

Supplement to:

Black race in GFR estimation and diabetes medication recommendations in CKD: National estimates

Study Population

We identified people from NHANES whose self-reported race was non-Hispanic Black. Self-reported multi-racial status, or categorization as Hispanic and Black, are not identifiable from the public NHANES datasets and were thus not included in the analysis.¹ We identified people with diabetes from either 1) Hgb A1c $\geq 6.5\%$ or 2) both reported diagnosis of diabetes and current use of diabetes medication. We sought to include only people with Type 2 diabetes. NHANES does not explicitly differentiate between type 1 and type 2 diabetes, and people with Type 1 diabetes have different medication eligibility. However, the CDC estimates that 90-95% of diabetes cases in the US are due to type 2 diabetes,² so these make up the majority of the diabetes cases in NHANES. We also used an algorithm (based on two previously published studies) to identify people likely to have Type 1 diabetes, who were then excluded from the analysis.^{3,4} People who were started on insulin within one year of diabetes diagnosis, who were younger than age 30 at diabetes diagnosis, and who were using insulin but no oral hypoglycemics at time of questionnaire administration were identified as Type 1 diabetics and excluded. Atherosclerotic cardiovascular disease was ascertained from self-report of prior heart attack, coronary heart disease, angina/angina pectoris, or stroke. Congestive heart failure was ascertained from self-report. Weight and height were measured at time of NHANES examination.

Antihyperglycemic Agents and eGFR thresholds

We used eGFR of 30 ml/min/1.73m² as the cutoff for metformin use, consistent with FDA guidance and KDIGO guidelines.⁵ For SGLT2 inhibitors, we used an eGFR lower threshold of 30 ml/min/1.73m², consistent with the KDIGO guidelines.⁵ This was based on inclusion criteria for the EMPA-REG, CANVAS, and CREDENCE trials.⁶⁻⁸ DAPA-CKD included participants with baseline eGFR as low as 25 ml/min/1.73m², and use of this threshold would have changed our results slightly.⁹ For GLP-1 receptor agonists, we used an eGFR lower threshold of 15 ml/min/1.73m², as one agent has been studied at eGFRs this low (dulaglutide in the REWIND trial).¹⁰

Analysis

We estimated weighted totals and proportions for those who met inclusion criteria and for subgroups in our analysis. To enable more stable estimates, we combined four 2 year data cycles (8 years), 2011-2018, and adjusted the weights accordingly, enabling estimates of totals and proportions of the US population with appropriate variances.¹¹ Inclusion in the study required participation in the NHANES exam phase, and thus we used the examination weights.¹² We used survey methods for all analyses, to account

for clustering, stratification, and weighting. Taylor series linearization was used for estimation of variances.^{12,13}

Urine albumin-to-creatinine ratios were missing for 41 of the 923 included observations (4.4%) and serum creatinine for 80 of the 923 observations (8.7%). To try to reduce possible bias, multiple imputation was used, under the Missing At Random (MAR) assumption. Twenty imputations were performed using chained equations and predictive mean matching, using analytic variables (creatinine, albumin, age, sex) and design variables (represented by a composite stratum x cluster indicator variable).¹³ Convergence was assessed using trace plots. Estimated glomerular filtration rates were passively imputed using the imputed serum creatinine levels. All estimations used the multiple imputations according to the combination rules of Rubin.¹⁴

NHANES data sets reports ages ≥ 80 years as 80 years to ensure anonymity. The average age of those reported as 80 years is 85 years for 2015-16,¹ which we used as the approximation for people with age recorded as 80 or older for purposes of eGFR estimation. All analyses were performed using Stata 14.2 (www.stata.com). The figure was created using the R version 4.0.2 (www.r-project.com).

Supplemental Table 1. Cross-sectional NHANES estimates for US non-Hispanic Black adults with type 2 diabetes.

Variable	Measure
Unweighted observations (N)	923
Weighted estimate, N, (95% CI)	4,007,966 (3,358,243-4,657,689)
Age, years, median (IQR)	58 (49-68)
Female, %	56.8%
Serum creatinine, mg/dl, median (IQR)	0.95 (0.78-1.18)
eGFR-Race coefficient, ml/min/1.73m ² , median (IQR)	87.4 (67.0-109.0)
eGFR-No race coefficient, ml/min/1.73m ² , median (IQR)	75.4 (57.8-94.0)
Urine albumin to creatinine ratio, mg/g, median (IQR)	12.9 (6.6-49.4)
BMI, kg/m ² , median (IQR)	33.0 (28.8-38.9)
Coronary heart disease, %	12.2%
Stroke, %	8.1%
Heart failure, %	10.2%

Notes: 2011-2018 NHANES data were used. All measures except number of observations are weighted estimates. Comorbidities obtained from questionnaire responses.

Abbreviations: NHANES, National Health and Nutrition Examination Survey; CI, confidence interval; IQR, interquartile range; BMI, body mass index.

References, Supplementary Methods

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