Received: 10 February 2022 | Revised: 10 April 2022 | Accepted: 3 May 2022

DOI: 10.1111/ajt.17090

BRIEF COMMUNICATION

Impact of having potential living donors on ethnic/racial disparities in access to kidney transplantation

Elisa J. Gordon[1] | Jungwha Lee[2] | Raymond Kang[3] | Juan Carlos Caicedo[4]

[1]Department of Surgery- Division of Transplantation, Center for Health Services and Outcomes Research, Center for Bioethics and Medical Humanities, Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

[2]Department of Preventive Medicine, Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

[3]Center for Community Health, Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

[4]Department of Surgery- Division of Transplantation, Northwestern University Feinberg School of Medicine, Chicago, Illinois, USA

Correspondence
Elisa J. Gordon, Department of Surgery-Division of Transplantation, Center for Health Services and Outcomes Research, Center for Bioethics and Medical Humanities, Feinberg School of Medicine, Northwestern University, 633 N. St. Clair, 20th Floor, Chicago, IL 60611, USA.
Email: e-gordon@northwestern.edu

Funding information
NIDDK funded this research (1R01DK104876 to EJ Gordon and JC Caicedo, Co-PIs).

Abstract

Racial/ethnic disparities persist in patients' access to living donor kidney transplantation (LDKT). This study assessed the impact of having available potential living donors (PLDs) on candidates' receipt of a kidney transplant (KT) and LDKT at two KT programs. Using data from our clinical trial of waitlisted candidates (January 1, 2014–December 31, 2019), we evaluated Hispanic and Non-Hispanic White (NHW) KT candidates' number of PLDs. Multivariable logistic regression assessed the impact of PLDs on transplantation (KT vs. no KT; for KT recipients, LDKT vs. deceased donor KT). A total of 847 candidates were included, identifying as Hispanic (45.8%) or NHW (54.2%). For Site A, both Hispanic (adjusted OR = 2.26 [95% CI 1.13–4.53]) and NHW (OR = 2.42 [1.10–5.33]) candidates with PLDs completing the questionnaire were more likely to receive a KT. For Site B, candidates with PLDs were not significantly more likely to receive KT. Among KT recipients at both sites, Hispanic (Site A: OR = 21.22 [2.44–184.88]; Site B: OR = 25.54 [7.52–101.54]), and NHW (Site A: OR = 37.70 [6.59–215.67]; Site B: OR = 15.18 [5.64–40.85]) recipients with PLD(s) were significantly more likely to receive a LDKT. Our findings suggest that PLDs increased candidates' likelihood of KT receipt, particularly LDKT. Transplant programs should help candidates identify PLDs early in transplant evaluation.

KEYWORDS
health disparities, kidney failure, Latinx

1 | INTRODUCTION

Living donor kidney transplantation (LDKT) is the optimal treatment for patients with kidney failure because it confers greater patient and graft survival, shorter waiting time, and better quality of life than deceased donor kidney transplantation (DDKT).[1–3] However, such patients encounter myriad barriers to receiving LDKT.[4,5] Moreover, Hispanic/Latinx (henceforth "Hispanic") patients with kidney failure receive disproportionately fewer LDKTs than non-Hispanic White patients (NHW).[6] Of all waitlisted Hispanic patients, only 5.2% received a LDKT, compared to 11.4% of waitlisted NHW patients in 2021.[7]

Patient, potential living donor (PLD), healthcare provider, and healthcare and other systemic factors contribute to ethnic

Abbreviations: DDKT, deceased donor kidney transplantation; KT, kidney transplantation; LDKT, living donor kidney transplantation; NHW, non-Hispanic White; OPTN, Organ Procurement and Transplant Network; PLD, potential living donor.

Registration: ClinicalTrials.gov registered (retrospectively) on 9-7-17 (NCT03276390).

disparities in and general barriers to LDKT.[8] Patient-related factors for Hispanics pertain to lack of LDKT knowledge, cultural/religious concerns, financial challenges, and distrust of healthcare providers.[9–11] PLD factors relate to knowledge of transplantation, eligibility, evaluation time, and expense. Provider-related factors relate to discordance in ethnic/racial background between providers and patients, attitudes, and Spanish language competency. System-related factors involve processes of care (e.g., interpreter availability, educational resources, accountability).[4,5,12,13]

An important patient factor that has received relatively little attention pertains to their PLDs. Because having a larger social network and number of PLDs is associated with candidates' increased access to LDKT,[14] some have posited that having fewer PLDs may help explain racial/ethnic disparities in LDKT.[15] However, studies report that transplant candidates' network size does not vary between African American and NHW candidates and dialysis patients,[15,16] rather, level of instrumental support provided by network members affects African American candidates' request for their network members to become LDs.[16] Yet no research has examined the number of available PLDs who initiate donor evaluation for Hispanic and NHW candidates.

This paper evaluates candidates' access to kidney transplantation based on the availability of PLDs, and describes characteristics of Hispanic and NHW candidates based on the availability of PLDs to identify avenues for increasing access to LDKT.

2 | METHODS

2.1 | Setting and design

This paper presents a data subset derived from a larger study designed to increase LDKT through a complex culturally competent transplant program involving outreach, education, and bicultural/bilingual staff.[17,18,19] The study was conducted at two transplant centers in the South (Site A) and Southwest (Site B) United States, which served large Hispanic populations and had large volumes of LDKTs, as previously described.[20] The present paper focuses on waitlisted kidney transplant candidates, who had initiated transplant evaluation between January 1, 2014 and December 31, 2019 to provide all patients comparable time to find a PLD and receive a transplant. Institutional Review Boards approved the study (Northwestern University: STU00201331, Mayo Clinic: #16–002328, Baylor: #016–115). The study was registered on 9–7-17 in ClinicalTrials.gov (NCT03276390).

