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Racial Disparities in End-Stage Kidney Disease Outcomes Among Asians and Native Hawaiians and Other Pacific Islanders Across Geographic Residence

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Abstract

Introduction: While Asians and Native Hawaiian and other Pacific Islanders (NHOPIs) have a high prevalence of kidney disease risk factors, there are sparse data examining their end-stage kidney disease (ESKD) outcomes. As Hawaii has high representation of Asians and NHOPIs, we

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Author Contributions

CMR and ASY were involved in the conception, design, and conduct of the study and interpretation of the results. ASY conducted the data analysis of the study. CMR and ASY wrote the first draft of the manuscript, and CMR, ASY, KCN, MKT, JD, VP, GH, YN, SFC, RN, FL, and KKZ edited, reviewed, and approved the final version of the manuscript. CMR had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Statements

Statement of Ethics

The study was approved by the Institutional Review Board of the University of California Irvine (IRB #2014–9987) and waived the need of written informed consent given the retrospective nature of data collection and the quality improvement study design. The study was conducted in accordance with the Declaration of Helsinki.

Conflict of Interest Statement

None of the authors have relevant disclosures to report.

compared their ESKD outcomes based on residence in the Mainland US vs. Hawaii/Pacific Islands (PIs).

Materials and Methods: Using United States Renal Data System data, we examined the impact of geographic residence in the Mainland vs. Hawaii/PIs on race—mortality associations among incident ESKD patients transitioning to dialysis over 1/1/2000–12/31/2016 using Cox regression. We examined likelihood of post-dialysis kidney transplantation using Cox models and cumulative incidence curves.

Results: Compared with White patients in the Mainland, Asians and NHOPIs in the Mainland had lower mortality: Adjusted HRs (aHRs) (95%CIs) 0.67 (0.66–0.67) and 0.72 (0.70–0.73), respectively. When examining Asians and NHOPIs in Hawaii/PIs, survival benefit was attenuated in Asians and diminished to the null in NHOPIs (ref: Mainland White patients). Cumulative incidence curves comparing Asian, NHOPI, and White patients showed Asians and NHOPIs in the Mainland had the highest likelihood of transplantation, whereas NHOPIs and Asians in Hawaii/PIs had the lowest likelihood.

Discussion/Conclusion: In the Mainland, Asians and NHOPIs had lower mortality vs. White patients, whereas in Hawaii/PIs this survival benefit was diminished in Asians and mitigated in NHOPIs. NHOPIs and Asians in Hawaii/PIs had less transplantation vs. those in the Mainland. Further research is needed to uncover factors contributing to differential ESKD outcomes among Asians and NHOPIs across geographic residence.

Plain Language Summary

While Asians and Native Hawaiian and other Pacific Islanders (NHOPIs) have a high burden of risk factors for kidney disease, there are major knowledge gaps regarding their survival and kidney transplantation outcomes after developing end-stage kidney disease (ESKD) and whether these clinical outcomes differ according to where they live. As Hawaii has high representation of Asians and NHOPIs, we compared their ESKD outcomes based on whether they lived in the Mainland US vs. Hawaii/Pacific Islands. We found that compared with White ESKD patients in the Mainland US, Asians and NHOPIs in the Mainland US had lower mortality risk. However, when examining Asians and NHOPIs in Hawaii/Pacific Islands, this survival benefit was reduced in Asians and was lost in NHOPIs. Further research is needed to determine the underlying causes and solutions for these disparities in ESKD outcomes across race/ethnicity and geographic residence.

Keywords

Asians; Native Hawaiians; Pacific Islanders; end-stage kidney disease

Introduction

In the US, Asian and Native Hawaiian and other Pacific Islander (NHOPI) populations are collectively the most rapidly expanding racial groups over the past two decades [1–4]. From 2000–2015, the US Asian population nearly doubled in growth [1], and as of 2018 the US Census Bureau reported that there were 22.8 million Asians residing in the US [2, 4]. Census data also indicate that the US is home to 1.6 million NHOPIs, with Native Hawaiians comprising the largest subgroup (>0.6 million) [2, 4].

Large population based studies show Asian-Americans have higher risk of kidney disease compared to their White counterparts [5–9]. National registry data also show that NHOPI registrants have the highest incidence of end-stage kidney disease (ESKD) vs. White and all other racial/ethnic minorities [10]. While the underpinnings of this heightened risk is not clear, certain Asian subgroups such as NHOPIs demonstrate higher rates of chronic kidney disease (CKD)-risk factors (diabetes, obesity, hypertension [8, 9, 11–14]) and barriers to health care access (higher uninsured rates [15, 16]). Despite their higher burden of disease, Asian and NHOPI patients remain among the most understudied racial/ethnic groups in kidney disease research [8, 9].

The state of Hawaii has the largest proportion of Asian and NHOPI residents, with 57% and 27% of Hawaii's population identifying as Asian and/or multi-racial (with at least one part Asian) and NHOPI, respectively (as compared with 7% and 0.5% of the broader US population, respectively) [17]. In parallel, two of the US Pacific Island territories, Guam and the Northern Mariana Islands, have a high prevalence of Asian residents (~half and one-third of these territories' populations, respectively [18]). Hence, the racial/ethnic diversity of Hawaii and the Pacific Islands enables greater study of kidney disease disparities amongst the Asian and NHOPI populations.

