

Review article

Factors associated with health inequities in access to kidney transplantation in the USA: A scoping review

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ABSTRACT

Background: The kidney is the most needed organ for transplantation in the United States. However, demand and scarcity of this organ has caused significant inequities for historically marginalized groups. In this review, we report on the frequency of inequities in all steps of kidney transplantation from 2016 to 2022. Search criteria was based on the National Institute of Health's (NIH) 2022 list of populations who experience health inequities, which includes: race and ethnicity; sex or gender; Lesbian, Gay, Bisexual, Transgender, Queer + (LGBTQ+); underserved rural communities; education level; income; and occupation status. We outline steps for future research aimed at assessing interventions and programs to improve health outcomes.

Methods: This scoping review was developed following guidelines from the Joanna Briggs Institute and PRISMA extension for scoping reviews. In July 2022, we searched Medline (via PubMed) and Ovid Embase databases to identify articles addressing inequities in access to kidney transplantation in the United States. Articles had to address at least one of the NIH's 2022 health inequity groups.

Results: Our sample of 44 studies indicate that Black race, female sex or gender, and low socioeconomic status are negatively associated with referral, evaluation, and waitlisting for kidney transplantation. Furthermore, only two studies from our sample investigated LGBTQ+ identity since the NIH's addition of SGM in 2016 regarding access to transplantation. Lastly, we found no detectable trend in studies for the four most investigated inequity groups between 2016 and 2022.

Conclusion: Investigations in inequities for access to kidney transplantation for the two most studied groups, race/ethnicity and sex or gender, have shown no change in frequencies. Regarding race and ethnicity, continued interventions focused on educating Black patients and staff of dialysis facilities may increase transplant rates. Studies aimed at assessing effectiveness of the Kidney Paired Donation program are highly warranted due to incompatibility problems in female patients. The sparse representation for the LGBTQ+ population may be due to a lack of standardized data collection for sexual orientation. We recommend this community be engaged via surveys and further investigations.

1. Introduction

Based on data from the Organ Procurement and Transplantation Network, nearly 90,000 patients are currently waitlisted to receive a kidney, making it the most needed organ for transplantation in the United States [1]. Owing to their high demand and relative scarcity, patients can be waitlisted for up to 4 years before transplantation [2]. Despite the extensive waiting process, kidney transplantation remains the best treatment option for most patients with end-stage kidney disease (ESKD) [3]. Unfortunately, equal access to kidney transplantation

has been hindered by a number of challenges associated with race and ethnicity, socioeconomic status, as well as other demographic factors that lead to inequities [4]. Associated factors are complex and arise from various levels in healthcare such as patient, provider, and the system itself [5].

Several studies show that race and ethnicity are factors frequently associated with inequities in access to kidney transplantation. For example, Wesselman et al. performed a retrospective medical record review of 1056 patients referred for kidney transplant and found that after adjusting for medical conditions (diabetes, hypertension, and

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obesity) and donor/recipient factors, Black patients were less likely than white patients to receive a kidney transplant. Additionally, Black patients were less likely than white patients to receive a kidney from a living-donor [4]. This finding is important since recipients who receive kidneys from living donors experience better outcomes [6]. Patzer et al. evaluated 2291 patients referred for kidney transplant evaluation to a transplant center in the Southeast United States [7] - an area with the highest prevalence of ESKD [8]. Their investigation found that Black patients were 59% less likely to receive a kidney transplant than white patients — individual and neighborhood level factors accounted for 30.6% of this reduction. Inequities were noted in access to referral, evaluation, waitlisting, and receipt of a kidney. Inequities, however, extend beyond race/ethnicity.

A scoping review by Harding et al. in 2021 examined the published literature on non-medical barriers in access to early steps in kidney transplantation, specifically referral and evaluation [9]. They reported on 33 studies, identifying patient-level barriers (eg., race/ethnicity, gender, socioeconomic status, social support, belief systems), provider-level barriers (eg., miscommunication, perceptions/attitudes), and systems-level variables (eg., geography, dialysis facility barriers) affecting these early steps [9]. We were interested in contributing to these findings more broadly by charting the literature across all stages of transplantation from referral to organ receipt. We also wanted to capture literature related to possible inequities in kidney transplantation within the LGBTQ+ community which was not included in the Harding et al. review. Thus, the aim of our scoping review is to build upon these previous findings by reporting on the changes in research over time, contribute a more comprehensive picture of inequities in kidney transplantation, and outline key steps to improve future research. The primary objective of this scoping review is exemplified by the following question: What factors are associated with inequities in access to kidney transplantation and how has research with a focus on these factors changed over the past seven years (2016–2022)? Regarding our comprehensive approach to marginalized groups, we wanted to determine how the NIH's addition of SGM as a population who experiences health inequities influenced current literature.

2. Methods

This scoping review was performed with the aim of mapping existing gaps in the current literature discussing inequities in access to kidney transplantation. This review was conducted in accordance with the Joanna Briggs Institute (JBI) methodology for scoping reviews [10] and the Preferred Reporting Items for Systematic reviews and Meta Analyses extension for Scoping Reviews (PRISMA-ScR) checklist [11]. Institutional Review Board oversight was not necessary as no human subjects were employed. All methodology was uploaded to Open Science Framework (OSF) [12] via a protocol. Additionally, the search strategy, Google Form, data, and statistical methods were uploaded to OSF.

2.1. Literature search

Databases MEDLINE (via PubMed) and Ovid Embase were searched to identify published articles on health inequities in kidney transplantation. The search was performed in July 2022, and the strategy was adapted in part from a recently published scoping review over health inequities in Laryngology [13]. Both databases were chosen based on the JBI Manual [10], which recommends the use of two databases that can procure studies relevant to the topic. Furthermore, a study has shown that using MEDLINE and Ovid Embase together retrieved 97.5% of the citations included in 120 systematic reviews [14]. Search criteria was based on the NIH's list of populations who experience health inequities, which includes: race and ethnicity, sex or gender, LGBTQ+ identity, underserved rural populations, education level, income, and occupation status [15]. Key terms were identified using PubMed's (MeSH) and Embase's (Emtree) controlled vocabulary.

