Nefrologia 46 (2026) 501430

Sociedad Española de Nefrología

nefrología

Revista de la Sociedad Española de Nefrología

journal homepage: www.revistanefrologia.com

Original article

What is the clinical impact of using EKFC equation for estimating glomerular filtration rate by creatinine in kidney transplant recipients?

¿Cuál es el impacto clínico del uso de la ecuación EKFC en la estimación de filtrado glomerular por creatinina en pacientes trasplantados renales?

Miguel Martínez-Belotto *, María José Ortega, Covadonga López del Moral, Rosalía Valero, Juan Carlos Ruiz, María de la Oliva Valentín, Emilio Rodrigo

Grupo de Inmunopatología, Servicio de Nefrología, Hospital Universitario Marqués de Valdecilla-IDIVAL, Universidad de Cantabria, Santander, Spain

ARTICLE INFO

Keywords:
Impact
Glomerular filtration rate
Chronic kidney disease
Kidney transplant
Reclassification

ABSTRACT

Background and objective: Chronic kidney disease (CKD) is a prevalent condition, typically assessed using indirect markers such as estimated glomerular filtration rate (eGFR). The CKDEPI-2009 equation has been the most widely used estimation equation over the past decade. However, due to its limitations, alternative formulas aiming for greater accuracy compared to measured GFR (mGFR) have been developed. In 2020, the European Kidney Function Consortium (EKFC) validated a new, more precise equation covering the full age spectrum, which has been studied in various populations but remains underexplored in kidney transplant recipients. Our objectives were to evaluate the impact of changing estimation equations in this population, to measure comorbidity prediction and to check CKD reclassification.
Materials and methods: We conducted a retrospective observational study including all kidney transplant recipients at our center from 2006 to 2022 with graft survival greater than one year. We analyzed differences between CKD-EPI 2009 and EKFC across the entire cohort and within subgroups based on diabetes mellitus, sex, and age. We compared the prediction of CKD-related comorbidities, including anemia, acidosis, hyperkalemia, and hyperphosphatemia. We assessed concordance and reclassification across CKD stages based on KDIGO criteria.
Results: In a cohort of 616 kidney transplant recipients, EKFC and CKD-EPI 2009 showed a high correlation with excellent agreement across all subgroups (Intraclass Correlation Coefficient = 0.9945). EKFC provided significantly lower estimates than CKD-EPI 2009 (−0.2 mL/min/1.73 m^2), particularly in CKD stages 1–3a, in women (−0.6 mL/min/1.73 m^2), and in patients over 60 years (−1.4 mL/min/1.73 m^2). Concordance in KDIGO staging was very good (weighted $\kappa = 0.946$). EKFC reclassified 6.5% of patients into a different CKD stage, mainly in earlier stages and more frequently in patients over 60. ROC curve analysis showed no clinically significant differences in predicting CKD-related comorbidities.
Conclusions: In kidney transplant recipients, EKFC and CKD-EPI 2009 show high correlation and are largely interchangeable. EKFC yields slightly lower eGFR values, particularly in women, older patients, and those with mild CKD, but the magnitude of these differences is small and of limited clinical relevance. These findings are consistent with the literature in this underrepresented population.

Palabras clave:
Impacto
Filtrado glomerular estimado
Enfermedad renal crónica
Trasplante renal
Reclasificación

RESUMEN

Antecedentes y objetivo: La enfermedad renal crónica (ERC) es una enfermedad prevalente y su evaluación se realiza por marcadores indirectos como el filtrado glomerular (FG) estimado. CKDEPI-2009 es la ecuación de estimación más utilizada en la última década, pero dadas sus limitaciones se intenta desarrollar otras fórmulas más precisas respecto al FG medido. En 2020 el Consorcio Europeo de la Función Renal (EKFC) validó una nueva fórmula más precisa incluyendo todo el espectro de edad que se ha estudiado en distintas poblaciones

* Corresponding author.
E-mail address: m.mbelotto@gmail.com (M. Martínez-Belotto).

