Roxadustat Versus Erythropoietin for Anemia Treatment in Diabetic Nephropathy.

Saim Shuja Cheema[1*], Mateen Akram[2], Rameen Fatima[3], Muhammad Usman Masood Butt[4], Sameer Sattar[5], Hassan Abdullah[6].

ABSTRACT:

Objective: To compare Roxadustat and Erythropoietin in improving haemoglobin levels among patients with diabetic nephropathy.

Methodology: This comparative observational study was conducted in the Department of Nephrology, Sheikh Zayed Hospital, Lahore. Sixty-four patients aged 18–75 years with diabetic nephropathy, chronic kidney disease, and anaemia were enrolled. Patients were allocated into two equal groups by the lottery method. Group A received Roxadustat 100 mg orally three times per week. Group B received erythropoietin 4000 IU subcutaneously twice weekly. Follow-up was three months. Data were analysed in SPSS version 27.0. A p-value of ≤0.05 was taken as significant.

Results: Baseline characteristics were similar between groups. Post-treatment haemoglobin was better among patients of Roxadustat group than in the group of erythropoietin (10.54 ± 1.75 vs 9.05 ± 2.17 g/dL). Mean haemoglobin rise was also greater (1.97 ± 1.21 vs 0.98 ± 1.87 g/dL). Haemoglobin response was higher with Roxadustat (78.1% vs 40.6%). Roxadustat was an independent predictor of haemoglobin response (adjusted OR 6.41, 95% CI 1.86-22.07; p=0.003).

Conclusion: We found Roxadustat more effective than erythropoietin for improving haemoglobin in anaemic patients with diabetic nephropathy.

Keywords: Anaemia; Diabetic nephropathy; Erythropoietin; Haemoglobin; Roxadustat.

Cite as: Cheema SS, Akram M, Fatima R, Butt MUM, Sattar S, Abdullah Hassan. Roxadustat Versus Erythropoietin for Anemia Treatment in Diabetic Nephropathy. J Muhammad Med Coll. 17(1) April-Oct 2026

Introduction:

Anaemia is a prevalent and significant complication of chronic kidney disease (CKD). In a population examination of the United States, 25.3% among adults with stage 3-5 CKD had anaemia, and 1.9% had more severe anaemia that could have qualified them for erythropoiesis-stimulating therapy.[1] In a 2024 Spanish study involving patients aged 50 years or older with diabetes, the prevalence of anaemia was 29.9%. The prevalence of anaemia had risen in those with kidney impairment than in those without (44.7% vs 28.0%).[2] Additionally, a substantial 2024 diabetes cohort demonstrated that anaemia became more prevalent as eGFR decreased. The prevalence of anaemia was 5% to 20% higher across patients with eGFR <30 mL/min/1.73 m² when macroalbuminuria was present compared to normoalbuminuria.[3]

Recent studies have improved the understanding of anaemia treatment in diabetic kidney disease and CKD, especially with the emergence of oral hypoxia-inducible factor prolyl hydroxylase inhibitors. In a 2022 retrospective cohort study of patients with diabetic kidney disease, Zhang et al. reported that Roxadustat improved renal anaemia and produced a higher haemoglobin response rate than erythropoietin, although the overall haemoglobin rise was broadly similar between groups.[4] In the same year, an updated meta-analysis in non-dialysis CKD found that Roxadustat improved haemoglobin and iron utilization parameters, but it also raised concerns about serious adverse events, deep venous thrombosis, and hypertension.[5] A 2023 pooled analysis of four phase 3 studies then showed that Roxadustat did not increase cardiovascular events or all-cause mortality compared with erythropoiesis-stimulating agents in non-dialysis-dependent or incident-to-dialysis CKD.[6] Further progress was reported in 2024, when a systematic review found that Roxadustat sustained same strength across different levels of C-reactive protein, suggesting possible benefit even in inflammatory CKD states where ESA response may be weaker.[7]

Despite these advances, an important gap remains. Most recent evidence comes from mixed CKD populations, pooled analyses, or retrospective studies. Direct comparative evidence focused only on patients with diabetic nephropathy is still limited. This is important because anaemia in diabetes is closely linked with reduced kidney function and albuminuria, and treatment response may differ in this subgroup. Therefore, a head-to-head comparison of Roxadustat and erythropoietin in diabetic nephropathy is needed. Such a study can provide disease-specific evidence, guide treatment choice, and support better management of anaemia in this high-risk group.

