From the Society for Vascular Surgery

The impact of neighborhood social disadvantage on presentation and management of first-time hemodialysis access surgery patients

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ABSTRACT

Objectives: The impact of social determinants of health on the presentation, management, and outcomes of patients requiring hemodialysis (HD) arteriovenous (AV) access creation have not been well-characterized. The Area Deprivation Index (ADI) is a validated measure of aggregate community-level social determinants of health disparities experienced by members living within a community. Our goal was to examine the effect of ADI on health outcomes for first-time AV access patients.

Methods: We identified patients who underwent first-time HD access surgery in the Vascular Quality Initiative between July 2011 to May 2022. Patient zip codes were correlated with an ADI quintile, defined as quintile 1 (Q1) to quintile 5 (Q5) from least to most disadvantaged. Patients without ADI were excluded. Preoperative, perioperative, and postoperative outcomes considering ADI were analyzed.

Results: There were 43,292 patients analyzed. The average age was 63 years, 43% were female, 60% were of White race, 34% were of Black race, 10% were of Hispanic ethnicity, and 85% received autogenous AV access. Patient distribution by ADI quintile was as follows: Q1 (16%), Q2 (18%), Q3 (21%), Q4 (23%), and Q5 (22%). On multivariable analysis, the most disadvantaged quintile (Q5) was associated with lower rates of autogenous AV access creation (OR, 0.82; 95% confidence interval [CI], 0.74-0.90; $P < .001$), preoperative vein mapping (OR, 0.57; 95% CI, 0.45-0.71; $P < .001$), access maturation (OR, 0.82; 95% CI, 0.71-0.95; $P = .007$), and 1-year survival (OR, 0.81; 95% CI, 0.71-0.91; $P = .001$) compared with Q1. Q5 was associated with higher 1-year intervention rates than Q1 on univariable analysis, but not on multivariable analysis.

Conclusions: The patients undergoing AV access creation who were most socially disadvantaged (Q5) were more likely to experience lower rates of autogenous access creation, obtaining vein mapping, access maturation, and 1-year survival compared with the most socially advantaged (Q1). Improvement in preoperative planning and long-term follow-up may be an opportunity for advancing health equity in this population. (J Vasc Surg 2023;■:1-7.)

Keywords: Hemodialysis access; Social determinants of health; Area Deprivation Index; Health outcomes; Vascular surgery

Patients with chronic kidney disease (CKD) often experience social barriers in care that affect the presentation and management of their disease. Previous analyses have studied the effects of race, ethnicity, and socioeconomic status (SES) on the prevalence of CKD and end-stage renal disease (ESRD).[1-6] Racial minorities have been shown to have decreased access to hemodialysis (HD) arteriovenous (AV) access creation and renal transplantation for renal replacement therapy in ESRD.[7-11] However, the effects of these social determinants of health (SDH) for patients undergoing AV access creation in the setting of ESRD are poorly understood.

Health insurance access and housing status have been shown to impact patients' pre-HD care and readmission rates for AV access creation.[12,13] Despite autogenous AV fistulas having superior outcomes to tunneled dialysis

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catheters (TDCs) and AV grafts for HD, patients of low SES have been found to be less likely to initiate HD via autogenous AV access than patients of higher SES.[14-19] Patients who identify as Black or Hispanic are also less likely to initiate HD via autogenous AV access.[20] However, no studies have assessed how the interplay between the SDH and a community's access to care impacts outcomes in AV access creation.