2.2 | Data sources

Patient-level data were obtained from medical chart review and were collected using Research Electronic Data Capture (REDCap), a secure, web-based application.[21] Data collected included: candidate demographics (i.e., age, gender, insurance), clinical characteristics that affect access to kidney transplantation and LDKT (i.e., kidney disease etiology, body mass index, comorbidities),[22] date of transplant waitlisting and specification of waitlisting, date and type of kidney transplantation (LDKT/DDKT), the number of PLDs who completed the medical health questionnaire (Breeze™), and linked number of PLDs who initiated donor evaluation. Medical records of PLDs linked to candidates were also reviewed to assess the relationship between PLDs and candidates. The PLDs' verbal expression of interest was reported by transplant candidates and/or their companions when meeting with the transplant surgeon during patient evaluation, as described elsewhere.[23]

2.3 | Participants and recruitment

For this article, eligible participants included adult (age 18+ years) self-identified (recruited prospectively 2017–2019) or medical record-identified (recruited retrospectively 2014–2016) Hispanic and NHW patients who had initiated transplant evaluation for a kidney transplant (KT) and had been cleared to be waitlisted between 1/1/2014–12/31/2019.

Written informed consent was prospectively obtained; the Institutional Review Boards granted a waiver of informed consent for retrospective chart review. Accordingly, all Hispanic patients retrospectively recruited were included, but we could only include data from the subset of Hispanic patients who prospectively consented. Those who consented prospectively were only included. An equivalent number of NHW patients to Hispanic patients was selected to minimize research staff workload, as described elsewhere.[20]

2.4 | Exposures

2.4.1 | PLD completion of the medical health questionnaire

This was the primary exposure defined as the number of PLDs per transplant candidate who completed the medical health questionnaire, Breeze.™

2.4.2 | PLDs verbally identified by candidates and families

This was a secondary exposure defined as the estimated number of PLDs per KT candidate, as verbally identified by candidates and/or their families during transplant evaluation. As this question was not asked as part of routine clinical practice in the retrospective data collection period, we only included this information in the prospective data collection period.

2.4.3 | PLD initiation of donor evaluation

This was a secondary exposure defined as the number of PLDs who initiated donor evaluation per transplant candidate.

2.5 | Outcomes

The outcomes of interest were: (1) kidney transplant status based on whether candidates received a kidney transplant (KT vs. not yet received KT), and (2) among transplant recipients, whether candidates received a LDKT (LDKT vs. DDKT).

2.6 | Statistical analysis

Descriptive statistics were reported to summarize waitlisted patients' demographic and clinical characteristics. Categorical variables were reported as frequency and percentages, and continuous variables were reported as mean, standard deviation, median, interquartile range, and range of minimum and maximum. To evaluate the number of PLDs who completed Breeze™ per waitlisted candidates on receipt of transplant, multivariable logistic regression models were used. Two binary outcomes were: (1) receipt of KT (vs. not yet received transplant), and (2) receipt of LDKT (vs. DDKT) among transplant recipients. The model included binary variables for 1 or more PLDs (vs. zero), Hispanic (vs. NHW), and a two-way interaction term (1 or more vs. 0 number of PLDs comparison between Hispanic and NHW patients). The adjusted models included history of diabetes, history of hypertension, married/with a partner, and insurance status from a covariate set of demographic and clinical variables in Table 1, selected based on clinical experience and factors influencing patients' receipt of LDKT.[24–28] All analyses were conducted at the site-level given that each transplant program's patient evaluation process and geographical location affect patient access to transplantation differently. All analyses were performed using SAS version 9.4 (Cary, NC).

3 | RESULTS

3.1 | Demographics

A total of 868 kidney transplant candidates were eligible for participation. However, after excluding 21 candidates whose PLDs had not completed Breeze™, the main predictor variable, the total sample of $n = 847$ candidates was included in the analyses (site A: $n = 196$, site B: $n = 651$). Candidates were on average, age 52 years, primarily male (60.2%), most had some college or less education (69.3%), and most did not have private insurance (56.0%). Candidates' leading cause of kidney failure was diabetes (44.0%), most had a history of hypertension (76.3%) or diabetes (48.8%), and were currently on dialysis (56.4%). Table 1 presents all candidates' demographic and clinical characteristics by race/ethnicity within each site. Candidates' demographic and clinical characteristics did not differ significantly between sites.

However, there were differences by race/ethnicity. For example, Hispanic candidates were generally younger (49.8 vs. 56.5 years), had lower education levels (84.3% vs. 56.6%), less private insurance (39.4% vs. 47.9%), and more diabetes (60.0% vs. 39.0%) than NHW candidates. Moreover, more Hispanic candidates were on dialysis (thus, had less opportunity to receive preemptive transplantation), and Hispanic candidates had a longer waiting time on dialysis, than NHW candidates.

3.2 | Number of PLDs per transplant candidate

Table 2 presents the number of PLDs per transplant candidate, along the continuum of donor evaluation. This continuum can be viewed as a funnel that tapers off, when reviewing the data in aggregate for each racial/ethnic group, starting with a large number of PLDs who candidates had identified as having expressed their interest in donating.

Across both sites, Hispanic and NHW candidates (and their accompanying family/friends) verbally reported a comparable number of PLDs interested in donating, which was divided by the number of Hispanic or NHW candidates to generate the PLD per potential recipient. For example, at Site A, a mean of 1.30 PLDs was reported per Hispanic candidate, while a mean of 1.27 PLDs was reported per NHW candidate. These numbers translated to an aggregate of 78 and 47 PLDs verbally identified by Hispanic and NHW candidates, respectively.

Thereafter, the mean number of PLDs completed Breeze™ per candidate generally declined across sites. For example, at site A, an average of 0.60 PLDs had completed Breeze™ per Hispanic candidate, while 1.92 PLDs had completed Breeze™ per NHW candidate. At Site A, the change in mean number of verbally identified PLDs per candidate to the number of PLDs who completed Breeze™ per candidate dropped by 54% for Hispanics but increased by 51% for NHW candidates.

