results from reduced dietary intake, increased nutrient losses, altered metabolism, inflammation, metabolic acidosis, gastrointestinal disturbances and hormonal dysregulation.[6,7] This condition is associated with reduced muscle mass, hypoalbuminemia, increased susceptibility to infections, disease progression, and higher mortality rates.[8] The Kidney Disease: Improving Global Outcomes (KDIGO) classification

stratifies CKD based on estimated glomerular filtration rate (eGFR) and albuminuria, categorizing the disease into five stages from G1 to G5.[9] Declining eGFR is associated with increasing metabolic disturbances, inflammation, cardiovascular risk, and nutritional impairment.[10] The risk of malnutrition rises substantially in advanced stages due to reduced intake and chronic inflammation[11] making nutritional assessment a critical component of CKD management.

Several dietary factors influence serum urate in CKD. High-purine foods, fructose-rich beverages and alcohol promote urate overproduction and reduce its excretion, whereas DASH and Mediterranean dietary patterns are associated with lower serum urate and reduced cardiovascular risk. Reviews of CKD and uric acid likewise highlight DASH, Mediterranean, plant-based and low-purine diets as approaches to managing hyperuricemia. [4] Nutrition plays a central role in slowing CKD progression and improving outcomes. Excessive protein intake increases intraglomerular pressure and nitrogenous waste production, potentially accelerating disease progression [12] Accordingly, KDIGO guidelines recommend avoidance of high protein intake and support moderate protein restriction in non-dialysis CKD patients.[13] Adequate energy intake is equally essential, as insufficient caloric intake promotes muscle catabolism and worsens nutritional status.[11] Sodium restriction also plays a key role in blood pressure control and prevention of fluid overload.[14] The prevalence of malnutrition in CKD varies widely depending on disease stage, assessment methods, and population characteristics. Meta-analytical evidence suggests a pooled global prevalence of approximately 40%.[15]. Despite guideline recommendations, no single gold-standard tool exists for nutritional assessment in CKD. Therefore, local studies are essential to assess nutritional status and guide interventions. This study aimed to assess the nutritional status of CKD patients using standardized tools and to determine its relationship with clinical outcomes.

Materials and Methods

Sample Selection

A cross-sectional observational study was conducted among patients with CKD attending Apollo Hospitals Unit, International Hospital, Guwahati. A total of 100 patients were selected using purposive sampling. Institutional Ethical Clearance was obtained from Assam Royal Global University, Guwahati, and informed consent was obtained from all participants.

Inclusion criteria: Adults aged above 18years, diagnosed with CKD and Hyperuricemia and respondents who are willing to provide informed consent.

Exclusion criteria: Patients with acute kidney injury, individuals with active malignancies or terminal illness and pregnant or lactating women.

Data collection

A structured and pre-tested interview schedule was conducted to collect information about the socio-demographics of the respondents, including gender, age, education, marital status, income status, height, weight and whether the risk of high blood pressure, diabetes, gout, and CKD stage, Fast-fasting blood samples were collected on the second day after hospitalization, albumin (FBS) and hemoglobin (Hb) were checked and measured by hospital laboratory. Subjective Global Assessment (SGA) was used to evaluate the nutritional status. 24 hour dietary recall method was used to assess the dietary intake of nutrients among the respondents.

Statistical analysis

Quantitative data that obeyed a normal distribution were expressed as mean ± standard deviation (X ± SD). Pearson's correlation analysis was done to assess the correlation between variables.

Results

Socio-Demographic Profile

According to the patients' age distribution (Fig. 1), the age group of 51–60 years old accounted for the biggest percentage (34%), followed by the age group of 41–50 years old (32%). The remaining age groups included a lesser percentage of participants. In general, middle-aged and older persons made up the majority of the study population. In terms of gender distribution (Fig. 2), 30% of the study population was female, and 70% of the population was male. As a result, the study's responders were overwhelmingly male.