https://doi.org/10.1016/j.nefroe.2026.501430
Received 7 April 2025; Accepted 6 October 2025
Available online 12 February 2026
2013-2514/© 2025 Sociedad Española de Nefrología. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

con baja representación en el paciente trasplantado renal. Nuestro objetivo es estudiar el impacto del cambio de ecuación en esta población, en capacidad predictiva de comorbilidad y reclasificación de ERC.
Materiales y métodos: Estudio retrospectivo observacional incluyendo la población trasplantada de nuestro centro desde 2006 hasta 2022 con una supervivencia mayor a un año. Estudiamos las diferencias entre CKDEPI-2009 y EKFC en la muestra total y por subgrupos de diabetes mellitus, sexo y edad. Comparamos la capacidad predictiva de comorbilidad de ERC como anemia, acidosis, hiperpotasemia e hiperfosfatemia. Estudiamos la concordancia y la reclasificación en los estadios de KDIGO de ERC entre ambas ecuaciones.
Resultados: En 616 pacientes trasplantados renales, EKFC y CKDEPI-2009 mostraron una alta correlación con muy buena concordancia en todos los subgrupos (Coeficiente de Correlación Intraclase = 0,9945). EKFC estimó valores significativamente más bajos que CKDEPI (-0,2 ml/min/1,73m^2), especialmente en estadios 1-3a de ERC, mujeres (-0,6 ml/min/1,73m^2), y mayores de 60 años (-1,4 ml/min/1,73m^2). La concordancia en clasificación KDIGO fue muy buena (κappa ponderado = 0,946). EKFC reclasificó al 6,5% de los pacientes a un grado distinto de ERC, especialmente en estadios leves y mayor en mayores de 60 años. La capacidad predictiva por curvas COR no demostró diferencias clínicamente significativas para la comorbilidad de ERC.
Conclusiones: Nuestro estudio en pacientes trasplantados renales compara las ecuaciones EKFC y CKDEPI-2009, encontrando alta correlación e intercambiabilidad. EKFC estima un FG más bajo especialmente en mujeres, pacientes mayores de 60 años y grados leves de ERC, pero en una magnitud pequeña que resulta poco relevante. Este estudio refuerza los hallazgos en la literatura en esta población infrarrepresentada.

Introduction

Chronic kidney disease (CKD) affects 9.1% of the global population[1] and 15% of the Spanish population.[2] It is associated with a high risk of adverse events and is well-known for the poor outcomes in affected patients.[3] In Spain, 1% of these patients require renal replacement therapy (RRT), which consumes up to 5% of the health care budget.[4] Among the options for RRT, 55% of patients with CKD undergo functional kidney transplantation (KT), including 3688 KT procedures performed in 2023.[5]

Regardless of whether KT is performed, renal function is assessed using the glomerular filtration rate (GFR) and proteinuria. The *Kidney Disease: Improving Global Outcomes* (KDIGO) criteria are used for CKD staging on the basis of these parameter.[1] Proteinuria and albuminuria are measured directly, while the GFR can be either measured directly (mGFR) or estimated (eGFR) using validated equations.

The mGFR, which is precise but complex to obtain (currently requiring inulin clearance or the use of isotopes),[6] is reserved for specific cases in specialized centers. The eGFR, on the other hand, can be obtained both in hospital settings and in outpatient centers. The eGFR is key in KT for understanding and anticipating comorbidities associated with CKD; by staging CKD, we can better understand the severity of the disease that can be useful for different aspects of the medical community beyond nephrology, for example, for guiding medication adjustment, diagnostic testing, and the development of appropriate therapeutic strategies.

The CKD-EPI 2009 equation remains the most commonly used formula for estimating the GFR in clinical practice regardless of the use of KT; however, while it exhibits advantages over other formulas, it also demonstrates a number of disadvantages.[6] This equation has undergone multiple updates, such as the elimination of the racial factor in 2021,[7] and while its accuracy in children and elderly individuals has diminished, that for individuals aged 18–70 years remains validated.[8] That said, to reduce the imprecision in estimating the GFR, more reliable formulas that include the entire age spectrum are needed.

In 2020, the *European Kidney Function Consortium* (EKFC) proposed a new equation based on the European population while using the same parameters as those of the CKD-EPI 2009: serum creatinine level, age and sex. The EKFC equation aims to overcome the limitations of the CKD-EPI with respect to age, its validity at advanced ages, and its general accuracy with respect to the mGFR.[9] However, few studies have compared the two formulas in transplant patients, who are generally excluded from the development of these equations. Our objective was to evaluate the clinical impact of the two equations in terms of behavior, their relationship with comorbidities, and the classification of CKD in our KT cohort.

Methods

We conducted a retrospective observational study of patients who underwent KT at our center between January 1, 2006, and February 15, 2022, and whose graft survival was greater than one year. We excluded those under 18 years of age and those who were non-Caucasian. We collected analytical parameters one year post-transplantation and input serum creatinine level (measured using the standardized enzymatic method), sex and age into the CKD-EPI 2009 and EKFC equations to calculate the eGFR (Appendix B, Table S1).