Lastly, the number of PLDs who initiated donor evaluation per candidate further declined across sites. For example, at site A, a mean of 0.27 PLDs initiated evaluation per Hispanic candidate, while a mean of 1.43 PLDs initiated evaluation per NHW candidate. At Site A, the change in mean number of PLDs who completed Breeze™ per candidate to the number of PLDs who initiated donor evaluation per candidate dropped by 55% for Hispanics and by 26% for NHW candidates. As these data show, Hispanic candidates within each site encountered greater declines in PLDs at the last two steps as compared to NHW candidates.

3.3 | Characteristics of candidates by number of PLDs completing Breeze™

As Table 3 shows, candidates with 0 versus 1 or more PLDs who completed Breeze™ exhibited demographic and clinical differences. Demographically, compared to candidates with 1 or more PLDs, candidates without any PLDs were significantly older (mean age 54.5 versus 52.1 years, $p = .0006$). Candidates with no PLDs were more

TABLE 1 Waitlisted candidates' sociodemographic and clinical characteristics of the HKTP study hispanic and non-hispanic white for overall and by site,[a] $n = 847$

Characteristic[b]	Overall, $N = 847$	All Sites, $n = 847$		Site A, $n = 196$		Site B, $n = 651$	
		Hispanic, $n = 388$	Non-Hispanic White, $n = 459$	Hispanic, $n = 88$	Non-Hispanic White, $n = 108$	Hispanic, $n = 300$	Non-Hispanic White, $n = 351$
Age, years, mean ± SD (range)	52.93 ± 13.66 (18–85)	49.80 ± 13.25 (18–77)	56.46 ± 13.26 (18–85)	47.64 ± 12.54 (19–73)	54.27 ± 11.73 (29–74)	50.36 ± 13.23 (18–77)	57.19 ± 13.66 (18–85)
Sex, male, *n* (%)	510 (60.21)	227 (58.51)	283 (61.66)	59 (67.1)	62 (57.4)	168 (56.0)	221 (63.9)
Marital status, married/with partner, *n* (%)	592 (69.89)	256 (65.98)	336 (73.20)	56 (63.6)	80 (74.1)	200 (66.7)	256 (72.9)
Highest education level, college degree and above, *n* (%)	260 (30.70)	61 (15.72)	199 (43.36)	11 (12.5)	42 (38.9)	50 (16.7)	157 (44.7)
Primary insurance coverage, private, *n* (%)	373 (44.04)	153 (39.43)	220 (47.93)	29 (33.0)	60 (55.6)	124 (41.3)	160 (45.6)
BMI, kg/m^2, mean ± SD (range)	29.06 ± 5.62 (15.44–53.08)	29.34 ± 5.54 (15.44–49.15)	28.73 ± 5.69 (15.82–53.08)	29.31 ± 5.22 (16.80–40.12)	29.16 ± 5.50 (17.16–53.08)	29.86 ± 5.83 (15.44–49.15)	28.59 ± 5.75 (15.82–45.00)
History of hypertension, *n* (%)	646 (76.27)	302 (77.84)	344 (74.95)	70 (79.6)	96 (88.9)	232 (77.3)	248 (70.7)
History of diabetes, *n* (%)	413 (48.76)	234 (60.31)	179 (39.00)	50 (56.8)	51 (47.2)	184 (61.3)	128 (36.5)
Primary cause of ESRD, *n* (%)							
Diabetes	373 (44.04)	209 (53.87)	164 (35.73)	47 (54.41)	45 (41.67)	162 (54.00)	119 (33.90)
Hypertension	134 (15.82)	61 (15.72)	73 (15.90)	22 (25.00)	25 (23.15)	39 (13.00)	48 (13.68)
Focal glomerular sclerosis	48 (5.67)	18 (4.64)	30 (6.54)	3 (3.41)	9 (8.33)	15 (5.00)	21 (5.98)
Chronic glomerulonephritis	32 (3.78)	15 (3.87)	17 (2.70)	3 (3.41)	6 (5.56)	12 (4.00)	11 (3.13)
Polycystic kidney disease	79 (9.33)	15 (3.87)	64 (13.94)	3 (3.41)	15 (13.89)	12 (4.00)	49 (13.96)
Iga nephropathy	40 (4.72)	11 (2.84)	29 (6.32)	2 (2.27)	1 (0.93)	9 (3.00)	28 (7.98)
Retransplant	10 (1.18)	2 (0.52)	8 (1.74)	2 (2.27)	1 (0.93)	0 (0.00)	7 (1.99)
Lupus	24 (2.83)	13 (3.35)	11 (2.40)	1 (1.14)	0 (0.00)	12 (4.00)	11 (13.13)
Other	52 (6.14)	28 (7.22)	24 (5.23)	4 (4.55)	6 (5.56)	24 (8.00)	18 (5.13)
Unknown	55 (6.49)	16 (4.12)	39 (8.50)	1 (1.14)	0 (0.00)	15 (5.00)	39 (11.11)
Currently on dialysis, *n* (%)	478 (56.43)	254 (65.46)	224 (48.80)	62 (70.4)	66 (61.1)	192 (64.0)	158 (45.0)
Dialysis time (days), median [IQR] (range), *n*	375 [831] (0, 6189), $n = 465$	447 [977] (0, 6189), $n = 247$	274.5 [654] (13, 4556), $n = 218$	415.5 [840] (2, 3075), $n = 59$	242 [564] (13, 2487), $n = 62$	428 [373] (0–6189), $n = 189$	301.5 [770] (13, 4556), $n = 155$
Waiting time (days), median [IQR] (range), *n*	106 [142] (8–1216), $n = 844$	125 [162] (8–1216), $n = 385$	89 [122] (3–1007), $n = 459$	178 [166] (14–1216), $n = 87$	146 [136.5] (11–567), $n = 108$	103.5 [144] (8–1144), $n = 298$	69 [100] (3–1007), $n = 351$
Number of prior transplants, *n* (%)							
0 transplant	772 (91.15)	360 (92.78)	412 (89.76)	85 (95.59)	93 (86.11)	275 (91.67)	319 (90.88)
1 transplant	63 (7.44)	25 (6.44)	38 (8.28)	3 (3.41)	11 (10.19)	22 (7.33)	27 (7.69)
2+ transplants	9 (1.06)	3 (0.77)	6 (1.31)	0 (0.00)	1 (0.93)	3 (1.00)	5 (1.42)

Abbreviation: SD, standard deviation.

