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MINIREVIEW

Examining post-donation outcomes in Hispanic/Latinx living kidney donors in the United States: A systematic review

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We conducted a systematic review to assess outcomes in Hispanic donors and explore how Hispanic ethnicity was characterized. We searched PubMed, EMBASE, and Scopus through October 2021. Two reviewers independently screened study titles, abstracts, and full texts; they also qualitatively synthesized results and independently assessed quality of included studies. Eighteen studies met our inclusion criteria. Study sample sizes ranged from 4007 to 143,750 donors and mean age ranged from 37 to 54 years. Maximum follow-up time of studies varied from a perioperative donor nephrectomy period to 30 years post-donation. Hispanic donors ranged between 6% and 21% of the donor populations across studies. Most studies reported Hispanic ethnicity under race or a combined race and ethnicity category. Compared to non-Hispanic White donors, Hispanic donors were not at increased risk for post-donation mortality, end-stage kidney disease, cardiovascular disease, non-pregnancy-related hospitalizations, or overall perioperative surgical complications. Compared to non-Hispanic White donors, most studies showed Hispanic donors were at higher risk for diabetes mellitus following nephrectomy; however, mixed findings were seen regarding the risk for post-donation chronic kidney disease and hypertension. Future studies should evaluate cultural, socioeconomic, and geographic differences within the heterogeneous Hispanic donor population, which may further explain variation in health outcomes.

KEYWORDS
clinical research/practice, disparities, donors and donation, donors and donation: donor follow-up, donors and donation: living, health services and outcomes research, kidney transplantation/nephrology, kidney transplantation: living donor

Abbreviations: CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus; ESKD, end-stage kidney disease; GN, glomerulonephritis; HCUP-NIS, Healthcare Cost and Utilization Project Nationwide Inpatient Sample; HTN, hypertension; LDKT, living donor kidney transplantation; NHANES, National Health and Nutrition Examination Survey; OPTN, Organ Procurement and Transplant; UNOS, United Network for Organ Sharing.

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1 | INTRODUCTION

The Hispanic population is the largest and one of the fasting growing minority groups in the United States, with over 62 million people identifying as Hispanic or Latino in 2020.[1] The terms "Hispanic" or "Latino" have been used to describe a population with a shared cultural heritage, and frequently a common language, but do not refer to race or ancestry.[2] Initially, the term "Hispanic" was propagated following efforts in the 1970s calling for the federal government to collect data on the Hispanic population.[3] In 1980, a "Hispanic" category was added to the Census to identify US residents of Mexican, Puerto Rican, Cuban, Central American, South American, and other Spanish-speaking country origins; this single term was later replaced by the interchangeable use of "Hispanic or Latino" in 1997.[3,4] More recently, "Latinx" has been popularized as a more gender-inclusive term to describe Hispanic ethnicity.[3] Herein we use the term Hispanic for reading ease, although we recognize that individuals may preferentially identify as Hispanic, Latino, Latina, Latinx, or a combination of these categories.

With the ability to collect data on the Hispanic population, research has highlighted numerous health disparities in this group and other minorities with kidney disease.[5–7] For instance, Hispanic individuals have a higher prevalence and incidence of type 2 diabetes mellitus (DM) compared to the general population.[8,9] Recent USRDS data demonstrate chronic kidney disease (CKD) prevalence is lower among Hispanic individuals at 11.9% compared to non-Hispanic White individuals (15.7%).[10] However, Hispanic individuals are 1.3 times more likely to develop end-stage kidney disease (ESKD) as compared to non-Hispanic White individuals,[10] and have a higher risk of CKD progression.[11–13] Hispanic persons with ESKD are less likely to undergo living donor kidney transplantation (LDKT) as compared to the non-Hispanic White population in the United States,[14,15] and have experienced a decline in biologically related living kidney donors under the age of 50.[16,17] Notably, Hispanic donors are the largest racial or ethnic subgroup (40%) among international living kidney donors.[18] National cohort studies following donors have evaluated health outcomes among varying racial or ethnic subgroups; one study showed Hispanic donors experience an increased risk of ESKD compared to White donors, albeit the absolute risk was small.[19] Another study showed that Hispanic donors had a higher risk of hypertension (HTN), drug-treated DM, and CKD after nephrectomy, as compared to White donors.[20] While recent reviews discuss the risks of living kidney donation across race and ethnicity,[21–23] we were particularly interested in reviewing post-donation health outcomes among donors that self-identified as Hispanic, and exploring how studies characterized Hispanic ethnicity.

2 | MATERIALS AND METHODS

2.1 | Study design and literature search strategy

We performed a systematic review of published, peer-reviewed original research evaluating post-donation outcomes in Hispanic individuals. We compared study designs, participant characteristics and evaluated factors that may have compromised validity. Eligible studies evaluated clinical post-transplant outcomes in Hispanic donors. We included studies that categorized Hispanic donors into a mutually exclusive group or compared Hispanic donors to Hispanic controls.

We searched PubMed, EMBASE, and Scopus through October 2021. An expert clinical informationist (J.B.) and content experts within our team (F.A., C.E.C., and T.S.P.) developed search strategies to identify pertinent studies (Item 1).

2.2 | Data extraction, study inclusion, and exclusion criteria

Two reviewers screened study titles and abstracts from initial search results; full texts were subsequently reviewed. We included articles that evaluated post-donation outcomes in Hispanic living kidney donors who were 18 years of age or older and living in the United States. We excluded abstracts or published manuscripts that did not include original research or if they were not written in English. We hand-searched bibliographies of articles meeting inclusion and exclusion criteria and three additional review papers[21–23] to identify studies that may have been missed by initial search strategies.

2.3 | Data classification and analysis

We decided a priori to not conduct a formal meta-analysis because we expected studies to be methodologically diverse and focusing on disparate clinical outcomes. Instead, we synthesized results qualitatively within summary tables to compare differences and similarities between studies. Among these comparisons, we have highlighted perspectives of risk among living donors as previously described by Lentine et al.[24] We noted how Hispanic ethnicity was defined in each study.

