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Comparison of Anaemia Severity between Diabetic and Non-Diabetic Chronic Kidney Disease Patients Attending at a Tertiary Level Hospital in Bangladesh

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Abstract

Background: Anaemia is a common and clinically significant complication of chronic kidney disease (CKD) that contributes to cardiovascular morbidity and accelerated disease progression. Diabetes mellitus (DM), a leading cause of CKD has been independently associated with a higher prevalence and greater severity of anaemia. ***Objective:*** To compare the prevalence and severity of anaemia between diabetic and non-diabetic CKD patients and to identify independent predictors of moderate-to-severe anaemia in this population. ***Methods:*** This comparative cross-sectional study was conducted in the Department of Nephrology, Tangail Medical College and Hospital, Tangail, Bangladesh, from June 2024 to May 2025. A total of 348 patients with CKD were enrolled, including 174 diabetic CKD patients and 174 age- and sex-comparable non-diabetic CKD patients. Anaemia was defined according to World Health Organization (WHO) sex-specific hemoglobin (Hb) cut-offs (<13 g/dL in males and <12 g/dL in females) and further classified as mild, moderate or severe. Data were analyzed and compared by statistical tests. ***Results:*** Diabetic CKD patients were significantly older (59.2±10.2 versus 55.8±11.7 years; p= 0.005) and had a more advanced CKD stage distribution (56.9% versus 42.5% in Stage 4-5; p<0.001). Mean hemoglobin was significantly lower in the diabetic group (10.04±1.89 versus 11.16±2.04 g/dL; p<0.001), and anaemia was significantly more prevalent (87.4% versus 71.3%; p<0.001), with a significant shift toward moderate-to-severe grades (48.9% versus 27.6%; p<0.001). Diabetic status remained an independent predictor of moderate-to-severe anaemia after adjustment for CKD stage, age and disease duration [adjusted odds ratio (AOR) 2.24, 95% CI 1.36–3.68; p= 00.001], with CKD Stage 4-5 the strongest predictor (AOR 6.32, 95% CI 3.81–10.48; p<0.001). ***Conclusion:*** Diabetic CKD patients demonstrated significantly higher prevalence and severity of anaemia than non-diabetic CKD patients, which is independent of CKD stages. Routine, regular hemoglobin screening should be incorporated into the clinical management of diabetic CKD patients.

Keywords: Anaemia Severity, Chronic Kidney Disease (CKD), Diabetes Mellitus (DM), Disease Duration, Hemoglobin.

INTRODUCTION

Chronic kidney disease (CKD) is a major non-communicable disease and a growing public health concern worldwide, defined by persistent abnormalities of kidney structure or function and associated with progressive loss of renal function, heightened cardiovascular risk, and premature mortality [1, 2]. The global burden of CKD continues to rise

disproportionately in low- and middle-income countries, where diabetes mellitus (DM), hypertension (HTN), delayed diagnosis and limited access to specialized renal care drive disease progression [1, 3].