2.2. Training

Training regarding scoping review objectives and methodology was accomplished using the JBI Manual [10] and The Cochrane Learning Live webinar [16]. These trainings were conducted in person and/or on video conference.

2.3. Selection process

Studies identified by our comprehensive search string were uploaded to a title and abstract screening platform, Rayyan [17,18]. Two investigators (ZE & AW) then removed duplicates and screened the remaining titles and abstracts to be included for full-text screening. Based on the comments that emerged from peer review, the reference lists from the 44 included studies were screened manually. This addition is a deviation from our original protocol. The inclusion criteria can be found in the paragraph below. For any articles that were excluded, a reason was provided in the PRISMA flow diagram. All screening was performed in masked duplicate fashion. Any discrepancies were resolved with discussion between the two investigators, with a third author (AP) available for mediation.

2.4. Inclusion and exclusion criteria

Inclusion criteria for this scoping review was created in accordance with the JBI Manual's *population, concept, and context* framework [10]. The *population* of this review included literature focused on factors associated with inequities in access to kidney transplantation with the following study designs: clinical trials, retrospective analyses, systematic reviews, meta-analyses, scoping reviews, literature reviews, cross-sectional analyses, cohort studies, and case-control studies.

Study designs that were excluded include correspondences, letters to the editor, and commentaries. These designs do not typically report original research, thus they were excluded.

The *concept* of this review was addressed by only selecting studies that mentioned at least one factor associated with a health inequity group in access to kidney transplantation. Outcomes included: referral, evaluation, pre-emptive waitlisting, waitlisting, and receipt of kidney. The *context* of this review was addressed by limiting the inequities examined to the NIH's list of populations who experience health inequities, which is in accordance with our search strategy [15]. Regarding language, we only included articles published in English to promote study viability [19,20]. Regarding date and geographic restrictions, the inclusion criteria of this scoping review was limited to articles published in the United States between 2016 and 2022 due to the NIH's classification of SGMs as a minority population in 2016 [21]. Only studies published in the United States were included on account of many inequity definitions being specific to their respective country [22]. Additionally, some definitions could have multiple associations and uses across different cultures.

The exclusion criteria included any study meeting the following conditions: (1) published before 2016, (2) failed to examine factors associated with at least one of the health inequities as a primary outcome, (3) written on a topic unrelated to inequities in access to kidney transplantation, (4) written in a language other than English, (5) individuals below 18 years of age, (6) written as a correspondence, commentary, or letter to the editor, and (7) published outside of the United States. A complete summary of the selection process was presented in our PRISMA flow diagram.

2.5. Data charting

Using a pilot-tested Google Form, the following study characteristics were extracted from the included studies: study title, PubMed identifier, author name, publication year, study design, years analyzed, number of subjects enrolled, setting (e.g., single-institution, multiple-institution),

and condition. The Google Form was developed following the JBI Reviewers' Manual 2020 [10]. For each article, health inequities were extracted in accordance with the aforementioned NIH list. Inequities were coded as a 'yes' if the study reported an outcome related to that inequity. Both quantitative and qualitative findings were summarized and recorded.

Prior to complete data extraction, two authors (ZE & AW) completed a calibration exercise to promote consistency by independently extracting data from 5 included articles. The authors then reconciled the data and resolved any conflicts through discussion with a third author (AP) available as adjudicator. After completion of this trial, these authors continued data extraction for the remaining articles in similar fashion. All extraction was conducted in a masked, duplicate manner.

2.6. Use of language

All language describing health inequities was standardized using the *Advancing Health Equity: A Guide to Language, Narrative and Concepts*, a guide provided by the AMA [23]. This guide was developed to encourage deeper understanding of equity-focused, person-first language, and rationale for each term recommended was provided in the guide. For studies that did not use the AMA guide, efforts were made to maintain the standardization throughout this review, while conserving the original intention of the included studies.

The AMA uses the term "Historically marginalized" to describe racial and ethnic groups who have been historically oppressed, exploited, excluded or segregated [23]. Further race-conscious terminology includes: Black, white, Hispanic/Latina/Latino/Latinx, Native peoples/

Indigenous peoples/American Indian and Alaska Native [23]. The AMA defines 'race and ethnicity' as social constructs rather than biological, which aids in reducing bias in research [23,24].

Additionally, the AMA recognizes the terms sex and gender as different concepts [23]. The term 'sex' is used to describe the sex assigned at birth, and the term 'gender' refers to the social, psychological, and emotional factors that define a man, woman, both or neither. To ensure the inclusion of all sexual identities and in consideration of the growing understanding of sex and gender, the acronym LGBTQ+ was used [23]. For articles that failed to distinguish between sex and gender, outcomes were coded under both terms.

2.7. Synthesis

To summarize data from our included studies investigating inequities in access to kidney transplantation, we used Stata 17.0 (StataCorp, LLC, College Station, TX) to produce descriptive statistics. These statistics include: (1) the frequency and percentage of included studies looking at each inequity, (2) the type of study design of each study included in our review, and (3) the setting in which each included study was conducted (i.e. Single-institution, Multiple-institution, etc.). Further, an analysis of longitudinal changes in inequities research as a function of time was conducted. The most relevant changes over time were demonstrated by limiting the frequency figures to the four most prevalent inequities. For transparency, all raw data, reconciled data, and statistical analysis methods were uploaded to OSF.