Growing evidence suggests geographic residence has an important bearing on racial/ethnic disparities in ESKD patients receiving dialysis [19]. To date, only one study has previously compared ESKD outcomes among Asian and NHOPI patients residing within Hawaii/Pacific Islands vs. outside of this region (Northern California) [20]. However, inference from these findings are limited by the non-examination of Asian and NHOPI patients in the broader US catchment, thereby restricting generalizability. While there are a high density of Asian and NHOPI patients in other states [21], there has not been prior research specifically comparing ESKD outcomes among Asians and NHOPI's in the Mainland US vs. Hawaii/Pacific Islands. To address this knowledge gap, we examined a well-characterized, longitudinal incident ESKD cohort from the United States Renal Data System (USRDS) registry in order to compare survival and kidney transplantation among Asian, NHOPI, and other racial groups residing in the Mainland US vs. Hawaii/Pacific Islands. The primary objective of this study was to determine the impact of geographic residence on associations of Asian and NHOPI race with ESKD outcomes among incident ESKD patients transitioning to dialysis.

Methods

Source Population

We conducted a historical cohort study using data from the USRDS Standard Analytic Files [22–24]. In this study, patients were included provided that they were age ≥18 years old at the time of transitioning to dialysis; had their initial dialysis treatment between the period of 1/1/2000–12/31/2016; and had a plausible follow-up time (i.e., did not have a nonsensical follow-up time value, such as the death date preceding the dialysis transition date). Patients were excluded if they had an outlier age value at the time of transitioning to ESKD (≥100 years old); underwent a pre-emptive kidney transplant; and had a geographic residence outside of the Mainland US or Hawaii/Pacific Islands at the time of their first dialysis

treatment. The study was approved by the Institutional Review Board of the University of California Irvine.

Exposure Ascertainment

We examined the impact of geographic residence on associations of Asian and NHOPI race with ESKD outcomes, namely survival and kidney transplantation, among incident ESKD patients transitioning to dialysis. Associations between race and ESKD outcomes were examined in the overall cohort, as well as across geographic residence parsed as the Mainland US vs. Hawaii/Pacific Islands. Data on ESKD outcome events, namely all-cause mortality and kidney transplantation following dialysis initiation, were ascertained from the USRDS Patient Profile and Treatment History files.

Our primary exposure of interest was self-reported race, which was ascertained from the USRDS Patient Profile File [22–24] and was categorized into seven groups: Asian, NHOPI, White, Black, American Indian/Alaska Native, Other/Multiracial, and Unknown race. Geographic residence at the time of dialysis initiation was examined as an effect modifier of the association between race and ESKD outcomes, which was ascertained from the USRDS Residence File [22–24]. Patients were grouped according to geographic residence at the time of transition to dialysis: Mainland US, which was designated as the 49 states that are located in the continental US and the District of Columbia, vs. Hawaii/Pacific Islands, with the latter including US territories available in the USRDS database (American Samoa, Guam, Northern Mariana Islands).

Outcome Ascertainment

Our primary outcome was all-cause mortality risk. Follow-up began the day after dialysis initiation and continued until the patient experienced the outcome of interest or a censoring event, and two different approaches were used to define censoring events. In primary analyses (designated as Approach A), patients were censored for kidney transplantation, loss to follow-up, or at the end of the study period (12/31/2016), whichever occurred first. In sensitivity analyses (designated as Approach B), patients were censored only for loss to follow-up or at the end of the study period (i.e., in contrast to Approach A, in Approach B patients who underwent transplantation were followed until death, loss to follow-up, or at the end of the study period).

Our secondary outcome was time to the first kidney transplant following dialysis initiation. Follow-up began the day after dialysis initiation and continued until the patient experienced the outcome of interest or a censoring event. Patients were censored for death, loss to follow-up, or at the end of the study period (12/31/2016), whichever occurred first. Information on mortality, transplantation events, and follow-up time following dialysis initiation were obtained from the USRDS Patient Profile and Treatment History files [22–24].

Statistical Methods

Baseline characteristics across racial groups were compared using chi-square, ANOVA, and Kruskal-Wallis tests according to variable type. We examined the association between race

and all-cause mortality using Cox models. Cox models were analyzed using four levels of covariate adjustment:

1. Unadjusted model: Included race as the primary exposure;
2. Case-mix model: Adjusted for age, sex, initial dialysis modality, cause of ESKD, year of dialysis initiation, and diabetes status;
3. Expanded case-mix model: Adjusted for covariates in the case-mix model, as well as dialysis access type, body mass index (BMI), pre-ESKD nephrology care, and the following 12 comorbid conditions: hypertension, coronary artery disease (CAD), arrhythmia, congestive heart failure (CHF), cerebrovascular disease, other cardiac disease, peripheral vascular disease (PVD), alcohol dependence, drug dependence, tobacco use, malignancy, and chronic obstructive pulmonary disease (COPD);
4. Expanded case-mix + laboratory model: Adjusted for covariates in the expanded case-mix model, as well as serum albumin, estimated glomerular filtration rate (eGFR) (as a proxy of timing of dialysis initiation), hemoglobin level, and erythropoietin-stimulating agent (ESA) use using the most proximate values to the time of transitioning to dialysis (up to one-year prior to transitioning to dialysis).