We collected data on the patients' serum hemoglobin, bicarbonate, phosphorus and potassium levels to define the following comorbidities associated with CKD: anemia (hemoglobin < 11 g/dL in women, < 12 g/dL in males), hyperphosphatemia (phosphorus > 4.5 mg/dL), hyperkalemia (potassium > 5 mEq/L) and acidosis (bicarbonate $<$ 22 mEq/L). We evaluated the discriminative capacity of both equations for these comorbidities with receiver operating characteristic (ROC) curve analysis and calculation of the area under the curve (AUC).

We studied the association between eGFR values calculated with each equation using Spearman's correlation and their concordance and interchangeability using Lin's intraclass correlation coefficient (ICC).

Bias between the equations was defined as the difference between the GFR values obtained by the CKD-EPI 2009 and those obtained by the EKFC (GFR-CKD-EPI 2009 – GFR-EKFC). We constructed a Bland–Altman plot to detect systematic biases or dispersion patterns. We also constructed a scatter plot with LOESS adjustment to visualize the relationship between age and bias. We evaluated the statistical significance of the bias using the Wilcoxon test for paired data.

In subgroup analyses, we used the Mann–Whitney *U* test for sex and diabetes mellitus (DM) groups and the Kruskal–Wallis test for age group, followed by the post hoc Mann–Whitney *U* test with Bonferroni correction for post hoc analyses between paired groups. We constructed a multiple linear regression model with bias as the dependent variable and age, sex and DM as independent variables to evaluate the simultaneous influence of these three variables.

We used contingency tables to analyze how the EKFC stages CKD with respect to the CKD-EPI 2009-based CKD staging. We used the chi-square test (χ^2) to assess the associations and the weighted kappa coefficient (κ) as a measure of agreement between equations, with $>$ 0.80 considered very good agreement.

SPSS and MedCalc were used for statistical analysis. We present quantitative variables as the mean ± standard deviation or the median and interquartile range (IQR) according to the distribution of the data. Qualitative variables are presented as absolute frequencies

and percentages. This study was approved by the Ethics Committee of our center (2025.139).

Results

Between January 2006 and February 2022, 628 patients underwent KT and had graft survival greater than 1 year. Twelve non-Caucasian patients were excluded. In total, the data of 616 patients were analyzed; their characteristics are shown in Table 1. A total of 31.2% (192) of the patients were women, and 41.2% (254) had diabetes. A total of 14.1% (87) were between 18 and 40 years old, and 37.3% (230) were > 60 years old. According to the CKD-EPI 2009, 54.3% of patients had stage 3 CKD.

The eGFRs obtained with both equations were strongly correlated, with a Spearman coefficient of 0.9956 ($p < 0.001$) and an ICC of 0.9945 (95% CI: 0.9936–0.9952), as represented in Appendix B, Fig. S1, and remained > 0.99 in all the subgroups analyzed (age, sex and DM).

According to the Wilcoxon signed-rank test, the eGFR values obtained with the two equations differed significantly (Appendix B, Table S2). The median bias was +0.2 mL/min [−1.0–1.6], with extreme values of −3.2–9.1 mL/min, indicating that compared with the EKFC, the CKD-EPI tended to estimate higher values.

In stratified analyses, the bias remained statistically significant among women (0.6 mL/min; $p < 0.001$) and diabetic patients (0.4 mL/min; $p = 0.046$) according to the Mann–Whitney test. After adjustment by multiple regression, the differences were maintained for sex and age ($p < 0.001$) but not for DM ($p = 0.624$). With respect to age groups, we did not detect significant differences in the bias between patients aged 18–40 years and those aged > 40–60 years, but compared with patients aged > 60 years, both groups showed significant differences (Appendix B, Fig. S2), where the bias was greater (median: 1.4 mL/min). The relationship between bias and age is represented by a V curve (Fig. 1): the bias decreases from 20 to 40 years of age and increases thereafter.

Table 1
Characteristics of our sample of renal transplant patients.

