JOURNAL OF SCIENCE & DISEASES

Factors associated with mortality in patients with chronic kidney disease

Facteurs associés à la mortalité chez les patients atteints de maladie rénale chronique

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Article original

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Keywords: Associated factors, Chronic kidney disease, Mortality, Hemodialysis.

Mots clés : Facteurs associés, Maladie rénale chronique, Mortalité, Hémodialyse.

ABSTRACT

Background: Chronic kidney disease (CKD) is a major cause of mortality worldwide, with disproportionately high rates in Africa, affecting patients' quality of life, management, and survival. This study aimed to identify factors associated with mortality among CKD patients receiving care in the hemodialysis unit of the Douala General Hospital.
Methodology: We conducted a prospective study in the hemodialysis unit of the Douala General Hospital over a 9-month period, during which 300 patients were monitored. Sociodemographic, clinical, and therapeutic follow-up data were collected using a structured questionnaire. Univariate and multivariate logistic regressions were performed to determine factors associated with mortality.
Results: The mean age of the patients was 49.46 ± 13.87 years, ranging from 17 to 78 years. Sixty-seven patients (26%) were aged 17 to 40 years, 124 (47%) were aged 40 to 60 years, and 71 (27%) were over 60 years old. Men accounted for 60% of the patients. Additionally, 63% of the patients were married, and 41% worked in the informal sector. The average number of years on dialysis was 3 years, and the mortality rate in our sample was 14.91%. Factors significantly associated with mortality included diabetes (aOR=4.28, CI: 1.86-9.73, p<0.001), physical inactivity (aOR=11.6, CI: 4.68-30.2, p<0.001), consumption of natural products (aOR=4.68, CI: 1.79-14.0, p=0.003), and clinical symptoms such as cramps (aOR=0.06, CI: 0.01-0.38, p=0.005), anuria (aOR=4.64, CI: 1.1-18.5, p=0.03), oliguria (aOR=5.76, CI: 1.43-21.2, p=0.009), and uremic syndrome (aOR=8.96, CI: 1.62-47.6, p=0.009).
Conclusion: Reducing mortality among CKD patients requires addressing risky behaviors such as sedentary lifestyles and the use of herbal decoctions, preventing vascular access infections, and managing comorbidities like diabetes.

RESUME

Contexte : La maladie rénale chronique (MRC) est une cause majeure de mortalité à l'échelle mondiale, avec des taux disproportionnellement élevés en Afrique, affectant la qualité de vie, la prise en charge et la survie des patients. Cette étude visait à identifier les facteurs associés à la mortalité chez les patients atteints de MRC recevant des soins dans l'unité d'hémodialyse de l'Hôpital Général de Douala.
Méthodologie : Nous avons mené une étude prospective dans l'unité d'hémodialyse de l'Hôpital Général de Douala sur une période de 9 mois, durant laquelle 300 patients ont été suivis. Les données sociodémographiques, cliniques et de suivi thérapeutique ont été recueillies à l'aide d'un questionnaire structuré. Des régressions logistiques univariées et multivariées ont été effectuées pour déterminer les facteurs associés à la mortalité.
Résultats : L'âge moyen des patients était de 49,46 ± 13,87 ans, avec une plage allant de 17 à 78 ans. 67 (26 %) patients avaient entre 17 et 40 ans, 124 (47 %) entre 40 et 60 ans, et 71 (27 %) avaient plus de 60 ans. Les hommes représentaient 60 % des patients. Par ailleurs, 63 % des patients étaient mariés et 41 % travaillaient dans le secteur informel. Le nombre d'années moyen d'ancienneté en dialyse était de 3ans et le taux de mortalité dans notre échantillon était de 14,91%. Les facteurs significativement associés à la mortalité étaient le diabète (aOR=4,28, IC: 1,86-9,73, p<0,001), la sédentarité (aOR=11,6, IC: 4,68-30,2, p<0,001), la consommation de produits naturels (aOR=4,68, IC: 1,79-14,0, p=0,003), les symptômes cliniques tels que les crampes (aOR=0,06, IC: 0,01-0,38, p=0,005), l'anurie (aOR=4,64, IC: 1,1-18,5, p=0,03), l'oligurie (aOR=5,76, IC: 1,43-21,2, p=0,009) et le syndrome urémique (aOR=8,96, IC: 1,62-47,6, p=0,009).
Conclusion : Réduire la mortalité chez les patients atteints de maladie rénale chronique nécessite de s'attaquer aux comportements à risque tels que le mode de vie sédentaire et l'utilisation de décoctions à base de plantes, de prévenir les infections des accès vasculaires et de gérer les comorbidités comme le diabète.