Using the Vascular Quality Initiative (VQI) registry, we studied how community-level SDH disparities affected health outcomes in AV access creation patients. The VQI is a multicenter database with contributions from surgeons throughout the country, providing a large sample size of patients from various socioeconomic backgrounds. The Area Deprivation Index (ADI) is an area-based composite social deprivation index, first described in 2003, that uses census tract data, namely community measures of poverty, education, housing, and employment, to quantify net social disparities experienced by members of a community and better captures the intersectionality of multiple SDH.[21] Our goal was to use the VQI with its ADI data to assess how neighborhood social disadvantage affects preoperative, perioperative, and postoperative outcomes in AV access creation.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective review of prospectively collected Vascular Quality Initiative
- **Key Findings:** Hemodialysis access creation patients in the highest Area Deprivation Index quintile in the Vascular Quality Initiative, compared with the lowest Area Deprivation Index quintile, were less likely to receive autogenous access creation (odds ratio [OR], 0.82), preoperative vein imaging (OR, 0.57), access maturation at last follow-up (OR, 0.82), and 1-year survival (OR, 0.81).
- **Take Home Message:** Greater social deprivation may lead to adverse health outcomes in hemodialysis access creation patients.

METHODS

Data source. A retrospective cohort study was performed querying the VQI for all patients who had undergone AV access creation in the HD AV access database between July 2011 and May 2022. The VQI HD AV access creation database contains patients from 18 regions, with 146 different centers and 754 participating physicians. This study was approved by the Boston University Chobanian and Avedisian School of Medicine Institutional Review Board as nonhuman subjects research. Requirements for patient informed consent were waived owing to the deidentified nature of this study.

Cohort selection. Inclusion criteria were all patients between this time frame with zip code data who were able to be matched to an ADI value. Exclusion criteria were previous autogenous AV access, AV graft, or peritoneal dialysis, to assess SDH effects on first-time access creation. Patients were assigned an ADI score between 1 and 100 according to the 2019 ADI available from the Neighborhood Atlas, a tool freely provided by researchers from the University of Wisconsin that has been validated across multiple medical research settings.[22-25] The median ADI score of all nine-digit zip codes within the same five-digit prefix was used given that the VQI only stores five-digit zip code. Higher ADI score corresponds with greater social disadvantage within a given neighborhood. Patients were then further divided into quintiles based on ADI score, with the lowest quintile spanning patients with scores of 1 to 20 (least socially disadvantaged) to the highest quintile spanning patients with scores of 81 to 100 (most socially disadvantaged), consistent with previous literature.[26-28] For patients with long-term follow-up (LTF) data, the latest LTF record was used for analysis.

Variables and definitions. Current smoking was defined as smoking cigarettes, pipes, or cigars within the past month, per the VQI definition, and former smoking as quitting for >1 month. Diabetes was separated between diet controlled, medication controlled, and insulin dependent. Coronary artery disease (CAD) was defined as either having a history of CAD or history of prior coronary artery bypass grafting or percutaneous coronary intervention. Early stage CKD, defined as CKD stages I to III, at time of surgery was used as an indicator of early access creation, seeing as the National Kidney Foundation's guidelines recommend autogenous access creation ≥6 months before the anticipated start of HD, typically occurring in CKD stage IV, and because the VQI is not able to differentiate CKD stage IV vs V for patients between July 2011 to October 2019.[29] Peripheral artery disease (PAD) was defined as experiencing claudication, rest pain, or tissue loss.

Outcomes. For primary outcomes, we examined how ADI quintiles affect a patient's presentation, procedural details, and postoperative outcomes. Preoperative dialysis using a TDC, including both short-term and tunneled line catheters, was evaluated as an indicator of delayed referral for access creation. Perioperatively, we examined how many patients received autogenous AV access over AV grafts and how many obtained vein mapping before access creation. Postoperatively, we examined the rates of successful access maturation, including both autogenous AV access and AV grafts, and the rates of 1-year reintervention and survival. Reinterventions recorded in the VQI include surgical revision; revascularization techniques including stenting, angioplasty, and thrombectomy; superficialization; lipectomy;

Table I. Demographics and comorbidities of study population stratified by Area Deprivation Index (ADI) quintile