1. Post Graduate Resident, Department of Nephrology, Shaikh Zayed Hospital Lahore.
2. Professor, Supervisor and Head of Nephrology Department, Shaikh Zayed Hospital Lahore.
3. Demonstrator, M.Phil. Physiology, University of Lahore. Lahore..
4. Post Graduate Resident, Department of Nephrology, Shaikh Zayed Hospital Lahore.
5. Post Graduate Resident, Department of Nephrology, Shaikh Zayed Hospital Lahore.
6. Post Graduate Resident, Department of Nephrology, Shaikh Zayed Hospital Lahore.

*=corresponding author :

Email: saimcheema75@gmail.com

Received: May 2026, Revision: August 2026

Accepted: September 2026

Objective:

To compare Roxadustat and erythropoietin in improving haemoglobin levels among patients with diabetic nephropathy.

Methodology:

This comparative observational study was conducted in the Department of Nephrology, Sheikh Zayed Hospital, Lahore. The study was completed over six months between Aug 2025 to Jan 2026, after approval from the Ethical Review Committee (ERC), of Sheikh Zayed Medical Complex, Lahore, vide TERC/SC/INT/2025/469 dated:16-07-2025. Written informed consent was taken from all patients before enrolment. The sample size was 64 patients. It was calculated by using the WHO sample size calculator. A 5% level of significance and 80% power were used. The expected haemoglobin values were 101.5 ± 16.8 g/L for the Roxadustat group and 94.1 ± 20.2 g/L for the erythropoietin group.[8] Non-probability consecutive sampling was used.

Patients aged 18 to 75 years were included. Patients had confirmed diabetes mellitus, either type 1 or type 2. Patients also had chronic kidney disease (CKD) stage 3a, 3b, 4, or 5. CKD staging was based on eGFR (estimated glomerular filtration rate) calculated by the CKD-EPI creatinine equation of 2021. Patients with anaemia were included. Anaemia was defined as haemoglobin below 13.0 g/dL in males and below 12.0 g/dL in females. Patients were eligible if they had not received erythropoiesis-stimulating agent treatment during the previous four weeks or were treatment naïve.

Patients were excluded if they had received blood transfusion within the previous eight weeks. Patients with active infection, malignancy, or inflammatory disease were excluded. Patients with a history of thromboembolic events or uncontrolled hypertension were also excluded. Pregnant and breastfeeding women were excluded. Patients with known hypersensitivity to Roxadustat or erythropoietin were excluded. Patients taking part in another interventional study within the previous 30 days were also excluded.

Baseline data were recorded on a predefined proforma. These included age, gender, height, weight, body mass index, CKD stage, type of diabetes, HbA1c, and baseline haemoglobin level. A total of 64 patients were allocated into two equal groups of 32 patients each by the lottery method. Group A received Roxadustat 100 mg orally three times per week. Group B received recombinant erythropoietin 4000 IU by subcutaneous injection twice weekly. All patients were followed for three months. Haemoglobin was measured again at the end of follow-up.

The primary outcome was change in haemoglobin level after treatment. Baseline haemoglobin, post-treatment haemoglobin, and change in haemoglobin (Hb) were assessed. Haemoglobin response was defined as a rise in haemoglobin of at least 1.0 g/dL.

SPSS version 27.0 was employed to input and analyse the data. The mean ± standard deviation was used to present quantitative variables. Frequency and percentage were employed to represent qualitative variables. Continuous variables were compared between the two groups using an independent sample t-test. Categorical variables were subjected to the Chi-square test or Fisher's exact test, as appropriate. Additionally, multivariable logistic regression was performed to identify determinants of haemoglobin response. Statistical significance was defined as a p-value of ≤0.05.

Results:

The baseline characteristics were comparable between the groups of Roxadustat and Erythropoietin. The mean age, height, weight, BMI, HbA1c, and baseline haemoglobin were not different significantly between the two groups. The distribution of male and female patients was equal as well. Most patients had CKD stage 5 in either group, while smaller numbers had stage 4 and stage 3a. Type 2 diabetes was the most common type in both groups. Overall, no significant baseline difference was observed between the two treatment groups, showing that both groups were comparable at the start of the study Table 1.

Table No1: Baseline characteristics of the study population by treatment group.