Total, *n*	616
Female, n (%)	192 (31.2)
Male, n (%)	424 (68.8)
DM, n (%)	254 (41.2)
No DM, n (%)	362 (58.8)
Age (years), median [IQR]	55.5 [45–63.7]
18–40 years, *n* (%)	87 (14.1)
>40–60 years, *n* (%)	299 (48.6)
>60 years, *n* (%)	230 (37.3)
Renal function according to creatinine level one year after transplantation	
Creatinine (mg/dL), median [IQR]	1.37 [1.1–1.74]
eGFR-CKD-EPI (mL/min/1.73 m^2), median [IQR]	53.3 [39.9–67.6]
eGFR-EKFC (mL/min/1.73 m^2), median [IQR]	53.0 [39.6–66.5]
Comorbidities	
Bicarbonate (mEq/L), median [IQR]	25.8 [23.8–27.6]
Acidosis, *n* (%)	63 (10.2)
Potassium (mEq/L), median [IQR]	4.5 [4.2–4.8]
Hyperkalemia, *n* (%)	85 (13.8)
Phosphorus (mg/dL), median [IQR]	3.2 [2.8–3.6]
Hyperphosphatemia, *n* (%)	25 (4.1)
Hemoglobin (g/dL), median [IQR]	13.2 [12–14.4]
Anemia, *n* (%)	104 (16.9)
Any comorbidity, *n* (%)	215 (34.9)
CKD stages according to CKD-EPI 2009, n (%)	
1	36 (5.8)
2	185 (30)
3a	182 (29.5)
3b	153 (24.8)
4	52 (8.4)
5	5 (1.3)
CKD stages according to EKFC, n (%)	
1	56 (9.1)
2	204 (33.1)
3a	169 (27.4)
3b	132 (21.4)
4	48 (7.8)
5	7 (1.1)

DM: diabetes mellitus; CKD: chronic kidney disease; eGFR: estimated glomerular filtration rate; mEq/L: milliequivalent/liter; IQR: interquartile range.

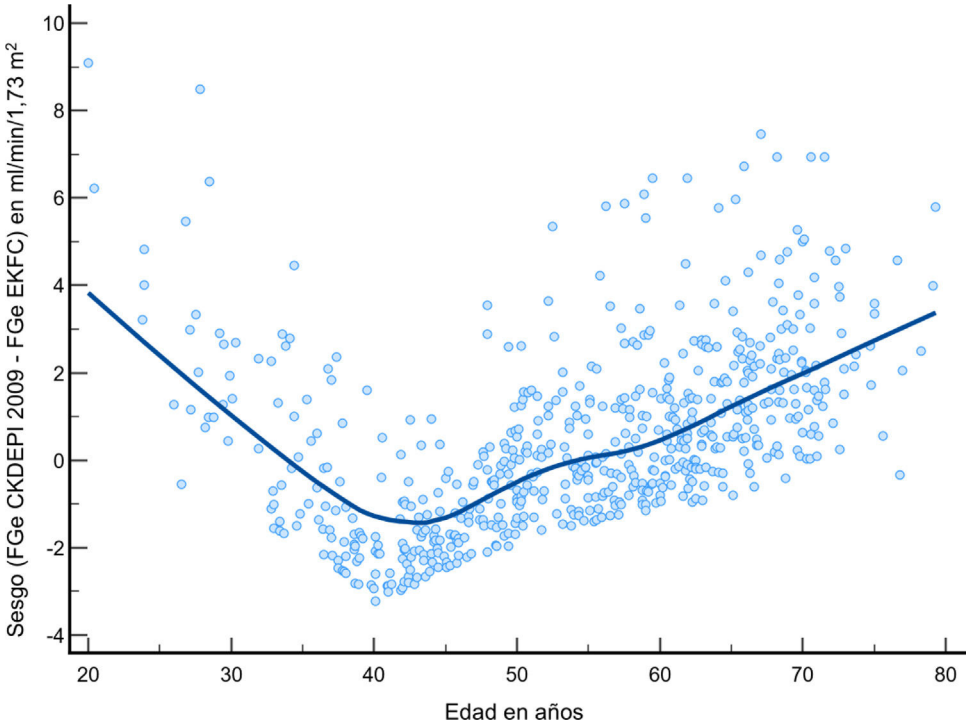

Figure 1. Scatter plot with LOESS adjustment for age and bias, defined as the difference between the outputs of the CKD-EPI 2009 and EKFC equations, of the estimated glomerular filtration rate.