We *a priori* defined the expanded case-mix adjusted model as our preferred model, which included core socio-demographic measures and other confounders of the race—mortality association, including indices of access to care (i.e., dialysis access type, pre-ESKD nephrology care), BMI, and comorbidity burden. Effect modification of race—mortality associations according to geographic residence were examined through the addition of two-way interaction terms with race using likelihood ratio testing. Analogous analyses were conducted for the association of race and the secondary outcome of kidney transplantation. For the outcome of kidney transplantation, we also conducted sensitivity analyses comparing likelihood of transplantation amongst the three largest racial groups in Hawaii/Pacific Islands (Asian, NHOPI, White) across geographic residence using cumulative incidence curves to account for all-cause mortality as a competing event.

Information on comorbidities, vascular access, BMI, pre-ESKD nephrology care, and laboratory data were obtained from the Center for Medicare and Medicaid Services (CMS) Medical Evidence Form 2728 [22–24]. There were no missing data, except for sex (0.01%), BMI (2.3%), serum albumin (39.2%), eGFR (14.0%), and hemoglobin (24.3%). Multiple imputation was implemented to address missing covariate data. Proportional hazards assumptions were confirmed by graphical analysis. Analyses and figures were generated using SAS version 9.4 (SAS Institute Inc., Cary, NC), Stata version 13.1 (Stata Corporation, College Station, TX), and SigmaPlot Version 12.5 (Systat Software, San Jose, CA).

Results

Study Population

Among 1,802,826 incident ESKD patients who met eligibility criteria (Supplementary Figure S1), 3% (N=61,148), 1% (N=17,862), 66% (N=1,191,461), 28% (N=506,059), 1% (18,342), 0.4% (N=6589), and 0.08% (N=1365) of patients were of Asian, NHOPI, White, Black, American Indian/Alaska Native, Other/Multiracial, and Unknown race, respectively. In Hawaii/Pacific Islands, there was a higher prevalence of Asian (45%%) and NHOPI (43%) incident ESKD patients in comparison to the Mainland, where Asians and NHOPIs represented 3% and 0.7% of the incident ESKD population, respectively (Table 1).

Patients' baseline characteristics across geographic residence and race are shown in Table 1. Compared to patients in the Mainland, those in Hawaii/Pacific Islands were younger; were more likely to have diabetes and less likely to have hypertension as the cause of ESKD; were more likely to have an AVF and less likely to have a catheter; were more likely to have received pre-ESKD nephrology care; were more likely to have diabetes and hypertension; were less likely to have malignancy, COPD, and other cardiovascular disease; had lower eGFRs (suggesting later dialysis initiation); and were more likely to be receiving ESA upon transitioning to ESKD.

Associations of Race with Mortality Risk: Mainland US vs. Hawaii/Pacific Islands

Patients contributed a total of 5,453,301 patient-years of follow-up during which time 1,119,582 deaths occurred. The median (IQR) at-risk time was 26 (9, 53) months. In the overall cohort, in primary analyses using Approach A, compared to White incident ESKD patients, all racial groups except for those of Other/Multiracial race had lower all-cause mortality risk in expanded case-mix Cox models: adjusted HRs (aHRs) (95%CIs) 0.65 (0.65–0.66), 0.74 (0.73–0.76), 0.85 (0.85–0.86), 0.86 (0.84–0.87), and 0.72 (0.65–0.79) for incident ESKD patients of Asian, NHOPI, Black, American Indian/Alaska Native, and Unknown race, respectively (Supplementary Table S1). In contrast, Other/Multiracial race patients had higher death risk: aHR (95%CI) 1.19 (1.16–1.23) in expanded case-mix analyses. These associations were robust following incremental adjustment for expanded case-mix+laboratory covariates (Supplementary Table S1) and in sensitivity analyses using Approach B that did not censor for kidney transplantation (Supplementary Table S2).

In analyses that compared race and survival across geographic residence, we observed a differential relationship between incident ESKD patients residing in the Mainland vs. Hawaii/Pacific Islands. Among patients residing in the Mainland, both Asians and NHOPIs had lower mortality compared to White patients: aHRs (95%CIs) 0.65 (0.64–0.66) and 0.69 (0.67–0.70), respectively, in expanded case-mix analyses (Figure 1 and Supplementary Table S1). However, upon comparing patients in Hawaii/Pacific Islands, this survival benefit was attenuated in Asians and was diminished to the null in NHOPIs (reference: White patients in Hawaii/Pacific Islands): aHRs (95%CIs) 0.72 (0.66–0.78) and 0.93 (0.85–1.01), respectively, in expanded casemix analyses (p-interaction <0.001). A similar pattern of findings was observed following incremental adjustment for expanded case-mix+laboratory covariates

(Figure 1 and Supplementary Table S1) and in sensitivity analyses that used Approach B (Figure 2 and Supplementary Table S2).

