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Estimation of Black-White Disparities in CKD Outcomes: Comparison Using the 2021 Versus the 2009 CKD-EPI Creatinine Equations

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Supplementary Material
Supplementary File (PDF)
Items S1–S2; Table S1.

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To the Editor:

Estimated glomerular filtration rate (eGFR) has been commonly used as a measure of kidney function in clinical practice and research. The widely used CKD-EPI creatinine equation uses sex, age, race (Black or non-Black), and serum creatinine level (Scr) to calculate eGFR, assigning a 16% higher eGFR for individuals identified as Black despite the same age, sex, and Scr.[1] Because race is a social, nonbiological construct,[2,3] to provide a unifying approach for GFR estimation[3] a new CKD-EPI creatinine equation that does not use the race variable was recently developed[4] and is currently recommended by the National Kidney Foundation and American Society of Nephrology Task Force for US adults.[5,6] To understand the potential impact of the new equation on estimating racial disparities in clinical outcomes, we assessed Black-White disparities in kidney replacement therapy (KRT) and death as outcomes after incident CKD defined using the 2009 and 2021 CKD-EPI creatinine equations (2009-CKD-EPI and 2021-CKD-EPI, respectively). Our hypothesis is that 2021-CKD-EPI, developed without using the race variable, would reduce estimates of racial disparities in CKD outcomes.

The US Veterans Health Administration (VHA) provided a single-source population from which veterans, either non-Hispanic White or non-Hispanic Black, were determined to have incident CKD GFR category 3 or higher based on outpatient Scr using (1) 2009-CKD-EPI with its race term included[1] to construct one cohort, and (2) 2021-CKD-EPI developed without the race variable[4] to construct an alternative cohort. Race and ethnicity were self-reported. We defined incident CKD by the first occurrence of 2 consecutive eGFRs <60 mL/min/1.73 m^2 at ≥ 91 days apart but within 18 months.[7] Follow-up time started from the second, confirmatory, eGFR value in each cohort to avoid immortal time bias and continued up to 10 years or May 31, 2018. For each cohort, we obtained hazard ratios of death (including death after KRT) for Black versus White veterans using Cox proportional hazards regression and for KRT using cause-specific hazards regression censored for death. Additional detail is given in Item S1. This study was approved by Institutional Review Boards.

Between January 2007 and December 2016, 84,090 Black and 507,303 White veterans had incident CKD defined by 2009-CKD-EPI, and 101,693 Black (including 67,038 [66%] who were in both cohorts and 34,655 [34%] patients new to this cohort) and 449,802 White veterans (366,118 [81%] in both cohorts and 83,684 [19%] new patients) had incident CKD by 2021-CKD-EPI. Some patients identified by 2009-CKD-EPI were not identified as *incident* CKD by 2021-CKD-EPI (Item S2). The Black incident CKD group defined by 2021-CKD-EPI was younger and had fewer comorbid conditions compared with its counterpart defined by 2009-CKD-EPI (Table 1), primarily owing to inclusion of younger and healthier Black veterans identified by 2021-CKD-EPI (Table S1). Conversely, the White group by 2021-CKD-EPI was slightly older, with more comorbid conditions (Table 1), primarily owing to removal of some healthier White veterans from its incident CKD group

(Table S1). Rates of KRT (10.5 vs 15.2 per 1,000 patient-years) and death (51.6 vs 62.9 per 1,000 patient-years) were both substantially reduced in Black veterans using 2021-CKD-EPI versus 2009-CKD-EPI (Table 2). Conversely, rates of KRT and death were both increased in White veterans. After adjustment for basic covariates, Black veterans had a 37% greater hazard of KRT than White veterans under 2021-CKD-EPI, a marked reduction from the 172% greater Black-versus-White hazard under 2009-CKD-EPI. Also, Black veterans had a 9% lower adjusted hazard of death than White veterans under 2021-CKD-EPI, in contrast to a 10% greater adjusted hazard of death with 2009-CKD-EPI. These disparities were similar after further adjustment for comorbidities.

In this national veteran population, we found that 2021-CKD-EPI resulted in smaller estimates of racial disparities in clinical outcomes, but a greater disparity in age of CKD onset and many comorbidities at incident CKD. A main strength of the study is that the comparison was robust because all groups of veterans were anchored in new diagnosis of CKD according to the equation and were followed for an extended duration. The main limitation is the predominance of male participants in VHA.

These findings have important implications. Despite no change in actual patient outcomes, our disparity estimates of clinical outcomes between non-Hispanic Black and White veterans following incident CKD changed substantially using 2021-CKD-EPI because it changes eGFR values for both races, resulting in different incident CKD cohorts of both races. The research community should consider how to interpret prior and future estimates of disparities based on different eGFR equations. Our findings also suggest that the 2021 equation will identify more Black adults with CKD who are younger and relatively healthier. This will provide an important opportunity for health care providers to engage and intervene early to mitigate risks of progression and adverse outcomes in this high-risk group.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Baseline Characteristics of Black and White Veterans at Incidence of CKD Defined by the 2021 and 2009 CKD-EPI Equations