Citation as J Sci Dis 2025, Vol 3 (1): 19 – 25

Introduction

Chronic kidney disease (CKD) is one of the leading causes of mortality worldwide, with its prevalence increasing significantly as populations age. Between 1990 and 2016, the global prevalence of CKD rose by 87%, while CKD-related mortality nearly doubled, increasing from 599,200 to 1,186,561 deaths, representing a 98% rise (1). During this period, CKD-related deaths per 100,000 population increased from 11.38 to 16.05, making CKD one of the fastest-growing causes of death globally (2,3). By 2040, CKD is projected to become the fifth leading cause of death worldwide (4).

In Africa, CKD poses a significant public health challenge, accounting for 4% to 22% of deaths in tropical regions (5,6). Despite the role of hemodialysis in preventing uremia-related deaths, survival rates remain low, with mortality rates ranging from 20% to 30% in Africa (7). For instance, Gavardo Hospital in Mali reported a mortality rate of 23%, compared to 9% in Japan, 15% in Europe, and 22% in the United States (8). In sub-Saharan Africa, mortality rates within the first 90 days of starting hemodialysis can reach as high as 90% (9,10). In Cameroon, Aseneh *et al.* reported that the overall mortality within 12 months of initiating hemodialysis ranged between 26.83% and 38.6% (11).

Several factors contribute to CKD-related mortality, including age, gender, hypertension, diabetes, acute kidney injury, cardiovascular diseases, hepatitis C, HIV, and malignancies. However, specific data from Cameroon remains limited. Hemodialysis remains the sole renal replacement therapy available in Cameroon, with access limited to a few centers, including the Douala General Hospital, one of the largest in the country (10). Understanding the factors contributing to CKD-related mortality in Cameroon is crucial for improving care, reducing mortality, and optimizing resources. This study aimed to investigate mortality among chronic hemodialysis patients followed up in the hemodialysis unit of Douala General Hospital.

Patients and methods

The study was conducted over a 9-month period (January to September 2024) in the hemodialysis unit of Douala General Hospital, Cameroon, with ethical approval and informed consent obtained. A total of 300 stage V CKD patients undergoing their first hemodialysis session and who agreed to participate in the study by providing informed consent were included. Data were collected using structured questionnaires and patient medical records, including sociodemographic information, medical history, dialysis side effects, therapeutic monitoring (calcium, phosphorus, CRP, and hemoglobin), and patient outcomes. Laboratory measurements followed standard methods: calcium (CPC method) (12), phosphorus (*Daly et al.*) (13), hemoglobin (colorimetric method) (14), and CRP (Latex Test Kit) (15). Vascular access infections were diagnosed based on clinical signs, microbiological analyses, and inflammatory markers, following guidelines from *Maki et al.* (11), IDSA (13), and *Lok & Mokrzycki* (14). Statistical analysis was performed using R software (version 4.4.2), with variables presented as frequencies and percentages. Fisher's and Pearson's chi-square tests were used to assess associations. Univariate and multivariate logistic regressions identified factors associated with mortality, with significance set at $p < 0.05$.

Results

Socio-demographic characteristics of patients

Table 1 shows that age and marital status were significantly associated with mortality. Patients over 60 years had the highest mortality rate (47%, $p = 0.016$), and widowed patients had a higher mortality rate (21%, $p = 0.038$). In contrast, sex ($p = 0.2$) and profession ($p = 0.4$) were not significantly associated with mortality, although higher mortality was noted in the informal sector (47%) and among retirees (21%). (**Table 1**).