Among incident ESKD patients residing in the Mainland, incident ESKD patients of Black, American Indian/Alaska Native, and Unknown race had lower mortality risk in expanded case-mix analyses (reference: White patients in the Mainland): aHRs (95% CI) 0.85 (0.85–0.86), 0.86 (0.84–0.88), and 0.72 (0.65–0.79), respectively. However, among patients in Hawaii/Pacific Islands, these survival benefits among those of Black, American Indian/Alaska Native, and Unknown race were attenuated to the null (reference: White patients in Hawaii/Pacific Islands). In both the Mainland and Hawaii/Pacific Islands, compared to White patients, those of Other/Multiracial race had higher mortality risk in expanded case-mix analyses: aHRs (95% CI) 1.20 (1.16–1.24) and 1.19 (1.02–1.38) for those residing in the Mainland US and Hawaii/Pacific Islands, respectively. These patterns were robust following incremental adjustment for expanded case-mix+laboratory covariates (Figure 1 and Supplementary Table S1) and in sensitivity analyses that used Approach B (Figure 2 and Supplementary Table S2).

Association of Race with Kidney Transplantation: Mainland US vs. Hawaii/Pacific Islands

There were a total of 167,903 kidney transplantation events following dialysis initiation over the study period. Using Cox regression to estimate likelihood of transplantation, in the overall cohort all racial groups except for those of Other/Multiracial and Unknown race had a lower likelihood of kidney transplantation compared to White patients in expanded case-mix analyses: aHRs (95%CIs) 0.91 (0.89–0.94), 0.62 (0.59–0.65), 0.60 (0.59–0.60), and 0.60 (0.57–0.63) for Asian, NHOPI, Black, and American Indian/Alaska Native patients, respectively (Supplementary Table S3). In contrast, patients of Other/Multiracial and Unknown race had similar likelihood of transplantation compared with White patients: aHRs (95%CIs) 1.06 (0.99–1.14) and 0.91 (0.78–1.06), respectively. These associations were robust following incremental adjustment for expanded case-mix+laboratory covariates (Supplementary Table S3).

In analyses that compared race and likelihood of kidney transplantation across geographic residence, we observed a differential relationship between incident ESKD patients residing in the Mainland vs. Hawaii/Pacific Islands. Among patients residing in the Mainland, NHOPIs were less likely to have transplantation (aHR [95%CI] 0.78 [0.74–0.82]) whereas Asians had a slightly lower likelihood compared to White patients (aHR [95%CI] 0.96 [0.94-0.98]) (Figure 3 and Supplementary Table S3) in expanded case-mix Cox analyses. However, upon comparing patients residing in Hawaii/Pacific Islands, both NHOPIs and Asians in Hawaii/Pacific Islands had a substantially lower likelihood of undergoing transplantation (reference: White patients in Hawaii/Pacific Islands: aHRs (95%CIs) 0.35 (0.26–0.46) and 0.71 (0.55–0.91), respectively (p-interaction <0.001). These patterns were robust following incremental adjustment for expanded case-mix+laboratory covariates (Figure 3 and Supplementary Table S3).

In sensitivity analyses using cumulative incidence curves to account for death as a competing risk, we compared the likelihood of kidney transplantation amongst Asian, NHOPI, and White incident ESKD patients in the Mainland vs. Hawaii/Pacific Islands.

In expanded case-mix adjusted cumulative incidence curves, we observed that Asian patients in the Mainland had the highest likelihood of transplantation over time, followed by NHOPI patients in the Mainland and White patients in the Mainland (Figure 4). In contrast, NHOPI patients in Hawaii/Pacific Islands had the lowest likelihood of transplantation, followed by Asian patients in Hawaii/Pacific Islands and White patients in Hawaii/Pacific Islands.

Discussion

In a large, national cohort of incident dialysis patients with comprehensive, longitudinal data from the USRDS Registry [22–24], we observed disparities in survival and kidney transplantation among Asians and NHOPIs residing in the Hawaii/Pacific Islands vs. those in the Mainland. Whereas Asians and NHOPIs had lower mortality risk compared to Whites in the Mainland, this survival benefit was diminished in Asians and was attenuated to the null among NHOPIs in Hawaii/Pacific Islands. In the Mainland, we also observed that NHOPIs were less likely to undergo kidney transplantation vs. Whites, with a slightly lower likelihood also observed in Asians. However, upon examining transplantation patterns in Hawaii/Pacific Islands, these disparities in NHOPIs and Asians were substantially amplified.

To date, there has been sparse examination of ESKD outcomes among Asian and NHOPI minorities, and how this varies according to geographic residence. In a seminal study by Hall et al. that examined 24,963 incident dialysis patients from ESRD Network 17 (TransPacific Renal Network encompassing Northern California, Hawaii, and selected Pacific Islands) over the period of 1995–2001, Asians and NHOPIs demonstrated lower mortality and transplant rates in comparison to Whites [20]. However, geographic location was found to be a modifier of race and ESKD outcomes, such that Asians and NHOPIs in Hawaii/Pacific Islands had *lower* transplant rates compared to their counterparts in Northern California, whereas Whites in Hawaii/Pacific Islands had *higher* transplant rates vs. those in Northern California. In addition, the majority of Asian subgroups and NHOPIs in Hawaii/Pacific Islands tended to be younger and had worse health indicators (less pre-ESKD care, lower serum albumin, higher blood urea nitrogen and creatinine concentrations) vs. those in Northern California. In a subsequent rigorous study of incident dialysis patients treated over 1995–2012, Yan et al. found that ESKD mortality across racial/ethnic groups differed across US territories (Puerto Rico, US Virgin Islands, Guam, Northern Mariana Islands, and American Samoa) vs. the 50 contiguous states [25]. Notably, Asians/NHOPIs (examined as an aggregate group) and Hispanics demonstrated higher death risk in the US territories, whereas similar survival across geographic location was observed among White and Black incident dialysis patients.