Characteristic	Roxadustat (n=32)	Erythropoietin (n=32)	Total (N=64)	p value
Age (years)	59.00 ±9.93	61.91 ±7.58	60.45 ±8.89	0.193
Height (cm)	162.95 ±7.07	163.79 ±6.93	163.37 ±6.96	0.630
Weight (kg)	66.65 ±12.26	62.69 ±10.03	64.67 ±11.29	0.163
BMI (kg/m²)	25.15 ±4.61	23.31 ±3.04	24.23 ±3.98	0.065
HbA1c (%)	8.68 ±1.29	8.71 ±1.03	8.69 ±1.16	0.907
Baseline Hb (g/dL)	8.56 ±1.30	8.07 ±1.16	8.32 ±1.24	0.113
Male	23 (71.9%)	21 (65.6%)	44 (68.8%)	0.788
Female	9 (28.1%)	11 (34.4%)	20 (31.2%)	0.788
CKD stage 3a	2 (6.2%)	2 (6.2%)	4 (6.2%)	0.830
CKD stage 4	8 (25.0%)	6 (18.8%)	14 (21.9%)	0.830
CKD stage 5	22 (68.8%)	24 (75.0%)	46 (71.9%)	0.830
Type 1 diabetes	5 (15.6%)	3 (9.4%)	8 (12.5%)	0.708
Type 2 diabetes	27 (84.4%)	29 (90.6%)	56 (87.5%)	0.708

The post-treatment haemoglobin level was comparatively higher in the Roxadustat group. The mean rise in haemoglobin was also greater in this group. In addition, the haemoglobin response rate was higher significantly in patients who were given Roxadustat as shown in table 2.

Table No 2: Haemoglobin outcomes after treatment: Roxadustat vs Erythropoietin.

Haemoglobin outcome	Roxadustat (n=32)	Erythropoietin (n=32)	Total (N=64)	p value
Baseline Hb (g/dL)	8.56 ±1.30	8.07 ±1.16	8.32 ±1.24	0.113
Post-treatment Hb (g/dL)	10.54 ±1.75	9.05 ±2.17	9.79 ±2.08	0.004
Hb (g/dL)	1.97 ±1.21	0.98 ±1.87	1.48 ±1.64	0.014
Hb response= Yes	25 (78.1%)	13 (40.6%)	38 (59.4%)	0.005
Hb response= No	7 (21.9%)	19 (59.4%)	26 (40.6%)	0.005

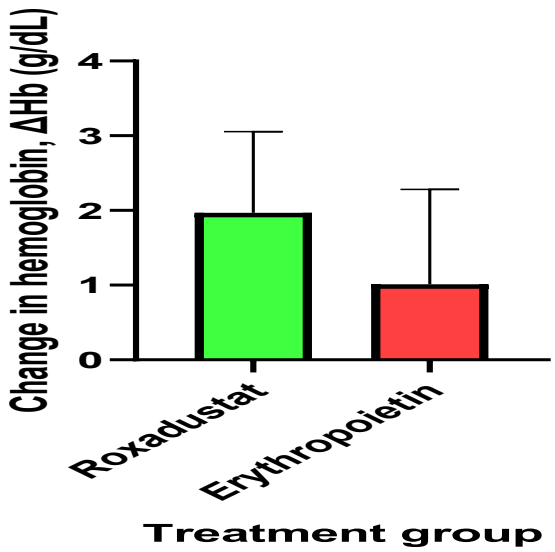
Multivariable logistic regression showed that treatment with Roxadustat was an independent predictor of haemoglobin response. Roxadustat group patients had significantly higher odds of achieving Hb response than those in the group of Erythropoietin. Age showed a weak trend, but it was not statistically significant. Sex, BMI, HbA1c, baseline haemoglobin, and CKD stage were also not significant predictors in the adjusted model as shown in table 3.

Table No 3. Analysis for predictors of haemoglobin response.

Variable	Adjusted OR	95% CI	p value
Roxadustat vs Erythropoietin	6.41	1.86-22.07	0.003
Age (per 1-year increase)	1.07	0.99-1.15	0.082
Male sex	0.93	0.25-3.43	0.912
BMI (per 1 kg/m² increase)	1.09	0.91-1.30	0.348
HbA1c (per 1% increase)	0.99	0.57-1.73	0.972
Baseline Hb (per 1 g/dL increase)	0.93	0.59-1.47	0.770
CKD stage 5 vs stage 3a-4	0.94	0.25-3.58	0.930

The figure 1 shows that hemoglobin mean change in the group of Roxadustat was higher than in the group of Erythropoietin. Roxadustat patients had an average rise in hemoglobin of about 2 g/dL, while those treated with Erythropoietin had an average rise of about 1 g/dL. This indicates a better treatment response with Roxadustat. The error bars also show variability in both groups, but the overall improvement remained greater in the Roxadustat group.