Comorbidities and Lifestyle Factors in Patients with Chronic Kidney Disease

Table 2 highlights that diabetes ($p < 0.001$), sedentary lifestyle ($p < 0.001$), and consumption of natural products ($p < 0.001$) were significantly associated with mortality. Deceased patients had higher rates of diabetes (39%), sedentary behavior (47%), and natural product use (82%) compared to survivors. Alcohol consumption was also significant ($p = 0.019$), with 47% of deceased patients consuming alcohol. Other comorbidities, such as hypertension, gout, HIV, and tobacco use, were not significantly associated with mortality. (**Table 2**).

Socio-demographic factors associated with mortality

Patients aged over 60 years have an increased risk of mortality (cOR = 3.61, 95% CI: 1.32-11.60, p = 0.019), and widowed individuals also show a higher risk (cOR = 4.62, 95% CI: 1.37-15.80, p = 0.013). In contrast, sex, occupation, and other age

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or marital status categories do not show a statistically significant relationship with mortality (p > 0.05). (**table3**).

Table1: *Socio-demographic characteristics of patients*

	Status			
	Overall (N = 262)	**Deceased (N = 228)**	**living (N = 34)**	
Socio-demographic parameters	**n (%)**	**n (%)**	**n (%)**	**p-value**
Age				**0.016**
40-60 years	124 (47%)	111 (49%)	13 (38%)	
>60 years	71 (27%)	55 (24%)	16 (47%)	
17-40 years	67 (26%)	62 (27%)	5 (15%)	
Sex				**0.2**
Masculin	157 (60%)	140 (61%)	17 (50%)	
Female	105 (40%)	88 (39%)	17 (50%)	
Marital status				**0.038**
Married	148 (63%)	128 (64%)	20 (59%)	
Single	67 (29%)	60 (30%)	7 (21%)	
Widower	18 (7.7%)	11 (5.5%)	7 (21%)	
Divorced	2 (0.9%)	2 (1.0%)	0 (0%)	
Profession				**0.4**
informal sector	88 (41%)	72 (40%)	16 (47%)	
liberal sector	43 (20%)	38 (21%)	5 (15%)	
Retirement	29 (14%)	22 (12%)	7 (21%)	
public sector	15 (7.0%)	14 (7.8%)	1 (2.9%)	
Student	14 (6.5%)	14 (7.8%)	0 (0%)	
without profession	15 (7%)	12 (6.7%)	3 (8.8%)	
private sector	10 (4.7%)	8 (4.4%)	2 (5.9%)	

Qualitative data are presented as frequencies (N, n) and percentages (%). P-value: the Pearson independence test was used to test for dependence between socio-demographic factors and mortality. For these tests, the confidence interval for the null hypothesis (Ho) was set at 95% and the margin of error at 5% (H0 rejected at p<0.05).

Table 2: *Comorbidities and Lifestyle Factors in Patients with Chronic Kidney Disease*

	Overall (N = 262)	Deceased (N = 228)	living (N = 34)	
Parameters	**n (%)**	**n (%)**	**n (%)**	**p-value**
Diabetes				**<0.001**
No	206 (83%)	186 (87%)	20 (61%)	
Yes	42 (17%)	29 (13%)	13 (39%)	
HTA				**>0.9**
No	48 (18%)	42 (18%)	6 (18%)	
Yes	213 (82%)	186 (82%)	27 (82%)	
Gout				**>0.9**
No	254 (97%)	221 (97%)	33 (97%)	
Yes	8 (3.1%)	7 (3.1%)	1 (2.9%)	
VIH				**0.6**
No	251 (96%)	219 (96%)	32 (94%)	
Yes	10 (3.8%)	8 (3.5%)	2 (5.9%)	
Tobacco				**0.084**
No	257 (98%)	225 (99%)	32 (94%)	
Yes	4 (1.5%)	2 (0.9%)	2 (5.9%)	
Alcohol				**0.019**
No	183 (70%)	165 (73%)	18 (53%)	
Yes	78 (30%)	62 (27%)	16 (47%)	
Sedentary				**<0.001**
No	229 (88%)	211 (93%)	18 (53%)	
Yes	32 (12%)	16 (7.0%)	16 (47%)	
Natural products				**<0.001**
No	133 (51%)	127 (56%)	6 (18%)	
Yes	128 (49%)	100 (44%)	28 (82%)	

Table 3: *Univariate Logistic Regression Analysis of Sociodemographic Factors and Mortality*