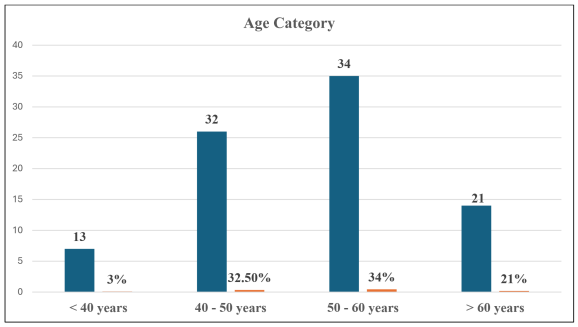


Fig 1. Distribution of respondents according to age group

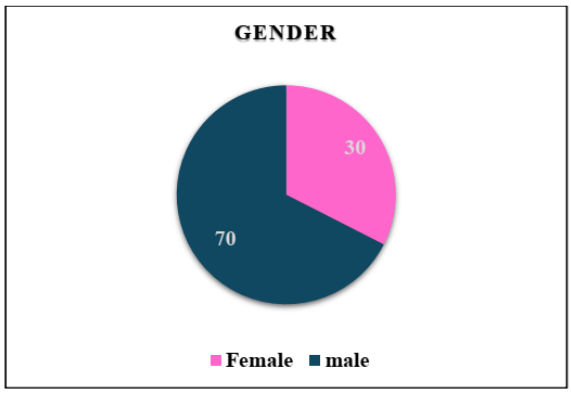


Fig 2. Distribution of respondents according to gender

Disease Profile

Diabetic renal failure (DMRF), which affected 61% of the study population, was the most commonly reported clinical condition, according to the illness profile of the respondents (Table 1). Renal failure (RF), which was reported by 22% of the respondents, came next, followed by hypertension (5%). Only 3% of respondents had diabetes mellitus. One percent of the study population had both diabetes with coronary artery disease and diabetes with hypertension. In general, the most common clinical condition among the respondents was diabetes-related kidney illness.

With 33% of the study population, Stage 3 was the most common stage of CKD, followed by Stage 2 (29%), Stage 4 (25%), and Stage 5 (13%). A significant percentage of the study group had moderate-to-severe renal disease, as evidenced by the fact that 71% of the responders had Stage 3–5 CKD. Just 1% of the responders were having hemodialysis, whilst 99% of them were receiving conservative management. As a result, non-dialysis CKD patients made up the majority of the study population.With respect to treatment status, 99% of respondents were receiving conservative management, whereas 1% were undergoing hemodialysis. The predominance of non-dialysis patients in the present study is relevant to dietary management because nutritional requirements and dietary prescriptions vary according to CKD stage and dialysis status.

Table 1. Distribution of Comorbidities among Respondents

Comorbidities	No of patients	Percentage
Diabetes Mellitus (DM)	64	64%
Hypertension (HTN)	6	6%
Both DM and HTN	1	1%
Others(Dyslipidemia, hyperthyroidism)	29	29%

Table 2. Distribution of Respondents According to Disease Stage

CKD stage	No of patients	Percentage
Stage-1	0	0.00%
Stage-2	29	29%
Stage-3	33	33%
Stage-4	25	25%
Stage-5	13	13%

Nutritional Status

The BMI assessment (Table 3) showed that 81.25% of the respondents had a normal BMI, while 13.75% were underweight. Thus, the majority of participants appeared to have an acceptable body weight based on BMI classification.

However, assessment using the Subjective Global Assessment (SGA) (Table 4) revealed that 40% of the patients were moderately malnourished. This indicates that a considerable proportion of patients had nutritional compromise despite having a normal BMI.

The findings demonstrate a difference between nutritional classification based on BMI and the more comprehensive assessment provided by SGA.

Table 3. Distribution of Respondents According to Body Mass Index (BMI)

BMI	Percentage
>18.5 (Underweight)	13.75%
18.5-24.9 (Normal)	81.25%
25-29.9 (Overweight)	5.00%
30-34.9 (Obesity I)	0.00%
35-39.9 (Obesity II)	0.00%

Table 4. Nutritional Status of the Respondents Based on SGA Score

SGA Score	Percentages
Well nourished (7-14)	60%
Moderately Malnourished (15-28)	40%
Severly Malnourished (29-35)	0%

Dietary assessment among the respondents showed mean energy intake of 27.5 kcal/kg/day, representing a 15.4% deficit from recommendations (Table 4). Protein intake was also inadequate (0.55 g/kg/day), with a 21.4% deficit, increasing the risk of muscle wasting and poor outcomes.[16,17] Fat intake accounted for only 22.5% of total energy, further contributing to overall energy deficiency.[18] These findings emphasize the need for individualized nutritional counseling in CKD patients.[11]

Table 5: Nutrient Intake of the Respondents Based on 24-Hour Dietary Recall

Nutrients	Mean Intake	Recommended Dietary Allowance (RDA)	%of RDA Achieved	% Deficit from RDA
Energy(Kcal)	27.5 kcal/kg body weight/ day	32.5 kcal/kg body weight/day	86.4%	15.4 %
Protein (g)	0.55	0.7	78.6	21.4
Fats (g)	22.5% of total energy	30% of total energy	75%	25%

Clinical Parameters

The biochemical assessment (Table 6) showed that elevated serum uric acid levels were present among a substantial proportion of the patients, indicating a high occurrence of hyperuricemia in the study population. Serum creatinine levels were elevated in the majority of patients, reflecting impaired renal filtration. The assessment of eGFR showed reduced values across the different CKD stages, indicating varying degrees of renal impairment among the respondents. Overall, the biochemical findings demonstrated the presence of hyperuricemia, elevated serum creatinine, and reduced eGFR in the study population. The observed abnormalities were consistent with the underlying renal dysfunction of the participants.