[a]All study participants were waitlisted during January 2014 to December 2019.

[b]Data collected at the time of starting potential recipient evaluation.

TABLE 2 Number of potential living donors (PLDs) per waitlisted candidate in 2017–2019, $n = 294$[a]

	Site A, $n = 97$		Site B, $n = 197$	
	Hispanic waitlisted patients, $n = 60$	Non-Hispanic White waitlisted patients, $n = 37$	Hispanic waitlisted patients, $n = 83$	Non-Hispanic White waitlisted patients, $n = 114$
Number of verbally identified PLDs per candidate, mean ± SD (range)	1.30 ± 1.29 (0–6)	1.27 ± 2.67 (0–13)	1.31 ± 1.81 (0–9)	1.20 ± 1.68 (0–8)
Total number of verbally identified PLDs	78	47	109	137
Number of PLDs who completed Breeze™ per candidate, mean ± SD (range)	0.60 ± 0.89 (0–3)	1.92 ± 3.97 (0–21)	0.49 ± 1.17 (0–6)	1.11 ± 1.68 (0–8)
Total number of PLDs based on Breeze™	36	71	41	126
Number of PLDs who initiated donor evaluation per candidate, mean ± SD (range)	0.27 ± 0.73 (0–4)	1.43 ± 3.48 (0–16)	0.41 ± 0.96 (0–5)	0.89 ± 1.45 (0–6)
Total number of PLDs who initiated donor evaluation	16	53	34	101

Abbreviation: SD, standard deviation.

[a]Includes non-missing only for three variables (number of verbally identified PLDs per candidate, number of PLDs who completed Breeze™ per candidate, number of PLDs who initiated evaluation per candidate) during the period of 2014–2019.

likely to be Hispanic (48.2% vs. 43.1% $p = .008$), less likely to be married or with a partner (64.5% vs. 75.9%, $p < .0001$), have less than a college degree (71.0% vs. 67.4%, $p < .0001$), and less likely to have private insurance (37.9% vs. 50.9%, $p < .0001$).

Clinically, compared to candidates without any PLDs, candidates with 1 or more PLD had a lower proportion of a history of diabetes (44.6% vs. 52.5%, $p = .005$), diabetes as the primary cause of kidney failure (38.6% vs. 48.9%, $p = .022$), current dialysis (47.1% vs. 64.7%, $p < .0001$); spent fewer days on dialysis (median 280 vs. 374.5, $p < .0001$) and on the waiting list (median 85 vs. 108.5, $p < .0001$); and had ultimately received more transplants (LDKT or DDKTs) (64.7% vs. 50.0%, $p < .0001$).

3.4 | Relationship between PLDs and their intended candidates

For candidates with PLDs, Figure 1a,b illustrates the relationships among Hispanic and NHW candidates and their PLD(s) who had initiated donor evaluation among candidates with at least one PLD ($n = 541$). Hispanic candidates had more biologically-related PLDs (i.e., parent, adult child) than NHW candidates (48.3% vs. 31.3%). By contrast, NHW candidates had more non-biologically related PLDs (i.e., a friend, spouse) than Hispanic candidates (37.7% vs. 29.8%). NHW candidates had more PLDs of other or unknown relationships than Hispanic candidates (31.0% vs. 21.9%). There was a significant difference in the distribution of relationships between Hispanic and NHW candidates ($p = .0003$). Of the waitlisted candidates with 1 or more PLD ($n = 541$), the preferred language of PLDs reporting their language and intending to donate to Hispanic candidates ($n = 228$) was primarily English (79%), but some spoke Spanish (16%) or both equally (1%). Most ($n = 37/40$, 93%) Spanish-speaking PLDs intended to donate to Hispanic candidates.

3.5 | Candidates' relationship between the number of PLDs per waitlisted candidates who completed Breeze™ and received KT

Table 4 presents the likelihood of candidates receiving a KT (vs. not yet received KT), and among transplant recipients, whether recipients received a LDKT (vs. DDKT) comparing 0 or 1 or more number of PLDs who completed Breeze™.

At site A, for both Hispanic and NHW candidates, the odds of receiving a KT (vs. not yet received a KT) were greater for those with 1 or more PLD(s) compared to no PLD (Hispanic: adjusted odds ratio (OR) = 2.26 (95% CI 1.13–4.53), $p = .022$; NHW: OR = 2.42 (95% CI 1.10–5.33), $p = .028$). There was no difference between the Hispanic and NHW candidate estimates (1+ vs. 0 PLDs) ($p = .895$).

By contrast, at site B, for both Hispanic and NHW candidates, the odds of receiving a KT (vs. not yet receiving a KT) were greater but not significantly different for those with 1 or more PLD(s) compared to no PLD (Hispanic: OR = 1.17 (95% CI 0.75–1.83), $p = .481$; NHW: OR = 1.39 (95% CI 0.90–2.14), $p = .138$). There was no difference between the Hispanic and NHW candidate estimates (1+ vs. 0 PLDs) ($p = .845$).

At site A, among Hispanic and NHW transplant recipients, the odds of receiving a LDKT (vs. DDKT) were greater for those with 1 or more PLD(s) compared to zero PLD (Hispanic: OR = 21.22 (95% CI 2.44–184.48), $p = .0006$; NHW: OR = 37.70 (95% CI 6.59–215.67), $p < .0001$). There was no difference between the Hispanic and NHW candidate estimates (1+ vs. 0 PLDs) ($p = .646$).

