Access to Transplant for African American and Latino Patients Under the 2014 US Kidney Allocation System

Teija Madhusoodanan, MD,[1,2] David P. Schladt, MS,[3,4] Grace R. Lyden, PhD,[3,4] Cinthia Lozano, PhD,[5] Jonathan M. Miller, PhD,[3,4] Joshua Pyke, PhD,[3,4] Tim Weaver, MS,[3,4] Ajay K. Israni, MD, MS,[5,6] and Warren T. McKinney, PhD[4,7]

Background. Kidney transplant offers better outcomes and reduced costs compared with chronic dialysis. However, racial and ethnic disparities in access to kidney transplant persist despite efforts to expand access to transplant and improve the equity of deceased donor allocation. Our objective was to evaluate after listing the association of race and ethnicity with access to deceased donor kidney transplant (DDKT) after changes to the allocation system in 2014. **Methods.** This retrospective study evaluated access to DDKT after listing since the implementation of the 2014 kidney allocation system. Waitlist status and transplant outcomes were ascertained from data from the Scientific Registry of Transplant Recipients. Our analysis included every adult kidney transplant candidate on the waiting list in the US from January 1, 2015, through June 30, 2023. **Results.** A total of 290 763 candidates were on the waiting list for DDKT during the study period. Of these, 36.4% of candidates were African American and 22.2% were Latino. Compared with White non-Latino patients, access to DDKT after listing was reduced for African American (unadjusted hazard ratio [HR], 0.93; 95% confidence interval [CI], 0.92-0.94) and Latino individuals (unadjusted HR, 0.88; 95% CI, 0.87-0.90). After controlling for demographic and clinical factors, these differences in access to transplant widened substantially for African American (HR, 0.78; 95% CI, 0.77-0.80) and Latino patients (HR, 0.73; 95% CI, 0.72-0.74). **Conclusions.** African American and Latino patients had reduced access to DDKT after listing. More effective approaches to improving access for African American and Latino individuals after listing are needed.

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[1] *Nephrology Division, Hennepin Healthcare, Minneapolis, MN.*

[2] *Department of Medicine, University of Minnesota, Minneapolis, MN.*

[3] *Chronic Disease Research Group (CDRG), Minneapolis, MN.*

[4] *Scientific Registry of Transplant Recipients (SRTR), Minneapolis, MN.*

[5] *Division of Nephrology, Department of Medicine, University of Texas Medical Branch, Galveston, TX.*

[6] *Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, Minneapolis, MN.*

[7] *Nephrology Division, Hennepin Healthcare Research Institute (HHRI), Minneapolis, MN.*

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W.T.M., A.K.I., and D.P.S. had full access to all the data in the study and take responsibility for the integrity of the study and the accuracy of the data analysis. The data that support the findings of this study are available from the Scientific Registry of Transplant Recipients (SRTR). Restrictions apply to the availability of these data which were used under license for this study. Data are available from W.T.M. with the permission of SRTR.

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INTRODUCTION

End-stage kidney disease (ESKD) affects >750 000 people in the United States.[1] The only life-sustaining options for the treatment of ESKD are dialysis and kidney transplant. Compared with dialysis, kidney transplants extend life, offer improved quality of life in patients with ESKD,[2,3] and are a more cost-effective treatment.[4,5] In 2022, >44 000 adults were added to the waiting list for kidney transplants and just >26 000 transplants were performed.[6] Of the transplants performed in 2022, just <5800 were from living donors. The discrepancy between the demand for transplant and the scarcity of deceased donor kidneys creates extended waiting times for candidates. Complicating this problem further, ESKD is known to disproportionately affect racial minority groups in the United States.[1] African American individuals are overrepresented on the kidney transplant waiting list and face longer waiting times.[1,7] Similarly, incident rates of ESKD in Latino communities exceed those of non–African American non-Latino individuals,[1,8] and cultural and linguistic barriers reduce the likelihood of completing the evaluation for candidacy[9] and reduce access to preemptive and living donor transplantation.[10,11]

The Organ Procurement and Transplantation Network (OPTN) and the United Network for Organ Sharing are responsible for managing the US national transplant waiting list, matching donors to recipients, and developing and implementing policy to improve efficiency and equity in the allocation of scarce donor organs. Policy changes to provide more equitable allocation have targeted structural barriers embedded within the kidney allocation system and reduced racial disparity in access to transplant according to unadjusted transplant rate models.[7] Allocation of priority points for HLA-A and B were discontinued because they reduced the transplant rate for patients in racial and ethnic minority groups as distributions of HLA types vary between groups.[12,13] Amendments implemented in late 2014 were expected to improve racial equity but were part of a larger effort to reduce geographic variability and make the organ transplantation system consistent across the country.[14] These modifications redefined the calculation of waiting time and gave priority points for longer time on dialysis before listing, as opposed to allocating points based on the amount of time that has passed since being added to the waiting list. Likewise, candidates with blood type B became eligible to receive offers from donors with blood type A2/A2B.[15-17] Together, these changes narrowed the gap in transplant rates between African American candidates and their non-Hispanic White counterparts as well as between Hispanic and non-Hispanic White patients.[7,18] Many barriers to living donor transplant for African American patients have been studied.[19-21] Subsequent to the 2014 kidney allocation system, examinations of barriers to deceased donor kidney transplant (DDKT) illuminated delayed and reduced access to the waiting list[22-24] and the negative role of inactive status, a conditional period when candidates are ineligible for donor offers, as major drivers of racial/ethnic disparities. Racial disparities were also found to persist between White non-Latino and African American patients within the calculated panel-reactive antibody (cPRA) categories of 80%–89% and ≥90%.[25] Analyses of social determinants of health and regional variation define race as a social construct and inform interventions targeting behavioral and programmatic change to improve access to the waiting list.[26-32]

In this study, our goals were to (1) evaluate the magnitude of the disparity in access to DDKT among African American and Latino individuals after listing and (2) identify candidate-level factors that contribute to the inequity after listing. Recognizing that race is a social construct without a direct clinical impact on access to transplant, we hope that by elucidating candidate-level factors, the field will be better able to address racial/ethnic barriers to kidney transplant.[33,34] Our approach is informed by the socioecological model proposed by Arriola of racial bias and racism in access to transplant; this model recognizes that racial bias may have a different impact on each level of social organization and results in inequities in individual health outcomes, institutional practices, and policymaking.[23] These insights could inform transplant center-level interventions to expand access to DDKT after listing via the expansion of behavioral and social support and adoption of novel clinical and programmatic approaches to increase efficiency in the allocation process.[35,36]