Covariate	Overall (n = 43,292)	Q1 (n = 7050)	Q2 (n = 7963)	Q3 (n = 9123)	Q4 (n = 9825)	Q5 (n = 9331)	*P* value
Demographics							
Age	62.8 ± 14.6	64.5 ± 14.9	63.5 ± 14.9	62.7 ± 14.6	62.2 ± 14.6	61.6 ± 14.3	**<.001**
Female sex	18,469 (42.7)	2676 (37.9)	3211 (40.3)	3970 (43.5)	4287 (43.6)	4329 (46.4)	**<.001**
Race							
White	23,977 (59.6)	3219 (54.4)	4518 (62.5)	5714 (66.8)	5902 (62.5)	4624 (51)	**<.001**
Black	13,786 (34.3)	1641 (27.7)	2259 (31.2)	2496 (29.2)	3260 (34.5)	4130 (45.4)	**<.001**
Asian	1466 (2.4)	812 (13.7)	317 (4.38)	190 (2.2)	95 (1)	52 (.57)	**<.001**
Hispanic ethnicity	4189 (9.7)	1242 (17.6)	937 (11.8)	814 (9)	653 (6.7)	543 (5.9)	**<.001**
LTF days	383.1 ± 240.7	374.5 ± 200	376.5 ± 194.3	372.6 ± 195.3	375.3 ± 237.6	411.8 ± 324.7	**.014**
Comorbidities							
Smoking							
Never	20,803 (48.1)	3887 (55.2)	3837 (48.2)	4141 (45.5)	4576 (46.7)	4362 (46.9)	**<.001**
Former	16,193 (37.5)	2509 (35.6)	3189 (40.1)	3680 (40.4)	3636 (37.1)	3179 (34.2)	**<.001**
Current	6225 (14.4)	645 (9.2)	928 (11.7)	1291 (14.2)	1595 (16.3)	1766 (19)	**<.001**
Diabetes							
Diet controlled	4340 (10.1)	774 (11)	799 (10.1)	931 (10.3)	932 (9.5)	904 (9.7)	**.004**
Medication	4370 (10.1)	879 (12.5)	774 (9.7)	846 (9.3)	907 (9.2)	964 (10.4)	**<.001**
Insulin	18,260 (42.3)	2562 (36.4)	3177 (40)	3950 (43.5)	4416 (45.0)	4155 (44.7)	**<.001**
Early stage CKD	1630 (3.9)	211 (3.1)	294 (3.8)	386 (4.3)	351 (3.7)	388 (4.3)	**.002**

CKD, Chronic kidney disease; *LTF*, long-term follow-up.
Q1 refers to ADI score of 1-20 (least socially disadvantaged). Q2 refers to ADI scores of 21-40. Q3 refers to ADI scores of 41-60. Q4 refers to ADI scores of 61-80. Q5 refers to ADI scores of 81-100 (most socially disadvantaged). Early stage CKD defined as stage III or below. Results of Cuzick's test for trend represented by *P* values. Bold signifies statistical significance. Percent calculated after excluding missing responses in each group, which may differ from overall total. Values are mean ± standard deviation or number (%).

liposuction; and transposition. One-year survival was determined using procedural survival days calculated by the VQI, which uses social security number flags and procedural data. For secondary outcomes, we examined the prevalence of demographic factors and medical comorbidities between ADI quintiles, as well as what other covariates affect patient health outcomes independent of ADI quintile. Reporting guidelines by Sidawy et al were referenced to define outcomes and covariates used in this study.[30]

Statistical analyses. Age, body mass index (BMI), and postoperative days at LTF were coded as a continuous variable, presented in mean ± standard deviation. All other variables were coded as categorical variables, presented as counts and percentages. Missing values were excluded in individual analyses. Univariable analyses were assessed using Cuzick's test for trend across ordered ADI quintile groups for binary outcomes. For 1-year outcomes, Kaplan-Meier survival analysis was performed with the log-rank test between ADI quintiles. Analysis of variance was used to compare differences in mean LTF days among ADI quintiles. Multivariable analyses were performed using multivariable logistic regression. The model adjusted for age, race, Hispanic ethnicity, gender, BMI, smoking status, hypertension, diabetes, early stage CKD, congestive heart failure (CHF), CAD, PAD, and chronic obstructive pulmonary disease (COPD). For rates of access maturation and 1-year reintervention, which require LTF data from the VQI, the numbers of days after the procedure at last LTF was also included in the regression to control in case longer follow-up led to higher rates of access failure or reintervention identified. Results are represented in odds ratios (OR) with 95% confidence intervals (CIs). All statistics were performed using Stata version 17.0. A *P* value of ≤.05 was considered statistically significant.