As an extension of these prior works, our primary objective was to determine the impact of geographic residence upon ESKD outcomes, specifically mortality risk and kidney transplantation, among US Asians and NHOPIs, two of the most understudied minority groups in kidney disease research [8, 9]. As Hawaii/Pacific Islands have a high concentration of Asians and NHOPIs [8, 9, 11, 21, 26], this geographic catchment is an important setting for examining ESKD disparities in these minority populations. While there has been growing recognition of NHOPIs as a highly vulnerable population with a disproportionate burden of chronic disease and impaired health care access, health policy research by the

Henry J. Kaiser Family Foundation has highlighted that there are “large gaps in data for understanding access and utilization of care for NHOPIs,” and has also underscored the barriers to accessing care and lower utilization of health care services among Asians and other minorities as compared to Whites [15, 16]. Hence, our study provides critical new knowledge to the field by showing that, in a contemporary US cohort of incident dialysis patients, (1) there are substantial disparities in survival among Asians and NHOPIs residing in Hawaii/Pacific Islands vs. Mainland US, and (2) whereas NHOPIs and Asians are more likely to undergo kidney transplant than Whites in the Mainland US, they have the lowest likelihood of transplant among these racial groups in Hawaii/Pacific Islands. Given the high incident ESKD rates in Asians and NHOPIs [7, 10], our findings call attention to Hawaii/Pacific Islands as high-risk regions rendering need for further epidemiologic study in order to inform broad-scale screening, targeted resource allocation, and enhanced public health interventions in these minority populations.

Our findings also highlight the need for more granular examination of racial/ethnic disparities in Asians vs. NHOPIs. While Asians and NHOPIs are oftentimes examined as an aggregate group due to the assumption that they are similar or because of methodological issues such as small sample size, we observed markedly different risk factors and patterns of disease in these two populations. Whereas Asian incident dialysis patients tended to be older and had more favorable health care indicators at the time of transitioning to ESKD (greater pre-ESKD nephrology care, AVF creation, ESA use), NHOPIs were younger and had less favorable indicators of pre-ESKD care (less pre-ESKD nephrology care, greater prevalence of catheters, lower serum albumin, higher BMI). These distinctions underscore the need for more in-depth study of Asians and NHOPIs as disaggregated groups in order to elucidate possible biologic associations (weathering), socio-economic, educational and other structural inequities, and cultural and environmental factors, and pre-ESKD healthcare system differences in the Mainland vs. Hawaii/Pacific Islands that may contribute to these ESKD disparities. Notably, while a “paradoxical survival advantage” among Asian vs. White incident dialysis patients was observed (albeit attenuated) in Hawaii/Pacific Islands, this may potentially be an artefact of the low transplant rates in Asians in this geographic catchment (low transplant rates among “healthier” Asian patients result in a dialysis cohort with greater longevity[27]). Indeed, greater recognition and more in-depth study of Asian and NHOPI kidney disease disparities are needed to address potential structural and systemic barriers to adequate health care access [15, 16] in these and other minority [28] populations.

Strengths of our study include its examination of a large, contemporary cohort of US incident dialysis patients; comprehensive availability of detailed patient-level information, including socio-demographic, comorbidity, dialysis treatment, and laboratory data; and an extended follow-up period to observe clinical outcomes. However, several limitations should be acknowledged. First, we had limited ability to distinguish Asian and NHOPI subgroups [29] who may have had differential severity of disease, survival, and access to transplantation. Second, while we had comprehensive availability of data from the Pacific Islands that are US territories (American Samoa, Guam, Northern Mariana Islands), we did not have access to data from Pacific Island regions outside of these geographic regions (independent countries in free association with the US, such as Micronesia, Marshall Islands, and Palau). Third, comorbidity data was ascertained from the Medical Evidence

2728 form in which comorbidities may have been under-reported. Fourth, while we sought to examine various indices of differential access to and/or quality of care, our examination of eGFR levels derived from serum creatinine concentrations at dialysis transition as a proxy of timing of dialysis initiation may have been confounded by factors independent of kidney function, including muscle mass and volume status. Finally, we cannot exclude the possibility of residual confounding.

Conclusion

In conclusion, our study's findings have uncovered a complex interplay between geographic residence and Asian and NHOPI disparities in kidney disease. In addition to observing the attenuation in the survival benefit of Asian and NHOPI incident dialysis patients among those living in Hawaii/Pacific Islands, we also found that Asians and NHOPIs in this geographic catchment were less likely to undergo kidney transplantation vs. those in the Mainland. Given the geographic variations in kidney disease burden, risk factor distribution, and access to health care resources, further studies are needed to identify interventions that can attenuate the worse outcomes in Asian and NHOPI ESKD patients living in Hawaii/Pacific Islands.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

Portions of these data have been presented as an abstract at the 2020 American Society of Nephrology Kidney Week Meeting, October 22nd to 25th, 2020.