Table 6: Biochemical Profile of the Respondents

Biochemical Parameters	Mean ± SD	Reference Range	Percentage of Patients below Normal (%)	Percentage of Patients Above Normal (%)
Uric Acid		3.2-7.2	-	100%
Haemoglobin (g/dL)	10.07 ± 1.42	12–16	97%	0%
Serum Albumin (g/dL)	3.44 ± 0.58	3.7 – 5.0	42%	0%
Serum Creatinine (mg/dL)	4.78 ± 2.69	0.6 – 1.3 mg/dL	0%	99%
Serum Potassium (mEq/L)	4.93 ± 0.77	3.5–5.0	8%	44%
Serum Sodium (mEq/L)	135. 33 ± 4.88	135– 145	26%	0%

Discussion

The majority of participants in the 51–60 age range indicates that middle-aged and older adults were more likely to have CKD in the current study. The comparatively large percentage of patients (32%) who were between the ages of 41 and 50 suggests that CKD may have a significant impact even before advanced old age. This result is in line with the known data that the risk of chronic kidney disease (CKD) rises with age, in part because of cumulative exposure to metabolic risk factors such as diabetes, hypertension, and cardiovascular disease. According to Jha et al. [19], the burden of CKD is rising globally, and aging and related comorbidities play a significant role.The current study revealed a significant male predominance (70%). Previous studies have documented similar gender disparities in the epidemiology of CKD. According to Carrero et al. [20], there are significant sex-related variations in the incidence, course, and results of chronic kidney disease (CKD), with males frequently exhibiting a higher risk of developing severe renal disease. The greater percentage of men in this study may also be due to variations in the distribution of CKD risk factors, referral patterns, occupational and lifestyle-related exposures, and healthcare-seeking behaviors. The research sample and hospital-based recruitment may have an impact on the gender distribution, so the observed male predominance should be regarded with caution.

Diabetes was a significant clinical disease linked to renal impairment among the study participants, as evidenced by the prevalence of diabetic renal failure (61%) in the current investigation. This result is in line with the notion that diabetes is one of the main risk factors and causes of chronic kidney disease (CKD). In order to decrease the progression of CKD and lessen related consequences, the KDIGO 2024 Clinical Practice Guideline places a strong emphasis on the early detection and adequate management of diabetes, hypertension, and other modifiable risk factors. The substantial burden of advanced renal dysfunction in the study population is further demonstrated by the comparatively large percentage of persons with renal failure (22%). Even if they are seen in smaller amounts, the presence of diabetes, hypertension, and their combinations emphasizes how cardiometabolic disorders contribute to kidney damage.

The ADA–KDIGO Consensus Report, which highlights that diabetes and CKD frequently coexist and that integrated management of glycaemia, blood pressure, cardiovascular risk, and kidney function is essential to reduce disease progression and

complications, further supports the high prevalence of diabetic renal failure [21].The current study's high prevalence of stage 3 CKD (33%) suggests that many patients were at a point where proper dietary and medicinal management may be crucial for halting the course of the disease. The study population had extensive kidney failure, as seen by the significant proportion of Stages 4 and 5 (38% combined). The KDIGO 2024 Clinical Practice Guideline states that CKD should be categorized according to its cause, GFR category, and albuminuria category since these variables offer crucial information about the prognosis of the illness and support tailored treatment. The distribution found in this study emphasizes the necessity of regular kidney function monitoring and stage-specific dietary treatments.

Particularly pertinent to nutritional treatment is the discovery that 99% of participants were receiving conservative care. Non-dialysis CKD patients, in contrast to those receiving dialysis, may need dietary regimens aimed at preserving sufficient energy and nutritional status while regulating protein, salt, phosphorus, potassium, and other nutrients in accordance with specific clinical needs. In order to slow the progression of chronic kidney disease (CKD) and its complications, KDIGO 2024 places a strong emphasis on tailored, patient-centered therapy with suitable lifestyle and nutritional therapies. The study location, patient selection, referral patterns, or inclusion criteria may also have an impact on the extremely low percentage of patients receiving hemodialysis in this particular study. As a result, these results could not accurately reflect the distribution of treatments for the larger CKD population. Although 81.25% of participants had a normal BMI, the finding that 40% were moderately malnourished according to SGA highlights the limitations of BMI as a sole indicator of nutritional status in CKD patients. A normal BMI does not necessarily indicate adequate nutritional status because CKD can be associated with loss of muscle mass, depletion of fat stores, inflammation, metabolic abnormalities, and fluid retention.