Anaemia is among the most common and clinically significant complications of CKD. It typically emerges as glomerular filtration rate declines and becomes increasingly prevalent in advanced disease stages [4]. Its pathogenesis is multifactorial, encompassing reduced renal erythropoietin production, iron deficiency, chronic low-grade inflammation, shortened erythrocyte survival, accumulation of uraemic toxins and impaired iron utilization [4, 5]. Anaemia in CKD is not merely a laboratory finding; it is associated with fatigue, diminished exercise tolerance, impaired quality of life, accelerated progression of renal dysfunction, cardiovascular morbidity, hospitalization and increased mortality [4]. Diabetes mellitus is one of the leading causes of CKD and may independently aggravate anaemia. In diabetic CKD, anaemia can appear earlier and pursue a more severe course than in non-diabetic CKD with comparable renal impairment. Proposed mechanisms include diabetic nephropathy, tubulointerstitial damage, blunted erythropoietin response, autonomic neuropathy, chronic inflammation, albuminuria and associated nutritional or cardiovascular complications [6]. In a nested case-control study matching 184 diabetic and 184 non-diabetic CKD patients by age, sex, and estimated glomerular filtration rate (eGFR), Loutradis *et al.,* reported a substantially higher prevalence of anaemia among diabetic patients than non-diabetic patients (47.8% versus 33.2%), with the disparity most pronounced in CKD Stage 3a (60.4% versus 26.4%) [7]. These findings indicate that diabetes may act as an independent contributor to anaemia in CKD, over and above the degree of renal impairment itself. In South Asia, including Bangladesh, both CKD and diabetes mellitus are increasing public health concerns, and access to renal replacement therapy remains constrained relative to disease burden [8]; however, local evidence comparing anaemia severity between diabetic and non-diabetic CKD patients remains limited, particularly outside major metropolitan centers. District-level tertiary hospitals, which manage a substantial share of the country's CKD caseload, have been especially underrepresented in the existing literature. This study was therefore conducted to compare the severity of anaemia between diabetic and non-diabetic CKD patients attending at a tertiary level hospital in Tangail, Bangladesh, with the intention of contributing setting-specific evidence to inform earlier identification and more targeted clinical management of anaemia in this population.

METHODOLOGY

Study Design and Setting

This was a hospital-based comparative cross-sectional study conducted in the Department of Nephrology, Tangail Medical College and Hospital, Tangail, Bangladesh, over a 12-month period from June 2024 to May 2025.

Study Population

The study population comprised adult patients (aged 18 years or above) with a confirmed diagnosis of chronic kidney disease (CKD) who attended the nephrology outpatient and inpatient services of this hospital during the study period.

Sample Size Determination

The sample size was calculated using the standard formula for comparison of two independent proportions, based on the reported prevalence of anaemia among diabetic CKD patients (47.8%) and non-diabetic CKD patients (33.2%) by Loutradis *et al.,*[7], with a 5% level of significance and 80% statistical power. The calculated minimum sample size was 174 patients per group, giving a total requirement of 348 CKD patients (174 diabetic and 174 non-diabetic).

Study Groups

Participants were divided into two comparison groups according to diabetic status: Group I-Diabetic CKD patients (n= 174); Group II- Non-diabetic CKD patients (n= 174).

Inclusion Criteria

Adult patients aged 18 years or above with a diagnosed chronic kidney disease who provided informed written consent were included.

Exclusion Criteria

Patients with acute kidney injury (AKI), active bleeding, recent blood transfusion (within the preceding 3 months), known hematological malignancy, pregnancy or those unwilling to participate were excluded.

Sampling Technique

Participants were enrolled purposively according to the eligibility criteria until the required sample size in each group was achieved.

Data Collection Procedure

Data were collected using a pre-tested, structured data collection sheet. Socio-demographic variables (age, sex, residence, socioeconomic status) and clinical information (diabetic status, duration of CKD, CKD stage, history of hypertension, treatment history and relevant comorbidities) were recorded from patient history, clinical examination, and review of available medical records. Staging of CKD was done by estimated glomerular filtration rate (eGFR) determined by the Modification of Diet in Renal Disease (MDRD) formula.

Laboratory Assessment

Venous blood samples were collected under aseptic precautions for estimation of haemoglobin (Hb) and relevant biochemical parameters. Haemoglobin (Hb) concentration was measured by an automated

hematology analyzer. Anaemia was defined and graded according to World Health Organization (WHO)/KDIGO-consistent cut-offs (Table- 1) [5].

Table 1: Anaemia severity classification used in this study

Anaemia Severity	Men (Hb, g/dL)	Women (Hb, g/dL)
Mild anaemia	11.0-12.9	11.0-11.9
Moderate anaemia	8.0-10.9	8.0-10.9
Severe anaemia	<8.0	<8.0

Additional biochemical parameters including-serum creatinine, blood urea, fasting blood sugar (FBS), glycated haemoglobin (HbA1c) and estimated glomerular filtration rate (eGFR,), were recorded where available and CKD was staged according to KDIGO criteria [5].