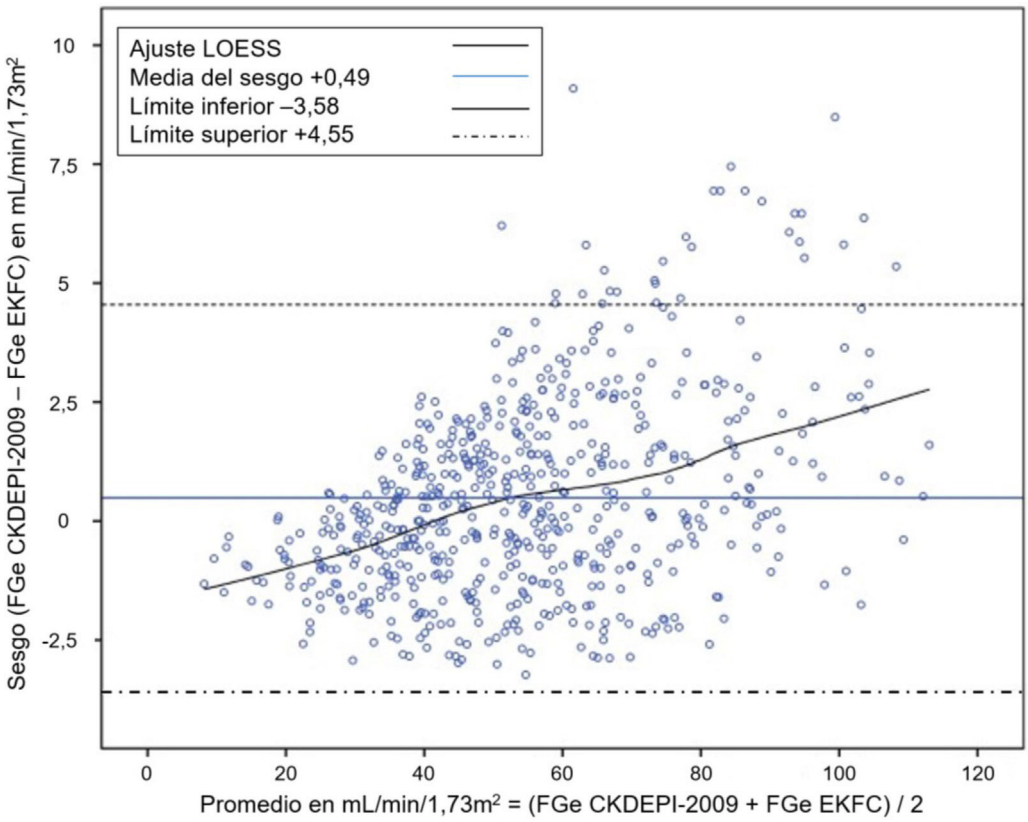

Figure 2. Bland–Altman plot of the estimated glomerular filtration rate (GFR); specifically the difference between the GFR estimated with the CKD-EPI 2009 and the GFR estimated with EKFC (bias) for each patient as the ordinate and the average of the two values for each patient as the abscissa. The LOESS fit line was obtained with the Tricube weight function (SPSS).

Bland–Altman analysis (Fig. 2) revealed a nonlinear relationship, with an inflection point at an average GFR 45 mL/min/1.73 m^2, with bias in favor of the CKD-EPI 2009 for higher values and of the EKFC for lower values. The dispersion was greater for values indicative of stages 1–3a CKD: the median (IQR) bias was +2.3 mL/min (0.9–5.4) in stage 1, +1.2 mL/min (0.3–2.7) in stage 2, +0.5 mL/min (-0.6–1.7) in stage 3a, +0.2 mL/min (−0.9–1.1) in stage 3b and −1.0 mL/min (−1.5 to −0.3) in stage 4.

The predicted CKD stage showed very good agreement between the two equations (weighted $\kappa = 0.946$). In all the subgroups, κ exceeded 0.9, with the lowest being 0.921 in those > 60 years. The results of the χ^2 test were significant ($p < 0.001$) both overall and in all the subgroups.

A total of 3.57% of patients were reclassified to a higher stage of CKD with the EKFC classification, whereas 2.92% were reclassified to a lower stage. As shown in Fig. 3, reclassification to a higher stage mainly occurred for those with higher GFRs, whereas reclassification to a lower stage mainly occurred for those with lower GFRs. This pattern was maintained when patients were stratified by age and was more pronounced in those > 60 years.

The AUCs of the eGFRs for both equations were less than 0.8 for all events. We observed that the CKD-EPI 2009 eGFR performed best for predicting hyperphosphatemia (AUC = 0.770; 95% CI: 0.735–0.803) and the worst for predicting hyperkalemia (AUC = 0.619; 95% CI: 0.589–0.648).