Socio-demographic factors	***cOR***	**CI 95%**	**P**
Sexe			**0.2**
Feminin	1		
Masculin	0.63	0.30-1.30	0.2
Age			**0.022**
17-40years	1		
40-60years	1.45	0.52-4.70	0.5
>60years	3.61	1.32-11.60	0.019
Marital Status			**0.043**
Single	1		
Married	1.34	0.56-3.57	0.5
Widower	4.62	1.37-15.80	0.013
Occupation			**0.60**
Informal Sector	1		
Retired	1.71	0.60-4.5	0.3
Without Profession	1.34	0.28-4.83	0.7
Liberal Sector	0.71	0.22-1.96	0.5
Private Sector	1.34	0.19-5.99	0.7
Public Sector	0.38	0.02-2.13	0.4

cOR: Crude Odds ratio. CI: confidence intervalle

Comorbidities associated with mortality

Among the comorbidities studied, diabetes was significantly associated with an increased risk of mortality (cOR = 4.17, 95% CI: 1.85-9.25, p < 0.001). However, hypertension (HTA), drop (hypotension during dialysis), and HIV did not show statistically significant associations with mortality, as their p-values were greater than 0.05. (**Table 4**).

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Table 4: *Univariate Logistic Regression Analysis of Comorbidities and Mortality*

Comorbities	cOR	IC 95%	P
Diabete			**<0.001**
No	1		
Yes	4.17	1.85-9.25	<0.001
Hta			>0.9
No	1		
Yes	1.02	0.42-2.86	>0.9
Drop			>0.9
No	1		
Yes	0.96	0.05-5.62	>0.9
Vih			0.5
No	1		
Yes	1.71	0.25-7.21	0.5

HTA: high blood pressure, VIH: human immunodeficiency virus, cOR= Crude Odds Ratio, CI 95%= 95% Confidence Interval. P-value significant if p<0.05.

Behavioural factors associated with mortality

Alcohol consumption: individuals who reported consuming alcohol have a cOR of 2.37 (95% CI: 1.13-4.94) with a p-value of 0.021, indicating a significant association. For tobacco use, although the cOR is 7.03 (95% CI: 0.82-60.3) with a p-value of 0.055, this association is not statistically significant (p>0.05). Sedentary individuals have a cOR of 11.7 (95% CI: 5.07-27.7) and a p-value of <0.001, suggesting a strong significant association with the sedentary factor. Finally, the use of natural products shows a cOR of 5.93 (95% CI: 2.52-16.3), with a p-value of <0.001, indicating a significant association as well (Table 5).

Table 5: *Logistic Regression Analysis of Behavioral Factors and Mortality*

Behavioural Factors	cOR	IC 95%	p
Alcohol			**0.023**
No	1		
Yes	2.37	1.13-4.94	**0.021**
Tobacco			0.072
No	1		
Yes	7.03	0.82-60.3	**0.055**
Sedentary			**<0.001**
No	1		
Yes	11.7	5.07-27.7	**<0.001**
Natural Products			**<0.001**
No	1		
Yes	5.93	2.52-16.3	**<0.001**

cOR= Crude Odds Ratio, CI 95%= 95% Confidence Interval. P-value significant if p<0.05.

Symptomatologies factors associated with mortality

Patients presenting with nausea (cOR = 9.26, 95% CI: 3.42-25.6), cramps (cOR = 14.6, 95% CI: 4.68-50.9), insomnia (cOR = 10.4, 95% CI: 3.57-31.5), drowsiness (cOR = 7.14, 95% CI: 2.1-24.4), or uremic syndrome (cOR = 18.6, 95% CI: 7.15-52) have a significantly increased risk (P < 0.05) compared to asymptomatic patients. Conversely, symptoms such as convulsions (cOR = 6.18, 95% CI: 0.24-159, P = 0.2) and anuria (cOR = 1.96, 95% CI: 0.95-4.12, P = 0.07) do not show a statistically significant relationship with the outcome studied. Oliguria is associated with a significantly reduced risk (cOR = 0.36, 95% CI: 0.16-0.77, P = 0.01). (**Table 6**).