2.4 | Assessment of studies' quality (internal and external validity for relevant outcomes)

An adapted version of previously published instruments[25–27] was used to independently assess the validity of included studies

(Item 2). Regarding internal validity, we evaluated whether studies were at minimal risk for selection bias, used valid outcome assessments, rigorous statistical analyses, and appropriately discussed limitations and potential sources of bias. Inclusion and exclusion criteria were used to evaluate external validity. Two reviewers independently assessed study quality with a third party available to resolve disagreements.

3 | RESULTS

Our search identified 1543 non-duplicate records (i.e., citations and abstracts), of which 54 were deemed eligible for full-text review. We retained 15 articles meeting inclusion criteria. From hand-searching bibliographies of the final 15 articles and 3 review papers,[21–23] we obtained 3 additional articles resulting in the final inclusion of 18 studies[19,20,24,28–42] (Figure 1, Table 1). The results in the tables highlight outcomes evaluated among Hispanic donors and respective comparison groups (Tables 2 and 3).

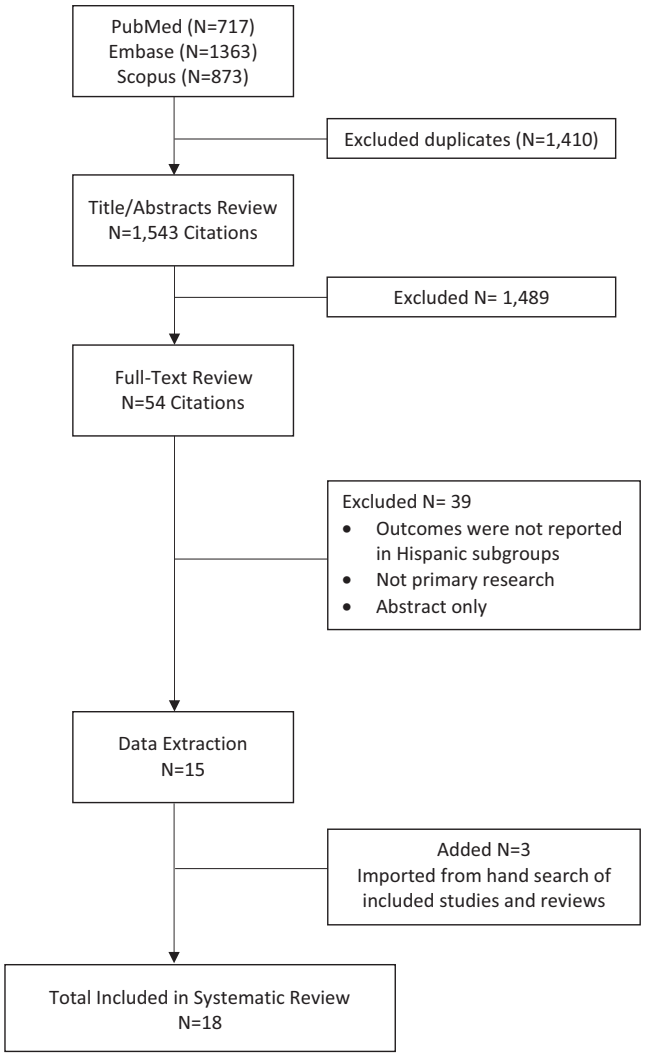

FIGURE 1 Summary of literature search and article review process

Studies retrospectively linked living donor data to national databases such as CMS data[19,28,37,38,41] national transplant waiting and recipient lists,[19,41] living donor follow-up form data,[30,42] or the Social Security Death Master File.[40,41] Donor information was also linked to administrative insurance data,[20,24,31,34,36] Medicare billing claims,[35] State Inpatient Databases (SID),[39] hospital discharge information,[29] and administrative records from an academic hospital consortium.[33] Studies included 4007 to 143 750 living donors, with mean ages of 37–54. Maximum follow-up time varied from a perioperative donor nephrectomy period to 30 years post-donation. Slightly more than half of study participants were women (≥54.8%). Hispanic donors ranged between 5.7% and 21.0% of the donor populations across studies. Most studies reported a combined race and ethnicity category and evaluated Hispanic donors as a mutually exclusive group (e.g., Hispanic donors, non-Hispanic White, non-Hispanic Black); one study specified an ethnicity category (Hispanic vs. all non-Hispanic donors), separate from race.[30] Hispanic ethnicity by country of origin was not reported. Post-donation health outcomes included mortality, perioperative complications, hospitalizations, ESKD, CKD, cardiovascular disease (CVD), DM, HTN, and gout.

In a large national study linking OPTN data to the Social Security Death Master File, Hispanic donors were not at increased for 90-day surgical mortality as compared to White donors.[40] This study also evaluated mortality for donors of all racial and ethnic groups to healthy (non-donor) controls over a 12-year follow-up. The risk of 12-year mortality was no higher for all donors compared to matched healthy controls. However, mortality comparisons were not specifically reported between Hispanic donors and healthy (non-donor) Hispanic controls.

Compared to White donors, Hispanic donors were more likely to develop Clavien grade IV or higher surgical complications, but were not at increased risk of developing complications overall, or by specific subtypes including genitourinary, vascular, bleeding, thrombosis, wounds, hernias, cardiac, respiratory, or other complications.[33] "Other complications" was a wide-ranging category that included, but was not limited to nervous system complications, conversion to open nephrectomy, ICU stays, or death. Hispanic donors did not have an increased risk of post-donation non-pregnancy-related hospitalizations as compared to White donors.[39]

Most studies did not show a difference in the risk for developing ESKD among Hispanic donors compared to White donors. In a national study evaluating 123,526 donors, Hispanic donors were not at increased risk of ESKD at 20 years post-donation compared to White donors after multivariable adjustment (adjusted hazard ratio [aHR]: 1.29 [95% CI 0.8–2.07]).[41] Furthermore, Anjum et al. evaluated the risk of ESKD by comparing the likelihood of late post-donation (10–25 years) ESKD risk versus early post-donation (0–9 years) ESKD risk, and by ESKD etiology.[28] Compared to White donors, the incidence of late post-donation HTN-related ESKD compared with early post-donation HTN-related ESKD in Hispanic donors was numerically greater but was not statistically significant.[28] There was no difference in the incidence of late post-donation DM- or glomerulonephritis (GN)-related ESKD compared with early post-donation