MATERIALS AND METHODS

Study Population and Data

This study used data from the Scientific Registry of Transplant Recipients (SRTR). The SRTR system includes data on all donors, waitlisted candidates, and transplant recipients in the United States, submitted by the members of the OPTN, and has been described elsewhere.[37] The Health Resources and Services Administration, US Department of Health and Human Services, provides oversight of the activities of the OPTN and SRTR contractors. SRTR reports the race and ethnicity (Hispanic/Latino) of candidates as a single data element to reflect the collection of data; patients may identify as one race and/or ethnicity, "other" or "unknown." Data on waitlist activity, comorbidities, and demographics are included in the SRTR data, and categorical differences across groups were evaluated by the χ^2 tests.

The study was approved by the Institutional Review Board of Hennepin Healthcare and a waiver of consent was obtained. All adult (aged 18 y or older) DDKT candidates on the waiting list from January 1, 2015, through June 30, 2023, were identified using SRTR data (n = 290 763). Candidates were censored at 10 y postlisting. The start date was selected to capture waitlist activity after the aforementioned changes to the kidney allocation system (implemented in December 2014).[16] The end date was selected to maximize follow-up time. Waitlist and fixed covariates were assessed at the candidate level.

The funding organizations mentioned above did not play a role in the design and conduct of the study; collection, management, and analysis of the data; or the preparation, review, approval, or decision to submit the manuscript for publication. The data reported here have been supplied by HHRI as the contractor for SRTR. The interpretation and reporting of these data are the responsibility of the author(s) and in no way should be seen as an official policy of or interpretation by SRTR or the US Government.

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Correspondence: Warren T. McKinney, PhD, Division of Nephrology, Hennepin Healthcare Research Institute, 701 Park Ave, Shapiro 5, Minneapolis, MN 55415. (wmckinney@hhrinstitute.org).

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Missing values were treated as one of the levels in the categorical variables (and all the variables in the models were formatted as categorical variables). This study reported results according to the Strengthening the Reporting of Observational Studies in Epidemiology reporting guideline for cohort studies (Table 1).

Statistical Analysis and Model Covariates

Candidates on the waiting list for kidney transplant were classified racially as either African American or White. Ethnic classifications included Latino (African American Latino and White Latino) and non-Latino. Racial and ethnic classifications were ascertained from self-reported race and ethnicity in the SRTR database. We did not create separate categories for Asian, American Indian and Alaska Native, Native Hawaiian and Pacific Islander, or multiracial individuals in the study due to small sample size.

Univariable and multivariable Cox proportional hazards models with the outcome of time to transplant were constructed to evaluate the unadjusted and adjusted association of African American race and Latino ethnicity on the likelihood of receiving a transplant. Candidates were followed from listing until the earliest of transplant, death, removal from the waiting list, end of study, or 10 y postlisting. Candidates listed before the beginning of the study were left truncated on January 1, 2015. Fixed candidate factors included race/ethnicity, blood type, diabetes status, primary cause of kidney failure, body mass index, previous kidney transplant, sex, dialysis time at listing, simultaneous kidney-pancreas candidate, education status, and insurance status. Time-varying factors included age at status updates, cPRA, and inactive status. We calculated transplant-free survival Kaplan-Meier estimates by race and ethnicity using the same left truncation and right censoring.

We performed Schoenfeld tests and plotted smoothed curves of the residuals to evaluate the proportional hazards assumption for the association of race and ethnicity with access to deceased donor transplant after listing.

A sensitivity analysis was conducted to account for confounding by inactive status by including only the time a candidate was active on the list and removing candidates who were never active. Accounting for inactive time on the waiting list did not appreciably change the disparities in the full multivariable model. Additional sensitivity analyses included (1) subgroup multivariable models by era of allocation policy whereby 250 miles around the donor hospital was the first unit of allocation (ie, pre-KAS250 versus post-KAS250), (2) a multivariable model with a fixed effect for OPTN regions, and (3) a multivariable model with a random effect for donation service area (DSA) to evaluate temporal and geographic variation. Analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC) and R software version 4.0 (www.r-project.org). The dplyr package version 1.0.5 handled data cleaning and management.[38] The survival package version 3.2 estimated the Cox proportional hazard models[39]; a P value of <0.05 was considered significant.

RESULTS

Among the 290 763 candidates waitlisted during the primary study period, 105 919 (36.4%) were African American patients and 64 635 (22.2%) were Latino patients (Table 2). Of all candidates, 35.7% received a transplant; by race and ethnicity, 36.4% of African American, 35.2% of White non-Latino, and 35.5% of Latino patients received a transplant. Median waiting times were 4.62 y (95% confidence interval [CI], 4.56-4.68) for African American patients, 4.99 y (95% CI, 4.92-5.06) for Latino candidates, and 4.20 y (95% CI, 4.15-4.24) for White non-Latino candidates. African American patients were more likely to have the following characteristics: higher body mass index, blood type B, women, higher cPRA value, inactive time on the waiting list, younger age, and Medicare as their primary insurance (all $P < 0.001$). Latino individuals on the waiting list were more likely to have the following factors: diabetes, reliance on Medicaid, and high school education or less (all $P < 0.001$). The accumulated waiting time for African American patients was longer than for non–African American patients, with a higher proportion of the African American candidates waitlisted for ≥3 y (24.3%) compared with Latino candidates (22.1%) and White non-Latino candidates (18.1%; all $P < 0.001$). Fewer African American patients (24.0%) and Latino patients (21.8%) gained access to the waiting list before initiating dialysis compared with White non-Latino candidates (45.2%; $P < 0.001$). In addition, African American candidates were more likely to have >1 y of total inactive time on the waiting list (29.8%) than their White non-Latino counterparts (28.7%) ($P < 0.001$). Conversely, Latino candidates were more likely to have no inactive time on the waiting list (42.8%) than their White non-Latino counterparts (33.9%).