RESULTS

Demographics. There were 43,292 patients who met inclusion criteria out of 67,211 patients identified in the VQI. Of patients excluded from 2019 onward, 300 (1.6%) were previously on peritoneal dialysis. There were 32,793 patients (76%) who had LTF data. The average age for patients in the study was 63±15 years. Overall, 34% of patients were Black, 10% identified as Hispanic, and 43% were female. Eighty-five percent received autogenous AV access. The average number of days for latest LTF was 383±241 days. The mean LTF days stratified by ADI quintile are as follows: quintile 1 (Q1), 374±200 days; Q2, 377±194 days; Q3, 372±195 days; Q4, 375±237 days; and Q5, 412±325 ($P < .001$). The distribution of demographic factors and prevalence of medical comorbidities varied among ADI quintiles (Table I). Additional

Table II. Univariable outcomes stratified by ADI quintile

Outcome	Q1	Q2	Q3	Q4	Q5	*P* value
Autogenous access formation	87.1	85	84.6	83.6	84	**<.001**
Preoperative vein mapping	90.6	90.9	91.6	91.4	89.6	.097
Access matured at last follow-up	85.6	82.7	82.5	83.5	81.6	**<.001**
1-Year reintervention	32.1	33.7	32.9	34.6	36.9	**.019**
1-Year survival	88.9	87.4	87.4	88.4	88.3	**.039**
Preoperative HD through catheter	52.6	50.2	46.8	46.1	46	**<.001**

HD, Hemodialysis.
Q1 refers to ADI scores of 1-20 (least socially disadvantaged). Q2 refers to ADI scores of 21-40. Q3 refers to ADI scores of 41-60. Q4 refers to ADI scores of 61-80. Q5 refers to ADI scores of 81-100 (most socially disadvantaged). Values represented in percent of each cohort positive for each outcome. Results of Cuzick's test for trend represented by *P* values. Results of 1-year analyses were assessed using Kaplan-Meier analysis, and *P* values represent result of log-rank test between groups. Bold signifies statistical significance. Values are percent.

demographics and comorbidities listed in the Supplementary Table (online only). Patient distribution by ADI quintile was as follows: Q1 (16%), Q2 (18%), Q3 (21%), Q4 (23%), and Q5 (22%). Compared with Q1 (least socially disadvantaged), Q5 (most socially disadvantaged) tended to have younger patients (mean age, 61.6±14.3 years vs 64.5±14.9 years; $P < .001$), a greater proportion of Black patients (45.4% vs 27.7%; $P < .001$), and contained more current smokers (19% vs 9.2%; $P < .001$); these trends seem to increase stepwise with each quintile. Q5 had the greatest proportion of patients requiring insulin for diabetes management (44.7% vs 36.4%; $P < .001$). However, Q5 patients were also more likely to have access creation in early stage CKD compared with Q1 (4.3% vs 3.1%; $P = .002$).

Autogenous access formation. On univariable analysis (Table II), Q5 was associated with lower rates of autogenous AV access formation compared with Q1 (84% vs 87.1%; $P < .001$). Rates of autogenous access also decreased stepwise from Q1 to Q2 and Q3, and then to Q4 and Q5. On multivariable analysis (Table III), lower autogenous access creation continued to be associated with ADI Q5 compared with Q1 (OR, 0.82; 95% CI, 0.74-0.90; $P < .001$). It was also associated with Black race (OR, 0.56; 95% CI, 0.52-0.59; $P < .001$) and female gender (OR, 0.55; 95% CI, 0.52-0.58; $P < .001$). Early stage CKD at time of creation was associated with higher autogenous AV access creation compared with AV grafts (OR, 1.22; 95% CI, 1.04-1.42; $P = .014$).