Figure 1: Mean change in haemoglobin (ΔHb) by treatment group. Patients treated with Roxadustat showed a greater rise in haemoglobin than those treated with Erythropoietin.



Discussion:

The main finding of this study was that Roxadustat produced a higher post-treatment haemoglobin level, a greater mean rise in haemoglobin, and a higher haemoglobin response rate than erythropoietin in patients with diabetic nephropathy and anaemia. This finding is important because renal anaemia remains a major burden in our setting. In a Pakistani real-world study, anaemia was common in maintenance haemodialysis patients, and diabetes was also a frequent comorbidity.[8] Recent reviews have also shown that anaemia in CKD is driven by low erythropoietin production, disturbed iron handling, and chronic inflammation, which together worsen outcomes and make treatment difficult.[9]

Our result is biologically plausible. Roxadustat works through hypoxia-inducible factor stabilization. It increases endogenous erythropoietin in a more physiologic range and improves iron use by lowering hepcidin and increasing iron availability.[10] This may explain why a recent 8-week diabetic nephropathy study also found that Roxadustat corrected anaemia well and maintained its effect even in the presence of inflammation or reduced renal function.[11]

At the regional level, our findings are close to those reported from China in diabetic CKD. Jin et al. found that Roxadustat produced higher haemoglobin levels than erythropoietin after propensity score matching in non-dialysis CKD patients with diabetes.[12] In contrast, the international ROCKIES trial in dialysis patients showed that Roxadustat was mainly non-inferior, rather than clearly superior, to epoetin alfa for haemoglobin correction.[13] The difference may be due to variation in population, dialysis status, inflammation load, and study design. Our study only included diabetic nephropathy patients, which may have made the treatment effect more visible.

Other phase 3 studies also support the efficacy of Roxadustat, although many reported non-inferiority instead of superiority. The SIERRAS study showed that Roxadustat effectively treated anaemia in kidney failure patients on dialysis.[14] The PYRENEES study also found that Roxadustat maintained haemoglobin control in stable dialysis patients and performed similarly to ESA therapy.[15] These studies agree with our direction of effect, but our study showed a stronger advantage over erythropoietin. This may be because our follow-up was focused on diabetic nephropathy and used a direct head-to-head comparison with haemoglobin response as a simple clinical endpoint.

Evidence from non-dialysis CKD also supports our findings. Akizawa et al. reported that Roxadustat was not lower to darbepoetin alfa in non-dialysis CKD patients and maintained haemoglobin within the target range.[16] Fishbane et al. further showed that Roxadustat was superior to placebo in raising haemoglobin in CKD patients not on dialysis.[17] These results suggest that Roxadustat is effective across different CKD stages. Our study adds to this evidence by focusing on diabetic nephropathy, which is a clinically important subgroup.

The present findings are also supported by pooled analyses. Provenzano et al. showed that Roxadustat increased haemoglobin and reduced transfusion need in non-dialysis CKD across three randomized trials.[18] Minutolo et al. later reported in a phase 3 meta-analysis that hypoxia-inducible factor prolyl hydroxylase inhibitors were effective in correcting anaemia compared with ESA therapy and also had favourable effects on iron metabolism.[19] This helps explain why Roxadustat performed better than erythropoietin in our patients. Better iron mobilization may be especially helpful in diabetic nephropathy, where inflammation and functional iron deficiency are common.