Direct comparison with the EKFC eGFR revealed only statistically significant differences in favor of the CKD-EPI 2009 eGFR in predicting acidosis in males (AUC = 0.784 vs. 0.777; $p = 0.0436$) and in predicting hyperkalemia in individuals > 40–60 years (AUC = 0.601 vs. 0.594; $p = 0.0127$) (Appendix B, Table S3, Fig. S3).

Discussion

Our study evaluated the clinical impact of the eGFR-EKFC vs. the eGFR-CKD-EPI 2009 in KT recipients. The values obtained with both equations were positively correlated and showed excellent agreement; however, at times the EKFC equation estimated significantly lower values than the CKD-EPI equation did, especially in women, individuals older than 60 years and those with stages 1−3a CKD. While the inflection point of the EKFC equation is 40 years,[10] we observe the greatest difference after 60 years. This is not unexpected, since the EKFC equation is adjusted to adapt the eGFR to the physiological changes associated with age, and thus its estimates more accurately reflect the mGFR in the Caucasian population.[9,11–13] In a study comparing the eGFRs obtained with the EKFC equation with those obtained with the CKD-EPI 2009, CKD-EPI 2021 and MDRD equations with respect to the inulin clearance-derived mGFR in a KT population, the MDRD equation showed the best results in all patients except without CKD; the EKFC equation obtained the best results in people over 65 years of age, and overall, its performance was non-inferior performance to MDRD in the overall cohort. The CKD-EPI 2021 equation had the greatest errors with respect to the mGFR.[12]

Given their design, it is unsurprising that the bias between the equations can be attributed to variations in sensitivity to age but not to comorbidities such as DM, whose significance in the bivariate model disappears when adjusted for age and sex. Both equations are less accurate in diabetic patients, although the reason is unclear, and the lack of accuracy does not favor one or the other in particular,[14] suggesting that global renal assessments are needed, rather than guidance solely by the eGFR. Delanaye et al. reported that the EKFC equation is more accurate when cystatin C (CysC) is alone or in combination with creatinine.[15] The inclusion of CysC has some