Preoperative vein mapping. Q5 was not associated with lower rates of receiving preoperative vein mapping compared with Q1 on univariable analysis (89.6% vs 90.6%; $P = .097$). However, on multivariable analysis, a lower rate of preoperative vein mapping was again associated with ADI Q5 compared with Q1 (OR, 0.76; 95% CI, 0.67-0.85; $P < .001$). Higher rates of vein mapping were associated with Black race (OR, 1.25; 95% CI, 1.15-1.36; $P < .001$), female gender (OR, 1.08; 95% CI, 1-1.16; $P = .05$), diet-controlled diabetes (OR, 1.17, CI 1.03-1.34; $P = .018$), insulin-dependent diabetes (OR, 1.11, CI 1.02-1.21; $P = .012$), CHF (OR, 1.27; 95% CI, 1.16-1.38; $P < .001$), and CAD (OR, 1.18; 95% CI, 1.08-1.29; $P < .001$). Lower rates of vein mapping were associated with early stage CKD (OR, 0.71; 95% CI, 0.6-0.83; $P < .001$) and COPD (OR, 0.85; 95% CI, 0.78-0.93; $P = .001$).

Access maturation at last follow-up. With respect to postoperative outcomes, Q5 was associated with lower rates of access maturation at last LTF compared with Q1 on univariable analysis (81.6% vs 85.6%; $P < .001$). On multivariable analysis, lower rates of access maturation at last LTF were associated with ADI Q5 compared with Q1 (OR, 0.82; 95% CI, 0.71-0.95; $P = .007$). Lower access maturation was also associated with Black race (OR, 0.77; 95% CI, 0.71-0.84; $P < .001$) and female gender (OR, 0.75; 95% CI, 0.69-0.82; $P < .001$).

One-year reintervention. There were higher rates of 1-year intervention in Q5 compared with Q1 (36.9% vs 32.1%; $P = .019$). Standard deviation is <10% at 1 year (percent at risk at 1 year: 39.8% for Q1, 37.6% for Q2, 39% for Q3, 36.5% for Q4, and 36.6% for Q5). ADI quintile had no effect on 1-year reintervention rates on adjusted analysis. Conversely to rates of access maturation, Black race (OR, 1.09; 95% CI, 1.01-1.18; $P = .026$) and female gender (OR, 1.2; 95% CI, 1.12-1.28; $P < .001$) were associated with increased rates of 1-year reintervention for their access site. Early stage CKD at time of access creation was associated with lower rates of 1-year reintervention (OR, 0.74; 95% CI, 0.62-0.88; $P < .001$).

One-year survival. Patients in Q5 had a lower 1-year survival compared with Q1 (88.3% vs 88.9%; $P = .039$). Standard deviation is <10% at 1 year (percent at risk at 1 year: 61.8% for Q1, 70.1% for Q2, 72.4% for Q3, 71.1% for Q4, and 72% for Q5). On multivariable analysis, decreased 1-year survival was associated with ADI Q5 compared with Q1 (OR, 0.81; 95% CI, 0.71-0.91; $P = .001$). Black race (OR, 1.60; 95% CI, 1.48-1.74; $P < .001$), Asian race (OR, 2.04; 95% CI, 1.61-2.57; $P < .001$), and Hispanic ethnicity (OR,

Table III. Multivariable outcomes stratified by Area Deprivation Index (ADI) quintile