TABLE 1 Characteristics of included studies

				Demographics			Socioeconomic status	
Study	**Outcome**	**Sample size**	**Data source and study design**	**Mean age**	**Female sex (%)**	**Race and ethnicity (%)**	**Insurance (%)**	**Education (%)**
2010, Friedman	Perioperative complications	6320	Cross-sectional analysis using discharge data (1995–2005) from the HCUP-NIS, ICD-9 diagnostic, and procedure codes (1999–2005) from cases of patients undergoing LKD. Mean LOS: 3.3 days	40	59	*n* = 4329 Hispanic: 11 Black: 12 Other■: 6 White: 68	*n* = 6210 Private: 44 Self-Pay: 13 Medicare: 13 Medicaid 2 No charge 1 Other: 26	NR
2010, Lentine ◊	CKD, CVD, DM, HTN	4650	Linkage of OPTN data (1987–2007) with administrative billing claims from a private health insurer (2000–2007) CKD outcome evaluated among coding subgroup of 2307 LKDs. Median follow-up: 7.7 yrs	37	55	Hispanic: 8.2 Non-Hispanic Black: 13.1 Non-Hispanic White: 76.3 Other■: 2.4	Private: 100	*n* = 3385 College graduate • Hispanic: 23 • Black: 21 • White: 28 <12th grade • Hispanic 27 • Black 23 • White: 16
2010, Segev	Mortality	80 347	Linkage of OPTN LKD data (1994–2009) and SSDMF. Median follow-up: 6.3 yrs	18–39: 49 40–49: 30 5 0–59: 17 ≥60: 4	59	*n* = 80 286 Hispanic: 12.3 Black: 13.1 Other□: 1.6 White: 73.1	NR	*n* = 41 146 GS: 2 HS: 36 Some college: 28 College graduate: 24 Post-college: 10
2011, Lentine ◊	DM, HTN (accounted for relatedness to recipient)	4650	Linkage of OPTN data (1987–2007) with administrative billing claims from a private health insurer (2000–2007)	See Lentine 2010				
2014, Lentine *Am J Nephrol*◊	HTN	4650	Linkage of OPTN data (1987–2007) with administrative billing claims from a private health insurer (2000–2007), specifically using pharmacy fills	See Lentine 2010				
2014, Lentine *Transp.*	CKD, DM, HTN	4007	Linkage of OPTN data (1987–2008) with Medicare-insured living donors. Median follow-up: 6 yrs	55	60	Hispanic: 5.7 Non-Hispanic Black: 8.1 Non-Hispanic White: 83.4 Other■: 2.8	Medicare: 100	NR

TABLE 1 (Continued)

Study	Outcome	Sample size	Data source and study design	Demographics			Socioeconomic status	
				Mean age	Female sex (%)	Race and ethnicity (%)	Insurance (%)	Education (%)
2014, Muzaale	ESKD	96 217	Linkage of OPTN LKD data (1994–2011) and national kidney replacement treatment records. Healthy controls from NHANES III (screened for health exclusions to donation, matched by demographic and clinical factors) LKD. Median follow-up: 7.6 yrs	40	59	Hispanic: 12.5 Black: 12.9 White/other □: 74.6	NR	HS or less: 36 Some college: 28 College graduate: 25 Post college: 10
2014, Schold	Rehospitalization	4524	Retrospective cohort using State Inpatient Databases compiled by AHRQ. Data from North Carolina, New York, Florida, California. Follow-up: 731 days	41	*n* = 3861 60	*n* = 3395 Hispanic: 21 Black: 10 White: 63	NR	NR
2015, Lam ◊	Gout	4650	Linkage of OPTN data (1987–2007) with administrative billing claims from a private health insurer (2000–2007)	See Lentine 2010				
2015, Lentine ◊	Proteinuria Nephrotic syndrome Nephritis/nephropathy Renal failure, any kidney diagnosis, CKD (accounting for relatedness)	4650	Linkage of OPTN data (1987–2007) with administrative billing claims from a private health insurer (2000–2007)	See Lentine 2010				
2016, Anjum	ESKD, early (0–9 yrs), and late (10–25 yrs) post-donation by subtype: • DM-related • HTN-related • GN-related	125 427	Linkage of OPTN data (1987–2014) and national kidney replacement treatment records. Median follow-up: 11 yrs	40	59	Hispanic: 12 Black: 13 White or other■: 75	NR	HS or less: 35 Attended college: 28 Graduate or more: 37

(Continues)

TABLE 1 (Continued)

				Demographics			Socioeconomic status	
Study	Outcome	Sample size	Data source and study design	Mean age	Female sex (%)	Race and ethnicity (%)	Insurance (%)	Education (%)
2016, Lentine	Perioperative complications	14 964	Linkage of OPTN data (2008–2012) with UHC database, an alliance of 107 academic medical centers and 234 of affiliated hospitals. Follow-up: perioperative period	42	62	Hispanic: 11 Black: 12 Other: 5 White: 72	Insured: 73 Uninsured: 12 Missing: 15	NR
2017, Massie	ESKD	133 824	Linkage of OPTN data (1987–2015) and national kidney replacement treatment records, SSDMF. Median follow-up: NR	40*	ESKD: 39 No ESKD: 59	Hispanic: % NR ESKD, Black: 34 No ESKD, Black: 13	NR	NR
2018, Wainright	ESKD	123 526	Linkage of OPTN LKD data (1994–2016) and national kidney replacement treatment records, SSDMF. Median follow-up: 10.3	ESKD: 38 No ESKD: 41	ESKD: 42 No ESKD: 60	ESKD • Hispanic: 11.0 • Black: 32.1 • Other□: 5.1 • White: 51.8 No ESKD • Hispanic: 12.9 • Black: 12.3 • Other□: 4.8 • White: 70.1	NR	NR
2019, Holscher	Early (within first 2 yrs post-donation) • DM • HTN	41 260	Linkage of OPTN data (2008–2014) with OPTN living donor follow-up form data. Max follow-up: 2 yrs	42*	62	Hispanic ethnicity, reported separately from race: 14 Race: • White: 84 • Asian: 4 • Black: 12 • Other■: 1	Insured 73 Uninsured: 13 Unknown: 14	Some college or higher • Yes: 64 • No: 27 • Unknown: 9