Outcome Variable

The primary outcome variable was severity of anaemia (mild, moderate, severe) compared between diabetic and non-diabetic CKD patients. Secondary outcomes included mean haemoglobin level and associations between anaemia severity and selected clinical/biochemical parameters.

Statistical Analysis

Data were checked, cleaned, coded, and analyzed using appropriate software Statistical Package for Social Sciences (SPSS) version 26. Quantitative variables were expressed as mean with standard deviation (±SD), or median with interquartile range (IQR) where the distribution was skewed; normality was assessed using the Shapiro-Wilk test. Quantitative variables were compared between groups using the Independent-sample t-test (normally distributed data) or the Mann-Whitney U test (non-normally distributed data). Qualitative variables were expressed as frequency with percentage and compared using the Chi-square test or Fisher's exact test where expected cell counts were below 5. Binary logistic regression was used to identify independent predictors of moderate-to-severe anaemia, with results expressed as adjusted odds ratios (AOR) and 95% confidence intervals (CI). A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from each participant after explaining the purpose, procedure, risks and benefits of the study in the local language. Confidentiality and anonymity of all participant information were strictly maintained throughout data collection, analysis and reporting.

RESULTS

A total of 348 patients with chronic kidney disease were enrolled in this comparative cross-sectional study, comprising 174 diabetic CKD patients and 174 non-diabetic CKD patients. The results of socio-demographic, clinical, biochemical, and hematological comparisons between the two groups are presented below, followed by the distribution of anaemia severity and the results of multivariable logistic regression for predictors of moderate-to-severe anaemia.

Table-2 shows the socio-demographic characteristics of diabetic and non-diabetic CKD patients. Diabetic CKD patients were significantly older than non-diabetic CKD patients (59.2±10.2 versus 55.8±11.7 years; p= 0.005). Sex distribution was almost similar between the groups (p= 0.914). A higher proportion of diabetic CKD patients lived in urban areas, but the difference was not statistically significant (p= 0.097).

Table 2: Socio-demographic characteristics of diabetic and non-diabetic CKD patients (N= 348)

Variable	Diabetic CKD n= 174	Non-diabetic CKD n= 174	p-value
Age (years)	59.2±10.2	55.8±11.7	0.005*
Sex			
Male	94 (54.0)	96 (55.2)	0.914**
Female	80 (46.0)	78 (44.8)	
Residence			
Urban	116 (66.7)	100 (57.5)	0.097**
Rural	58 (33.3)	74 (42.5)	

Data were expressed as mean±SD and frequency with percentage, values within the parentheses indicate corresponding percentage, *Independent t-test and ** Chi-square test was done

In this study, diabetic CKD patients had a significantly longer duration of CKD than non-diabetic CKD patients [3.6 (2.3-4.9) versus 2.7 (1.8-3.9) years; p<0.001]. Advanced CKD, particularly stage 5, was more common among diabetic CKD patients, while early-stage CKD was more frequent among non-diabetic patients (p<0.001). Hypertension was also significantly more common in diabetic CKD patients (83.9% versus 74.7%; p= 00.047). Mean eGFR was significantly lower in diabetic CKD patients, indicating poorer renal function (27.9±21.3 versus 40.0±22.8 mL/min/1.73m²; p<0.001) (Table- 3).