ADI quintile	OR	95% CI	*P* value
Autogenous access creation			
1	(ref)	(ref)	(ref)
2	0.81	(0.73-0.9)	**<.001**
3	0.76	(0.69-0.85)	**<.001**
4	0.72	(0.65-0.8)	**<.001**
5	0.82	(0.74-0.90)	**<.001**
Preoperative vein mapping			
1	(ref)	(ref)	(ref)
2	0.96	(0.84-1.09)	.55
3	1.05	(0.93-1.19)	.423
4	1.01	(0.89-1.14)	.878
5	0.76	(0.67-0.85)	**<.001**
Access matured at last follow-up			
1	(ref)	(ref)	(ref)
2	0.85	(0.73-0.98)	**.029**
3	0.84	(0.72-0.97)	**.016**
4	0.9	(0.78-1.05)	.178
5	0.82	(0.71-0.95)	**.007**
1-Year reintervention			
1	(ref)	(ref)	(ref)
2	0.97	(0.85-1.1)	.642
3	0.9	(0.80-1.02)	.115
4	0.91	(0.81-1.03)	.151
5	0.99	(0.87-1.11)	.808
1-Year survival			
1	(ref)	(ref)	(ref)
2	0.82	(0.72-0.93)	**.001**
3	0.79	(0.70-0.89)	**<.001**
4	0.9	(0.80-1.01)	.081
5	0.81	(0.71-0.91)	**.001**
Preoperative HD through catheter			
1	(ref)	(ref)	(ref)
2	0.99	(0.92-1.07)	.772
3	0.86	(0.80-0.93)	**<.001**
4	0.84	(0.78-0.90)	**<.001**
5	0.82	(0.77-0.88)	**<.001**

CI, Confidence interval; *HD*, hemodialysis; *OR*, odds ratio.
Q1 refers to ADI scores of 1-20 (least socially disadvantaged). Q2 refers to ADI scores of 21-40. Q3 refers to ADI scores of 41-60. Q4 refers to ADI scores of 61-80. Q5 refers to ADI scores of 81-100 (most socially disadvantaged). Results of multivariable logistic regression with *P* values shown. Bold signifies statistical significance.

1.56; 95% CI, 1.29-1.88; $P < .001$) were associated with increased 1-year survival.

Preoperative HD through catheters. Q5 was associated with lower rates of preoperative HD through TDC compared with Q1 on univariable analysis (46% vs 52.6%; $P < .001$), and rates were also found to decrease stepwise from Q1 to Q5. On multivariable analysis, Q5 was associated with lower preoperative HD through TDC than Q1 (OR, 0.82; 95% CI, 0.77-0.88; $P < .001$). Additional factors associated with decreased preoperative HD through TDC include increasing age, increasing BMI, former and current smoking, hypertension, and diet-controlled diabetes (all OR <1; $P < .05$). Notably, early stage CKD at time of access creation was also associated with lower rates of HD via TDC compared with patients with CKD stage IV or V (OR, 0.82; 95% CI, 0.73-0.91; $P = .001$). Black and Asian race (compared with White race), Hispanic ethnicity, diet-controlled diabetes, CHF, CAD, PAD, and COPD were all associated with increased rates of HD through TDC (all OR >1; $P < .05$).

DISCUSSION

In this national cohort of patients with first-time AV access from the VQI, we found that neighborhood social disadvantage, as quantified by ADI score, impacted various perioperative and postoperative outcomes surrounding access creation surgery. Compared with the most socially advantaged patients (Q1), patients in the most socially disadvantaged neighborhoods (Q5) had lower rates of receiving autogenous AV access over AV graft. These patients were also significantly less likely to receive vein mapping before their procedure on adjusted analysis. Postoperatively, patients in Q5 were found to experience lower rates of access maturation by their last recorded follow-up appointment compared with patients in Q1. Although they did not have significant differences in 1-year reintervention rates on adjusted analysis, patients in Q5 were shown to have lower rates of 1-year survival compared with patients in Q1. Consequently, further work is required to ensure equitable access to AV access creation and postoperative management across North America.

Previous studies on the effects of SDH disparities on AV access creation have been inconclusive. For example, whereas Yolgösteren[31] showed that the AV fistula failure rate was inversely correlated with higher educational attainment in one patient population, Huang et al[32] showed that poor compliance in an indigent population did not affect the rates of AV fistula maturation. In this study using a large, national cohort of patients, we found that the most socially disadvantaged patients had higher rates of AV access failure, but no differences in rates of reintervention on adjusted analysis, suggesting that these patients do not receive reintervention for their failed AV access and instead likely rely on TDC to initiate HD. Ultimately, this factor may contribute to the lower rates of 1-year survival in this population.