TABLE 1 (Continued)

Study	Outcome	Sample size	Data source and study design	Demographics			Socioeconomic status	
				Mean age	Female sex (%)	Race and ethnicity (%)	Insurance (%)	Education (%)
2019, Lentine	DM • Primary: anti-diabetic medications use • Non-insulin anti-diabetic med use • Insulin use	28 515	Retrospective cohort study using a large US pharmaceutical claims data warehouse- comprises National Council for Prescription Drug Program 5.1-format prescription claims aggregated from multiple sources including data clearinghouses, retail pharmacies, and prescription benefit managers (2007 to 2016). Mean follow-up: 3.8 yrs	43	67	Hispanic: 12 White: 74 Black: 11 Other■: 4	Insured: 79 Uninsured: 10 Unknown: 11	College or higher: 67 GS/HS: 25 Unknown: 8
2020, Muzaale	ESKD, stratified by biological relatedness	143 750	Linkage of OPTN LKD data (1987–2017) and national kidney replacement treatment records. Median follow-up: 12 yrs	40	59	Hispanic: 13 Asian: 3 Black: 12 White: 72	NR	College graduate: 26 Post-graduate education: 11
2021, Augustine	Change in eGFR, proteinuria	34 504	LKD data (2008–2014) from the SRTR registry. Max follow-up: 2 yrs	42	63	Hispanic: 13.7 Black: 11.0 Other■: 4.8 White: 70.5	Insured: 85	HS or less: 29 Some college or higher: 71

Note: ■ other, not explicitly defined; ◊ same cohort (original study: Lentine et al., 2010); *median; median time follow-up from donation to the end of observed insurance benefits; □ other, defined as American Indian, Native Hawaiian, Alaskan Native, Pacific Islander, and multiracial.

Abbreviations: AHRQ, Agency for Healthcare Research and Quality; *Am J Nephrol*, *American Journal of Nephrology*; CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus; ESKD, end-stage kidney disease; GN, glomerulonephritis, eGFR, estimated glomerular filtration rate; GS, grade school; HCUP-NIS, Healthcare Cost and Utilization Project-National (Nationwide) Inpatient Sample; HS, high school; HTN, hypertension; LKD, living kidney donor; LOS, length of stay; NHANES, National Health and Nutrition Examination Survey; NR, not reported; OPTN, Organ Procurement and Transplantation Network; SRTR, Scientific Registry of Transplant Recipients; SSDMF, Social Security Death Master File; *Transp*, *Transplantation*; yrs, years.

TABLE 2 Findings of included studies

Study	Post-donation outcomes	Risk perspective[b]	Findings
2010, Friedman	Perioperative complications	Descriptive Comparative: within donors	Adjusted OR for all complications after nephrectomy, in Hispanic donors compared to White donors: 0.97 (95% CI 0.75–1.25)
2010, Lentine[a]	CKD CVD DM HTN	Descriptive Comparative: within-donor. Comparison of Hispanic versus White individuals, and general population using NHANES 2005–2006	Adjusted HR, at 5 yrs post-donation, of: • CKD in Hispanic donors compared to White donors (medical claims): 1.90 (95% CI 1.05–3.43). In NHANES data, adjusted HR of patient-reported CKD in Hispanic respondents compared to White respondents: 1.42 (95% CI 0.88–2.27) • CVD in Hispanic donors compared to White donors (medical claims): 0.91 (95% CI 0.37–2.26). In NHANES data, adjusted HR of patient-reported CVD in Hispanic respondents to White respondents: 1.04 (95% CI 0.71–1.52) • DM in Hispanic donors compared to White donors from medical claims: 1.65 (95% CI 1.00–2.74), and drug-treated: 2.94 (95% CI 1.57–5.51). In NHANES data, adjusted HR of patient-reported DM in Hispanic respondents compared to White respondents: 2.34 (95% CI 1.76–3.12) • HTN in Hispanic donors compared to White donors from medical claims: 1.36 (95% CI 1.04–1.78), and drug-treated: 1.03 (95% CI 0.73–1.46). In NHANES data, adjusted HR of patient-reported HTN in Hispanic respondents compared to White respondents: 0.65 (95% CI 0.51–0.83)Estimated prevalence of HTN among Hispanic living donors 5 yrs after nephrectomy, as compared to the general Hispanic population, according to subgroup: Female sex evaluated at age 40: 18.4 (95% CI 13.4–23.1) in Hispanic donors; 10.4 (95% CI 8.5–12.7) in Hispanic NHANES respondents Male sex, evaluated at age 40: 20.6 (95% CI 14.9–25.8) in Hispanic donors; 9.8 (95% CI 7.9–12.0) in Hispanic NHANES respondents Female sex evaluated at age 55: 40.2 (95% CI 30.5–48.6) in Hispanic donors; 21.6 (95% CI 18.1–25.6) in Hispanic NHANES respondents Male sex, evaluated at age 55: 44.2 (95% CI 33.3–53.3) in Hispanic donors; 20.5 (95% CI 16.9–24.5) in Hispanic NHANES respondents Estimated prevalence of DM among Hispanic living donors 5 yrs after nephrectomy, as compared to the general Hispanic population, according to subgroup: Female sex evaluated at age 40: 5.7 (95% CI 2.6–8.7) in Hispanic donors; 7.5 (95% CI 6.0–9.3) in Hispanic NHANES respondents Male sex, evaluated at age 40: 5.2 (95% CI 2.3–8.1) in Hispanic donors; 7.2 (95% CI 5.6–9.3) in Hispanic NHANES respondents Female sex evaluated at age 55: 10.8 (95% CI 4.8–16.4) in Hispanic donors; 14.5 (95% CI 11.8–17.7) in Hispanic NHANES respondents Male sex, evaluated at age 55: 9.9 (95% CI 4.2–15.4) in Hispanic donors; 14.5 (95% CI 11.8–17.7) in Hispanic NHANES respondents
2010, Segev	Mortality	Descriptive Comparative, within-donor	Surgical 90-Day mortality: 2.0 deaths per 10 000 donors (95% CI 0.2–7.3) among Hispanic donors compared to White donors 2.6 (95% CI 1.4–4.2) 12-month mortality: 6.1 deaths per 10 000 donors (95% CI 2.2–13.3) among Hispanic donors compared to White donors 5.5 deaths per 10 000 donors (95% CI 3.7–7.7) No significant difference in 12-month mortality between White, Black, and Hispanic donors ($p = .08$). 12-year mortality: Adjusted HR 1.0 (95% CI 0.3–3.2) for Hispanic donors compared to White donors