Table 3: Clinical characteristics of diabetic and non-diabetic CKD patients (N= 348)

Variable	Diabetic CKD n= 174	Non-diabetic CKD n= 174	p-value
Duration of CKD (years), median (IQR)	3.6 (2.3-4.9)	2.7 (1.8-3.9)	<0.001[a]
CKD stage, n (%)			
Stage 1-2	17 (9.8)	39 (22.4)	<0.001[b]
Stage 3	58 (33.3)	61 (35.1)	
Stage 4	40 (23.0)	46 (26.4)	
Stage 5	59 (33.9)	28 (16.1)	
History of hypertension, n (%)	146 (83.9)	130 (74.7)	0.047[b]
eGFR (mL/minute/1.73m²), mean±SD	27.9±21.3	40.0±22.8	<0.001[c]

Data were expressed as median (IQR), frequency with percentage and mean±SD, values within the parentheses indicate corresponding IQR/percentage, a= Mann-Whitney U test, b= Chi-square test, c= Independent t-test was done

Mean haemoglobin level was significantly lower among diabetic CKD patients than non-diabetic CKD patients (10.04±1.89 versus 11.16±2.04 g/dL; p<0.001). The proportion of patients with anaemia was also significantly higher in diabetic CKD patients compared with non-diabetic CKD patients (87.4% versus 71.3%; p<0.001) (Table- 4).

Table 4: Comparison of haemoglobin level between diabetic and non-diabetic CKD patients

Variable	Diabetic CKD n= 174	Non-diabetic CKD n= 174	p-value
Haemoglobin (g/dL)	10.04±1.89	11.16±2.04	<0.001*
Patients with anaemia (Hb below sex-specific cut-off)	152 (87.4)	124 (71.3)	<0.001**

Data were expressed as mean±SD and frequency with percentage, values within the parentheses indicate corresponding percentage, *Independent t-test and ** Chi-square test was done

It was observed that, distribution of anaemia severity differed significantly between the two groups (p<0.001).

Moderate-to-severe anaemia was present in 48.9% of diabetic patients compared with 27.6% of non-diabetic patients (Table- 5).

Table 5: Distribution of anaemia severity between diabetic and non-diabetic CKD patients

Severity of anaemia	Diabetic CKD n=174	Non-diabetic CKD n=174	p-value
No anaemia	22 (12.6)	50 (28.7)	<0.001*
Mild anaemia	67 (38.5)	76 (43.7)	
Moderate anaemia	60 (34.5)	35 (20.1)	
Severe anaemia	25 (14.4)	13 (7.5)	
Total	**174 (100.0)**	**174 (100.0)**	

Data were expressed as frequency with percentage, values within the parentheses indicate corresponding percentage, * Chi-square test was done

Table-6 shows the comparison of biochemical parameters between diabetic and non-diabetic CKD patients. Serum creatinine and blood urea levels were significantly higher among diabetic CKD patients than non-diabetic CKD patients (p<0.001), indicating poorer renal function in the diabetic group.

Fasting blood sugar (FBS) was also significantly higher in diabetic CKD patients (162.7±34.7 versus 93.7±10.4 mg/dL; p<0.001).

The mean HbA1c level among diabetic CKD patients was 7.80±1.40%, reflecting suboptimal glycaemic control.

Table 6: Comparison of biochemical parameters between diabetic and non-diabetic CKD patients

Variable	Diabetic CKD n= 174	Non-diabetic CKD n= 174	p-value
S. creatinine (mg/dL)	4.33 (2.10-7.14)	2.27 (1.67-4.82)	<0.001[a]
Blood urea (mg/dL)	88.2 (53.3-131.0)	58.5 (45.0-97.3)	<0.001[a]
FBS (mg/dL)	162.7±34.7	93.7±10.4	<0.001[b]
HbA1c (%)	7.80±1.40	N/A	-

Data were expressed as median (IQR) and mean±SD, values within the parentheses indicate corresponding IQR, a= Mann-Whitney U test, b= Independent t-test was done

Data analysis revealed that, diabetic status remained an independent predictor of moderate-to-severe anaemia after adjustment for CKD stages, age, and disease duration (AOR 2.24; p= 00.001). CKD Stage 4–5 was the strongest predictor (AOR 6.32; p<0.001), and CKD duration ≥5 years was also independently associated with greater anaemia severity (AOR 1.91; p= 00.033). Age ≥60 years was not significant in the adjusted model (p= 00.330) (Table- 7).