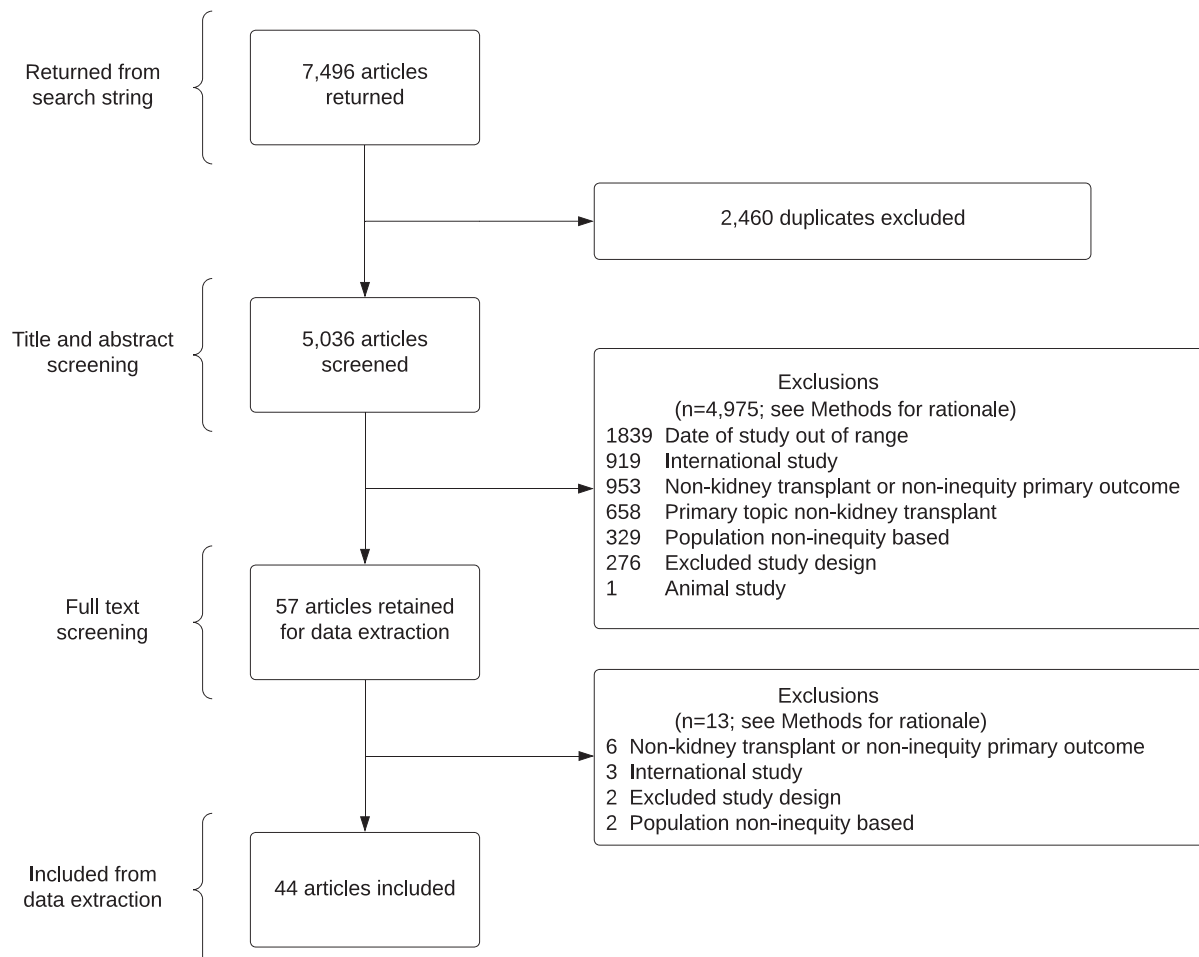


Fig. 1. Flow diagram of study selection.

3. Results

3.1. General characteristics of included studies

Our literature search yielded a total of 7496 records. Following deduplication, 5036 unique articles underwent title and abstract screening, with 57 of those being full-text review. After reviewing full-text, 44 studies met inclusion criteria and were included for data extraction. The PRISMA flow diagram – designated Fig. 1 – demonstrates the study selection process. Table 1 outlines the factors associated with inequities examined in the articles meeting inclusion criteria for this study. The most common factor examined was race/ethnicity (40/44, 90.91%), followed by rural underserved and sex or gender (14/44, 33.82%). Of the included studies, LGBTQ+ identity and occupation were the least assessed (Table 1). We also documented the study design (e.g. Retrospective Analysis of USRDS Data, cohort, etc.) and setting (e.g. Multiple State, Single Institution, etc.), which can be found in Table 1. Multiple State refers to studies in which patient data were collected in more than one state. Single Institution was used when a study collected data from a single transplant center or university, for example. Table 2 lists the factors examined and summarizes their findings with respect to inequities in each included study.

3.2. Factors associated with inequities in kidney transplant accessibility

3.2.1. Race/Ethnicity

Overall, our findings from Table 2 show that Black patients and other historically marginalized groups were less likely to be referred [25–28], waitlisted [29–36], or receive kidney transplantation compared to white patients [4,37–47]. Preemptive referral was significantly less likely for Black patients compared to white patients [25]. Black patients also waited more days for notification [48]. However, following education programs, implementation of the Kidney Allocation System, and Medicaid expansion, inequities in kidney transplantation improved for Black, Hispanic, and other races [49–53]. Two studies found that neither

increased distance to transplant center [54] nor medical eligibility differences [55] could explain racial inequities in kidney transplantation. Although Harding et al.'s 2017 review found race and kidney transplant rate to vary by region in original research published prior to 2012 [5], a 2020 study found race to be a nonfactor in initiating transplant evaluation [56]. In contrast, Patzer et al. found that, although more Black patients were referred for evaluation, they were less likely to start the evaluation process [57].

3.2.2. Sex or gender

Ten of the included studies reported that females have a lower referral rate [28,57,58], are less likely to be waitlisted [26,35], and have a lower transplant rate than males [43,45,47,59,60]. However, more deceased donor kidney transplant recipients were female following the Kidney Allocation System in 2014 [50]. Two studies reported sex or gender as a nonfactor for transplant evaluation [30,56], while another study found that high social support for Black males did not equate to increased evaluation completion [61]. A similar percentage was reported in 2018 among incident male and female ESKD patients being waitlisted or receiving a kidney transplant [8].