TABLE 3 Waitlisted candidates' sociodemographic and clinical characteristics by number of potential living donors (PLDs) who completed Breeze™ per candidate, $n = 847$[a]

Characteristic[b]	Zero number of PLDs, $n = 448$	1 or more number of PLDs, $n = 399$	*p-value*
Age, years, mean ± SD (range)	54.57 ± 12.95 (19–82)	52.10 ± 14.25 (18–85)	.0006
Sex, *n* (%)			
Male	275 (61.4)	235 (58.9)	.745
Female	173 (38.6)	164 (41.1)	
Race/ethnicity, *n* (column %)			
Hispanic	216 (48.2)	172 (43.1)	.008
White	232 (51.8)	227 (56.9)	
Marital status, *n* (column %)			
Married/with partner	289 (64.5)	303 (75.9)	<.0001
Other	159 (35.5)	96 (24.1)	
Highest education level, *n* (column %)			
College degree and above	130 (29.0)	130 (32.6)	<.0001
Less than college degree	318 (71.0)	269 (67.4)	
Primary insurance coverage, *n* (column %)			
Private	170 (37.9)	203 (50.9)	<.0001
Other	278 (62.1)	196 (49.1)	
BMI, kg/m^2, mean ± SD (range)	29.32 ± 5.67 (16.64–49.15)	29.05 ± 5.76 (15.44–53.08)	.685
History of hypertension, *n* (column %)	336 (75.0)	310 (77.7)	.823
History of diabetes, *n* (column %)	235 (52.5)	178 (44.6)	.005
Primary cause of ESRD, *n* (column %)			
Diabetes	219 (48.9)	154 (38.6)	.022
Hypertension	77 (17.2)	57 (14.3)	
Focal glomerular sclerosis	17 (3.8)	31 (7.8)	
Chronic glomerulonephritis	16 (3.6)	16 (4.0)	
Polycystic kidney disease	33 (7.4)	46 (11.5)	
Iga nephropathy	16 (3.6)	24 (6.0)	
Retransplant	5 (1.1)	5 (1.3)	
Lupus	12 (2.7)	12 (3.0)	
Other	25 (5.6)	27 (6.8)	
Unknown	28 (6.3)	27 (6.8)	
Currently on dialysis, *n* (column %)	290 (64.7)	188 (47.1)	<.0001
Time on dialysis (days), median [IQR] (range), *n*	374.5 [951] (2, 6189), $n = 290$	280 [725] (0, 3321), $n = 188$	<.0001
Waiting time (days), median [IQR] (range), *n*	108.5 [153] (8, 114), $n = 446$	85 [125] (3, 1216), $n = 398$	<.0001
Transplant, *n* (column %)			
LDKT	12 (2.5)	124 (31.1)	<.0001
DDKT	213 (47.5)	134 (33.6)	
Transplant not received	224 (50.0)	141 (35.3)	

Abbreviation: SD, standard deviation.

[a]There were no significant site differences.

[b]Data collected at the time of starting potential recipient evaluation.

Similarly, at site B, among Hispanic and NHW transplant recipients, the odds of receiving a LDKT (vs. DDKT) were greater for those with 1 or more PLD(s) compared to zero LD (Hispanic: OR = 25.54 (95% CI 7.52–101.54), $p < .0001$; NHW: OR = 15.18 (95% CI 5.64–40.85), $p < .001$). There was no difference between the Hispanic and NHW candidate estimates (1+ vs. 0 PLDs) ($p = .518$).

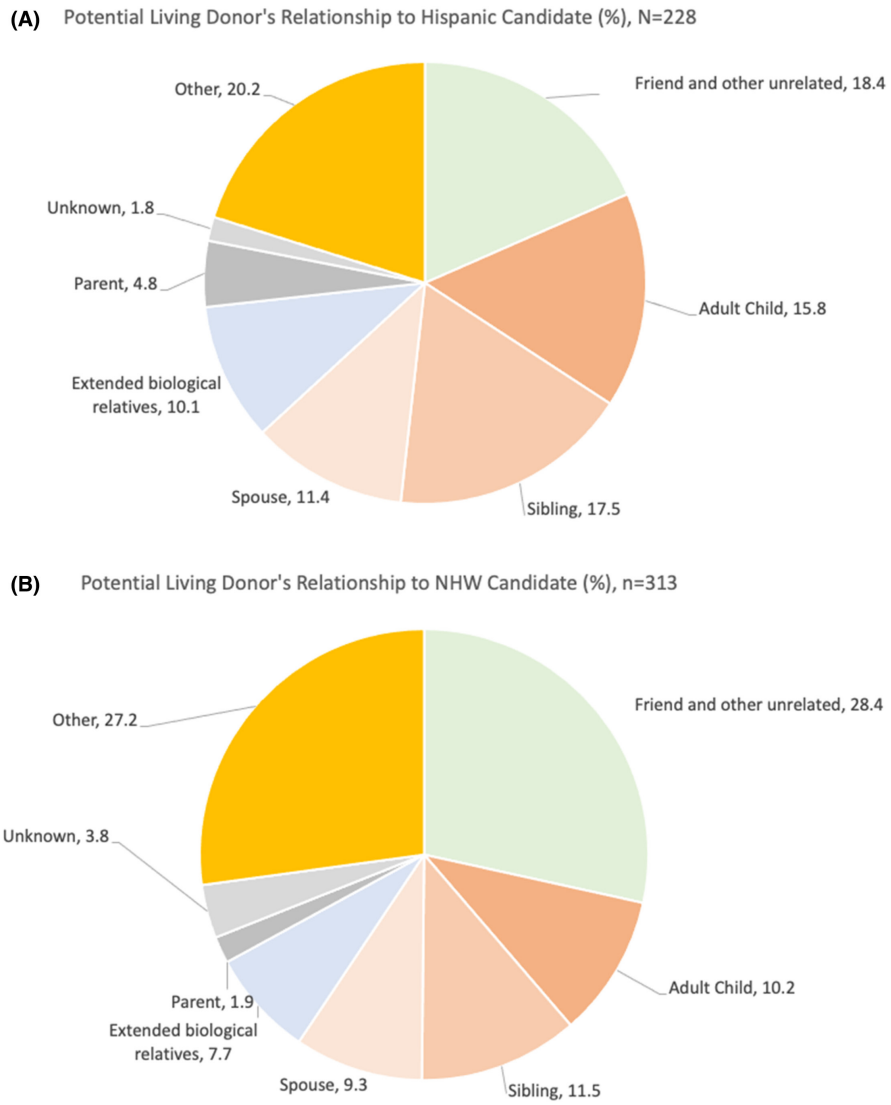

FIGURE 1 (A) Potential living donor's relationship to Hispanic candidate (%), $N = 228$. (B) Potential living donor's relationship to NHW candidate (%), $N = 313$.