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Data Availability Statement

Due to the nature of the research, due to restrictions (i.e., data containing information that could compromise the privacy of research participants), supporting data is not available. Further inquiries can be directed to the corresponding author.

References

1. Rhee CM, Chou JA, Kalantar-Zadeh K. Dialysis Prescription and Sudden Death. Seminars in nephrology. 2018;38(6):570–81. [PubMed: 30413252]
2. "Asian and Pacific Islander Population in the United States." https://www.census.gov/library/visualizations/2020/demo/aian-population.html. Accessed December 30, 2020.
3. Rhee CM. Serum Potassium and the Long Interdialytic Interval: Minding the Gap. American journal of kidney diseases : the official journal of the National Kidney Foundation. 2017;70(1):4–7. [PubMed: 28646982]
4. Rhee CM, Kalantar-Zadeh K. Implications of the long interdialytic gap: a problem of excess accumulation vs. excess removal? Kidney international. 2015;88(3):442–4. [PubMed: 26323071]

5. Derose SF, Rutkowski MP, Crooks PW, Shi JM, Wang JQ, Kalantar-Zadeh K, et al. Racial differences in estimated GFR decline, ESRD, and mortality in an integrated health system. Am J Kidney Dis. 2013;62(2):236–44. [PubMed: 23499049]

6. Hall YN, Hsu CY. New insights into the epidemiology of chronic kidney disease in US Asians and Pacific Islanders. Current opinion in nephrology and hypertension. 2006;15(3):264–9. [PubMed: 16609293]

7. Hall YN, Hsu CY, Iribarren C, Darbinian J, McCulloch CE, Go AS. The conundrum of increased burden of end-stage renal disease in Asians. Kidney international. 2005;68(5):2310–6. [PubMed: 16221234]

8. Kataoka-Yahiro MR, Davis J, Rhee CM, Wong L, Hayashida G. Racial/Ethnic Differences in Early Detection and Screening for Chronic Kidney Disease Among Adults in Hawaii: A 10-Year Population Health Study. Preventing chronic disease. 2020;17:E84. [PubMed: 32816667]

9. Wong LL, Kalantar-Zadeh K, Page V, Hayashida G, You AS, Rhee CM. Insights from Screening a Racially and Ethnically Diverse Population for Chronic Kidney Disease. American journal of nephrology. 2017;45(3):200–8. [PubMed: 28125810]

10. Rhee CM, Chen Y, You AS, Brunelli SM, Kovesdy CP, Budoff MJ, et al. Thyroid Status, Quality of Life, and Mental Health in Patients on Hemodialysis. Clinical journal of the American Society of Nephrology : CJASN. 2017;12(8):1274–83. [PubMed: 28705886]

11. Kataoka-Yahiro MR, Wong KA, Tamashiro J, Page V, Ching J, Li D. Evaluation of the National Kidney Foundation of Hawai'i's Kidney Early Detection Screening program. Hawai'i journal of medicine & public health : a journal of Asia Pacific Medicine & Public Health. 2012;71(7):186–92.

12. Mau MK, Sinclair K, Saito EP, Baumhofer KN, Kaholokula JK. Cardiometabolic health disparities in native Hawaiians and other Pacific Islanders. Epidemiologic reviews. 2009;31:113–29. [PubMed: 19531765]

13. Uchima O, Wu YY, Browne C, Braun KL. Disparities in Diabetes Prevalence Among Native Hawaiians/Other Pacific Islanders and Asians in Hawai'i. Preventing chronic disease. 2019;16:E22. [PubMed: 30789820]

14. Zhao B, Jose PO, Pu J, Chung S, Ancheta IB, Fortmann SP, et al. Racial/ethnic differences in hypertension prevalence, treatment, and control for outpatients in northern California 2010–2012. American journal of hypertension. 2015;28(5):631–9. [PubMed: 25352230]

15. Picard K Potassium Additives and Bioavailability: Are We Missing Something in Hyperkalemia Management? Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation. 2018.

16. Artiga S, Foutz J, Cornachione E, Garfield R. "The Henry J. Kaiser Family Foundation: Key Facts on Health and Health Care by Race and Ethnicity, June 2016." http://files.kff.org/attachment/Chartpack-Key-Facts-on-Health-and-Health-Care-by-Race-and-Ethnicity. Accessed December 30, 2020.

17. "Hawaii Population Characteristics 2019." https://census.hawaii.gov/wpcontent/uploads/2020/06/Hawaii-Population-Characteristics-2019.pdf. Accessed December 30, 2020.

18. Aaron KJ, Sanders PW. Role of dietary salt and potassium intake in cardiovascular health and disease: a review of the evidence. Mayo Clinic proceedings. 2013;88(9):987–95. [PubMed: 24001491]

19. Rodriguez RA, Hotchkiss JR, O'Hare AM. Geographic information systems and chronic kidney disease: racial disparities, rural residence and forecasting. Journal of nephrology. 2013;26(1):3–15. [PubMed: 23065915]

20. Hall YN, Sugihara JG, Go AS, Chertow GM. Differential mortality and transplantation rates among Asians and Pacific Islanders with ESRD. J Am Soc Nephrol. 2005;16(12):3711–20. [PubMed: 16236803]

21. "The Asian Population 2010." https://www.census.gov/prod/cen2010/briefs/c2010br-11.pdf. Accessed December 30, 2020.