Table 6: *Univariate Logistic Regression Analysis of Symptomatology Associated with Mortality*

Symptomatology	cOR	IC 95%	P
Nausea			**<0.001**
No	1		
Yes	9.26	3.42-25.6	<0.001
Cramps			**<0.001**
No	1		
Yes	14.6	4.68-50.9	<0.001
Insomnia			**<0.001**
No	1		
Yes	10.4	3.57-31.5	**<0.001**
Drowsiness			**0.002**
No	1		
Yes	7.14	2.1-24.4	**0.001**
Convulsion			0.2
No	1		
Yes	6.18	0.24-159	0.2
Anuria			0.07
No	1		
Yes	1.96	0.95-4.12	0.07
Oliguria			**0.008**
No	1		
Yes	0.36	0.16-0.77	**0.01**
Uremic Syndrome			**<0.001**
No	1		
Yes	18.6	7.15-52	**<0.001**

cOR: Crude Odds ratio. CI: confidence intervalle

Therapeutic follow-up factors associated with mortality

An elevated CRP is associated with an increased risk (cOR = 3.92, 95% CI: 1.24-17.4, P = 0.037). Patients undergoing monthly follow-ups have a significantly reduced risk (cOR = 0.23, 95% CI: 0.07-0.80, P = 0.013). Conversely, factors such as

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severe hypocalcemia (cOR = 1.66, 95% CI: 0.51-4.61, P = 0.4), hyperphosphatemia (cOR = 1, 95% CI: 0.37-2.49, P > 0.9), and severely reduced hemoglobin levels (cOR = 1.85, 95% CI: 0.87-4.01, P = 0.11) do not show a statistically significant association with the studied outcome (**Table 7**).

Tableau 7: *Logistic Regression Analysis of Therapeutic Follow-Up Markers and Mortality*

Therapeutic follow-up factors	*cOR*	IC 95%	p
Calcium			0.4
Normal serum calcium	1		
Severe hypocalcemia	1.66	0.51-4.61	0.4
CRP			**0.018**
Normal	1		
High	3.92	1.24-17.4	**0.037**
Hemoglobin			0.11
Normal hemoglobin	1		
Severe hemoglobin	1.85	0.87-4.01	0.11
Phosphorus			>0.9
Normal phosphatemia	1		
Hyperphosphatemia	1.	0.37-2.49	>0.9
Monthly review			**0.022**
No			
Yes	0.23	0.07-0.80	**0.013**

cOR: Crude Odds ratio. CI: confidence interval

Facteurs associés à la mortalité

Le diabète (aOR=4,28, IC: 1,86-9,73, p<0,001), la sédentarité (aOR=11,6, IC: 4,68-30,2, p<0,001) et la consommation de produits naturels (aOR=4,68, IC: 1,79-14,0, p=0,003) étaient significativement associés. Les symptômes cliniques tels que les crampes (aOR=0,06, IC: 0,01-0,38, p=0,005), l'anurie (aOR=4,64, IC: 1,1-18,5, p=0,03), l'oligurie (aOR=5,76, IC: 1,43-21,2, p=0,009) et le syndrome urémique (aOR=8,96, IC: 1,62-47,6, p=0,009) ont également montré des associations significatives (**Table 8**).

Discussion

Our study identified several factors significantly associated with mortality among hemodialysis patients. The mean age of the patients was 49.46 ± 13.87 years, with 27% being over 60 years old. Age was not significantly associated with mortality in multivariate analysis, contrasting with the findings of Epstein *et al.* (16) and Gourtsoyiannis *et al.* (17–19), which highlighted nephron loss and reduced renal blood flow associated with aging.

Table 8: *Multivariate logistic regression of factors associated with mortality in univariate analysis.*