TABLE 2 (Continued)

Study	Post-donation outcomes	Risk perspective[b]	Findings
2011, Lentine[a]	DM HTN Accounting for relatedness	Descriptive Comparative, within-donor	Adjusted HR, at 5 yrs post-donation, of developing DM or HTN among Hispanic donors related to recipients compared to White donors similarly related to recipients: • DM from Type 1 Diabetic recipient: 0.98 (95% CI 0.12–8.33) • DM from Type 2 Diabetic recipient: 3.14 (95% CI 0.83–11.86) • HTN from recipient with ESKD from HTN: 0.64 (95% CI 0.23–1.82)
2014, Lentine Am J Nephrol[a]	HTN	Descriptive Comparative, within-donor	Adjusted HR, at 5 yrs post-donation, likelihood of pharmacy fills for Hispanic compared to White donors: • Any anti-hypertensive medication: 1.02 (95% CI 0.74–1.40) • Diuretic: 1.07 (95% CI 0.68–1.70) • ACEi/ARB: 1.18 (95% CI 0.77–1.81) • CCB: 0.82 (95% CI 0.40–1.68) • BB: 0.74 (95% CI 0.40–1.37) • Vasodilator/other: 0.36 (95% CI 0.05–2.66)
2014, Lentine *Transp*.	CKD DM HTN	Descriptive Comparative, within-donor	Adjusted HR, at 5 yrs post-donation, among Hispanic donors with Medicare compared to White donors with Medicare of developing: • Any HTN: 1.17 (95% CI 0.95–1.46) • Benign HTN: 1.11 (95% CI 0.84–1.46) • Malignant HTN: 1.96 (95% CI 1.04–3.69) • Unspecified HTN: 1.36 (95% CI 1.08–1.70) • Any DM: 2.11 (95% CI 1.54–2.89) • Type 1 DM: 0.95 (95% CI 0.29–3.09) • Type 2 DM: 2.13 (95% CI 1.56–2.92) • CKD: 1.13 (95% CI 0.75–1.70) • Proteinuria: 0.98 (95% CI 0.40–2.44)
2014, Muzaale	ESKD	Descriptive Comparative, within-donor; Attributable: LKD versus healthy non-donors	Cumulative Incidence of ESKD at 15 yrs per 10 000, among Hispanic donors: 32.6 (95% CI 17.9–59.1), compared to White donors: 22.7 (95% CI 15.6–30.1) Cumulative Incidence of ESKD at 15 yrs for Hispanic donors: 32.6 per 10 000 (95% CI 17.9–59.1), compared to healthy Hispanic non-donors: 6.7 per 10 000 (95% CI 0.00–15.0), for an absolute risk increase of ESKD at 15 yrs of 25.9 per 10 000 ($p = .002$)
2014, Schold	Rehospitalization	Descriptive Comparative, within-donor	Cumulative Incidence of: • All-cause rehospitalization following initial discharge in Hispanic donors at 1 year:7%, 3 yrs: 19%, compared to White donors at 1 year: 5%, 3 yrs: 11% • Non-pregnancy related rehospitalizations following initial discharge in Hispanic donors at 1 year: 6%, at 3 yrs: 13%, compared to White donors at 1 year: 5%, 3 yrs: 9% Adjusted HR in Hispanic donors compared to White donors: • All-cause rehospitalizations following initial discharge: 1.28 (95% CI 1.02–1.61) • Non-pregnancy related: 1.29 (95% CI 0.97–1.70)
2015, Lam[a]	Gout	Descriptive Comparative within-donor	Adjusted HR, at 7 yrs post-donation, among Hispanic donors compared to White donors of developing gout (diagnostic billing claim or pharmacy fill), 0.60 (95% CI 0.19–1.9); gout diagnosis alone: 0.72 (95% CI not reported, p-value >0.05); starting gout medication alone: 1.05 (CI not reported, p-value >0.05)

(Continues)

TABLE 2 (Continued)