African American Race and Access to Transplant

In the unadjusted analysis, the hazard ratio (HR) for African American candidate access to DDKT was 0.93 (95% CI, 0.92-0.94; $P < 0.001$; Table 3). Adjusting for candidate clinical and demographic factors, the racial disparity in access to transplant increased (adjusted HR, 0.78; 95% CI, 0.77-0.79; $P < 0.001$; Figure 1). Likewise, when only including active waitlist time, the magnitude of the association of race with reduced transplant access increased compared with the unadjusted univariable model (HR, 0.76; 95% CI, 0.74-0.77; $P < 0.001$). Of the 243 742 active waitlisted-only patients, 89 540 (36.71%) were African American and 55 193 (22.64%) were Latino. Table 4 provides the clinical and demographic characteristics of this subgroup. The Schoenfeld test of the adjusted model showed no significant violation of the proportional hazards assumption ($P = 0.91$).

Latino Ethnicity and Access to Transplant

In the unadjusted model, the HR for Latino candidates' access to DDKT was 0.88 (95% CI, 0.87-0.90; $P < 0.001$). The adjusted model accounting for demographic and clinical factors resulted in an increased ethnic disparity (adjusted HR, 0.73; 95% CI, 0.72-0.74; $P < 0.001$). Sensitivity analysis for active waiting status showed a similar disparity (HR, 0.73; 95% CI, 0.71-0.74; $P < 0.001$). The Schoenfeld test of the adjusted model showed no significant violation of the proportional hazards assumption ($P < 0.085$).

KAS250 and Geography

The effect of race and ethnicity was not as large but still significant following the implementation of KAS250 in March

TABLE 1.
STROBE checklist

	Item No.	Recommendation	Location
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Abstract—Design
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract—Results
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction—Para. 2
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction—Para. 3
Methods			
Study design	4	Present key elements of study design early in the article	Methods
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods—Study Population and Data
Participants	6	(a) Cohort study—give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—give the eligibility criteria, and the sources and methods of selection of participants	Methods—Statistical Analysis and Model Covariates
		(b) Cohort study—for matched studies, give matching criteria and number of exposed and unexposed Case-control study—for matched studies, give matching criteria and the number of controls per case	Methods—Statistical Analysis and Model Covariates
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods—Statistical Analysis and Model Covariates
Data sources/ measurement	8[a]	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is >1 group	Methods—Statistical Analysis and Model Covariates
Bias	9	Describe any efforts to address potential sources of bias	Methods—Statistical Analysis and Model Covariates—Para. 3
Study size	10	Explain how the study size was arrived at	Methods—Statistical Analysis and Model Covariates—Para. 2
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods—Statistical Analysis and Model Covariates
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Methods—Statistical Analysis and Model Covariates
		(b) Describe any methods used to examine subgroups and interactions	Methods—Statistical Analysis and Model Covariates
		(c) Explain how missing data were addressed	Methods—Study Population and Data
		(d) Cohort study—if applicable, explain how loss to follow-up was addressed Case-control study—if applicable, explain how matching of cases and controls was addressed Cross-sectional study—if applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	Methods—Statistical Analysis and Model Covariates
Participants	13[a]	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed	Methods—Statistical Analysis and Model Covariates
		(b) Give reasons for nonparticipation at each stage	NA
		(c) Consider use of a flow diagram	NA

Continued next page

TABLE 1. (Continued)

	Item No.	Recommendation	Location
Descriptive data	14[a]	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Results
		(b) Indicate number of participants with missing data for each variable of interest	Methods—Study Population and Data
		(c) Cohort study—summarize follow-up time (eg, average and total amount)	Methods—Statistical Analysis and Model Covariates
Outcome data	15[a]	Cohort study—report numbers of outcome events or summary measures over time	Results
		Case-control study—report numbers in each exposure category, or summary measures of exposure	NA
		Cross-sectional study—report numbers of outcome events or summary measures	NA
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Results
Other analyses	17	Report other analyses done—eg, analyses of subgroups and interactions, sensitivity analyses	Results
Discussion			
Key results	18	Summarize key results with reference to study objectives	Discussion—Para. 1
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion—Study Limitations
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Conclusion
Generalizability	21	Discuss the generalizability (external validity) of the study results	Discussion
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Support

[a]The following text appears in the footnote in the source documents for the STROBE checklist: "Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohorts and cross-sectional studies."
STROBE, Strengthening the Reporting of Observational Studies in Epidemiology.

2021. In KAS250 era subgroup models, the HR for African American candidates' access to DDKT was 0.738 (95% CI, 0.722-0.750; $P < 0.001$) before KAS250 and 0.875 (95% CI, 0.852-0.899; $P < 0.001$) after KAS250. The HR for Latino candidates was 0.692 (95% CI, 0.677-0.707; $P < 0.001$) before KAS250 and 0.789 (95% CI, 0.765-0.813; $P < 0.001$) after KAS250. A multivariable model with a fixed effect for the OPTN region revealed that the effect of race and ethnicity was still significant after accounting for the OPTN region. The HR for African American race was 0.809 (95% CI, 0.796-0.821; $P < 0.001$), and the HR for Latino ethnicity was 0.905 (95% CI, 0.887-0.922; $P < 0.001$; Figure 2). However, the effect of Latino ethnicity decreased substantially, suggesting that some amount of the disparity between Latino and White non-Latino candidates is due to regional differences in transplant rate. Similarly, a multivariable model with a random effect for DSA and transplant centers (data not shown) showed that the effect of race/ethnicity remains significant; however, the effect for Latino ethnicity reverses. The HR of the African American race was 0.875 (95% CI, 0.861-0.889; $P < 0.001$), and the HR for Latino ethnicity was 1.040 (95% CI, 1.019-1.061; $P < 0.001$).

