

## LETTER TO THE EDITOR

### The 2009 and 2021 CKD-EPI Equations: A Graphical Analysis of the Effect of Refitting GFR Estimating Equations Without a Race Coefficient



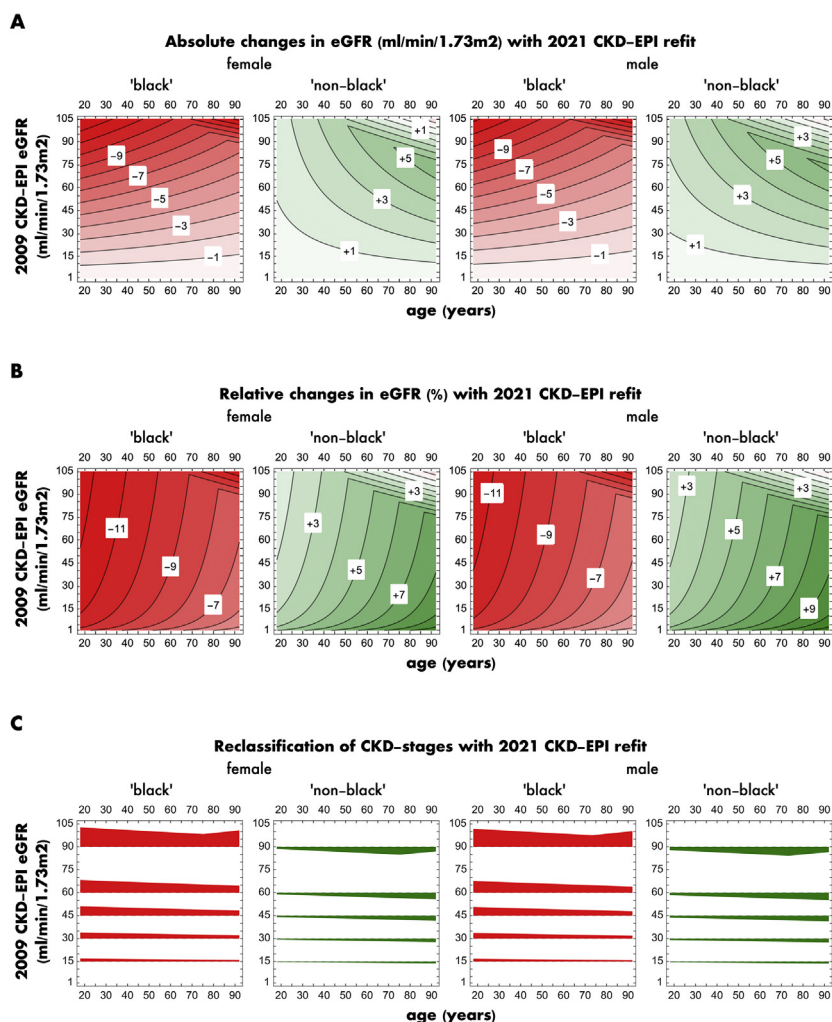
To the Editor:

The National Kidney Foundation and American Society of Nephrology Task Force on Reassessing the Inclusion of Race in Diagnosing Kidney Disease recommends implementing the 2021 CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) creatinine equation refit

without the race variable<sup>1</sup> for reporting creatinine-based estimated glomerular filtration rates (eGFRs) in the United States.<sup>2,3</sup>

Here, we provide a systematic visual analysis of the effect on eGFR values when using the 2021 CKD-EPI creatinine equation refit compared with the 2009 CKD-EPI creatinine equation with a race coefficient.<sup>4</sup>

Our analyses were purely mathematical and were done using procedures described previously.<sup>5</sup> We solved the 2009 equation for creatinine and used this term in the 2021 refit formula (Item S1). Using the software Mathematica, we designed different contour plots. Contour plots can be considered as topographical maps



**Figure 1.** Changes caused by switching from the 2009 CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) creatinine equation with a race coefficient to the 2021 CKD-EPI creatinine equation refit without the race variable as a function of age (x-axis, 18-92 years) and the 2009 CKD-EPI estimated glomerular filtration rate (eGFR) values (y-axis, 1-105 mL/min/1.73 m<sup>2</sup>). (A) Contour plots of absolute differences in eGFR (2021 CKD-EPI refit minus 2009 CKD-EPI). Contours were drawn for every 1 mL/min/1.73 m<sup>2</sup> difference. Areas where the 2021 CKD-EPI refit eGFR was lower than that in the 2009 CKD-EPI were shaded in red and where it was higher were shaded in green. (B) Contour plots of the relative differences in eGFR ( $100 \times [2021 \text{ CKD-EPI refit} - 2009 \text{ CKD-EPI}] / 2009 \text{ CKD-EPI}$ ). Contours were drawn for every 1% difference. Areas where the 2021 CKD-EPI refit eGFR was lower than that in the 2009 CKD-EPI were shaded in red and where it is higher were shaded in green. (C) Region plots showing discordant chronic kidney disease stages. Areas where the chronic kidney disease stage according to 2021 CKD-EPI refit was higher than that according to 2009 CKD-EPI (ie, eGFR was worse) were shaded in red, and areas where the chronic kidney disease stage was lower (ie, eGFR was better) were shaded in green. In the white areas, chronic kidney disease stages are the same with both equations.

where 2 variables define the x-axis and the y-axis and a third variable is shown by isolines within this coordinate system. Similar to a topographical map, all sorts of information can be displayed for different spots defined by the 2 coordinates.

We demonstrated the absolute and relative differences in eGFRs (Fig 1A and B) between the 2009 equation and the 2021 refit as a function of age (x-axis) and the 2009 eGFR values (y-axis). Because chronic kidney disease (CKD) is classified according to eGFR, we added plots—with the very same coordinate system—where we marked all the age/2009 CKD-EPI regions that have differing CKD classification results between the 2 equations (Fig 1C).

In comparison with the 2009 CKD-EPI values, the 2021 refit values were lower for Black persons and higher for non-Black persons. Absolute differences (Fig 1A) are mostly dependent on kidney function, being very small for low eGFRs. Relative differences (Fig 1B) show a race-discordant age dependency: for Black persons, they are highest in young people; and for non-Black persons, they are highest in the elderly. Regions with discordant CKD classification (Fig 1C) are very small for higher CKD stages. (An analogous figure comparing the Modification of Diet in Renal Disease equation with the 2021 CKD-EPI refit can be found in Item S2.)

Our plots provide an instant and global picture of the range and distribution of eGFR changes and of the effects on CKD staging that result from switching to the new equation. We believe that these graphics will help clinicians in the transition to the 2021 CKD-EPI creatinine equation refit without the race variable.

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## SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Item S1: Formulas

Item S2: MDRD Equation Compared With the 2021 CKD-EPI Refit

## ARTICLE INFORMATION

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