3.2.3. Income status

In 9 of 13 included studies evaluating income, patients with lower income were found less likely to be waitlisted [9,33,35,54] and received kidney transplantation less often [4,29,38,46,61]. However, McPherson et al. found neighborhood poverty in the Southeastern United States had no effect on the association between patient distance from transplant center and referral rate [62]. Two separate studies found income to either have no effect on being waitlisted [32] or to have no effect on acceptance for patients with free Veterans Affairs' medical care [48].

3.2.4. Rural underserved

Studies evaluating Rural underserved and its effect on kidney transplantation reported positive, negative, or no associations (Table 2). Lack of proximity to transplant centers resulted in either fewer rural patients initiating evaluation [56], predicted delays in transplantation [38], or meant that patients not within a donor service area did not have equal opportunity for transplantation [28]. Kidney transplant rates in certain geographic areas worsened following the Kidney Allocation System in 2014 [63]. Black patients in Chicago and those living in the West and South were less likely to be waitlisted and had lower transplant rates [34,46]. In contrast, distance to transplant center for patients in the Southeastern United States was not associated with referral or evaluation rates [57,62]. Further, the effect of distance on transplantation rates either had very little influence or varied by region [5,30]. Whelan et al. reported that increased distance between dialysis facilities and transplant centers was not associated with racial inequity for transplantation [54].

3.2.5. Education

Overall, 11 (of 12, 92.67%) studies evaluating education reported a positive association for patients with higher education and receiving kidney transplantation (Table 2); this includes Black patients [61]. Patients with an education level above high school were more likely to initiate transplant evaluation [56], have higher rates of pre-emptive transplantation [40], and receive a live donor kidney transplant rather than deceased donor kidney transplant [39]. However, Murphy et al. reported education level to have no effect on waitlisting for patients after completing evaluation [32].

3.2.6. LGBTQ+

Of the 42 included studies, only two evaluated the LGBTQ+ population. Hoch et al. reported the biggest barrier in optimal care is aimed at a lack of understanding and acceptance by providers [64]. Additionally, the effects from hormonal therapy, as well as psychosocial aspects may affect access to transplantation for transgender patients [26].

Table 1

Frequencies and Percentages of the Factors Associated with Inequities Among Included Studies.

Factors Examined	Frequency (n = 44)	Percentage (%)
Race/Ethnicity	40	90.91
Rural underserved	14	31.82
Sex or Gender	14	31.82
Income	13	29.55
Education	12	27.27
Occupation	5	11.36
LGBTQ+	2	4.55
Study Design		
Retrospective Analysis of USRDS, SRTR, UNOS, OPTN, or Single Institution Data	27	61.36
Prospective Cohort Study	5	11.36
Literature Review	5	11.36
Cross-sectional Analysis	2	4.55
Case-Control	1	2.27
Clinical Trial	1	2.27
Scoping Review	1	2.27
Retrospective Cohort	1	2.27
Systematic Review/Meta-Analysis	1	2.27
Study Setting		
US Sample	21	47.73
Multiple State	6	13.64
Single State	5	11.36
Single Institution	5	11.36
N/A*	7	15.91

* Amended Scoping Review, Literature Review, and Systematic Review from 'Study Setting'.

Table 2
Characteristics of Included Studies.

Author(s)	Study Design	Population, Setting	No. of Subjects	Factors Examined	Primary Outcome	Findings
Adler et al., 2021	Retrospective Analysis of USRDS Data	Long-Term Dialysis Patients in the US 2013–2018	$n = 507,581$	Race/Ethnicity	Waitlisting	Black patients were less likely than white patients to get on the waitlist for a kidney transplant.
Ahearn et al., 2021	Retrospective Analysis of USRDS Data	Adults on Kidney Replacement Therapy in the US 2005–2017	$n = 1,478,037$	Sex or Gender	Time to Transplantation	When compared to men, women had lower rates of deceased-donor kidney transplants (DDKT).
Bromberger et al., 2017	Retrospective Analysis of Single Institution Data	Kidney Transplant Candidates, Pennsylvania Transplant Center 2007–2013	$n = 2587$	Sex or Gender	Transplantation, Removal from Waitlist, or Patient Death	Females received live donor kidney transplantation (LDKT) less than males.
DuBay et al., 2021	Retrospective Analysis of USRDS and SRTR data	ESKD Patients, Waitlisted Patients, and Patients Completing Transplantation in the US 2017	$n = 122,659$	Rural underserved	Waitlisting or DDKT	After the implementation of the KAS, geographic inequities in access to kidney transplantation have worsened for areas with low transplantation rates, more vulnerable patient populations, and higher rates of ESKD.
Freeman et al., 2017	Prospective Cohort	Patients Undergoing Initial Evaluation at Multiple VA Kidney Transplantation Centers in the US 2010–2014	$n = 602$	Race/Ethnicity, Income	Time to Acceptance for Transplantation	Acceptance time for a kidney transplant was not significantly associated with race or income when receiving veterans' affairs medical care.
Gander et al., 2017	Retrospective Analysis of USRDS Data	Patients on dialysis 2012–2014	$n = 987,046$	Race/Ethnicity	Racial disparities in waitlisting	27.4% of dialysis facilities had a 3-year racial disparity in waitlisting
Gander et al., 2018	Retrospective Analysis of USRDS Data	Patients Evaluated for Transplantation in Georgia 2005–2012	$n = 7752$	Race/Ethnicity	Pre-emptive Referral	Black patients were less likely to be preemptively referred for kidney transplant evaluation or receive kidney transplantation when compared to white patients. Patients from more affluent neighborhoods and patients with at least a high school education were more likely to initiate kidney transplantation evaluation. No other factors examined were associated with differences in initiating kidney transplantation evaluation.
Hamoda et al., 2020	Cross-Sectional Analysis	Patients Referred for Transplant Evaluation in Georgia 2014–2016	$n = 528$	Race/Ethnicity, Sex or Gender, Rural Underserved, Education level, Occupation status	Evaluation Initiation	Race, unemployment, low income, and low education level were associated with reduced waitlisting and kidney transplantation rates, while sex/gender was mostly a nonfactor for transplant evaluation. When analyzing the African American population inequities in kidney transplantation rate between income and distance from transplant centers, all varied by region in the United States.
Harding et al., 2021	Scoping Review	ESKD Patients in 16 States and Mid-Atlantic Region in the US 1990–2018		Race/Ethnicity, Sex or Gender, Income, Rural underserved, Education level	Referral, Evaluation Initiation, Evaluation Completion	Compared to those not preemptively waitlisted, kidney transplant recipients who were pre-emptively waitlisted were more likely to be white and college graduates. Additionally, the implementation of the Kidney Allocation System resulted in more female and fewer white recipients of deceased donor kidneys.
Harding et al., 2017	Literature Review	ESKD Patients		Race/Ethnicity, Income, Rural underserved		Pre-emptive listings for kidney transplantation in the post-expansion period for Medicaid patients increased for all races/ethnicities.
Harhay et al., 2018	Retrospective Analysis of USRDS Data	DDKT Patients in the US 2011–2017	$n = 65,385$	Race/Ethnicity, Sex or Gender, Education level	Pre-emptive Waitlistings for Medicaid Patients	Providers lacking understanding and acceptance is the biggest barrier to optimal care of LGBTQ+ patients.
Harhay et al., 2018	Retrospective Analysis of UNOS Data	DDKT recipients in the US 2011–2016		Race/Ethnicity	Pre-transplant Dialysis Duration for Patients with and without Pre-emptive Waitlisting	African Americans had a lower risk of LDKT than other races.
Hoch et al., 2016	Literature Review	Transgender Patients with ESKD		LGBTQ+		
Husain et al., 2016	Retrospective Analysis of SRTR Data	Kidney transplant candidates in US 2015–2016	$n = 58,752$	Race/Ethnicity	Patients Receiving LDKT	