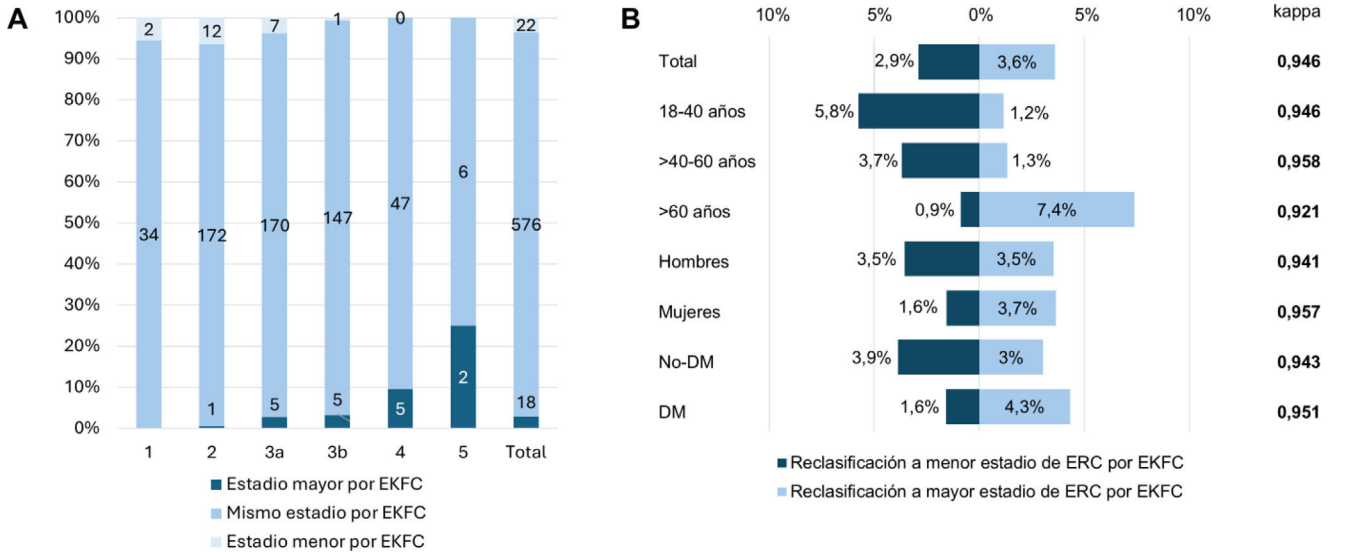

Figure 3. Stacked bar graph of CKD stage reclassification. The global sample with the stages and the gross number of patients according to whether they remained in the same stage is shown in Figure A; reclassification was performed with the EKFC equation and is depicted as better or worse with respect to the CKD-EPI 2009 CKDEPI equation, with the percentage with respect to the total on the vertical axis; note that a greater percentage of patients are reclassified to a lower stage with better renal function, whereas the opposite occurs in those with worse renal function (the data for stage 5 are nonsignificant because of the small sample). The percentage of reclassification in each of the subgroups analyzed is shown in Figure B, alongside the kappa coefficient of agreement in each subgroup; notably, women, those with DM and those aged > 60 years were more likely to be reclassified to higher stages, in contrast to the lower reclassification in those aged < 60 years. DM: diabetes mellitus; CKD: chronic kidney disease.

limitations,[7] however, and creatinine continues to be an essential parameter for using the equations in clinical practice, while the gold standard continues to be the mGFR.[1,16]

The CKD classification showed very good agreement between the equations. The percentage of reclassified patients was lower than that observed in the literature; Napier et al. reported a reclassification rate of 12.6%, with 97.43% of patients with stage 1–3a disease being reclassified to a higher stage[17]; this was not the case for patients with stage 3b–5 disease, however as also reported in a study by Pottel et al., where the differences were smaller and less in line with the mGFR.[9] Lu et al. reported that the agreement between the equations was best for patients with stage 3b-5 disease; however, as in our cohort, no patient with stage 5 CKD was reclassified to stage 4.[18] They performed the same analysis in a Korean population and observed that the EKFC equation was better than the CKD-EPI 2009 equation was for classifying patients into CKD stages except for those with stage 1 disease; specifically, the eGFR was underestimated in the population with better renal function.[11] However, among those who were reclassified, a small magnitude of bias was observed in patients with renal failure (eGFR < 60 mL/min/1.73 m^2), reducing the risk of possible complications associated with pharmacological adjustment.[19]

The predictive capacity of the two equations was significantly different (in favor of the CKD-EPI 2009) for acidosis in men and hyperkalemia in those > 40–60 years, although neither performance was clinically relevant; all the AUCs indicate a low level of accuracy. However, the eGFR continues to be the main indicator of renal function [1] as well as the main factor that indicates whether a certain comorbidity may be associated with CKD. To our knowledge, no studies have compared the accuracy of both these equations in predicting these events; we have observed similar results in comparisons with other equations such as the MDRD equation, which had better performance than the CKD-EPI in predicting metabolic syndrome,[20] although overall, the MDRD equation provides lower eGFR values, as does the EKFC equation.

Our study has important limitations, including its retrospective design and the lack of comparisons with the mGFR. Even though the goal of the EKFC equation was to provide a convenient solution to the need for two different equations, we did not explore how the eGFR changes from the pediatric age to the adult age, since we do not perform pediatric transplantation in our center.[21] The data in Fig. 1 demonstrate the importance of expanding this study to the pediatric population.

In conclusion, our study on KT revealed that the results for both equations are comparable to those reported in studies on nontransplant populations, reinforcing the need to obtain suitable information in this underrepresented population. We detected differences among women, patients aged > 60 years and those with CKD stages 1–3a, while the EKFC result was highly concordant and interchangeable with that of the CKD-EPI 2009 equation in stages 3b–5. The magnitude of the difference is small, particularly in patients with stages 1–3a CKD, but in the population > 60 years, we observed substantial variability; an interdisciplinary approach may be necessary for managing patients in this age range, but interventional studies are needed to confirm this statement.

Financing

This research has not received specific support from public sector agencies, the commercial sector or nonprofit entities.

Declaration of competing interest

The authors declare that the information contained in this document is not influenced by any conflicts of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.nefroe.2026.501430.