The 2024 ESPEN practical guideline emphasizes that patients with CKD are at increased risk of malnutrition and muscle wasting due to inadequate dietary intake, chronic inflammation, metabolic disturbances, and disease-related factors [23]. Therefore, nutritional deterioration may occur even when body weight remains within the normal BMI range.The discrepancy between BMI and SGA observed in the present study is particularly important. Fluid retention, which is common in advanced CKD, may increase body weight and potentially mask the loss of lean body mass. Consequently, relying only on BMI may underestimate the prevalence and severity of malnutrition. The present findings support the use of a multidimensional nutritional assessment in CKD, incorporating dietary intake, anthropometric measurements, biochemical parameters, functional measures, and validated nutritional assessment tools such as SGA. This approach can facilitate early identification of nutritional risk and appropriate nutritional intervention, consistent with current renal nutrition recommendations [22,23].

The inadequate energy intake observed in the present study may have important implications for the nutritional status of CKD patients. A mean energy intake of 27.5 kcal/kg/day was below the recommended level, which may contribute to negative energy balance and progressive depletion of body protein stores when sustained over time. The mean protein intake of 0.55 g/kg/day was also relatively low. While controlled protein intake is an important component of nutritional management in non-dialysis CKD, excessive restriction without adequate energy provision may increase the risk of loss of lean body mass and protein-energy wasting. Previous literature has emphasized the importance of maintaining an appropriate balance between protein restriction and nutritional adequacy in CKD [16,17].

The contribution of fat to total energy intake was only 22.5%, which may have further contributed to the overall inadequate energy intake. In CKD patients, sufficient energy intake is particularly important because inadequate energy availability can promote the utilization of endogenous protein for energy, potentially aggravating muscle wasting and nutritional deterioration [18]. These findings emphasize the importance of individualized dietary counselling for CKD patients. Nutritional interventions should not focus solely on restricting protein but should also ensure adequate energy intake and appropriate distribution of macronutrients according to CKD stage, comorbidities, nutritional status, and treatment status. Individualized nutrition therapy is therefore essential for maintaining nutritional status while supporting the management of CKD and its associated complications [11].

The high occurrence of elevated serum uric acid observed in the present study may be explained by impaired renal excretion of uric acid in patients with CKD. As kidney function declines, the ability of the kidneys to eliminate uric acid decreases, resulting in its accumulation in the circulation [22]. Hyperuricemia is clinically relevant in CKD because it may be associated with gout and other cardiometabolic complications [24]. The elevated serum creatinine levels observed in the majority of participants are consistent with reduced kidney filtration capacity. Creatinine is commonly used as an

indicator of kidney function, and its elevation generally reflects impaired renal clearance. Reduced renal function may also contribute to impaired uric acid excretion and consequently higher serum uric acid concentrations. Therefore, uric acid levels should be interpreted in conjunction with serum creatinine and eGFR rather than as an isolated marker of kidney disease severity.

The reduced eGFR observed across the different CKD stages confirms varying degrees of renal impairment among the study participants. Since the kidneys play a major role in uric acid elimination, declining GFR can contribute to increased serum uric acid concentrations. However, hyperuricemia alone should not be considered a definitive marker of CKD progression, as the relationship between serum uric acid and deterioration of kidney function is complex and may be influenced by several clinical and dietary factors [22]. From a nutritional perspective, these findings highlight the importance of individualized dietary management for CKD patients with hyperuricemia. Dietary counselling may include moderation of purine-rich foods and excessive fructose intake, while ensuring adequate energy and an appropriate protein intake according to CKD stage and individual nutritional requirements. Such an approach can help address hyperuricemia while minimizing the risk of malnutrition and protein-energy wasting in CKD patients.

Conclusion

The study demonstrates that malnutrition is highly prevalent among patients with chronic kidney disease and is frequently under-recognized when relying solely on anthropometric measures such as BMI. Comprehensive assessment using SGA, dietary evaluation, and biochemical markers revealed significant nutritional deficits, anaemia, and hypoalbuminemia. These findings underscore the importance of integrating routine nutritional screening and individualized dietary management into standard nephrology care. Early nutritional intervention may reduce complications, improve metabolic stability, and enhance overall prognosis and quality of life in CKD patients.

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Author contribution

The methodology and concept of research was given by Dr. Priyanka Bhattacharyya. Conduction of research was done by Jebin Sultana. Supervision of research work was done by Sameya Sultana

Declarations

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Conflict of interest

The author(s) do not have any conflict of interest.

Data availability statement

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics statement

The human experimental procedures were reviewed and approved by the Institutional Ethics Committee (IAEC) of Apollo Hospitals, Guwahati on14/06/2023. All experiments were conducted in accordance with relevant national and international guidelines.

Informed consent statement

Prior consent was taken by the respondents before commencement of the research. The informed consent was designed as per the guidelines of Apollo Hospitals, Guwahati, Assam.

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