Interestingly, there were fewer patients in Q5 than Q1 that were receiving preoperative HD through TDC. This finding suggests that the most socially deprived patients are initiating HD before permanent access creation at lower rates than patients in the most advantaged

quintile. This finding may reflect practice differences where patients in higher ADI regions are being referred for access creation earlier than patients in lower ADI regions. This finding is supported partially by the higher rates of access creation at early stage CKD with higher ADI quintile on univariable analysis. Alternatively, a possible explanation is that the VQI is an outcomes-based database, such that the patients who are recorded must have been successfully referred to and received AV access creation. Thus, some patients in higher ADI neighborhoods may have a worse ESRD prognosis and do not even receive AV access creation referral or do not have access to a nearby access creation physician, and so they are not represented in the data. This finding is further supported by Lee et al,[33] who assessed the distribution of vascular access physician across the United States found that these physicians were concentrated in neighborhoods with larger White populations, higher per capita income, and greater educational attainment, likely more associated with a lower ADI quintile.

Several other notable covariates affected outcomes independent of ADI quintile. Factors such as Black race and female gender were associated with decreased rates of autogenous access formation, lower access maturation, and higher rates of 1-year reintervention, suggesting that factors beyond community-level barriers are contributing to adverse outcomes in these domains. This finding is consistent with previous work that has shown that Black race but not insurance status increased one's likelihood of receiving AV graft over autogenous AV access.[7] Furthermore, Black race, Asian race, and Hispanic ethnicity were associated with increased rates of 1-year survival. These findings are similar to previous studies which reported that non-Hispanic White race increased risk for 2-year and 5-year mortality after AV access creation.[7,34]

Of note, it is important to acknowledge that several factors outside demographics and comorbidities may impact a patient's decision of when to undergo HD access creation, choice between autogenous access or graft, choice of preoperative vein mapping, and decision to undergo reintervention if initial access creation fails. Factors that we cannot assess for in this study but may impact these outcomes may include insurance coverage, patient preference, and surgeon expertise in offering different procedures. Furthermore, because exact CKD stage or glomerular filtration rate at time of access creation cannot be discerned from the VQI dataset, we are unable to assess the urgency to initiate HD, which may affect the decision to form autologous access vs AV graft or impact decision to use TDC preoperatively.

This study has the following limitations. Although the ADI does better quantify the net effects of social disparities experienced by members within a community than single measures, it is not able to identify specific contributors to social disadvantage for targeted interventions. Additionally, because the VQI does not have nine-digit zip codes, five-digit zip codes were correlated with the median ADI score for the neighborhoods within the same five-digit prefix, which may fail to capture socioeconomic disparities within adjacent neighborhoods in the same five-digit zip code area. However, given the range of ADI scores across the country, significant differences in ADI scores tend to only manifest when comparing different regions of the country than among nine-digit zip codes within the same five-digit prefix. Furthermore, because ADI was analyzed as score quintiles and not as a continuous variable, the small differences in ADI score between a patient's actual nine-digit zip code and their median score within the five-digit prefix are unlikely to change the ADI quintile under which they were analyzed. Regardless, even if nine-digit zip codes were available, ADI scores assume that an individual is representative of the overall members within a given community, which may not be the case in more heterogeneous neighborhoods. Furthermore, the VQI is an outcomes-based database, so it only captures patients who underwent AV access creation for their ESRD, and does not capture patients with ESRD who elected peritoneal dialysis, underwent a kidney transplant, received HD via TDC without access creation, or died before undergoing access creation surgery. Additionally, the VQI misses patients from centers who do not participate, and thus results drawn from this study are biased toward centers who contribute to the database, which limits generalizability.