DISCUSSION

Racial disparities in referral to transplant and successful completion of the waitlist evaluation have been extensively investigated during the past 2 decades.[15,23,25,27,40-42] Our unadjusted and adjusted analyses showed that among waitlisted patients, African American and Latino candidates undergo DDKT at lower rates than their White non-Latino counterparts. Previous investigations have suggested multiple factors that may be causing this lack of equity in transplantation, often identifying patient-level factors.[25] Our study details that African American patients are disproportionately affected by many of these factors. For instance, during our primary study period, a higher proportion of African American patients had type B blood type, higher body mass index (>30 kg/m^2, obese category), longer waiting times, and higher sensitivity to HLAs (demonstrated by higher cPRA values), and spent more time on the waiting list as "inactive." In addition, waitlisted African American patients were more likely to have Medicare and less likely to have private insurance compared with their non–African American counterparts. Our adjusted analysis indicated that African American candidates accessed DDKT 19% less often during the study period. African American candidates had more cumulative dialysis time than their non–African American counterparts. At the same time, survival analyses indicated that the association between race and access to transplant varied with time and was more pronounced after 1 y on the waiting list. Our study also found that Latino ethnicity was associated with access to transplant and that Latino candidates faced greater disparities than African American

TABLE 2.

Distribution of clinical and demographic characteristics

Characteristic	Total, % (N)	White Americans, % (n)	African Americans, % (n)	Latino, % (n)	*P*
Total	290 763	41.34 (120 209)	36.43 (105 919)	22.23 (64 635)	
Transplant					
No	64.34 (187 088)	64.80 (77 897)	63.75 (67 524)	64.47 (41 667)	<0.0001
Yes	35.66 (103 675)	35.20 (42 312)	36.25 (38 395)	35.53 (22 968)	
ABO type					
A	31.39 (91 272)	39.35 (47 305)	24.60 (26 060)	27.70 (17 907)	<0.0001
AB	3.41 (9914)	3.76 (4520)	3.89 (4118)	1.97 (1276)	
B	14.24 (41 408)	10.95 (13 161)	20.65 (21 873)	9.86 (6374)	
O	50.96 (148 169)	45.94 (55 223)	50.86 (53 868)	60.46 (39 078)	
Diabetes					
No	53.45 (155 422)	57.74 (69 403)	53.38 (56 540)	45.61 (29 479)	<0.0001
Yes	46.55 (135 341)	42.26 (50 806)	46.62 (49 379)	54.39 (35 156)	
Primary cause of kidney failure					
Diabetes	37.09 (107 833)	31.99 (38 449)	36.60 (38 763)	47.38 (30 621)	<0.0001
Hypertension	22.74 (66 131)	15.24 (18 315)	34.49 (36 536)	17.45 (11 280)	
Glomerulonephritis	12.31 (35 803)	14.42 (17 337)	10.40 (11 011)	11.53 (7455)	
Cystic kidney disease	8.13 (23 646)	12.92 (15 534)	4.06 (4303)	5.89 (3809)	
Other/unknown	19.72 (57 350)	25.43 (30 574)	14.45 (15 306)	17.75 (11 470)	
BMI, kg/m^2					
Missing	0.37 (1086)	0.41 (488)	0.35 (367)	0.36 (231)	<0.0001
<18.5	1.29 (3744)	1.50 (1799)	1.08 (1144)	1.24 (801)	
18.5–<25	19.25 (55 982)	19.84 (23 849)	17.84 (18 898)	20.48 (13 235)	
25–<30	31.72 (92 236)	30.93 (37 182)	29.96 (31 736)	36.08 (23 318)	
30–<35	27.65 (80 394)	27.52 (33 083)	28.08 (29 745)	27.18 (17 566)	
≥35	19.71 (57 321)	19.81 (23 808)	22.69 (24 029)	14.67 (9484)	
Prior kidney transplant					
No	88.12 (256 216)	86.94 (104 508)	87.64 (92 828)	91.10 (58 880)	<0.0001
Yes	11.88 (34 547)	13.06 (15 701)	12.36 (13 091)	8.90 (5755)	
Sex					
Female	38.38 (111 603)	37.22 (44 747)	40.70 (43 111)	36.74 (23 745)	<0.0001
Man	61.62 (179 160)	62.78 (75 462)	59.30 (62 808)	63.26 (40 890)	
SPK					
Kidney	100.00 (290 763)	100.00 (120 209)	100.00 (105 919)	100.00 (64 635)	
Education					
Unknown	3.34 (9719)	3.83 (4604)	3.15 (3340)	2.75 (1775)	<0.0001
High school or less	47.21 (137 271)	37.84 (45 487)	44.75 (47 396)	68.67 (44 388)	
More than high school	49.45 (143 773)	58.33 (70 118)	52.10 (55 183)	28.58 (18 472)	
Insurance type					
Medicaid	9.98 (29 009)	6.04 (7260)	10.04 (10 638)	17.19 (11 111)	<0.0001
Medicare	48.26 (140 330)	45.96 (55 253)	52.08 (55 163)	46.28 (29 914)	
No insurance	0.12 (343)	0.13 (155)	0.12 (125)	0.10 (63)	
Other public	2.72 (7902)	2.70 (3244)	3.28 (3471)	1.84 (1187)	
Other/unknown	0.23 (670)	0.32 (385)	0.21 (221)	0.10 (64)	
Private	38.69 (112 509)	44.85 (53 912)	34.27 (36 301)	34.50 (22 296)	
Waiting time at last status, y					
<1	56.48 (164 220)	58.61 (70 458)	53.06 (56 202)	58.11 (37 560)	<0.0001
1–<2	12.63 (36 727)	13.54 (16 282)	12.58 (13 324)	11.02 (7121)	
2–<3	9.65 (28 057)	9.76 (11 736)	10.07 (10 663)	8.75 (5658)	
3–<5	12.33 (35 842)	11.43 (13 738)	13.57 (14 371)	11.96 (7733)	
≥5	8.91 (25 917)	6.65 (7995)	10.72 (11 359)	10.15 (6563)	
Last cPRA					
Missing	15.74 (45754)	16.23 (19514)	13.19 (13975)	18.98 (12265)	<0.0001
<1%	43.17 (125523)	46.30 (55658)	39.58 (41923)	43.23 (27942)	
1%–<20%	9.29 (27 008)	9.22 (11 078)	9.81 (10 394)	8.57 (5536)	
20%–<80%	17.07 (49 636)	15.60 (18 754)	19.43 (20 583)	15.93 (10 299)	

Continued next page

TABLE 2. (Continued)