	Identified by the 2021 CKD-EPI (n = 551,495)		Identified by the 2009 CKD-EPI (n = 591,393)	
Characteristic	**Black**	**White**	**Black**	**White**
No. of participants	101,693	449,802	84,090	507,303
Age, y	65.3 ± 10.2	74.1 ± 9.6	67.0 ± 10.3	73.2 ± 9.6
Age <65 years	52,656 (51.8%)	80,685 (1 7.9%)	37,875 (45.0%)	103,429 (20.4%)
Male sex	96,095 (94.5%)	437,603 (97.3%)	80,234 (95.4%)	492,891 (972%)
BMI, kg/m^2	29.8 ± 6.3	29.9 ± 6.0	29.8 ± 6.5	29.9 ± 5.9
Systolic BP, mm Hg	133.0 ± 19.8	130.2 ± 18.2	133.4 ± 20.4	130.3 ± 17.9
Diastolic BP, mm Hg	77.1 ± 12.3	71.2 ± 11.1	76.3 ± 12.6	71.8 ± 11.1
eGFR, mL/min/1.73 m^2	51.2 ± 8.4	51.4 ± 7.8	50.6 ± 8.9	51.4 ± 7.8
Hypertension	94,644 (93.1%)	416,629 (92.6%)	80,320 (95.5%)	461,841 (91.0%)
Diabetes	54,467 (53.6%)	230,136 (51.2%)	49,053 (58.3%)	246,490 (48.6%)
Heart failure	21,653 (21.3%)	130,674 (29.1%)	21,235 (25.3%)	132,569 (26.1%)
Coronary artery disease	33,652 (33.1%)	242,851 (54.0%)	31,835 (37.9%)	259,190 (51.1%)
Cardiac dysrhythmia	27,377 (26.9%)	1 98,826 (44.2%)	25,425 (30.2%)	211,704 (41.7%)
Other cardiac diseases	29,208 (28.7%)	185,218 (41.2%)	26,507 (31.5%)	198,232 (39.1%)
CVA/TIA	19,497 (19.2%)	129,699 (28.8%)	18,179 (21.6%)	137,146 (27.0%)
PVD	24,310 (23.9%)	1 64,778 (36.6%)	22,826 (27.1%)	174,148 (34.3%)
COPD	26,390 (26.0%)	165,477 (36.8%)	23,168 (27.6%)	181,023 (35.7%)
Anemia	38,656 (38.0%)	1 79,468 (39.9%)	36,180 (43.0%)	185,669 (36.6%)
Cancer	23,490 (23.1%)	124,088 (27.6%)	21,364 (25.4%)	134,297 (26.5%)
GI bleeding disorders	13,880 (13.6%)	64,031 (14.2%)	12,310 (14.6%)	68,880 (13.6%)
Liver disease	6,581 (6.5%)	24,696 (5.5%)	5,656 (6.7%)	27,478 (5.4%)
UACR				
<30 mg/g	25,698 (25.3%)	117,343 (26.1%)	21,127 (25.1%)	132,422 (26.1%)
30–300 mg/g	12,596 (12.4%)	59,265 (13.2%)	11,946 (14.2%)	60,357 (11.9%)
>300 mg/g	4,946 (4.9%)	16,282 (3.6%)	5,336 (6.3%)	15,216 (3.0%)
Missing	58,453 (57.5%)	256,912 (57.1%)	45,681 (54.3%)	299,308 (59.0%)
Incident years 2007–2010	33,672 (33.1%)	1 72,355 (38.3%)	27,715 (33.0%)	197,405 (38.9%)
Incident years 2011–2013	28,171 (27.7%)	121,379 (27.0%)	23,542 (28.0%)	134,849 (26.6%)
Incident years 2014–2016	39,850 (39.2%)	156,068 (34.7%)	32,833 (39.0%)	1 75,049 (34.5%)

Values for continuous variables given as mean ± standard deviation. Categories may not sum to 100% due to rounding. Abbreviations: CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; BMI, body mass index; BP, blood pressure; CVA/TIA, cerebrovascular accident/transient ischemic attack; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; GI, gastrointestinal; UACR, urinary albumin-creatinine ratio.

Table 2.

Hazard Ratios of Outcomes for Black Veterans Compared toWhite VeteransWith Incident CKD Defined by Each Equation

	Event Rate (per 1,000 Patient-Years)	HR (95% CI)		
		Unadjusted	Adjusted for Basic Covariates[a]	Additionally Adjusted for Comorbidities[b]
KRT				
2021-CKD-EPI[c]				
Black	10.5	2.39 (2.31–2.47)	1.37 (1.32–1.42)	1.27 (1.22–1.32)
White	4.4	1.00 (reference)	1.00 (reference)	1.00 (reference)
2009-CKD-EPI[c]				
Black	15.2	4.56 (4.40–4.71)	2.72 (2.62–2.82)	2.21 (2.13–2.29)
White	3.4	1.00 (reference)	1.00 (reference)	1.00 (reference)
Death				
2021-CKD-EPI[c]				
Black	51.6	0.62 (0.61–0.62)	0.91 (0.90–0.92)	0.96 (0.94–0.97)
White	83.5	1.00 (reference)	1.00 (reference)	1.00 (reference)
2009-CKD-EPI[c]				
Black	62.9	0.85 (0.84–0.86)	1.10 (1.09–1.12)	1.10 (1.08–1.11)
White	74.3	1.00 (reference)	1.00 (reference)	1.00 (reference)

Abbreviation: HR, hazard ratio.

[a]Basic covariates included age, sex, eGFR, and incident-year period.

[b]Covariates were basic covariates plus BMI, systolic and diastolic BPs, and 13 comorbidities (hypertension, diabetes, heart failure, coronary artery disease, cardiac dysrhythmia, other cardiac diseases, CVA/TIA, PVD, COPD, anemia, cancer, GI bleeding disorders, and liver disease).

[c]Analyses were performed separately for the 2 equations. For each equation, Black veterans were compared to the White veterans.