Study	Post-donation outcomes	Risk perspective[b]	Findings
2015, Lentine[a]	Proteinuria Nephrotic Syndrome Nephritis/ Nephropathy Renal Failure Any kidney diagnosis CKD Accounting for relatedness	Descriptive Comparative, within-donor	Adjusted HR, at 7 yrs post-donation, among Hispanic donors compared to White donors for: • Proteinuria 1.47 (95% CI 0.67–3.26) • Nephrotic syndrome 5.61 (95% CI 0.49–64.30) • Nephritis/nephropathy 0.70 (95% CI, 0.09–5.33) • Renal failure, unspecified 0.44 (95% CI 0.06–3.23) • Any kidney diagnosis 1.31 (95% CI 0.82–2.09) • CKD 1.90 (95% CI 1.05–3.43) Adjusted HR (including adjustment for donor-recipient relationship), at 7 yrs post-donation, for Hispanic donors compared to White donors for: • Proteinuria: 1.45 (95% CI 0.66–3.21) • Nephrotic syndrome: 5.46 (95% CI 0.48–62.57) • Nephritis/nephropathy: 0.69 (95% CI 0.09–5.30) • Renal failure unspecified: 0.44 (95% CI, 0.06–3.28) • Any renal diagnosis: 1.32 (95% CI 0.83–2.11) • Disorders of impaired renal function: 1.07 (95% CI 0.65–1.78) • CKD: 1.91 (95% CI 1.06–3.44)
2016, Anjum	ESKD, early (0–9 yrs) & late (10–25 yrs) post- donation: DM-related HTN-related GN- related	Descriptive Comparative, within-donor	IRR of late post-donation (10–25 yrs) ESKD compared with early post donation ESKD (0–9 yrs) in Hispanic donors compared to White donors: • DM-related: 0.8 (95% CI 0.2–3.4) • HTN-related: 2.1 (95% CI 1.0–4.1) • GN-related: 0.8 (95% CI 0.2–2.6)
2016, Lentine	Perioperative Complications	Descriptive Comparative, within donors	Adjusted OR (95% CI) of perioperative complications in Hispanic donors compared to White donors: Any complication: 1.01 (0.86–1.18); Clavien grade II or higher 1.04 (0.85–1.27); Clavien grade III or higher 1.20 (0.98–1.48); Clavien grade IV or higher 1.69 (1.24–2.31) Adjusted OR (95% CI) of risk of perioperative complication in Hispanic compared to White donors: Genitourinary: 0.74 (0.45–1.23); Vascular 0.59 (0.23-: 1.48); Bleeding 1.25 (0.86–1.82); Thrombosis 0.36 (0.11–1.15), Wound 0.71 (0.34–1.48); Hernia 0.71 (0.34–1.48); Injury 0.92 (0.53–1.63); 0.65 (0.40–1.05); Cardiac 1.53 (0.79–2.95), Respiratory 1.08 (0.72–1.61), Gastrointestinal 0.80 (0.57–1.13); Other types 0.84 (0.60–1.19)
2017, Massie	ESKD	Descriptive Comparative, within-donor	Adjusted HR of ESKD within Hispanic donors compared to White donors 1.16 (95% CI 0.75–1.80; $p = .5$)
2018, Wainright	ESKD	Descriptive Comparative, within-donor	Cumulative Incidence at 20 yrs post-donation: 40.7 events per 10 000 Hispanic compared to White donors: 38.0 events per 10 000 Adjusted HR, at 20 yrs post-donation, of ESKD in Hispanic donors compared to White donors: 1.29 (95% CI 0.8–2.07; *p*-value 0.291) Adjusted HR of ESKD, per 10-year increase in age, among Hispanic donors: 1.18 (95% CI 0.81–1.73) Cumulative incidence of ESKD in LKD by income quartile: Among Hispanic donors, those residing in neighborhoods in the lowest income quartile did not have a greater risk of ESKD among donors from poorer neighborhoods (graphical depiction only)
2019, Holscher	Early, w/in 2 yrs post-donation: DM HTN	Descriptive Comparative, within-donor	Adjusted IRR for risk among Hispanic versus non-Hispanic donors: • DM: 2.45 (95% CI 1.14–5.26) • HTN: 0.71 (95% CI 0.55–0.93)

TABLE 2 (Continued)

Study	Post-donation outcomes	Risk perspective[b]	Findings
2019, Lentine,	Anti-DM med use, Non-insulin anti-DM med use, Insulin use	Descriptive Comparative, within-donor	Adjusted HR, at 9 yrs post-donation, among Hispanic donors compared to White donors of: • Taking any anti-diabetic medication (ADM) 1.29 (95% CI 0.95–1.77) • Use of non-insulin ADM 1.27 (95% CI 0.92–1.75) • Insulin use 2.91 (95% CI 1.05–8.12)
2020, Muzaale	ESKD, stratified by biological relatedness	Descriptive Comparative, within Hispanic donor only	For Hispanic donors, the 20-year post-donation risk (cumulative Incidence) for ESKD per 10 000 donors: 35 (95% CI 19–64) for full siblings, 35 (95% CI 12–100) for offspring, 39 (95% CI 17–91) for parents, 52 (95% CI 17–165), for half-sibling/other biologic relatives, 22 (95% CI 6–79) for biologically unrelated donors Adjusted OR, at 20-year post-donation, of ESKD among Hispanic donors, compared with unrelated Hispanic donors: was undefined for identical twins, 1.4-fold (95% CI 0.6–3.3) for full siblings, 1.5-fold (95% CI 0.5–3.8) for offspring, 1.5-fold (95% CI 0.6–3.7) for parents, 1.0-fold (95% CI 0.3–3.7) for half-siblings or other biologic relatives. Adjusted HR, at 20-year post-donation, of ESKD among Hispanic donors, compared with unrelated Hispanic donors: was undefined for identical twins, 1.7-fold (95% CI 0.5–6.4) for full siblings, 2.2-fold (95% CI 0.5–9.5) for offspring, 1.6-fold (95% CI 0.4–11.7) for parents, 2.3-fold (95% CI 0.4–11.7) for half-siblings or other relatives.
2021, Augustine	Change in eGFR, Proteinuria	Descriptive Comparative, within-donor	Estimated mean of 2-year % change in eGFR for Hispanic donors: 28.4, compared to White donors: 29.9. *p*-value reported as <0.05 OR of proteinuria at any time point during the 2-year follow-up (n = 28 727) for Hispanic compared to White donors: 1.54 (95% CI 1.39–1.71)

Abbreviations: ACEi, ace inhibitor; ADM, anti-diabetic medication; *Am J Nephrol*, *American Journal of Nephrology*; ARB, angiotensin receptor blocker; BB, beta blocker; CCB, calcium channel blocker; CI, confidence interval; CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus; ESKD, end-stage kidney disease; GN, glomerulonephritis; HR, hazard ratio; HTN, hypertension; NHANES, National Health and Nutrition Examination Survey; OR, odds ratio; *Transp, Transplantation*; yrs, years.

[a]Same cohort (original study: Lentine et al., 2010).

[b]Perspective of risk among Hispanic living kidney donors, as previously described in Lentine et al.[24]

TABLE 3 Quality assessment of included studies: percentage of studies meeting quality criteria by outcome