CONCLUSIONS

Of the patients receiving first-time AV access creation in the VQI, those experiencing the most social disadvantage had lower rates of AV fistula formation, vein imaging, AV access maturation, and 1-year survival compared with patients in the most advantaged quintile. Rates of 1-year reintervention were not significantly different on adjusted analysis. The most socially disadvantaged quintile had lower rates of preoperative HD before permanent access creation than the most advantaged quintile, which may reflect a limitation in that the VQI does not capture patients who do not receive AV access creation from other potential barriers. Addressing these differences in outcomes between the most and least socially disadvantaged groups of patients can help to promote health equity in AV access creation.

AUTHOR CONTRIBUTIONS

Conception and design: MZ, LM, JJS
Analysis and interpretation: MZ, LM, AF, MLS, ED, AA, AK, NM, MM, JJS
Data collection: MZ, LM, JJS
Writing the article: MZ, LM, JJS
Critical revision of the article: MZ, LM, AF, MLS, ED, AA, AK, NM, MM, JJS

Final approval of the article: MZ, LM, AF, MLS, ED, AA, AK, NM, MM, JJS
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Overall responsibility: MZ

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Supplementary Table (online only). Demographics and comorbidities (continued) of study population stratified by Area Deprivation Index (ADI) quintile

Covariate	Overall (n = 43,292)	Q1 (n = 7050)	Q2 (n = 7963)	Q3 (n = 9123)	Q4 (n = 9825)	Q5 (n = 9331)	*P* value
Demographics							
Insurance							
Commercial	13,733 (32.3)	2.043 (29.4)	2398 (30.7)	3054 (34.2)	3344 (34.5)	2893 (31.7)	**<.001**
Medicare	21,688 (51)	3535 (50.8)	4065 (52)	4493 (50.3)	4896 (50.6)	4699 (51)	**<.001**
Medicaid	5610 (13.2)	1167 (16.8)	1030 (13.2)	994 (11.1)	1133 (11.7)	1286 (14.1)	.68
Uninsured	1125 (2.7)	192 (2.8)	249 (3.2)	302 (3.4)	220 (2.3)	162 (1.8)	**<.001**
Ambulatory							
Ambulatory	23,462 (77.4)	3339 (76.7)	4312 (78.7)	5058 (78.7)	5366 (76.7)	5387 (76.1)	**<.001**
With assist	4923 (16.2)	759 (17.4)	859 (15.7)	1006 (15.7)	1.141 (16.3)	1158 (16.4)	**<.001**
Nonambulatory	1949 (6.4)	254 (5.8)	306 (5.6)	366 (5.7)	487 (7)	536 (7.6)	**<.001**
Living in SNF	1649 (3.8)	241 (3.4)	276 (3.5)	325 (3.6)	426 (4.3)	381 (4.1)	**.001**
Comorbidities							
BMI	30.0 ± 8	28.3 ± 7.2	29.3 ± 7.5	30.3 ± 8	30.4 ± 8.1	30.9 ± 8.4	**<.001**
Hypertension	40,808 (94.7)	6656 (94.8)	7500 (94.6)	8558 (94.5)	9241 (94.3)	8853 (95.3)	.28
CHF	13,647 (31.6)	2194 (31.1)	2457 (30.9)	2989 (32.8)	3117 (31.8)	2890 (31)	.786
CAD	10,663 (24.6)	1816 (25.8)	2008 (25.2)	2194 (24.1)	2464 (25.1)	2181 (23.4)	**.001**
PAD	2826 (6.6)	437 (6.4)	477 (6.1)	567 (6.3)	659 (6.7)	686 (7.4)	**.001**
COPD	7981 (18.4)	928 (13.2)	1484 (18.6)	1765 (19.4)	2002 (20.4)	1802 (19.3)	**<.001**

BMI, Body mass index; *CAD*, coronary artery disease; *CHF*, congestive heart failure; *COPD*, chronic obstructive pulmonary disease; *PAD*, peripheral artery disease; *SNF*, skilled nursing facility; *SD*, standard deviation.
Results of Cuzick's test for trend represented by *P*-values. Bold signifies statistical significance. Percent calculated after excluding missing responses in each group, which may differ from overall total. Values are mean ± SD or number (%).