22. Kistler BM, Benner D, Burrowes JD, Campbell KL, Fouque D, Garibotto G, et al. Eating During Hemodialysis Treatment: A Consensus Statement From the International Society of Renal

Nutrition and Metabolism. Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation. 2018;28(1):4–12. [PubMed: 29249295]

23. "United States Renal Data System: 2019 Researcher's Guide to the USRDS Database Appendix A: USRDS Products and Services." https://www.usrds.org/media/2451/researchers_guide_appendix_a_19.pdf. Accessed January 1, 2021.
24. Saglimbene VM, Wong G, Ruospo M, Palmer SC, Garcia-Larsen V, Natale P, et al. Fruit and Vegetable Intake and Mortality in Adults undergoing Maintenance Hemodialysis. Clinical Journal of the American Society of Nephrology. 2019;14(2):250–60. [PubMed: 31738182]
25. Yan G, Shen JI, Harford R, Yu W, Nee R, Clark MJ, et al. Racial and Ethnic Variations in Mortality Rates for Patients Undergoing Maintenance Dialysis Treated in US Territories Compared with the US 50 States. Clin J Am Soc Nephrol. 2020;15(1):101–8. [PubMed: 31857376]
26. Mau MK, West M, Sugihara J, Kamaka M, Mikami J, Cheng SF. Renal disease disparities in Asian and Pacific-based populations in Hawai'i. Journal of the National Medical Association. 2003;95(10):955–63. [PubMed: 14620708]
27. Tsukamoto Y End-stage renal disease (ESRD) and its treatment in Japan. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association. 2008;23(8):2447–50. [PubMed: 18469312]
28. Rhee CM, Lertdumrongluk P, Streja E, Park J, Moradi H, Lau WL, et al. Impact of age, race and ethnicity on dialysis patient survival and kidney transplantation disparities. American journal of nephrology. 2014;39(3):183–94. [PubMed: 24556752]
29. Narayan KM, Aviles-Santa L, Oza-Frank R, Pandey M, Curb JD, McNeely M, et al. Report of a National Heart, Lung, And Blood Institute Workshop: heterogeneity in cardiometabolic risk in Asian Americans In the U.S. Opportunities for research. Journal of the American College of Cardiology. 2010;55(10):966–73. [PubMed: 20202512]