Characteristic	Total, % (N)	White Americans, % (n)	African Americans, % (n)	Latino, % (n)	*P*
80%–<98%	7.23 (21 032)	6.51 (7821)	8.33 (8826)	6.78 (4385)	
≥98%	7.50 (21 810)	6.14 (7384)	9.65 (10 218)	6.51 (4208)	
Age at last status, y					
18–<35	9.12 (26 517)	7.27 (8742)	8.90 (9430)	12.91 (8345)	<0.0001
35–<50	24.06 (69 964)	18.32 (22 020)	28.73 (30 429)	27.10 (17 515)	
50–<65	43.64 (126 878)	43.00 (51 694)	44.13 (46 742)	44.00 (28442)	
≥65	23.18 (67 404)	31.41 (37 753)	18.24 (19 318)	15.99 (10 333)	
Dialysis time at listing, y					
None	32.29 (93 887)	45.22 (54 359)	24.03 (25 453)	21.78 (14 075)	<0.0001
<2	42.46 (123 449)	38.91 (46 772)	43.57 (46 153)	47.23 (30 524)	
2–<4	13.46 (39 125)	9.45 (11 365)	15.99 (16 933)	16.75 (10 827)	
4–<6	5.50 (15 995)	3.44 (4140)	7.10 (7524)	6.70 (4331)	
6–<10	4.34 (12 633)	2.20 (2646)	6.23 (6602)	5.24 (3385)	
≥10	1.95 (5674)	0.77 (927)	3.07 (3254)	2.31 (1493)	
Total inactive time, d					
None	36.89 (107 258)	33.90 (40 746)	36.71 (38 882)	42.75 (27 630)	<0.0001
<120	17.05 (49 576)	19.08 (22 938)	16.30 (17 266)	14.50 (9372)	
120–<365	17.25 (50 155)	18.35 (22 054)	17.24 (18 260)	15.23 (9841)	
≥365	28.81 (83 774)	28.68 (34 471)	29.75 (31 511)	27.53 (17 792)	
Distance to Tx center, miles					
Missing	0.34 (1002)	0.39 (468)	0.35 (369)	0.26 (165)	<0.0001
<9	24.03 (69 870)	14.46 (17 379)	33.21 (35 173)	26.79 (17 318)	
9–<23	24.89 (72 376)	23.10 (27 771)	25.27 (26 766)	27.60 (17 839)	
23–<68	25.47 (74 055)	31.58 (37 957)	20.76 (21 991)	21.83 (14 107)	
≥68	25.26 (73 460)	30.48 (36 634)	20.41 (21 620)	23.53 (15 206)	
Region					
1	4.28 (12 446)	6.23 (7485)	2.85 (3021)	3.00 (1940)	<0.0001
2	12.38 (35 996)	13.33 (16 023)	15.79 (16 724)	5.03 (3249)	
3	15.30 (44 482)	11.62 (13 974)	23.11 (24 478)	9.33 (6030)	
4	10.94 (31 808)	7.14 (8578)	8.36 (8857)	22.24 (14 373)	
5	16.30 (47 380)	12.29 (14 777)	6.51 (6899)	39.77 (25704)	
6	2.37 (6884)	4.02 (4827)	0.87 (921)	1.76 (1136)	
7	7.63 (22 199)	9.50 (11 422)	6.70 (7100)	5.69 (3677)	
8	5.17 (15 040)	7.86 (9447)	3.38 (3585)	3.11 (2008)	
9	7.21 (20 973)	6.43 (7731)	8.23 (8714)	7.01 (4528)	
10	7.38 (21 472)	10.57 (12 704)	7.48 (7926)	1.30 (842)	
11	11.03 (32 083)	11.01 (13 241)	16.71 (17 694)	1.78 (1148)	

Percentages may not total 100 because of rounding.
cPRA, calculated panel-reactive antibody; HCV, hepatitis C virus; SPK, simultaneous pancreas-kidney; Tx, transplant.

patients. The overall effect of race was maintained after adjusting the OPTN region and DSA. However, the effect of ethnicity decreased and even reversed when adjusting for DSA. This may suggest that the disparity in transplant rates for Latinos is in large part due to differences in transplant rates by geography.

Although Latino patients were less likely to have factors known to impact access to transplant, such as blood type B or high cPRA values, Latino candidates were more likely to have diabetes and Medicaid reliance than both African American and White non-Latino patients. Our full model indicated that Latino candidates accessed transplants 25% less often during the study period. This disparity contributes to Latinos having more cumulative waiting and dialysis time than White non-Latinos. As with the racial disparity, we found that the ethnic disparity was more pronounced with time. Unlike the effect of race, the effect of ethnicity reverses when adjusting for DSA, with Latino patients in some DSAs having higher rates of transplant than White non-Latino patients.

Multiple changes to the kidney allocation system implemented in December 2014 aimed to improve equity in kidney transplantation. HLA typing in the prior allocation system was associated with higher transplant rates among White individuals compared with non-White individuals.[43] The OPTN proposed that a new allocation system that removed HLA-B priority would allow for a more equitable distribution of organs by increasing transplant rates among non-White people.[43] The 2014 changes to the kidney allocation system also added dialysis time as a factor to prioritize patients with longer dialysis time undergoing transplant sooner. As our study confirms, African American patients had longer dialysis times and were less likely than their non–African American counterparts to be added to the waiting list before initiating dialysis.[1,44-46] Another 2014 change to the kidney allocation system was to allow deceased donors

TABLE 3.

Hazard models for access to transplant among African American and Latino candidates after waitlisting

Model	Characteristic	Reference group	Group	HR (95% CI)	Type I, *P*
Univariable	Race/ethnicity	White non-Latino	African American	0.93 (0.92-0.94)	<0.001
N = 103 675/290 763		White non-Latino	Latino	0.88 (0.87-0.90)	<0.001
Multivariable[a]	Race/ethnicity	White non-Latino	African American	0.78 (0.77-0.79)	<0.001
N = 103 675/290 763		White non-Latino	Latino	0.73 (0.72-0.74)	<0.001
Multivariable: active only[b]	Race/ethnicity	White non-Latino	African American	0.78 (0.77-0.79)	<0.001
N = 103 569/243 742		White non-Latino	Latino	0.73 (0.71-0.74)	<0.001

[a]Fixed candidate factors included race/ethnicity, blood type, diabetes status, primary cause of kidney failure, body mass index, previous kidney transplant, sex, dialysis time at listing, simultaneous kidney-pancreas candidate, education status, and insurance status. Time-varying factors included age at status updates, calculated panel-reactive antibody, and inactive status.
[b]Active only refers to an analysis that removes inactive subject status times during the analysis.
CI, confidence interval; HR, hazard ratio.