Outcome Total studies ($n = 18$)	Minimal risk for selection bias	Well-described criteria	Valid outcome assessment	Limitations and potential bias discussed	Adjustment for confounders	Comments
ESKD ($n = 5$)	100%	100%	100%	100%	100%	Conclusions made about Hispanic donors based on exploratory analysis (Massie 2017) SES variables not accounted for in analysis comparing Hispanic donors to White donors (Muzaale 2014; Anjum 2016; Massie 2017) SES variables not accounted for in analysis comparing Hispanic donors of varying relatedness (Muzaale 2020)
CKD, change in eGFR, proteinuria ($n = 4$)	25%	100%	75%	100%	100%	Comprised of privately insured donors, only 8.2% Hispanic donors (Lentine 2010; Lentine 2015) Comprised of Medicare insured donors, only 5.7% Hispanic donors (Lentine 2014 *Transp*) Proteinuria not well defined (Augustine 2021) SES variables not accounted for in analysis (Lentine 2010; Lentine 2014 *Transp*; Lentine 2015)
DM ($n = 5$)	20%	100%	100%	100%	100%	Comprised of privately insured donors, only 8.2% Hispanic donors (Lentine 2010; Lentine 2011; Lentine 2019) Comprised of Medicare insured donors, only 5.7% Hispanic donors (Lentine 2014, *Transp*) SES factors not accounted for in analysis (Lentine 2010; Lentine 2011; Lentine 2014 *Transp*)
HTN ($n = 5$)	20%	100%	100%	100%	100%	Comprised of privately insured donors, only 8.2% Hispanic donors (Lentine 2010; Lentine 2011; Lentine 2014 AJN) Comprised of Medicare insured donors, only 5.7% Hispanic donors (Lentine 2014 Transp) SES factors not accounted for in analysis (Lentine 2010, Lentine 2011; Lentine 2014 AJN; Lentine 2014 Tranp)
Mortality ($n = 1$)	100%	100%	100%	100%	100%	SES factors not accounted for in analysis, Mortality comparisons between Hispanic donors and Hispanic healthy controls not reported (Segev 2010)
CVD ($n = 1$)	0%	100%	100%	100%	100%	Comprised of privately insured donors, only 8.2% Hispanic donors. SES factors not accounted for in analysis (Lentine 2010)

TABLE 3 (Continued)

Outcome Total studies ($n = 18$)	Minimal risk for selection bias	Well-described criteria	Valid outcome assessment	Limitations and potential bias discussed	Adjustment for confounders	Comments
Preoperative Complications ($n = 2$)	50%	100%	100%	100%	100%	Subsampling and possible misrepresentation of total Hispanic living donors not fully addressed (Friedman 2010) Socioeconomic variables not accounted for in analysis (Friedman 2010)
Hospitalization ($n = 1$)	0%	100%	100%	100%	100%	Hospitalizations possibly underestimated but would have affected all racial/ethnic groups. Unclear if study data is representative to OPTN Data (Schold 2014)
Gout ($n = 1$)	0%	100%	100%	0%	100%	Comprised of privately insured donors, only 8.2% Hispanic donors. Diagnosis not made by joint fluid analysis (Lam 2015)

Abbreviations: *AJN, American Journal of Nephrology*; CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus, HTN, hypertension; eGFR, estimated glomerular filtration rate; ESKD, end-stage kidney disease; SES, socioeconomic; *Transp, Transplantation*.

DM- or GN-related ESKD, respectively, in Hispanic donors, compared to White donors. However, to further evaluate the risk of ESKD associated with kidney donation, Muzaale et al. assessed the 15-year risk of ESKD between Hispanic donors and a healthy, matched non-donor Hispanic population. The risk of ESKD among Hispanic donors was 32.6 per 10 000, and for healthy Hispanic non-donors it was 6.7 per 10 000, for an absolute risk increase of 25.9 per 10 000 for Hispanic donors compared to the healthy non-donor Hispanic population.[19]

Hispanic donors had approximately twice the risk of developing CKD compared to White donors in a cohort of living kidney donors linked to administrative data of a private US health insurer[20]; this elevated risk persisted even after accounting for relatedness,[34] but there was not an increased risk of developing proteinuria or nephrotic syndrome. Among a cohort of Medicare-insured donors, Hispanic donors were not at increased risk of CKD or proteinuria compared to White donors.[35]

In a cohort of donors linked to private insurance claims, Hispanic donors were more likely to have post-donation drug-treated DM compared to White donors (aHR: 2.94 [95% CI 1.57–5.51]),[20] although the difference in risk for reported DM from medical claims between Hispanic and White donors only reached borderline statistical significance. When relatedness was incorporated into the analysis, compared to White donors, the risk of post-donation type 2 DM in Hispanic donors was numerically greater but was not statistically significant.[36] When OPTN data were linked to a US pharmaceutical claims data warehouse, there was no significant difference in the risk of taking any anti-diabetic medications in Hispanic compared to White donors, but Hispanic donors were more likely to start insulin therapy.[32] Using Medicare claims, at 5 years post-donation, Hispanic donors had twice the relative risk of post-donation DM compared to White donors.[35] Regarding early post-donation outcomes, relative to White donors, Hispanic donors were more likely to develop post-donation DM within the first two years (aHR: 2.45 [95% CI 1.14–5.26]).[30]

Mixed results were seen in the risk for developing post-donation HTN among Hispanic donors compared to White donors. When OPTN data were linked to private insurance medical claims, compared to White donors, Hispanic donors had a 36% higher relative risk of post-donation HTN diagnosis (from medical claims), but there was not an increased relative risk of post-donation drug-treated HTN.[20] Notably, this study demonstrated that the prevalence of HTN among Hispanic donors was higher than the general population (using data from the National Health and Nutrition Examination Survey [NHANES]). When accounting for relatedness, there was not an increased risk for post-donation HTN diagnosis among Hispanic donors with private insurance, compared to similarly insured White donors.[36] In a study evaluating national living donor registry data linked to Medicare claims, Hispanic donors were not at increased risk of developing any post-donation HTN or benign HTN in Hispanic relative to similarly insured White donors.[35] In terms of early post-donation outcomes, compared to White donors, Hispanic donors were less likely to develop HTN in the first two years post-donation.

Of note, this last study included all OPTN data for living donors, and the analysis adjusted for several variables including education, employment, smoking, preoperative body mass index, and systolic blood pressure.

From the initial cohort linking 4650 donors from OPTN donor data to private insurance medical claims to evaluate the risk of post-donation CKD, DM, and HTN, the relative risk of CVD and gout was also evaluated. Hispanic donors were not more likely to experience post-donation CVD or gout compared to White donors.[20,31]

4 | DISCUSSION

In this systematic review, we found a wide array of health outcomes were evaluated among Hispanic living kidney donors. There was no significant difference in mortality between Hispanic and White donors. Although inferences cannot be made for mortality risk between Hispanic donors to Hispanic healthy controls, in a national cohort of live kidney donors, the 12-year mortality was similar for overall racial and ethnic donors compared to matched healthy controls.[40] Most studies did not show a difference in long-term risk for ESKD for Hispanic donors compared to White donors. There was a small absolute risk increase for ESKD among Hispanic donors compared to a healthy control group of Hispanic non-donors.[19] As in the general population, most studies showed Hispanic donors were at higher risk for DM following nephrectomy as compared to White donors; however, mixed findings were seen regarding the risk for post-donation CKD and HTN.