4 | DISCUSSION

Our study examined KT candidate characteristics relating to the availability of PLDs and likelihood of receiving a kidney transplant. Our findings are novel in highlighting how the availability of one or more PLD(s) who complete the medical health questionnaire is associated with a significantly greater likelihood of receiving a transplant, particularly a LDKT. Additionally, we did not observe statistically significant differences by race/ethnicity in KT receipt among recipients with at least one PLD.

Our findings showed that Hispanic and NHW candidates verbally reported a comparable proportion of PLDs per candidate. This finding advances understanding of the PLD evaluation process by discounting the differential access hypothesis, which presumes that lower rates of LDKT among Hispanic and other minoritized candidates are due to having fewer PLDs.[15] By evaluating the reported number of verbal reports of interest in donating, rather than relying on the number of PLDs who actually initiated evaluation, we can see that Hispanic candidates have just as many PLDs from the outset as NHW candidates.[15]

Clinical practice and research on LD evaluation commonly focuses on PLDs who complete the medical health questionnaire or initiate donor evaluation.[15] However, as our findings and other reports[15] show, this focus is too narrow. Transplant programs can recognize a broader number of PLDs by also accounting for transplant candidates' (and accompanying family/friends') verbally reported number of PLDs.

Our findings indicate that for Hispanic candidates, there was an even greater decrease in PLDs between the verbal report and completing Breeze™ and initiating donor evaluation than for NHW candidates. Specifically, NHW candidates had more than double the proportion of PLDs complete Breeze™ per candidate than Hispanic candidates. Our findings suggest that the disparity in donor evaluation arises early in the evaluation process. This disparity may have arisen due to demographic and structural factors. Demographically, Hispanic candidates in our sample were less educated than NHW candidates, and therefore may have been less Internet savvy or were even afraid to complete the online Breeze™ given the "digital divide," which is shrinking.[24] The absence of a Spanish language telephone line to complete Breeze™ with a bilingual transplant nurse may have

TABLE 4 Association of one or more potential living donors (PLDs) who completed Breeze™ per waitlisted candidate and receipt of KT and LDKT by site, $n = 847$

	Site A, $n = 196$				Site B, $n = 651$			
	Comparison: 1+ versus 0 donors				Comparison: 1+ versus 0 donors			
	OR[a]	(95% CI)	*p-value*	Comparison: Hispanic versus NHW[c] b (95% CI), *p-value*	OR[a]	(95% CI)	*p-value*	Comparison: Hispanic versus NHW[c] b (95% CI), *p-value*
Unadjusted								
KT versus not yet received KT				0.04 (−0.98, 1.06), $p = .942$				−0.06 (−0.67, 0.55), $p = .845$
Hispanic	2.36	(1.22, 4.59)	.011		1.26	(0.82, 1.95)	.293	
NHW	2.27	(1.05, 4.92)	.028		1.34	(0.88, 2.06)	.177	
LDKT versus DDKT				−0.53 (−2.80, 1.74), $p = .646$				0.65 (−0.90, 2.21), $p = .411$
Hispanic	16.11	(3.36, 77.2)	.0005		30.22	(8.99, 101.54)	<.0001	
NHW	27.44	(5.31, 141.82)	<.0001		15.72	(5.92, 41.78)	<.0001	
Adjusted[b]								
KT versus not yet received KT				−0.07 (−1.11, 0.97), $p = .895$				−0.17 (−0.79, 0.45), $p = .845$
Hispanic	2.26	(1.13, 4.53)	.022		1.17	(0.75, 1.83)	.481	
NHW	2.42	(1.10, 5.33)	.028		1.39	(0.90, 2.14)	.138	
LDKT versus DDKT				−0.53 (−2.80, 1.74), $p = .646$				0.52 (−1.06, 2.10), $p = .518$
Hispanic	21.22	(2.44, 184.48)	.0006		25.54	(7.52, 101.54)	<.0001	
NHW	37.70	(6.59, 215.67)	<.0001		15.18	(5.64, 40.85)	<.0001	

[a]Odds ratio (95% confidence interval).

[b]Adjusted for history of diabetes, history of hypertension, married/with partner and insurance (private vs. other). 5 patients not included in adjusted analyses for site A.

[c]Compares the difference (Hispanic vs. NHW) of difference (1 or more PLDs vs. 0 PLDs), where b denotes the regression coefficient from the interaction term of Hispanic and PLDs in the logistic regression model.

comprised a structural barrier for Spanish-speaking PLDs. Thus, our data suggest that despite similar interest in donating across Hispanic and NHW candidates, systemic barriers may have arisen upon undergoing donor evaluation that generated disparities for Hispanic candidates in accessing LDKT.

However, the number of PLDs throughout donor evaluation declined more steeply among Hispanic than NHW candidates. The Hispanic population has higher rates of diabetes, hypertension, and obesity than the NHW population, which may explain why more Hispanic candidates' PLDs were medically excluded after completing the medical health questionnaire than were NHW candidates' PLDs. Other studies of candidates' characteristics associated with racial/ethnic disparities in access to LDKT found that health insurance coverage contributed to racial and ethnic differences in LDKT.[25,26]

Given the impact of having PLDs on KT and LDKT, and the considerable drop-out rate for Hispanic PLDs undergoing evaluation, future research should evaluate, on a larger scale, whether transplant programs that help Hispanic candidates identify PLDs at the beginning of their transplant evaluation process could reduce disparities. Transplant programs primarily deliver one-on-one transplant education rather than group discussion,[27] however, Hispanics prefer group education with family and friends.[28] Education about living donation in a group setting may offer an optimal opportunity to help Hispanic patients recognize PLDs. Because most Hispanic candidates' PLDs were biologically- and non-biologically-related family, including Hispanic patients' family in the transplant education and evaluation process may help to increase PLDs.