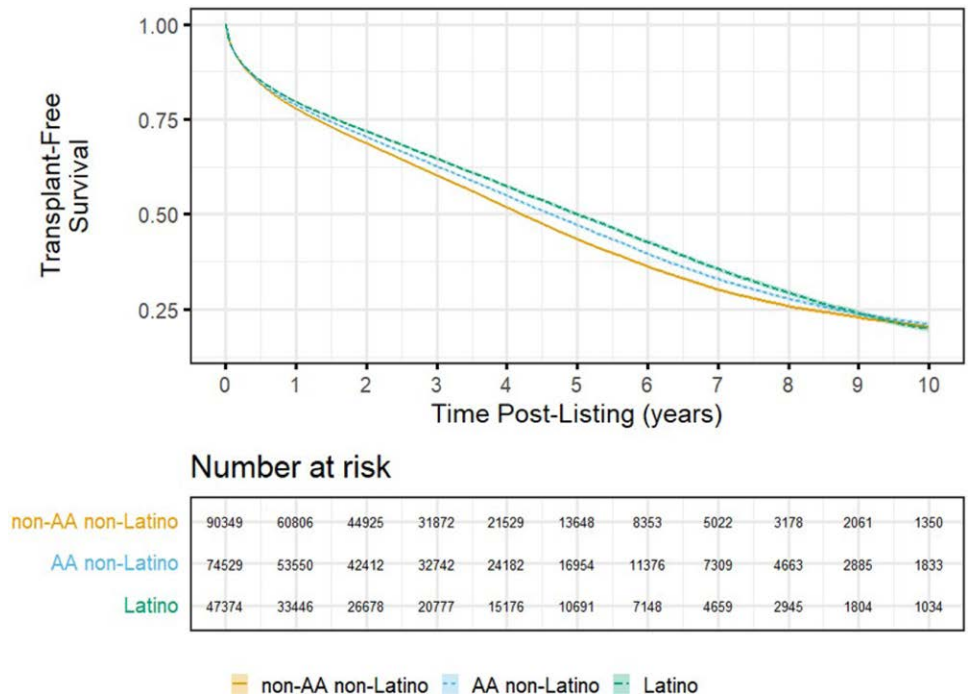

FIGURE 1. Kaplan-Meier survival curve on the association of race and ethnicity with deceased donor kidney transplant (January 1, 2015–June 30, 2023). AA, African American.

with blood type A2 to donate to candidates with blood type B because people with blood type B have the lowest transplant rates. African American individuals are more likely to have blood type B; thus, it has been hypothesized that this contributes to the disparity in transplant rates. Unfortunately, these 2014 changes did not resolve the disparity in transplant rates among African American, Latino, and White groups. As seen in our study, after adjusting for dialysis time and ethnicity, African American and Latino candidates continue to access transplant substantially less than their non–African American peers after the implementation of the 2014 changes to the kidney allocation system, indicating that disparities in transplant rates persist among both African American and Latino patients.

Our goal was to adjust for candidate-level variables associated with variations in access to transplant to inform transplant program- and transplant system-level interventions. Our univariable model indicates that African American candidates had only a slightly reduced likelihood of receiving a transplant (HR, 0.93; 95% CI, 0.92-0.94), which approximates the national outcomes data reported by SRTR.[47] However, when adjusting for candidate-specific variables, the disparity widened. Similar to our findings for African American patients, univariable models of the association of Latino ethnicity with access to transplant (HR, 0.88; 95% CI, 0.87-0.90) revealed smaller disparities than the multivariable model (HR, 0.73; 95% CI, 0.72-0.77).

Our findings contribute to a growing body of evidence on the persistence of racial disparities in access to DDKT and kidney transplant more broadly. Kulkarni et al[25] demonstrated that after the 2014 changes to the kidney allocation system, highly sensitized African American patients still had less access to transplant compared with White patients. In addition, they found that individuals from non-White groups had greater difficulty being transferred off of the inactive waiting list. While we did not create separate models stratified by cPRA, our approach did account for barriers around inactive status and revealed that African Americans had more inactive time and, in contrast, more Latino patients had no inactive status time than non-Latino

TABLE 4.