References

1. KDIGO. KDIGO 2024 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int. 2024;105:S117–314.

2. Gorostidi M, Sanchez-Martinez M, Ruilope LM, Graciani A, de la Cruz JJ, Santamaria R, et al. Chronic kidney disease in Spain: prevalence and impact of accumulation of cardiovascular risk factors. Nefrologia (Engl Ed). 2018;38:606–15.
3. Collaborators GBDRF. Global burden of 87 risk factors in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396:1223–49.
4. Navarro González JF, Ortiz A, Cebrián Cuenca A, Moreno Barón M, Segú L, Pimentel B, et al. Proyección de la carga clínica y económica de la enfermedad renal crónica entre 2022 y 2027 en España: resultados del proyecto Inside CKD. Nefrología. 2024;44:807–17.
5. Trasplantes ONT. In: Balance de actividad en 2023. Madrid: Ministerio de Sanidad; 2024.
6. Levey AS, Coresh J, Tighiouart H, Greene T, Inker LA. Measured and estimated glomerular filtration rate: current status and future directions. Nat Rev Nephrol. 2020;16:51–64.
7. Inker LA, Eneanya ND, Coresh J, Tighiouart H, Wang D, Sang Y, et al. New creatinine- and cystatin C-based equations to estimate GFR without race. N Engl J Med. 2021;385:1737–49.
8. Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF 3rd, Feldman HI, et al. A new equation to estimate glomerular filtration rate. Ann Intern Med. 2009;150:604–12.
9. Pottel H, Bjork J, Courbebaisse M, Couzi L, Ebert N, Eriksen BO, et al. Development and validation of a modified full age spectrum creatinine-based equation to estimate glomerular filtration rate: a cross-sectional analysis of pooled data. Ann Intern Med. 2021;174:183–91.
10. Pottel H, Hoste L, Yayo E, Delanaye P. Glomerular filtration rate in healthy living potential kidney donors: a meta-analysis supporting the construction of the full age spectrum equation. Nephron. 2017;135:105–19.
11. Jeong TD, Hong J, Lee W, Chun S, Min WK. Accuracy of the new creatinine-based equations for estimating glomerular filtration rate in Koreans. Ann Lab Med. 2023;43:244–52.
12. Delanaye P, Masson I, Maillard N, Pottel H, Mariat C. The new 2021 CKD-EPI equation without race in a European cohort of renal transplanted patients. Transplantation. 2022;106:2443–7.
13. Ma Y, Wei L, Yong Z, Yu Y, Chen Y, Zhu B, et al. Validation of the European kidney function consortium equation in Chinese adult population: an equation standing on the shoulders of predecessors. Nephron. 2024;148:63–73.
14. Silva LCF, Rocha BM, Escott GM, Porgere IF, Tochetto LA, de Almeida Brondani L, et al. Accuracy evaluation of 2021 Chronic Kidney Disease Epidemiology Collaboration, Full Age Spectrum and European Kidney Function Consortium equations for estimating glomerular filtration rate in type 2 diabetes mellitus and healthy adults. Clin Chim Acta. 2022;534:14–21.
15. Delanaye P, Bjork J, Vidal-Petiot E, Flamant M, Ebert N, Schaeffner E, et al. Diabetic status and the performances of creatinine- and cystatin C-based eGFR equations. Nephrol Dial Transplant. 2025;40:516–23.
16. Gonzalez-Rinne A, Luis-Lima S, Escamilla B, Negrin-Mena N, Ramirez A, Morales A, et al. Impact of errors of creatinine and cystatin C equations in the selection of living kidney donors. Clin Kidney J. 2019;12:748–55.
17. Napier K, Lim D, Thomas E, Boyd J, Chakera A, Williamson J, et al. Impact of routine reporting of estimated glomerular filtration rate using the European Kidney Function Consortium and Chronic Kidney Disease Epidemiology Collaboration equations in a Western Australian community population. Nephrology (Carlton). 2022;27:823–33.
18. Lu S, Robyak K, Zhu Y. The CKD-EPI 2021 equation and other creatinine-based race-independent eGFR equations in chronic kidney disease diagnosis and staging. J Appl Lab Med. 2023;8:952–61.
19. Posadas Salas MA, Taber DJ, Chua E, Pilch N, Chavin K, Thomas B. Critical analysis of valganciclovir dosing and renal function on the development of cytomegalovirus infection in kidney transplantation. Transpl Infect Dis. 2013;15:551–8.
20. Sanchez-Chaparro MA, Calvo-Bonacho E, Gonzalez-Quintela A, Cabrera M, Quevedo-Aguado L, Fernandez-Labandera C, et al. Estimating the glomerular filtration rate in the Spanish working population: chronic kidney disease prevalence and its association with risk factors. J Hypertens. 2014;32:1970–8. discussion 8.
21. Pottel H, Bjork J, Bokenkamp A, Berg U, Asling-Monemi K, Selistre L, et al. Estimating glomerular filtration rate at the transition from pediatric to adult care. Kidney Int. 2019;95:1234–43.