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Table 2 (continued)

Author(s)	Study Design	Population, Setting	No. of Subjects	Factors Examined	Primary Outcome	Findings
Jones et al., 2018	Cross-Sectional Analysis	Dialysis Patients in Denver, Colorado 2016	$n = 167$	Race/Ethnicity		Black patients were significantly less likely to be evaluated for kidney transplantation than Hispanic or white patients. Of those completing evaluation, Hispanic patients were much more likely to be waitlisted than Black or white patients. Black patients, after referral, were less likely to complete kidney transplant evaluation, and women were less likely to be waitlisted for transplant and receive deceased donor kidneys or live donor kidneys. Transgender patients may face extra challenges such as the effects of hormonal therapy and psychosocial aspects.
Katz-Greenberg & Shah 2022	Literature Review	Patients with Advanced CKD or ESKD		Race/Ethnicity, Sex or Gender, LGBTQ+		Indigenous race, below poverty level income, and distance from transplant centers were all predictive of delays in kidney transplantation. Black patients were significantly less likely to receive a LDKT compared to white patients. LDKT recipients were more likely to be working for income and had more than a high school education compared to their counterparts. Overall, the likelihood of receiving kidney transplant was increased for white patients, patients working for an income, and patients that had greater than a high school education.
Keddis et al., 2018	Retrospective Cohort	Patients Referred for Transplant Evaluation in Arizona 2012–2016	$n = 600$	Race/Ethnicity, Income, Rural underserved	Time from Referral to Evaluation	White race, female sex, and education levels above high school were all associated with higher rates of pre-emptive kidney transplantation. Racial/ethnic inequities are not explained by medical eligibility differences.
Killian et al., 2021	Retrospective Analysis of SRTR Data	Transplant Recipients in the US 2018	$n = 19,287$	Race/Ethnicity, Income, Rural underserved, Education level	Kidney Transplant Donor Type	White and Hispanic patients with high sensitization were more likely to receive kidney transplants than Black patients with high sensitization. Over time, Black non-directed LDKT recipients, and those waitlisted, have decreased. Compared to waitlist candidates, non-directed LDKT recipients had higher education. Black patients with lower poverty status and education were associated with less likelihood of transplantation compared to white patients. Higher levels of social support did not lead to higher levels of evaluation completion for Black males.
King et al., 2019	Retrospective Analysis of SRTR Data	Patients Receiving DDKT in the US 2000–2018		Race/Ethnicity, Education level	Pre-emptive Transplantation	Despite the implementation of the Kidney Allocation System, minority groups with blood group B have seen no improvement in transplantation rates. The average patient receiving these kidneys post-implementation was male.
Ku et al., 2020	Retrospective Analysis of USRDS Data	ESKD Patients in the US 2005–2014		Race/Ethnicity	LDKT and DDKT	In the Southeastern US, patient distance from a transplant center was not associated with kidney transplantation referral rates. Further, this association was not affected by race/ethnicity, neighborhood poverty, or rural/urban classification.
Kulkarni et al., 2019	Retrospective Analysis of OPTN Data	Patients on Transplant Waitlist in the US 2014–2016	$n = 42,558$	Race/Ethnicity	Transplant Outcomes After Implementation of KAS	
Kumar et al., 2017	Retrospective Analysis of USRDS Data	Waitlist Registrants in the US 2000–2015		Race/Ethnicity, Education level	Non-Directed LDKT	
Lockwood et al. 2016	Systematic Review	Patients with ESKD in the US 2006–2015		Race/Ethnicity, Sex or Gender, Income, Education		
Martins et al., 2018	Case-Control	Blood Group B DDKT in the US 2013–2017		Race/Ethnicity, Sex or Gender	Likelihood of A2i DDKT	
McPherson et al., 2020	Retrospective Analysis of USRDS Data	ESKD Patients on Dialysis in Georgia, North Carolina and South Carolina 2012–2015		Race/Ethnicity, Income, Rural underserved	Referral and Evaluation Initiation	

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Table 2 (continued)