Distribution of clinical and demographic characteristics: active-only subgroup

Characteristic	Total, % (n)	White Americans, % (n)	African Americans, % (n)	Latino, % (n)	*P*
Total	243 742	40.62 (99 009)	36.74 (89 540)	22.64 (55 193)	
Transplant					
No	57.51 (140 173)	57.33 (56 762)	57.14 (51 164)	58.43 (32 247)	<0.0001
Yes	42.49 (103 569)	42.67 (42 247)	42.86 (38 376)	41.57 (22 946)	
ABO type					
A	31.29 (76 258)	39.33 (38 941)	24.61 (22 032)	27.69 (15 285)	<0.0001
AB	3.41 (8321)	3.78 (3745)	3.91 (3498)	1.95 (1078)	
B	14.24 (34 714)	10.93 (10 819)	20.64 (18 480)	9.81 (5415)	
O	51.06 (124 449)	45.96 (45 504)	50.85 (45 530)	60.54 (33 415)	
Diabetes					
No	54.41 (132 629)	58.75 (58 164)	54.16 (48 495)	47.05 (25 970)	<0.0001
Yes	45.59 (111 113)	41.25 (40 845)	45.84 (41 045)	52.95 (29 223)	
Primary cause of kidney failure					
Diabetes	36.39 (88 705)	31.13 (30 819)	36.21 (32 426)	46.13 (25 460)	<0.0001
Hypertension	22.92 (55 862)	15.25 (15 103)	34.68 (31 056)	17.58 (9703)	
Glomerulonephritis	12.67 (30 876)	14.78 (14 635)	10.65 (9536)	12.15 (6705)	
Cystic kidney disease	8.34 (20 323)	13.35 (13 219)	4.14 (3710)	6.15 (3394)	
Other/unknown	19.68 (47 976)	25.49 (25 233)	14.31 (12 812)	17.99 (9931)	
BMI, kg/m^2					
Missing	0.30 (743)	0.36 (353)	0.26 (237)	0.28 (153)	<0.0001
<18.5	1.27 (3091)	1.48 (1469)	1.05 (943)	1.23 (679)	
18.5–<25	19.45 (47 402)	20.01 (19 815)	17.94 (16 067)	20.87 (11 520)	
25–<30	32.26 (78 627)	31.39 (31 075)	30.46 (27 278)	36.73 (20 274)	
30–<35	28.06 (68 397)	28.06 (27 785)	28.50 (25 516)	27.35 (15 096)	
≥35	18.66 (45 482)	18.70 (18 512)	21.78 (19 499)	13.54 (7471)	
Prior kidney transplant					
No	88.26 (215 134)	87.04 (86 174)	87.86 (78 671)	91.11 (50 289)	<0.0001
Yes	11.74 (28 608)	12.96 (12 835)	12.14 (10 869)	8.89 (4904)	
Sex					
Female	37.81 (92 169)	36.73 (36 363)	39.90 (35 723)	36.39 (20 083)	<0.0001
Man	62.19 (151 573)	63.27 (62 646)	60.10 (53 817)	63.61 (35 110)	
SPK					
Kidney	100.00 (243 742)	100.00 (99 009)	100.00 (89 540)	100.00 (55 193)	
Education					
Unknown	2.96 (7225)	3.48 (3441)	2.74 (2454)	2.41 (1330)	<0.0001
High school or less	47.23 (115 111)	38.00 (37 619)	44.28 (39 647)	68.57 (37 845)	
More than high school	49.81 (121 406)	58.53 (57 949)	52.98 (47 439)	29.02 (16 018)	
Insurance type					
Medicaid	9.52 (23 199)	5.85 (5793)	9.55 (8554)	16.04 (8852)	<0.0001
Medicare	48.59 (118 446)	46.34 (45 884)	52.27 (46 802)	46.67 (25 760)	
No insurance	0.10 (244)	0.11 (105)	0.10 (94)	0.08 (45)	
Other public	2.80 (6823)	2.79 (2765)	3.40 (3041)	1.84 (1017)	
Other/unknown	0.20 (479)	0.28 (278)	0.17 (154)	0.09 (47)	
Private	38.79 (94 551)	44.63 (44 184)	34.50 (30 895)	35.28 (19 472)	
Waiting time at last status, y					
<1	65.75 (160 256)	67.16 (66 497)	63.27 (56 651)	67.23 (37 108)	<0.0001
1–<2	10.80 (26 313)	11.61 (11 498)	10.71 (9588)	9.47 (5227)	
2–<3	7.83 (19 091)	7.89 (7813)	8.20 (7340)	7.13 (3938)	
3–<5	9.33 (22 740)	8.69 (8608)	10.26 (9189)	8.96 (4943)	
≥5	6.29 (15 342)	4.64 (4593)	7.56 (6772)	7.21 (3977)	
Last cPRA					
Missing	11.18 (27 242)	10.92 (10 810)	9.23 (8265)	14.80 (8167)	<0.0001
<1%	46.76 (113 972)	50.68 (50 173)	42.23 (37 812)	47.08 (25 987)	
1%–<20%	9.58 (23 348)	9.50 (9405)	10.23 (9162)	8.66 (4781)	
20%–<80%	17.35 (42 295)	15.84 (15 685)	19.89 (17 811)	15.94 (8799)	

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TABLE 4. (Continued)

Characteristic	Total, % (n)	White Americans, % (n)	African Americans, % (n)	Latino, % (n)	*P*
80%–<98%	7.39 (18 020)	6.72 (6652)	8.46 (7578)	6.87 (3790)	
≥98%	7.74 (18 865)	6.35 (6284)	9.95 (8912)	6.65 (3669)	
Age at last status, y					
18–<35	9.63 (23 467)	7.58 (7502)	9.44 (8452)	13.61 (7513)	<0.0001
35–<50	24.76 (60 362)	18.69 (18 509)	29.53 (26 438)	27.93 (15 415)	
50–<65	43.60 (106 276)	43.29 (42 864)	43.93 (39 334)	43.63 (24 078)	
≥65	22.01 (53 637)	30.44 (30 134)	17.11 (15 316)	14.83 (8187)	
Dialysis time at listing, y					
None	29.43 (71 740)	41.83 (41 420)	21.61 (19 352)	19.87 (10 968)	<0.0001
<2	43.98 (107 191)	41.23 (40 824)	44.77 (40 089)	47.61 (26 278)	
2–<4	14.16 (34 526)	10.07 (9973)	16.58 (14 849)	17.58 (9704)	
4–<6	5.78 (14 100)	3.69 (3653)	7.36 (6591)	6.99 (3856)	
6–<10	4.57 (11 151)	2.35 (2322)	6.46 (5788)	5.51 (3041)	
≥10	2.07 (5034)	0.83 (817)	3.21 (2871)	2.44 (1346)	
Total inactive time, d					
None	44.00 (107 258)	41.15 (40 746)	43.42 (38 882)	50.06 (27 630)	<0.0001
<120	17.34 (42 263)	19.64 (19 442)	16.57 (14 841)	14.46 (7980)	
120–<365	16.13 (39 324)	17.17 (16 998)	16.14 (14 448)	14.27 (7878)	
≥365	22.52 (54 897)	22.04 (21 823)	23.87 (21 369)	21.21 (11 705)	
Distance to Tx center, miles					
Missing	0.33 (797)	0.37 (365)	0.33 (297)	0.24 (135)	<0.0001
<9	23.90 (58 244)	14.22 (14 082)	32.63 (29 219)	27.07 (14 943)	
9–<23	25.14 (61 275)	22.94 (22 717)	25.70 (23 009)	28.17 (15 549)	
23–<68	25.54 (62 254)	31.72 (31 409)	20.93 (18 739)	21.93 (12 106)	
≥68	25.10 (61 172)	30.74 (30 436)	20.41 (18 276)	22.58 (12 460)	
Region					
1	3.84 (9348)	5.61 (5553)	2.54 (2272)	2.76 (1523)	<0.0001
2	12.18 (29 682)	13.19 (13 061)	15.45 (13 838)	5.04 (2783)	
3	15.86 (38 663)	12.31 (12 192)	23.36 (20 916)	10.06 (5555)	
4	11.54 (28 119)	7.64 (7564)	8.79 (7871)	22.98 (12 684)	
5	15.86 (38 649)	11.68 (11 562)	6.32 (5655)	38.83 (21 432)	
6	2.32 (5654)	3.94 (3899)	0.86 (771)	1.78 (984)	
7	7.36 (17 948)	8.95 (8860)	6.58 (5892)	5.79 (3196)	
8	5.42 (13 212)	8.32 (8236)	3.57 (3196)	3.23 (1780)	
9	6.77 (16 491)	6.13 (6069)	7.76 (6946)	6.30 (3476)	
10	7.66 (18 665)	11.18 (11 074)	7.64 (6844)	1.35 (747)	
11	11.20 (27 311)	11.05 (10 939)	17.13 (15 339)	1.87 (1033)	