Contrasting inferences regarding the risk of post-donation CKD observed among Hispanic donors compared to White donors are likely due to study populations, that is, one involving a cohort of younger privately insured kidney donors versus a study sample with older donors with Medicare coverage. For example, relative to White donors with private insurance, insured Hispanic donors had a higher risk of developing CKD. A positive association between having health insurance and prevalent CKD was also seen in a cross-sectional study of over 15 000 Hispanic adults.[43] This may be related to increased comorbid conditions affecting individuals with CKD, making them more likely to obtain health insurance.[43] Regarding post-donation HTN, in the national cohort using administrative insurance data by Lentine et al., the point estimates for the prevalence of HTN five years post-donation for Hispanic donors in this cohort were higher than the general population using NHANES data.[20] This may be due to enhanced medical follow-up following donor nephrectomy and subsequent diagnosis of underlying HTN, as compared to the general population.[20] It bears mentioning that the lack of risk differences or risk conflicting data does not imply a lack of inherent risk among Hispanic donors following nephrectomy. Nonetheless, research to date helps reassure that absolute risks following donor nephrectomy are low overall.[19,20,40]

In most studies, Hispanic ethnicity was reported under race or a combined race and ethnicity category as a mutually exclusive subgroup from non-Hispanic White, non-Hispanic White/other, non-Hispanic Black, or Other. Only one study reported Hispanic ethnicity separately from race.[30] Country of birth or residence, or duration of residence in the United States was not reported. This is likely due to small sample sizes in each subcategory of Hispanic donors and/or lack of data. The Living Donor Registration Worksheet by the United Network for Organ Sharing (UNOS) includes subsections regarding ethnicity and race for individuals to choose from. For Hispanic or Latino origin, individuals may choose between subcategories of Mexican, Puerto Rican, Cuban, other, or unknown.[44] If individuals identify with a different country of origin, this information may not be captured. The Worksheet also inquires about citizenship status and year of entry into the United States. These details are critical when evaluating health outcomes in the increasingly diverse Hispanic population, particularly since previous research shows the prevalence of various chronic diseases such as HTN, DM, and CKD vary markedly as a function of Hispanic background.[43,45–47]

The Hispanic population is diverse, wherein individual-level behaviors and beliefs may be influenced by a confluence of factors, including country of origin or residence, English proficiency, time of residence in the United States, etc. To explore the role of acculturation in health and disease, the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) was developed. HCHS/SOL is a multicenter epidemiologic study that has enrolled over 16 000 Hispanic adults living in the United States and aims to propagate future research examining health disparities among Hispanic communities.[48,49] In addition to reproaching how data are collected, investigators have redesigned health interventions targeting Hispanic communities, with a focus on cultural competency, which refers to "a set of congruent behaviors, attitudes, and policies that come together in a system, agency, or among professionals that enables effective work in cross-cultural situations."[50] Within transplantation, cultural competency has been a critical component of health interventions aimed at mitigating persistent disparities in LDKT rates among minority populations.[14,15,51,52] To date, interventions aimed at increasing LDKT among Hispanic donors include a culturally competent educational website about LDKT,[53,54] a Spanish language mass media campaign on living organ donation attitudes and perceptions among Hispanics,[55] a hospital-based, culturally sensitive LDKT-specific educational program,[56] and the development of a culturally competent transplant program.[57–59] In a recent nonrandomized, multi-site, hybrid trial, the implementation of a comprehensive culturally competent kidney transplant program, increased LDKT rates for Hispanic patients.[60] Positive results from culturally competent interventions further reinforce that sociocultural factors influence LDKT disparities.[61–63] In addition to cultural differences among Hispanic individuals, heath-related behaviors or beliefs may be shaped by income, insurance status, knowledge of LDKT, geography, among other factors. Future studies should continue to evaluate unique barriers to LDKT that may arise within Hispanic communities residing in different regions of the country. Next steps also necessitate collaboration with community stakeholders to understand the complicated underpinnings giving rise to differences in outcomes and access to care.

To our knowledge, this is the most comprehensive evaluation of health outcomes in Hispanic living kidney donors to date. Our review incorporates a carefully constructed literature search across several databases and the use of methods consistent with PRISMA guidelines.[64] We employed a comprehensive quality assessment of potential factors influencing the validity of included studies. Most studies had well-defined outcomes, well-described inclusion and exclusion criteria, and elucidated limitations and potential sources of bias (Table 3, Table S1). Included studies provided a diverse set of adult patient populations of varying ages, insurance status, sources of health information, and relatedness from cohorts stretching broad time periods.

Findings from our review are limited by several factors including relatively limited follow-up time particularly as it relates to outcomes such as mortality, ESKD, or CVD-related events. Acknowledging the limitations of the data, no clear associations emerged among variables that would likely be linked in clinical contexts, including hypertension, proteinuria, CKD, and ESKD. Some outcomes were examined in selective groups of living kidney donors, such as those with private insurance or Medicare. Only seven studies accounted for some level of socioeconomic status in their analyses (Table S1). Hispanic donors were classified into one homogeneous group, we were not able to ascertain national geographic variations in post-donation outcomes, and lastly, our findings may lack generalizability to donor populations in other countries.

In summary, available evidence suggests there is not a substantial difference in long-term risk of mortality, ESKD, CVD, or non-pregnancy-related hospitalizations in Hispanic donors as compared to White donors in the United States. Hispanic donors appeared at higher risk for DM following nephrectomy as compared to White donors; however, there were mixed results for the risk of developing post-donation HTN and CKD. Overall absolute risks of donation remain small and should encourage efforts to expand LDKT. Future studies should evaluate cultural, socioeconomic, and geographic differences within the heterogeneous Hispanic donor population, which may further explain variation in health outcomes.

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DISCLOSURE

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

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no new data were generated during the current study. The data that support the findings of this study are available in the manuscript tables and supplementary material of this article.

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SUPPORTING INFORMATION

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