Factors	*aOR*	IC 95%	p
Age groups			
17-40years	1		0.7
40-60years	1.09	0.33-4	0.9
>60years	2.02	0.52-8.56	0.3
Marital status			0.3
Single	1		
Married	1.18	0.42-3.66	0.8
Diabete			**<0.001**
No	1		
Yes	4.28	1.86-9.73	<0.001
Alcohol			0.2
No	1		
Yes	1.75	0.72-4.31	0.2
Tobacco			0.8
No	1		
Yes	1.42	0.11-17.2	0.8
Sedentary			**<0.001**
No	1		
Yes	11.6	4.68-30.2	<0.001
Natural Products			**0.001**
No	1		
Yes	4.68	1.79-14.0	0.003
Nausea			0.4
No	1		
Yes	0.4	0.05-3.26	0.4
Cramps			**0.002**
No	1		
Yes	0.06	0.01-0.38	0.005
Insomnia			0.1
No	1		
Yes	0.19	0.02-1.36	0.1
Drowsiness			0.11
No	1		
Yes	7.67	0.66-140	0.13
Anuria			**0.037**
No	1		
Yes	4.64	1.1-18.5	0.03
Oliguria			**0.03**
No	1		
Yes	5.76	1.43-21.2	0.009
Uremic syndrome			**0.013**
no	1		
Yes	8.96	1.62-47.6	0.009
CRP			0.2
Normal	1		
High	2.96	0.64-22.1	0.2
Monthly review			0.3
No	1		
Yes	0.36	0.06-2.33	0.3

CRP:C-Reactive Protein, aOR: Ajust Odds ratio; CI: Confidence interval

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However, previous studies in Cameroon reported that age was not a significant factor, likely due to the higher prevalence of younger patients in dialysis cohorts.

Diabetes emerged as a strong predictor of mortality (aOR = 4.28, 95% CI: 1.86–9.73, p < 0.001), consistent with global evidence on its detrimental impact on the progression of chronic kidney disease (20–21). In line with Tonelli *et al.* (22), sedentary behavior (aOR = 11.6, 95% CI: 4.68–30.2, p < 0.001) and the use of natural decoctions (aOR = 4.68, 95% CI: 1.79–14.0, p = 0.003) were also significant. These behaviors, prevalent in Cameroon, are known to exacerbate CKD progression and increase mortality, mainly due to chronic inflammation and delays in seeking appropriate care (23–25).

Clinical symptoms such as cramps (aOR = 0.06, 95% CI: 0.01–0.38, p = 0.005), anuria (aOR = 4.64, 95% CI: 1.1–18.5, p = 0.03), oliguria (aOR = 5.76, 95% CI: 1.43–21.2, p = 0.009), and uremic syndrome (aOR = 8.96, 95% CI: 1.62–47.6, p = 0.009) were significantly associated with mortality. These findings align with local studies highlighting the severity of symptoms in advanced stages of CKD and their contribution to mortality (26–29).

Infections associated with temporary catheters were significantly linked to mortality (p = 0.017). These results are consistent with previous studies emphasizing the increased risk of infections and complications associated with central venous catheters compared to arteriovenous fistulas (27–29). Cameroonian data also stress the importance of optimizing vascular access to reduce catheter-related mortality among hemodialysis patients.

Elevated levels of C-reactive protein (CRP) (p = 0.018) were associated with mortality in univariate analysis but lost significance in multivariate analysis. CRP, a marker of systemic inflammation, is recognized as a predictor of mortality in CKD patients (30–32). Monthly clinical reviews, rarely conducted, showed a protective trend (p = 0.032), suggesting that regular follow-up could improve outcomes. However, their impact remains underexplored in Cameroon, highlighting the need for further research on their role in enhancing survival.

Conclusion

Diabetes, sedentary behavior, the use of natural products, symptoms of advanced CKD stages, and catheter-related infections were significant predictors of mortality. These findings underscore the importance of addressing modifiable risk factors and optimizing therapeutic strategies, particularly in resource-limited settings like Cameroon, to improve survival outcomes in hemodialysis patients.

Conflicts of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

Authors' contributions

ENLPJ **designed the experimental approach and the writing plan**. ENLPJ and NNE **recruited the participants and carried out the laboratory analyses.** ENLPJ and FH **carried out the statistical analysis**. ENLPJ **drew all the figures**. ENLPJ **wrote the draft**. ANLPJ, NNA and FH **reviewed the manuscript.** All the authors mentioned made a substantial, direct and intellectual contribution to the work and approved it for publication.

Acknowledgements

Many thanks to all the people who voluntarily agreed to take part in the study, and to the staff of the haemodialysis department at the General Hospital for their support throughout the work.

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Citation as **J Sci Dis 2025, Vol 3 (1): 19 – 25**