Author(s)	Study Design	Population, Setting	No. of Subjects	Factors Examined	Primary Outcome	Findings
Melanson et al., 2017	Retrospective Analysis of USRDS Data	Waitlist Patients in the US 2013–2016		Race/Ethnicity	Monthly Transplantation Rate Among	The Kidney Allocation System narrowed the transplantation rate gaps between historically marginalized groups and white patients.
Murphy et al., 2020	Prospective Cohort	Patients with ESKD in Maryland and Michigan 2009–2018		Race/Ethnicity, Income, Education level, Occupational status	Patients Receiving Transplant After First Active Listing	Black patients were less likely than white patients to be put on the waitlist for kidney transplantation after completing the evaluation. Education level, income, and occupation status had no effect on this association
Myaskovsky et al., 2019	Prospective Cohort	Veterans Evaluated for Transplantation at 4 National VA Kidney Transplant Centers in the US 2010–2012	$n = 611$	Race/Ethnicity, Rural underserved	Receipt of LDKT and DDKT, among others	Hispanic patients are less likely than white patients to receive living-donor kidneys in VA transplant centers, but not deceased donor kidneys. When comparing VA transplant center regions to similar UNOS regions, the VA had higher rates of kidney transplantation among Black patients.
Ng et al., 2020	Prospective Cohort	Patients Referred for Evaluation at University of Pittsburgh Medical Center 2010–2018	$n = 1055$	Race/Ethnicity, Income	Patients Receiving Waitlist Status	Black patients were less likely than white patients to be waitlisted for kidney transplantation. Lower income was also associated with a reduced likelihood of being placed on the transplant waitlist.
Nguyen et al., 2021	Retrospective Analysis of USRDS Data	HCV-seronegative Adult DDKT Recipients in the US 2017–2020		Race/Ethnicity, Sex or Gender, Education level	Patients Receiving Transplantation	Kidney transplantation from HCV-viremic donors has increased, but racial/ethnic minorities, women, and those with less education were still less likely to receive kidney transplantation from an HCV-viremic donor.
Olufajo et al., 2017	Retrospective Analysis of USRDS Data	Black and White Kidney Transplant Patients in the US 2000–2013		Race/Ethnicity, Income, Rural underserved	Kidney Transplantation Rates	Compared to counties in the Northeast, kidney transplant rates were lower in the West and South for Black patients, whereas transplant rates in counties of the West were lower for white patients. Higher median household income was associated with higher transplant rates for Black patients.
Patzer et al., 2017	Clinical Trial	Patients on Dialysis at a Single Transplantation Center in Georgia 2014		Race/Ethnicity	Referral for Transplantation	Before the implementation of a kidney transplantation education program, Black patients were slightly more likely to be referred for kidney transplantation evaluation than white patients. After implementation, Black patients were much more likely to be referred for kidney transplantation evaluation.
Patzer et al., 2020	Retrospective Analysis of USRDS Data	Patients with ESKD in Georgia, North Carolina and South Carolina 2012–2016	$n = 34,857$	Race/Ethnicity, Sex or Gender, Rural underserved, Education	Referral and Evaluation for Kidney Transplantation	Female sex was associated with lower referral rate and evaluation initiation. Facilities in the lowest tertile of referral performance had a lower proportion of black patients in a neighborhood and a lower proportion of high school graduates in a neighborhood.
Peng et al., 2018	Retrospective Analysis of USRDS Data	Patients Starting Dialysis in Chicago, Illinois 2005–2009		Race/Ethnicity, Rural underserved, Occupation status	Time from Dialysis Initiation to Transplant Evaluation	Black patients in Chicago and living in low SES neighborhoods had the lowest likelihood of being put on the waitlist. Patients that were unemployed were also less likely to be waitlisted for kidney transplantation.
Purnell et al., 2018	Retrospective Analysis of SRTTR Data	First Time Kidney Transplant Candidates in the US 1995–2014		Race/Ethnicity, Sex or Gender, Education level	Time to LDKT	LDKT recipients in all marginalized ethnic/race groups are more likely to be male, have a college degree, and be preemptively placed on the kidney transplantation waiting list.

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Table 2 (continued)

Author(s)	Study Design	Population, Setting	No. of Subjects	Factors Examined	Primary Outcome	Findings
Rodriguez et al., 2021	Retrospective Analysis of USRDS Data	Patients with ESKD in North Carolina and the US 2000–2018		Race/Ethnicity, Rural underserved	Changes in Yearly Incidence of Kidney Transplantation Rates	The kidney transplantation waitlist in North Carolina for Latino, Black, and white patients has increased over time.
Schold et al., 2021	Retrospective Analysis of USRDS Data	Patient with ESKD and Patients on the Waitlist in the US 1997–2016	n = 1,309,998	Race/Ethnicity, Sex or Gender, Income, Occupation status	Patients Receiving Waitlist or LDKT	Factors associated with a higher likelihood of being waitlisted for or receiving kidney transplant were non-Black race, male sex or gender, higher median income, and employed working status.
Smothers et al. 2022	Retrospective Analysis of USRDS Data	Patients with ESKD in Georgia, North Carolina and South Carolina 2012–2016	n = 45,015	Race/Ethnicity, Sex or Gender,	12-Month Referral	Patients of non-white race had a higher likelihood of 12-month referral compared to white patients. Women were less likely to be referred within 12 months.
Suliman et al., 2019	Retrospective Analysis of Single Institution Data	Patients on Dialysis at University of Florida Health 2016–2018	n = 200	Race/Ethnicity	Referral	Hispanic patients were referred for kidney transplant evaluation at a lower rate than Black and white patients.
Venkataraman & Kendrick, 2020	Literature Review	Patients with ESKD		Race/Ethnicity, Sex or Gender, Income, Rural underserved, Education		Black patients, females, those living in lower SES neighborhoods and with lower education levels were negatively associated with kidney transplantation referral and procedure rates.
Wesselman et al., 2021	Prospective Cohort	Patients with ESKD at University of Pittsburgh Medical Center 2010–2012		Race/Ethnicity, Income	Time from Transplant Evaluation to Transplant Completion	Black race, and lower income were negatively associated with receiving kidney transplantation.
Whelan et al., 2020	Retrospective Analysis of USRDS Data	Patients on Dialysis in the US 2005–2015		Race/Ethnicity, Rural underserved	Time to Kidney Transplantation	The racial/ethnic inequity in kidney transplantation rates is not explained by the increased distance between dialysis facilities and transplantation centers.
Yilma and Hirose 2021	Literature Review	Waitlisted and Referred Patients		Race/Ethnicity		Black patients and other disadvantaged groups had improved access to kidney transplantation following the implementation of the Kidney Allocation System.
Zhang et al., 2018	Retrospective Analysis of USRDS Data	ESKD Patients in the US 2005–2015		Race/Ethnicity	Patients Receiving Waitlist	Before the Kidney Allocation System was created, Black patients were less likely to be placed on the waitlist for kidney transplantation. After this system, the inequity improved for both.