Table 7: Predictors of moderate-to-severe anaemia in CKD patients (binary logistic regression)

Variable	Adjusted Odds Ratio (95% CI)	p-value
Diabetic status (versus non-diabetic)	2.24 (1.36-3.68)	0.001
CKD stage 4-5 (versus stage 1-3)	6.32 (3.81-10.48)	<0.001
Age ≥60 years	0.78 (0.47-1.29)	0.330
Duration of CKD ≥5 years	1.91 (1.05-3.47)	0.033

DISCUSSION

Anaemia is a common and consequential complication of CKD that contributes to fatigue, impaired quality of life, cardiovascular complications, and accelerated disease progression[4]. Diabetes mellitus, a leading cause of CKD, may further aggravate anaemia through diabetic nephropathy, blunted erythropoietin response, chronic inflammation, and associated renal injury [6]. Anaemia in CKD patients attributable to relative erythropoietin deficiency, chronic inflammation and autonomic dysfunction superimposed on declining renal function [4]. Although several studies have documented a higher anaemia burden among diabetic CKD patients [7-9], evidence from Bangladesh, and particularly from district-level tertiary hospitals, remains limited. This study was aimed to compare anaemia severity between diabetic and non-diabetic CKD patients attending at a tertiary level hospital in Tangail, Bangladesh, with the aim of supporting earlier detection, risk stratification and more individualized clinical management.

In this comparative study of 348 CKD patients, diabetic patients had significantly lower mean haemoglobin (10.04 g/dL versus 11.16 g/dL; p<0.001), a higher prevalence of anaemia (87.4% versus 71.3%; p<0.001), and a significant shift toward moderate-to-severe grades (48.9% versus 27.6%). Diabetic status remained an independent predictor of moderate-to-severe anaemia after adjustment for CKD stages, age and duration (AOR 2.24), while CKD Stage 4-5 was the strongest overall predictor (AOR 6.32). These results are discussed below against the regional and international literature.

The higher anaemia burden among diabetic CKD patients found here consistent with most comparative studies. Loutradis *et al*., in a matched case-control study of 184 diabetic and 184 non-diabetic CKD patients, reported 47.8% versus 33.2% anaemia prevalence (OR 2.21) [7], closely mirroring the independent effect size found in the present cohort. Maravi *et al.,* reported a similar gradient (47.7% versus 33.0%) among hemodialysis patients in India, with normocytic normochromic anaemia predominating in diabetic CKD [9]- consistent with an erythropoietin-deficient rather than purely iron-deficient process. Earlier population-based work supports the same direction of effect: Astor *et al*., analyzing NHANES III data, found diabetes conferred an odds ratio of 1.6 for anaemia [10], Thomas *et al.,* reported a 23% prevalence of unrecognised anaemia in diabetics, two to three times that of non-diabetics with comparable renal function [11] and Dmitrieva *et al.*, in a primary-care cohort of over a million CKD patients, found anaemia prevalence roughly twice as high in diabetics (30% versus 15%) [12]. However, Cana-Ruiu *et al.,* found no significant difference between diabetic and non-diabetic CKD patients (67.8% versus 63.4%) [13] and Badri *et al.,* also found no significant diabetes-anaemia association in a Karnataka cohort where diabetics formed only 16.5% of the sample [14]. Although, both used smaller or unbalanced samples and non-WHO anaemia thresholds, which likely explains the discrepancy with the present, equally-powered 174-versus-174 design. By contrast, Ghamri *et al.,* reported an exceptionally high prevalence (86.6%) among 1,208 diabetic patients at a Saudi tertiary hospital [15], while another study, auditing a UK community diabetes-CKD clinic, found a lower prevalence of 12%, with haemoglobin correlating

positively with eGFR [16], underscoring that case-mix and care setting strongly influence reported prevalence.