Transplant providers have an opportunity to facilitate a discussion among the patient and family to address barriers to donation and enable them to verbally identify PLDs, reminding them that donor evaluation is kept confidential to prevent potential undue influence to donate. This is especially relevant when some PLDs wait to initiate evaluation after other PLDs have been ruled out. By tracking the number of verbally identified PLDs and their progress through the evaluation process, the provider could contact the patient, inform them of the number of PLDs who have been ruled out or have not yet been evaluated, and encourage patients to inform their family of this update, without asking them to donate. Therefore, recording the number of verbally reported PLDs in their medical records could potentially help providers follow-up with candidates regarding their PLDs. Systematic research should evaluate the impact of eliciting and tracking verbal reports of PLDs on increasing the number of PLDs initiating and completing donor evaluation.

Our study advances the literature by showing how having one or more PLDs appears to contribute to KT and LDKT access, and extends work by others.[29] However, the status of having one or more PLDs may be a surrogate for transplant program fast-tracking the evaluation of candidates with PLDs, or candidate and/or potential donor activation. KT recipient patient activation level is positively associated with LDKT receipt.[30] Therefore, further research should ascertain the relationship between having one or more PLDs and these potential surrogates.

We found that the association between recipients having one or more PLDs and receipt of KT or LKDT was unrelated to ethnicity/race. This suggests that having one or more PLDs may help to mitigate racial/ethnic disparities in LDKT, which should be assessed in future research.

This study has strengths. This multi-site study was conducted in two geographic regions, supporting generalizability of findings. The study included a large PLD sample and novel granular data (i.e., nationality) on Hispanic candidates and their PLDs, which advances the literature on ethnic disparities in access to LDKT. Our study provides a rich analysis of the PLD evaluation process by examining novel predictor variables (i.e., verbal report).

Our study has limitations. Candidates included may not be representative of candidates elsewhere. Candidates' verbal report of PLDs may not reflect actual numbers; some PLDs prefer to get evaluated without informing candidates, thus, our results may be more conservative. Analysis of one variable (verbal report) was collected during part of the analysis period. Hispanic candidates in our sample were primarily of Mexican national heritage; findings may vary for Hispanic patients of other nationalities. Medical records may not accurately depict patients' race/ethnic identity,[31] which could have led to bias in the results. Because Breeze™ became available in Spanish at the study sites in 2018, our findings may have underreported PLDs' use of Breeze™.

5 | CONCLUSION

Our findings suggest that the availability of PLDs signifies a greater likelihood of access to kidney transplantation, particularly LDKT. Transplant programs tracking the availability of PLDs initiating evaluation, beginning with candidates' verbal report of PLDs, may attain a more granular understanding of the sources of potential disparities in candidates' access to LDKT.

ACKNOWLEDGMENTS

REDCap is supported at Northwestern University Feinberg School of Medicine by the Northwestern University Clinical and Translational Science (NUCATS) Institute. Research reported in this publication was supported, in part, by the National Institutes of Health's National Center for Advancing Translational Sciences, Grant Number UL1TR001422. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. This work was supported in part by Health Resources and Services Administration contract 234-2005-370011C. The content is the responsibility of the authors alone and does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

DATA AVAILABILITY STATEMENT

Research data are not shared to protect site confidentiality.

DISCLOSURE

The authors of thismanuscript have no conflicts of interest to disclose as described by the *American Journal of Transplantation*.

ORCID

Elisa J. Gordon https://orcid.org/0000-0003-0969-1998
Jungwha Lee https://orcid.org/0000-0002-0806-0847
Raymond Kang https://orcid.org/0000-0001-7762-8152
Juan Carlos Caicedo https://orcid.org/0000-0003-3936-6395