Some recent reviews also help in understanding both the strengths and the caution points of our findings. Takkavatakarn et al. found that HIF stabilizers improved haemoglobin and iron-related markers, but they also reported signals for thrombotic events and acute kidney injury in some studies.[20] Sackeyfio et al. showed in network meta-analyses that HIF-PHIs were generally competitive with standard ESA treatment in both dialysis and non-dialysis settings, although differences between agents and populations remained.[21] Therefore, our result is encouraging, but it should still be interpreted with clinical caution. Safety remains an important point. Tian et al. reviewed cardiovascular and renal safety outcomes of Roxadustat and highlighted the need for careful long-term assessment of adverse outcomes.[22] Haraguchi et al. also reported that Roxadustat may affect thyroid function in patients with renal anaemia, which is an issue not captured in our dataset.[23] For this reason, the better haemoglobin response seen in our study should not be taken to mean that Roxadustat is free of risk. Efficacy and safety must be judged together. Another reason for caution is that Roxadustat outcomes may be influenced by haemoglobin dynamics and vascular risk. Hamano et al. found that thromboembolic risk in dialysis-dependent CKD was linked to factors such as low transferrin saturation, previous vascular risk, and unstable haemoglobin patterns.[24] Zhang et al.[25] also showed that HIF-PH inhibitors may increase the risk of hypertension compared with placebo, although risk may differ when compared with ESA therapy. These reports do not weaken our result, but they do show that future studies should include adverse events, blood pressure, and iron markers together with haemoglobin outcomes.

This study had some limitations. It was done at a single centre. The size of the sample was small. The period which was followed included three months. Only haemoglobin-based outcomes were assessed. Iron indices, hepcidin, inflammatory markers, transfusion need, kidney outcomes, and cardiovascular events were not evaluated. Adverse effects were also not analysed in detail. These factors limit the strength and generalizability of the findings.

Future studies should be multicentre and should include a larger sample. Longer follow-up is needed. Future work should assess iron profile, inflammation markers, blood pressure, thromboembolic events, cardiovascular outcomes, renal outcomes, and treatment adherence. Subgroup analysis by CKD stage and diabetes severity would also be useful. A well-designed prospective trial in diabetic nephropathy alone would give stronger evidence for treatment choice in this high-risk group.

Conclusion:

Roxadustat was more effective than erythropoietin in improving haemoglobin levels in patients with diabetic nephropathy and anaemia. It produced a greater rise in haemoglobin and a higher haemoglobin response rate. Roxadustat may be a useful treatment option in this group.

Source of funding: None

Conflict of interest: None

References:

1. Kovesdy CP, Davis JR, Duling I, Little DJ. Prevalence of anaemia in adults with chronic kidney disease in a representative sample of the United States population: analysis of the 1999-2018 National Health and Nutrition Examination Survey. Clin Kidney J. 2022 Nov 12;16(2):303-311. doi: 10.1093/ckj/sfac240. PMID: 36755833; PMCID: PMC9900579.
2. Michán-Doña A, Jiménez-Varo E, Escribano-Cobalea M, Casto-Jarillo C, López-Ceres A, et al. Prevalence and characteristics of anemia in patients with diabetes mellitus aged 50 or older in health unit area of Cadiz (Spain). Rev Clin Esp (Barc). 2024 Aug-Sep;224 (7):457-465. doi: 10.1016/j.rceng.2024.06.008. Epub 2024 Jun 13. PMID: 38879004.
3. Okada A, Yamaguchi S, Imaizumi T, Oba K, Kurakawa KI, Yamauchi T, Kadowaki T, Nangaku M. Modification Effects of Albuminuria on the Association Between Kidney Function and Development of Anemia in Diabetes. J Clin Endocrinol Metab. 2024 Mar 15;109(4):1012-1032. doi: 10.1210/clinem/dgad660. PMID: 37955878; PMCID: PMC10940265.
4. Zhang L, Liu Y, Huang Y, Zhao Y, Wei C, et al. Effect of Roxadustat versus erythropoietin (EPO) for treating anemia in patients with diabetic kidney disease: a retrospective cohort study. Ann Transl Med. 2022 Nov;10 (22):1224. doi: 10.21037/atm-22-4344. PMID: 36544686; PMCID: PMC9761136.
5. Abdelazeem B, Shehata J, Abbas KS, El-Shahat NA, Malik B, et al. The efficacy and safety of roxadustat for the treatment of anemia in non-dialysis dependent chronic kidney disease patients: An updated systematic review and meta-analysis of randomized clinical trials. PLoS One. 2022 Apr 1;17(4):e0266243. doi: 10.1371/journal.pone.0266243. PMID: 35363823; PMCID: PMC8974992.
6. Barratt J, Dellanna F, Portoles J, Choukroun G, De Nicola L, Young J, Dimković N, Reusch M. Safety of Roxadustat Versus Erythropoiesis-Stimulating Agents in Patients with Anemia of Non-dialysis-Dependent or Incident-to-Dialysis Chronic Kidney Disease: Pooled Analysis of Four Phase 3 Studies. Adv Ther. 2023 Apr;40(4):1546-1559. doi: 10.1007/s12325-023-02433-0. Epub 2023 Feb 7. PMID: 36749544; PMCID: PMC10070224.
7. Luo X, Li G, Yang H, Chen L, Gao Y, et al. Impact of C -reactive protein on the effect of Roxadustat for the treatment of anemia in chronic kidney disease: a systematic review of randomized controlled trials. BMC Nephrol. 2024 Feb 5;25(1):47. doi: 10.1186/s12882-024-03474-5. PMID: 38311719; PMCID: PMC10840261.
8. Moussa O, Feng C, Wang JX, Li XS, Zhang FX, Tang XH. Safety and Effectiveness of Roxadustat in Dialysis -Dependent Patients With Renal Anemia: A Hospital-Based Cohort Study. Cureus. 2022 Apr 23;14 (4):e24427. doi: 10.7759/cureus.24427. PMID: 35475244; PMCID: PMC9035214.
9. Badura K, Janc J, Wąsik J, Gnitecki S, Skwira S, Młynarska E, Rysz J, Franczyk B. Anemia of Chronic Kidney Disease-A Narrative Review of Its Pathophysiology, Diagnosis, and Management. Biomedicines. 2024 May 27;12(6):1191. doi: 10.3390/biomedicines12061191. PMID: 38927397; PMCID: PMC11200696.
10. Portolés J, Martín L, Broseta JJ, Cases A. Anemia in Chronic Kidney Disease: From Pathophysiology and Current Treatments, to Future Agents. Front Med (Lausanne). 2021 Mar 26;8:642296. doi: 10.3389/fmed.2021.642296. PMID: 33842503; PMCID: PMC8032930.
11. Jiang L, Jia R, Zheng Z, Zhang X, Xu Y, Raj A, Sun D. A clinical study on roxadustat for anemia in diabetic