Advancing CKD stage was the dominant predictor of anaemia severity in this study, consistent with Bishaw *et al*., who identified CKD Stage 4 (AOR 3.2) and Stage 5 (AOR 4.03) as independent anaemia predictors [4], and with El-Achkar *et al*., who found diabetes conferred a markedly higher anaemia prevalence specifically at moderate kidney insufficiency in the Kidney Early Evaluation Program [17]. Ravanan *et al.,* similarly found significantly lower haemoglobin in diabetic versus non-diabetic kidney disease only below an eGFR of 60 mL/minute/1.73m², with no difference at higher eGFR [18], indicating the diabetic excess in anaemia becomes apparent only once renal function has meaningfully declined- consistent with the strong stage effect observed here (AOR 6.32). Badri *et al.,* additionally found no significant diabetes–CKD stage association (p= 0.549) in a sample where diabetics formed a small minority [14], plausibly reflecting inadequate power rather than a true absence of effect, in contrast to the present balanced design.

The independent contribution of diabetes itself, beyond renal function, is corroborated by Al-Khoury *et al*., who reported a four-fold increase in anaemia risk with diabetes in CKD [19], and by Craig *et al.,* and Bosman *et al*., who demonstrated that anaemia and erythropoietin deficiency can occur in diabetic patients even before overt nephropathy develops [20, 21]. This supports the present finding that diabetic status remained significant (AOR 2.24) after full adjustment for CKD stage and duration, rather than being a simple proxy for more advanced renal disease.

Consistent with Adhikari *et al*., who found no association between anaemia severity and HbA1c (p= 00.22) in a Nepalese diabetic cohort [22], the present results point to renal function rather than glycaemic control as the dominant driver of anaemia. Fathi *et al.,* similarly identified creatinine, blood urea nitrogen (BUN) and eGFR- not HbA1c- as independent anaemia predictors in Palestinian T2DM patients [23]. Thomas *et al.,* and Hsu *et al.,* add that iron indices and nephropathy status, rather than glycaemic exposure, account for much of the variance in haemoglobin among diabetics [24, 25], reinforcing that the excess anaemia identified here is more plausibly mediated by renal and inflammatory pathways than by hyperglycaemia per se.

Mohanram *et al*., in the RENAAL cohort, showed that each 1 g/dL fall in haemoglobin independently raised the risk of progression to end-stage renal disease (ESRD) by 11% [6], and Kim *et al.,* found diabetic nephropathy patients with anaemia progressed to dialysis substantially faster (45.1 months versus 68.3 months; adjusted HR 8.1) [26]. This suggests the moderate-to-severe anaemia identified among diabetic patients in the present study may also carry prognostic weight for renal outcomes, although longitudinal data would be needed to confirm this locally. The biological basis is well described: some studies attribute diabetic CKD anaemia to relative erythropoietin deficiency, functional and absolute iron deficiency, autonomic neuropathy blunting the erythropoietin response, chronic inflammation, and renin–angiotensin–aldosterone system inhibitor use [27,28], while Tsai and Tarng similarly conclude that diabetic kidney disease anaemia begins earlier and is more severe than non-diabetic CKD anaemia through these combined mechanisms [29].

Anaemia was significantly more frequent and severe among diabetic CKD patients, with diabetes independently doubling the risk of moderate-to-severe anaemia, while advanced CKD stages remained the strongest predictor. These findings align with international evidence and support the KDIGO Clinical Practice Guideline for Anemia in Chronic Kidney Disease, which recommends early screening, evaluation, and timely management of anaemia in CKD, particularly among high-risk groups such as patients with diabetes, to improve clinical outcomes [30].

CONCLUSION

This study demonstrates that anaemia is both more prevalent and more severe among diabetic CKD patients than among non-diabetic CKD patients attending at a tertiary level hospital in Bangladesh, and that diabetic status independently contributes to this excess burden beyond the effect of renal function decline alone. Given the established prognostic significance of anaemia for progression of diabetic kidney disease, routine, proactive haemoglobin screening should be incorporated as a standard component of diabetic CKD care, with the goal of enabling earlier detection, timely intervention, and improved clinical outcomes for this high-risk patient group.