Percentages may not total 100 because of rounding.
cPRA, calculated panel-reactive antibody; HCV, hepatitis C virus; SPK, simultaneous pancreas-kidney; Tx, transplant.

Whites. A study by Zhang et al[48] showed a significant reduction in disparity regarding waiting time after the implementation of the 2014 kidney allocation system, but the disparity was not fully eliminated. That study relied on the United States Renal Data System to evaluate access to transplant and produced an estimate of access to transplant for all patients with ESKD rather than for those who have been referred and accepted onto the waiting list.

By addressing factors associated with transplant access at the patient level and the system level, policies can be designed to make a meaningful impact on reducing the racial and ethnic disparities in transplantation. From a national policy perspective, the OPTN has recognized and prioritized improving equity in transplantation.[49] Our analysis found that the association of race and ethnicity with access to transplant decreased following the implementation of KAS250. Recent studies and simulations done to improve disparities in kidney transplantation address factors such as time on dialysis and blood type B, as is the case for the proposed continuous distribution approaches. Other factors that contribute to the disparity, such as inactive status, may need to be included as well.

Transplant centers can take a more active role in reducing disparities. Centers should monitor their own data, adjust for waiting time, and identify racial and ethnic inequities for which the center can intervene. SRTR could provide these data securely (similar to how SRTR provides other data to centers already) to ensure that each center can prioritize reducing racial and ethnic disparities without placing the extra burden of data collection on the center itself. Centers should assess their center-level data comparing African American, Latino, and White non-Latino transplant rates and inactive statuses to design and evaluate interventions that might reduce these disparities. For example, a center could adopt an A2-to-B blood type policy if they notice that African American candidates with

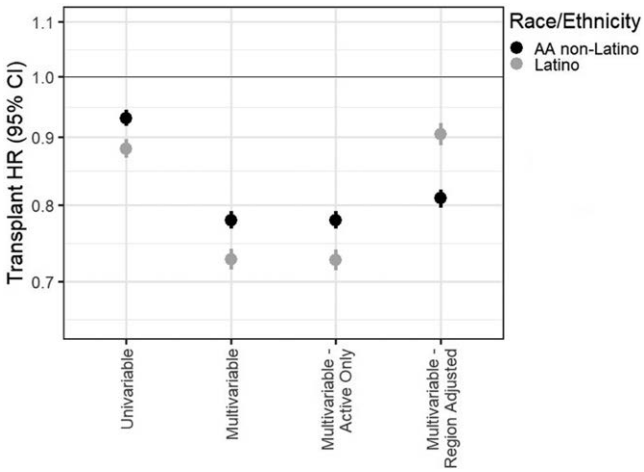

FIGURE 2. Hazard ratios showing the association between race and ethnicity (AA and Latino candidates vs White non-Latino candidates) with accessing deceased donor kidney transplant (January 1, 2015–June 30, 2023). AA, African American.

blood type B are receiving transplants less frequently than non–African American candidates with blood type B.[50-52] Likewise, if a center has a large cohort of African American or Latino patients with higher body mass index preventing them from being active on their waiting list, a center could consider implementing new surgical interventions (eg, minimally invasive/robot-assisted transplant) or better integration with weight loss clinicians that provides glucagon-like peptide-1 agonists, as some other centers have done.[53,54]

Study Limitations

Several limitations of our study should be acknowledged. First, we did not analyze family structure and social support among the variables that contribute to racial disparity in transplant rates.[27,55-57] Other social factors and specific social determinants of health that were not included in our study have been previously shown to contribute to the disparity in transplant rates, although other studies show that social determinants cannot fully account for the disparity.[27] Other well-documented factors contributing to the disparity include socioeconomic status and comorbidities.[15,27,31,58,59] In addition, we specifically focused on access to transplant after entry onto a waiting list, although disparities exist along the entire continuum from receiving a chronic kidney disease diagnosis to transplant. Additional potential confounding factors are physician-specific factors, unconscious bias in the medical system, and sociocultural factors.[28,60,61] Second, the SRTR data system has incomplete data on some candidates. We coded such cases as "missing" to avoid case-wise deletion in the analysis. Finally, our analysis does not examine the potential for racial bias in access to living donor transplant nor the interplay between access to living donor transplant with demand and access to deceased donor transplant.

CONCLUSIONS

In this large cohort study, even after listing, African American and Latino candidates accessed DDKT less when compared with White non-Latino patients. Accounting for baseline differences in candidate factors showed substantially stronger associations between race and ethnicity with worse access to transplant. Additional policy changes to provide equitable distribution of deceased donor kidneys in a timelier manner and close the racial and ethnic disparity gaps in transplantation should be considered. In support of this goal, OPTN data collection protocols could be expanded to include candidate- and community-level social determinants of health alongside a wider range of patient outcomes upstream of transplantation (ie, referral and evaluation outcomes and time to reactivation) and novel metrics of program performance. With a deeper and more complete vision of the transplant ecosystem, programs and policy makers would be better equipped to identify modifiable barriers and incentivize targeted measures to improve access to transplant.

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