3.2.7. Occupation status

Occupation status was evaluated in five of the included studies (Table 2). Killian et al. found that more live donor kidney transplant recipients were employed compared to deceased donor kidney transplant recipients [39]. Further, patients who were employed were more likely to be waitlisted for kidney transplantation [34,35]. In contrast, two studies found either no significant association with employment status and initiating transplant evaluation [56] or found employment status to have no effect on waitlisting after completing transplant evaluation [32].

3.2.8. Change in Research Over Time

Race/ethnicity, sex or gender, income and rural underserved were the four most commonly examined inequities within our sample. Research over Rural underserved and income inequities in regards to kidney transplantation has increased over time (Fig. 2). No detectable trend was found for sex or gender or race/ethnicity inequities over time (Fig. 2).

4. Discussion

Our analysis indicates that belonging to a historically marginalized group resulted in decreased access to each step of the transplant process. Specifically, our analysis revealed that Black race/ethnicity, female sex

or gender, and lower socioeconomic status were negatively associated with referral, evaluation, and waitlisting for kidney transplantation. Additionally, our finding – that only two studies in our sample investigated LGBTQ+ identity as an inequity – speaks to the gaps in the current literature. Our review has highlighted gaps in which the frequency of inequity research has remained stagnant for racial/ethnic and female sex or gender in the previous seven years. This stagnation is accompanied with a failure to implement practical strategies for equal access to transplantation. Therefore, we discuss interventions and programs being implemented that warrant future research for reducing these inequities. Additionally, with the LGBTQ+ population being least examined, we describe possible explanations for the sparse research and outline suggestions for increasing future research via a standardized approach.

4.1. Race/ethnicity

Significant factors associated with racial and ethnic inequities in access to kidney transplantation were consistently identified and discussed throughout the results of our review. Despite thorough investigation, reasons for these existing inequities remain complex. Inequities in access to transplantation were commonly attributed to race alone, socioeconomic status alone, or both [65]. For example, Black patients were notably less likely to receive a living-donor kidney transplant when compared to white patients, meanwhile patients working for an income

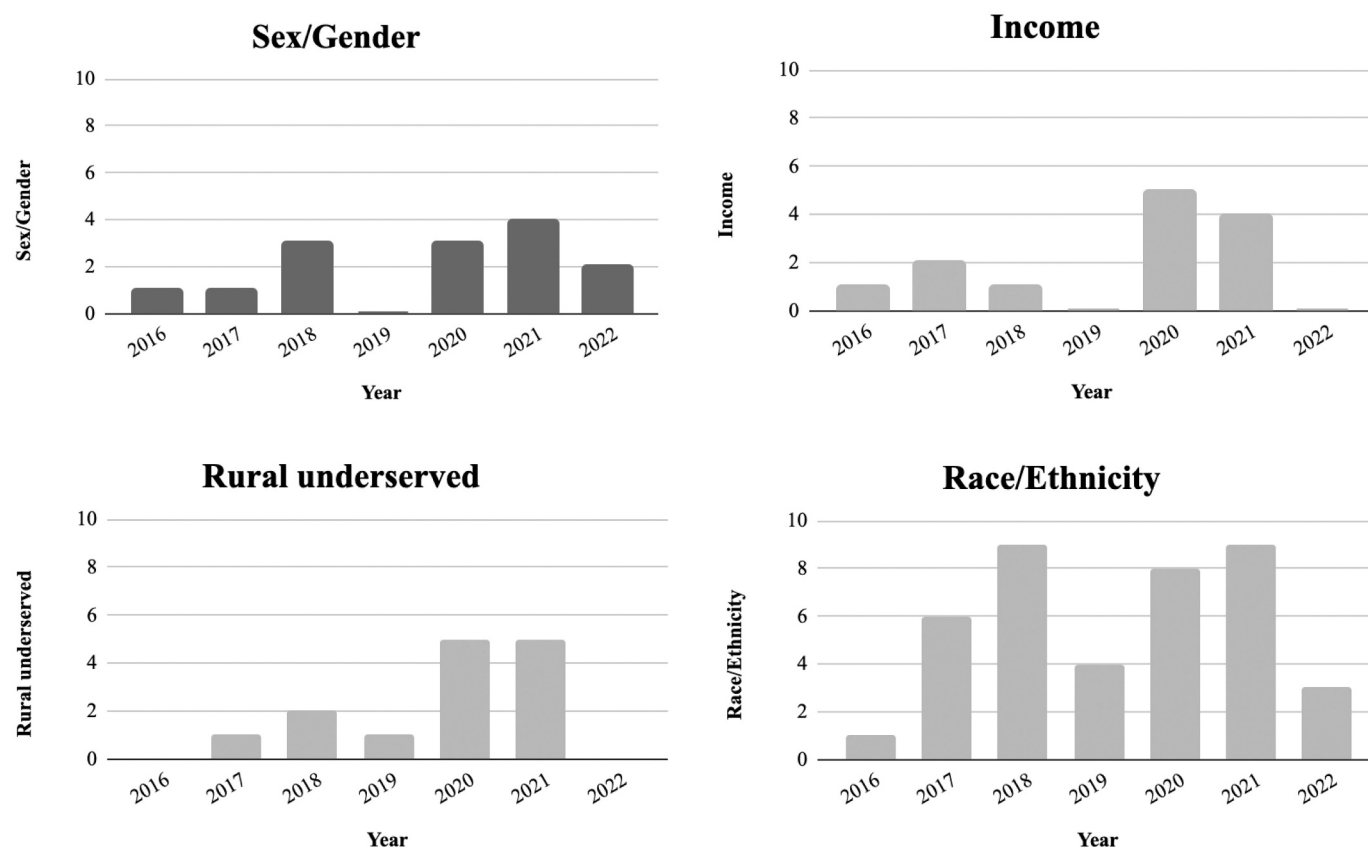


Fig. 2. - Frequency of Inequities Examined over Time.