Limitations of the study

The study was conducted at a single center. Randomization was not done because the sample was taken purposively. Moreover, important determinants of anaemia including- iron status, serum ferritin, transferrin saturation (TSAT), vitamin B12/folate levels, inflammatory markers, erythropoietin levels and the use of erythropoiesis-stimulating agents (ESA) or iron therapy were not evaluated. Finally, longitudinal follow-up was not performed; therefore, the impact of anaemia severity on CKD progression and long-term clinical outcomes could not be assessed.

RECOMMENDATIONS

Larger multicenter prospective studies are recommended to confirm these findings and evaluate the long-term impact of anaemia on CKD progression, cardiovascular outcomes and mortality in the Bangladeshi population

Conflicts of Interest

The authors have no competing interest to declare regarding this publication.

REFERENCES

1. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, Adebayo OM, Afarideh M, Agarwal SK, Agudelo-Botero M, Ahmadian E. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The lancet. 2020 Feb 29;395(10225):709-33.
2. Jha V, Garcia-Garcia G, Iseki K, Li Z, Naicker S, Plattner B, Saran R, Wang AY, Yang CW. Chronic kidney disease: global dimension and perspectives. The lancet. 2013 Jul 20;382(9888):260-72.
3. Mills KT, Xu Y, Zhang W, Bundy JD, Chen CS, Kelly TN, Chen J, He J. A systematic analysis of worldwide population-based data on the global burden of chronic kidney disease in 2010. Kidney international. 2015 Nov 1;88(5):950-7.
4. Bishaw F, Woldemariam MB, Mekonen G, Birhanu B, Abebe A. Prevalence of anemia and its predictors among patients with chronic kidney disease admitted to a teaching hospital in Ethiopia: A hospital-based cross-sectional study. Medicine. 2023 Feb 10;102(6):e31797.
5. KDIGO. Kidney disease: Improving Global Outcomes (KDIGO) Anemia Work Group. KDIGO clinical practice guideline for anemia in chronic kidney disease. Kidney International. 2012; 2:279-335.
6. Mohanram A, Zhang Z, Shahinfar S, Keane WF, Brenner BM, Toto RD. Anemia and end-stage renal disease in patients with type 2 diabetes and nephropathy. Kidney Int. 2004;66(3):1131-8.
7. Loutradis C, Skodra A, Georgianos P, Tolika P, Alexandrou D, Avdelidou A, *et al.,* Diabetes mellitus increases the prevalence of anemia in patients with chronic kidney disease: a nested case-control study. World J Nephrol. 2016;5(4):358-66.
8. Prasad N, Jha V. Hemodialysis in asia. Kidney Diseases. 2015 Nov 18;1(3):165-77.
9. Maravi MS, Dhawale S, Kanaujiya SK. Prevalence of anaemia among patients of chronic kidney disease on maintenance hemodialysis with and without type 2 diabetes mellitus: a comparative study. J Popul Ther Clin Pharmacol. 2025;32(8):1326-32.
10. Astor BC, Muntner P, Levin A, Eustace JA, Coresh J. Association of kidney function with anemia: the Third National Health and Nutrition Examination Survey (1988–1994). Arch Intern Med. 2002;162(12):1401-8.
11. Thomas MC, MacIsaac RJ, Tsalamandris C, Power D, Jerums G. Unrecognized anemia in patients with diabetes: a cross-sectional survey. Diabetes Care. 2003;26(4):1164-9.
12. Dmitrieva O, de Lusignan S, Macdougall IC, Gallagher H, Tomson C, Harris K, *et al.,* Association of anaemia in primary care patients with chronic kidney disease: cross sectional study of quality improvement in chronic kidney disease (QICKD) trial data. BMC Nephrol. 2013; 14:24.