REFERENCES

1. Axelrod DA, McCullough KP, Brewer ED, Becker BN, Segev DL, Rao PS. Kidney and pancreas transplantation in the United States, 1999-2008: the changing face of living donation. *Am J Transplant*. 2010;10(4 Pt 2):987-1002. doi:10.1111/j.1600-6143.2010.03022.x
2. Lamb KE, Lodhi S, Meier-Kriesche HU. Long-term renal allograft survival in the United States: a critical reappraisal. *Am J Transplant*. 2011;11(3):450-462. doi:10.1111/j.1600-6143.2010.03283.x
3. Gozdowska J, Zatorski M, Torchalla P, et al. Living-donor versus deceased-donor kidney transplantation: comparison of psychosocial consequences for recipients. *Transplant Proc*. 2016;48(5):1498-1505. doi:10.1016/j.transproceed.2016.01.075
4. Yohanna S, Naylor KL, Mucsi I, et al. A quality improvement intervention to enhance access to kidney transplantation and living kidney donation (EnAKT LKD) in patients with chronic kidney disease: clinical research protocol of a cluster-randomized clinical trial. *Can J Kidney Health Dis*. 2021;8:2054358121997266. doi:10.1177/2054358121997266
5. Garg AX. Helping more patients receive a living donor kidney transplant. *Clin J Am Soc Nephrol*. 2018;13(12):1918-1923. doi:10.2215/cjn.00760118
6. Purnell TS, Luo X, Cooper LA, et al. Association of race and ethnicity with live donor kidney transplantation in the United States from 1995 to 2014. *JAMA*. 2018;319(1):49-61. doi:10.1001/jama.2017.19152
7. OPTN/UNOS. Organ Procurement Transplant Network/United Network for Organ Sharing. Transplants by donor type. U.S. Transplants Performed: January 1, 1988 - December 31, 2021 [https://optn.transplant.hrsa.gov/data/view-data-reports/national-data/] Based on OPTN data as of January 16, 2022. (Accessed January 17, 2022). https://unos.org/data/transplant-trends/. 2021.
8. Purnell TS, Hall YN, Boulware LE. Understanding and overcoming barriers to living kidney donation among racial and ethnic minorities in the United States. *Adv Chronic Kidney Dis*. 2012;19(4):244-251.
9. Gordon EJ, Mullee JO, Ramirez DI, et al. Hispanic/Latino concerns about living kidney donation: a focus group study. *Prog Transplant*. 2014;24(2):152-162. doi:10.7182/pit2014946
10. Siegel JT, O'Brien EK, Alvaro EM, Poulsen JA. Barriers to living donation among low-resource Hispanics. *Qual Health Res*. 2014;24(10):1360-1367. doi:10.1177/1049732314546869
11. Ríos Zambudio A, López-Navas AI, Garrido G, et al. Attitudes of Latin American immigrants resident in Florida (United States) toward related living kidney donation. *Prog Transplant*. 2019;29(1):11-17. doi:10.1177/1526924818817073
12. Gordon EJ, Romo E, Amórtegui D, et al. Implementing culturally competent transplant care and implications for reducing health disparities: a prospective qualitative study. *Health Expect*. 2020;23(6):1450-1465. doi:10.1111/hex.13124
13. Hall EC, James NT, Garonzik Wang JM, et al. Center-level factors and racial disparities in living donor kidney transplantation. *Am J Transplant*. 2012;59(6):849-857. doi:10.1053/j.ajkd.2011.12.021
14. Kumar K, King EA, Muzaale AD, et al. A smartphone app for increasing live organ donation. *Am J Transplant*. 2016;16(12):3548-3553. doi:10.1111/ajt.13961
15. Daw J. Of kin and kidneys: do kinship networks contribute to racial disparities in living donor kidney transplantation? *Soc Sci Med*. 2014;104:42-47. doi:10.1016/j.socscimed.2013.11.043
16. Gillespie A, Gardiner HM, Fink EL, Reese PP, Gadegbeku CA, Obradovic Z. Does sex, race, and the size of a kidney transplant Candidate's social network affect the number of living donor requests? A multicenter social network analysis of patients on the kidney transplant waitlist. *Transplantation*. 2020;104(12):2632-2641. doi:10.1097/tp.0000000000003167
17. Gordon EJ, Lee J, Kang RH, et al. A complex culturally targeted intervention to reduce Hispanic disparities in living kidney donor transplantation: an effectiveness-implementation hybrid study protocol. *BMC Health Serv Res*. 2018;18(1):368.
18. Gordon EJ, Lee J, Kang R, et al. Hispanic/Latino disparities in living donor kidney transplantation: role of a culturally competent transplant program. *Transplant Direct*. 2015;1(8):e29.
19. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ*. 2008;337:a1655. doi:10.1136/bmj.a1655
20. Gordon EJ, Uriarte J, Lee J, et al. Effectiveness of a culturally competent care intervention in reducing disparities in Hispanic live donor kidney transplantation: a hybrid trial. *Am J Transplant*. 2021;22:474-488.
21. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381. doi:10.1016/j.jbi.2008.08.010
22. Gill JS, Hendren E, Dong J, Johnston O, Gill J. Differential association of body mass index with access to kidney transplantation in men and women. *Clin J Am Soc Nephrol*. 2014;9(5):951-959. doi:10.2215/cjn.08310813
23. Alhalel N, Francone NO, Salazar A, et al. Perceptions of a culturally targeted Hispanic kidney transplant program: a mixed methods study. *Clin Transplant*. 2019;33(6):e13577.
24. Brown A, Lopez G, Lopez M. Digital divide narrows for latinos as more Spanish speakers and immigrants go online, July 20. www.pewresearch.org/hispanic/wp-content/uploads/sites/5/2016/07/PH_2016.07.21_Broadbank_Final.pdf [Accessed 12-13-21]. 2016.
25. Purnell T, Xu P, Leca N, Hall Y. Racial differences in determinants of live donor kidney transplantation in the United States. *Am J Transplant*. 2013;13(6):1557-1565.
26. Reeves-Daniel AM, Farney AC, Fletcher AJ, et al. Ethnicity, medical insurance, and living kidney donation. *Clin Transplant*. 2013;27(4):E498-E503. doi:10.1111/ctr.12168
27. Gordon EJ, Caicedo JC, Ladner DP, Reddy E, Abecassis MM. Transplant center provision of education and culturally and linguistically competent care: a national study. *Am J Transplant*. 2010;10(12):2701-2707.
28. Gordon E, Reddy E, Gil S, et al. A culturally competent transplant program improves Hispanics' knowledge and attitudes about live kidney donation and transplantation. *Prog Transplant*. 2014;24(1):56-68.
29. Vedadi A, Bansal A, Yung P, et al. Ethnic background is associated with no live kidney donor identified at the time of first transplant assessment—an opportunity missed? A single-center retrospective cohort study. *Transpl. Int*. 2019;32(10):1030–1043.
30. Bailey PK, Caskey FJ, MacNeill S, Tomson CRV, Dor F, Ben-Shlomo Y. Mediators of socioeconomic inequity in living-donor kidney transplantation: results from a UKmulticenter case-control study. *Transplant Direct*. 2020;6(4):e540. doi:10.1097/txd.0000000000000986
31. Zingmond DS, Parikh P, Louie R, et al. Improving hospital reporting of patient race and ethnicity–approaches to data auditing. *Health Services Research*. 2015;50(Suppl 1):1372-1389. doi:10.1111/1475-6773.12324

How to cite this article: Gordon EJ, Lee J, Kang R, Caicedo JC. Impact of having potential living donors on ethnic/racial disparities in access to kidney transplantation. *Am J Transplant*. 2022;22:2433-2442. doi: 10.1111/ajt.17090