were more likely to receive living-donor kidney transplants which has consistently demonstrated improved outcomes in comparison with deceased-donor kidney transplants [39]. However, many studies focused on inequities between Black and white patients, excluding other races and ethnicities. Native Americans/American Indians have the highest rates of diabetes and ESKD among any racial/ethnic group, yet continue to face barriers such as poverty, geographic isolation, poor health literacy, and medical distrust [66,67]. Further research focused on this community could explain the existence of these barriers. We did not retrieve any implementation science studies on intervention delivery; however, successful interventions exist and have been tested at the state level. For example, the Reducing Disparities in Access to kidney Transplantation Community Study (RaDIANT) [49] was a randomized controlled trial representing more than 9000 patients on dialysis from 134 Georgia dialysis facilities. Transplant education and engagement activities were provided to patients, staff, and leaders of dialysis facilities in the experimental arm. The study found that facilities receiving the intervention had higher rates of referral at 12 months, especially among Black patients. It is critical that future studies determine how to use and adapt these successful interventions to their particular facilities and patient populations.

4.2. Sex or gender

Despite finding that females have lower rates of waitlisting [26] and kidney transplantation [59,60] compared to males, the current literature is inconclusive and has yet to answer ‘why’ females are overall less likely to receive kidney transplantation. Smothers et al. explains “gender disparities [in kidney transplantation] is less clear with few studies dedicated to exploring the issue.” [58] To advance the research agenda on sex or gender inequities in kidney transplantation, several lines of research are needed. First, referral patterns have not been widely

investigated by sex. Studies have shown that females are less likely to receive referrals; however, barriers to referral and reasons for non-referral are unknown. Second, female transplant candidates have known HLA incompatibility following sensitizing events, such as pregnancy, creating a barrier in access to transplantation. The Kidney Paired Donation is a program aimed at increasing transplantation for incompatible donor-recipient pairs, which can help increase transplant rates for females who have been sensitized following pregnancy. Studies on the effectiveness of this program on transplant rates are needed [68]. Third, the 2019 Executive Order, Advancing American Kidney Health, was devised to improve earlier treatment for at-risk populations, increase payments and incentives for providers, and improve kidney allocation [69]. Studies are needed to determine the extent to which enactment of this Executive Order has improved health outcomes. Finally, one promising avenue in kidney transplantation is the use of kidneys from hepatitis C viremic donors; however, females are 20% less likely to receive a kidney from this donor pool. Sheikh and Locke hypothesize that efforts to educate patients regarding HCV donors may have been misguided, creating an implicit bias [68]. They suggest a more accurate and culturally competent education format be implemented to meet the needs of the female population [68].

4.3. LGBTQ+

In our scoping review, only two studies evaluated factors associated with inequities in access to kidney transplantation for the LGBTQ+ community. Out of this diverse group, only transgender patients were assessed in the studies, further highlighting a lack of representation in current literature [70]. Without representation of the LGBTQ+ community in medical research, inequities in healthcare among these patients cannot be identified, and providers are unable to deliver well-informed care to this patient group [71–73]. The lack of literature

regarding the LGBTQ+ community is not unique to our topic, although attention to the healthcare needs of this community is increasing [74]. An explanation for this was provided by Lunn et al., who found that there is a lack of standardized data collection of patients' sexual orientation and gender identity in healthcare records and national surveys [75]. As many of the studies in our sample used national databases, the lack of standardized collection of LGBTQ+ datapoints likely heavily affects kidney transplantation research. Therefore, we recommend further surveys and investigations engaging this community to discover the optimal format to collect sexual orientation and gender identity data [76]. Additionally, systematic reviews focused on this patient population, similar to Harding et al.'s attention on Black patient inequities [77], should be conducted to evaluate the rates of referral, evaluation, waitlisting, and transplantation among LGBTQ+ patients, as it may expose an additional inequity in this community.

4.4. Strengths and limitations

Our scoping review has several strengths. First, including studies published up to 2022 provided the opportunity of assessing the most up-to-date research. Second, the protocol for this study was developed a priori and deposited to OSF to improve transparency and reproducibility. Third, data were screened and charted in a masked duplicate fashion for improving interrater reliability. Fourth, we followed the Joanna Briggs Institute guidance and PRISMA-ScR during the conduct and reporting of this investigation — both well known resources on scoping reviews. Our scoping review has some limitations. We limited primary studies to those published in English and based in the United States. These limiters may influence which studies were retained. Excluding non-U.S. articles may have also failed to return other factors associated with inequities in the transplant process, such as immigrant status. Further, language bias may be introduced as studies published in nonEnglish languages were excluded. It is also possible that our searches failed to return relevant studies, which would have added to the results of this investigation. Due to manual screening of reference lists from the 44 included articles, human error is possible when accounting for the precise number of duplicated articles and exclusion rationales, for example. However, the total number of excluded articles is accurate.

5. Conclusion

In conclusion, this scoping review has highlighted the significant factors associated with inequities in access to kidney transplantation for Black and female patients, those with low socioeconomic status, and SGM patients. No change in frequency of investigations was noted for the two most studied groups, race/ethnicity and sex or gender. However, future research focused on implementing interventions such as RADIANT and Kidney Paired Donation at a regional level may improve access to transplantation for historically marginalized groups. Furthermore, seeing how the factors are so intertwined, future research aimed at assessing each step in the transplant process with its associated factors creating inequities is vital to better understanding the causal pathways. Specifically for LGBTQ+ identity, we suggest a standardized approach to data collection in order to provide adequate representation for SGMs in kidney transplantation.

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Declaration of Competing Interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.trre.2023.100751>.

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