13. Cana-Ruiu D, Mota E, Trican E, Istrate N, Popescu M, Vasile R, *et al.,* Renal anemia and cardiac dysfunction in diabetic versus non-diabetic patients. Rom J Diabetes Nutr Metab Dis. 2012;19(2):131-41.
14. Badri VK, Chaitra KR, Devakar S, Neelopant SA. Clinical profile and etiology of chronic kidney disease in a tertiary care centre in Karnataka. Int J Acad Med Pharm. 2023;5(5):1060-6.
15. Ghamri R, Salawati E, Edrees GW, Alsaleh AK, Srouji AF, Radi TO, *et al.,* Anemia among adult patients with diabetes attending King Abdulaziz University Hospital: a retrospective study. Medicine (Baltimore). 2024;103(33):e39383.
16. New JP, Aung T, Baker PG, Yongsheng G, Pylypczuk R, Houghton J, Rudenski A, New RP, Hegarty J, Gibson JM, O'Donoghue DJ. The high prevalence of unrecognized anaemia in patients with diabetes and chronic kidney disease: a population-based study. Diabetic Medicine. 2008 May;25(5):564-9.
17. El-Achkar TM, Ohmit SE, McCullough PA, Crook ED, Brown WW, Grimm R, *et al.,* Higher prevalence of anemia with diabetes mellitus in moderate kidney insufficiency: the Kidney Early Evaluation Program. Kidney Int. 2005;67(4):1483-8.
18. Ravanan R, Spiro JR, Mathieson PW, Smith RM, Krishna S, Goodship THJ. Impact of diabetes on haemoglobin levels in renal disease. Diabetologia. 2007;50(1):26–31.
19. Al-Khoury S, Afzali B, Shah N, Covic A, Thomas S, Goldsmith DJ. Anaemia in diabetic patients with chronic kidney disease — prevalence and predictors. Diabetologia. 2006;49(6):1183-9.
20. Craig KJ, Williams JD, Riley SG, Smith H, Owens DR, Worthing D, *et al.,* Anemia and diabetes in the absence of nephropathy. Diabetes Care. 2005;28(5):1118-23.
21. Bosman DR, Winkler AS, Marsden JT, Macdougall IC, Watkins PJ. Anemia with erythropoietin deficiency occurs early in diabetic nephropathy. Diabetes Care. 2001;24(3):495-9.
22. Adhikari P, Acharya A, Bhattarai K, Gaire S. Prevalence of anemia among patients with diabetes mellitus attending a tertiary care center in Nepal: a descriptive cross-sectional study. J Diabetes Endocrinol Assoc Nepal. 2024;9(1):12-8.
23. Fathi AE, Shahwan M, Hassan N, Jairoun AA, Shahwan M. Prevalence of anemia in type 2 diabetic patients and correlation with body mass index and kidney function in Palestine. Diabetes Metab Syndr Obes. 2024; 17:2293-301.
24. Thomas MC, MacIsaac RJ, Tsalamandris C, Jerums G, Premaratne E, Panagiotopoulos S, *et al.,* The burden of anaemia in type 2 diabetes and the role of

nephropathy: a cross-sectional audit. Nephrol Dial Transplant. 2004;19(7):1792-7.
25. Hsu CY, McCulloch CE, Curhan GC. Iron status and hemoglobin level in chronic renal insufficiency. J Am Soc Nephrol. 2002;13(11):2783-6.
26. Kim SH, Lee KA, Jin HY, Baek HS, Park TS. The relationship between anemia and the initiation of dialysis in patients with type 2 diabetic nephropathy. Diabetes Metab J. 2015;39(3):240-6.
27. Stevens PE. Anaemia, diabetes and chronic kidney disease: where are we now? J Ren Care. 2012;38(Suppl 1):67-77.
28. Mehdi U, Toto RD. Anemia, diabetes, and chronic kidney disease. Diabetes Care. 2009;32(7):1320-6.
29. Tsai SF, Tarng DC. Anemia in patients of diabetic kidney disease. J Chin Med Assoc. 2019;82(10):752-5.
30. KDIGO Work Group. KDIGO clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Suppl. 2013;3(3):1.