nephropathy: a 8-week study. Int Urol Nephrol. 2024 Mar;56(3):1093-1101. doi: 10.1007/s11255-023-03757-0. Epub 2023 Aug 25. PMID: 37626163.
12. Jin C, Ren Y, Wang M, Hu X, Shang Y, Li Y, Zhu B, He Q, Shao L. Clinical effect of roxadustat vs. erythropoietin in non-dialysis CKD with diabetes: a single center propensity score matching analysis. Int Urol Nephrol. 2024 Aug;56(8):2683-2693. doi: 10.1007/s11255-024-03983-0. Epub 2024 Mar 15. PMID: 38489143.
13. Fishbane S, Pollock CA, El-Shahawy M, Escudero ET, Rastogi A, et al. Roxadustat Versus Epoetin Alfa for Treating Anemia in Patients with Chronic Kidney Disease on Dialysis: Results from the Randomized Phase 3 ROCKIES Study. J Am Soc Nephrol. 2022 Apr;33 (4):850-866. doi: 10.1681/ASN.2020111638. PMID: 35361724; PMCID: PMC8970450.
14. Charytan C, Manllo-Karim R, Martin ER, Steer D, Bernardo M, et al. A Randomized Trial of Roxadustat in Anemia of Kidney Failure: SIERRAS Study. Kidney Int Rep. 2021 Apr 17;6(7):1829-1839. doi: 10.1016/j.ekir.2021.04.007. PMID: 34307977; PMCID: PMC8258588.
15. Csiky B, Schömig M, Esposito C, Barratt J, Reusch M, et al. Roxadustat for the Maintenance Treatment of Anemia in Patients with End-Stage Kidney Disease on Stable Dialysis: A European Phase 3, Randomized, Open-Label, Active-Controlled Study (PYRENEES). Adv Ther. 2021 Oct;38(10):5361-5380. doi: 10.1007/s12325-021-01904-6. Epub 2021 Sep 19. PMID: 34537926; PMCID: PMC8478768.
16. Akizawa T, Iwasaki M, Otsuka T, Yamaguchi Y, Reusch M. Phase 3 Study of Roxadustat to Treat Anemia in Non-Dialysis-Dependant CKD. Kidney Int Rep. 2021 Apr 17;6(7):1810-1828. doi: 10.1016/j.ekir.2021.04.003. PMID: 34307976; PMCID: PMC8258605.
17. Fishbane S, El-Shahawy MA, Pecoits-Filho R, Van BP, Houser MT, et al.Roxadustat for Treating Anemia in Patients with CKD Not on Dialysis: Results from a Randomized Phase 3 Study. J Am Soc Nephrol. 2021 Mar;32(3):737-755. doi: 10.1681/ASN.2020081150. Epub 2021 Feb 10. PMID: 33568383; PMCID: PMC7920165.
18. Provenzano R, Szczech L, Leong R, Saikali KG, Zhong M, et al.Efficacy and Cardiovascular Safety of Roxadustat for Treatment of Anemia in Patients with Non-Dialysis-Dependent CKD: Pooled Results of Three Randomized Clinical Trials. Clin J Am Soc Nephrol. 2021 Aug;16(8):1190-1200. doi: 10.2215/CJN.16191020. PMID: 34362786; PMCID: PMC8455050.
19. Minutolo R, Liberti ME, Simeon V, Sasso FC, Borrelli S, et al. Efficacy and safety of hypoxia-inducible factor prolyl hydroxylase inhibitors in patients with chronic kidney disease: meta-analysis of phase 3 randomized controlled trials. Clin Kidney J. 2023 Jun 22;17 (1):sfad143. doi: 10.1093/ckj/sfad143. PMID: 38186871; PMCID: PMC10765094.
20. Takkavatakarn K, Thammathiwat T, Phannajit J, Katavetin P, Praditpornsilpa K, Eiam-Ong S, Susantitaphong P. The impacts of hypoxia-inducible factor stabilizers on laboratory parameters and clinical outcomes in chronic kidney disease patients with renal anemia: a systematic review and meta-analysis. Clin Kidney J. 2023 Jan 24;16(5):845-858. doi: 10.1093/ckj/sfac271. PMID: 37151413; PMCID: PMC10157772.
21. Sackeyfio A, Lopes RD, Kovesdy CP, Cases A, Mallett SA, et al. Comparison of outcomes on hypoxia-inducible factor prolyl hydroxylase inhibitors (HIF-PHIs) in anaemia associated with chronic kidney disease: network meta-analyses in dialysis and non-dialysis dependent populations. Clin Kidney J. 2023 Dec 7;17 (1):sfad298. doi: 10.1093/ckj/sfad298. PMID: 38250252; PMCID: PMC10799328.
22. Tian L, Wang M, Liu M, Pang Y, Zhao J, et al. Cardiovascular and renal safety outcomes of hypoxia-inducible factor prolyl-hydroxylase inhibitor roxadustat for anemia patients with chronic kidney disease: a systematic review and meta-analysis. Ren Fail. 2024 Dec;46(1):2313864. doi: 10.1080/0886022X.2024.2313864. Epub 2024 Feb 12. PMID: 38345037; PMCID: PMC10863523.
23. Haraguchi T, Hamamoto Y, Kuwata H, Yamazaki Y, Nakatani S, et al. Effect of Roxadustat on Thyroid Function in Patients With Renal Anemia. J Clin Endocrinol Metab. 2023 Dec 21;109(1):e69-e75. doi: 10.1210/clinem/dgad483. PMID: 37597171.
24. Hamano T, Yamaguchi Y, Goto K, Martin S, Jiletcovici A, et al. Risk Factors for Thromboembolic Events in Patients With Dialysis-Dependent CKD: Pooled Analysis of Four Global Roxadustat Phase 3 Trials. Adv Ther. 2024 Apr;41(4):1553-1575. doi: 10.1007/s12325-023-02728-2. Epub 2024 Feb 16. PMID: 38363466; PMCID: PMC10960763.
25. Zhang W, Li Y, Wang JG. Hypertension Induced by Hypoxia-Inducible Factor Prolyl Hydroxylase Inhibitors in Treating Anemia in Patients With Chronic Kidney Disease: A Mini-Review. J Clin Hypertens (Greenwich). 2024 Dec;26(12):1375-1383. doi: 10.1111/jch.14924. Epub 2024 Nov 4. PMID: 39494784; PMCID: PMC11654843.

Authors' contribution	
Saim Shuja Cheema	Conception, study design.
Mateen Akram	Data interpretation and analysis of the data
Rameen Fatima	Revision of the article for imperative intellectual content.
Muhammad Usman Masood Butt	Collection and assembly of data, Data analysis
Sameer Sattar	Critical revision of the manuscript.
Hassan Abdullah	Data curation.