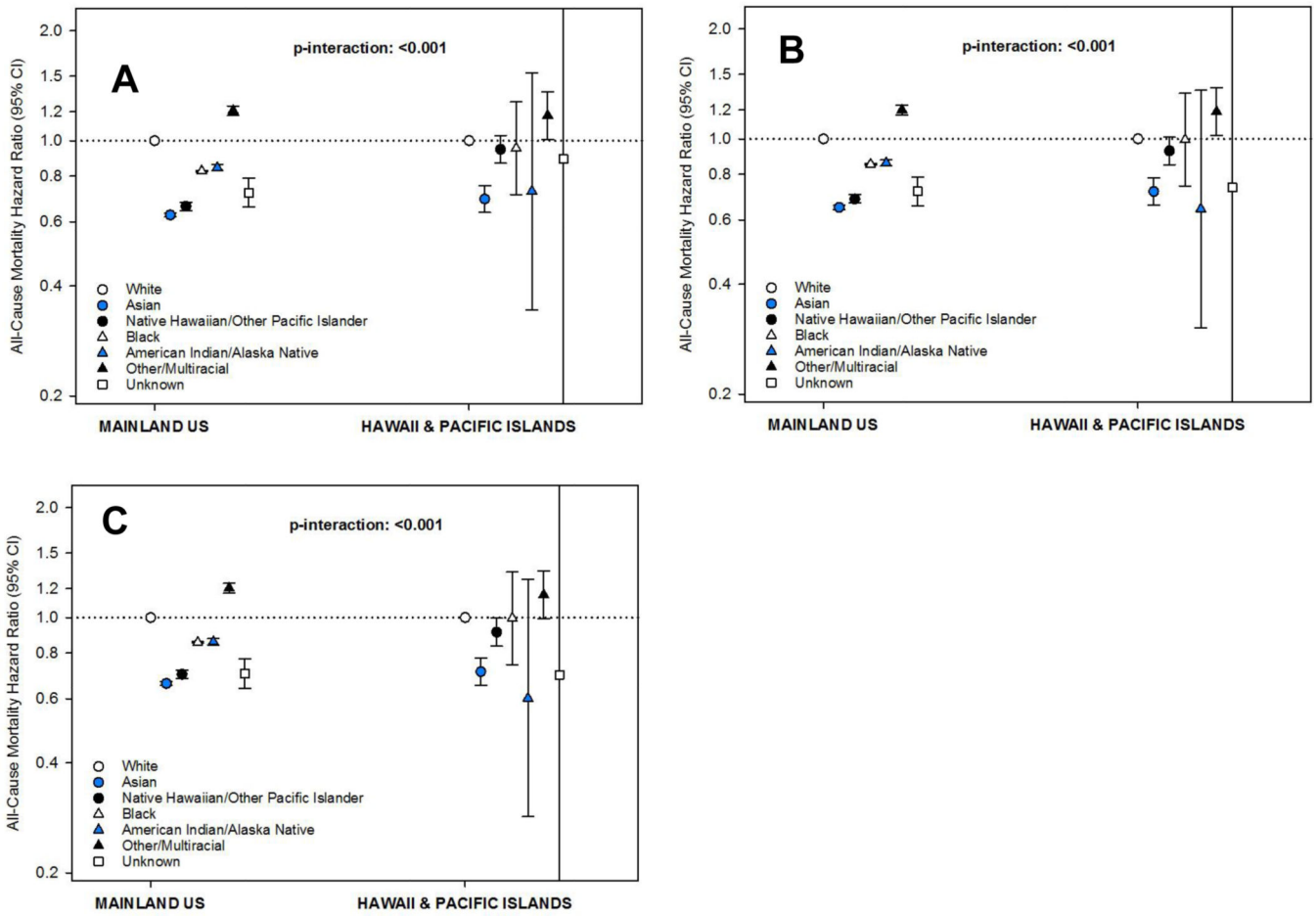

Figure 1.

Association between race and all-cause mortality across geographic residence among incident ESKD patients (Approach A): Case-mix, Expanded case-mix, Expanded case-mix+laboratory models (Panels A, B, and C, respectively).

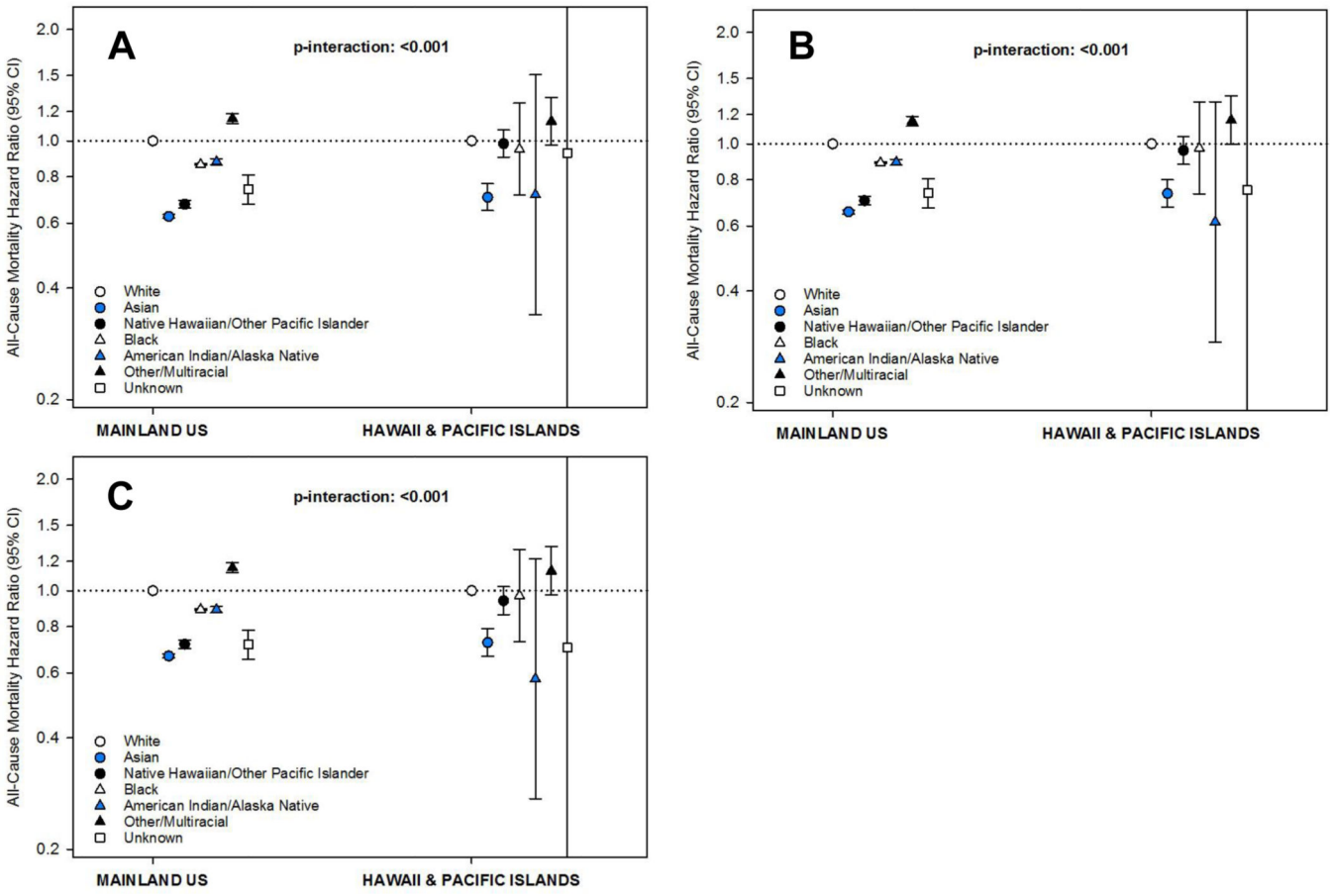

Figure 2.

Association between race and all-cause mortality across geographic residence among incident ESKD patients (Approach B): Case-mix, Expanded case-mix, and Expanded case-mix+laboratory models (Panels A, B, and C, respectively).

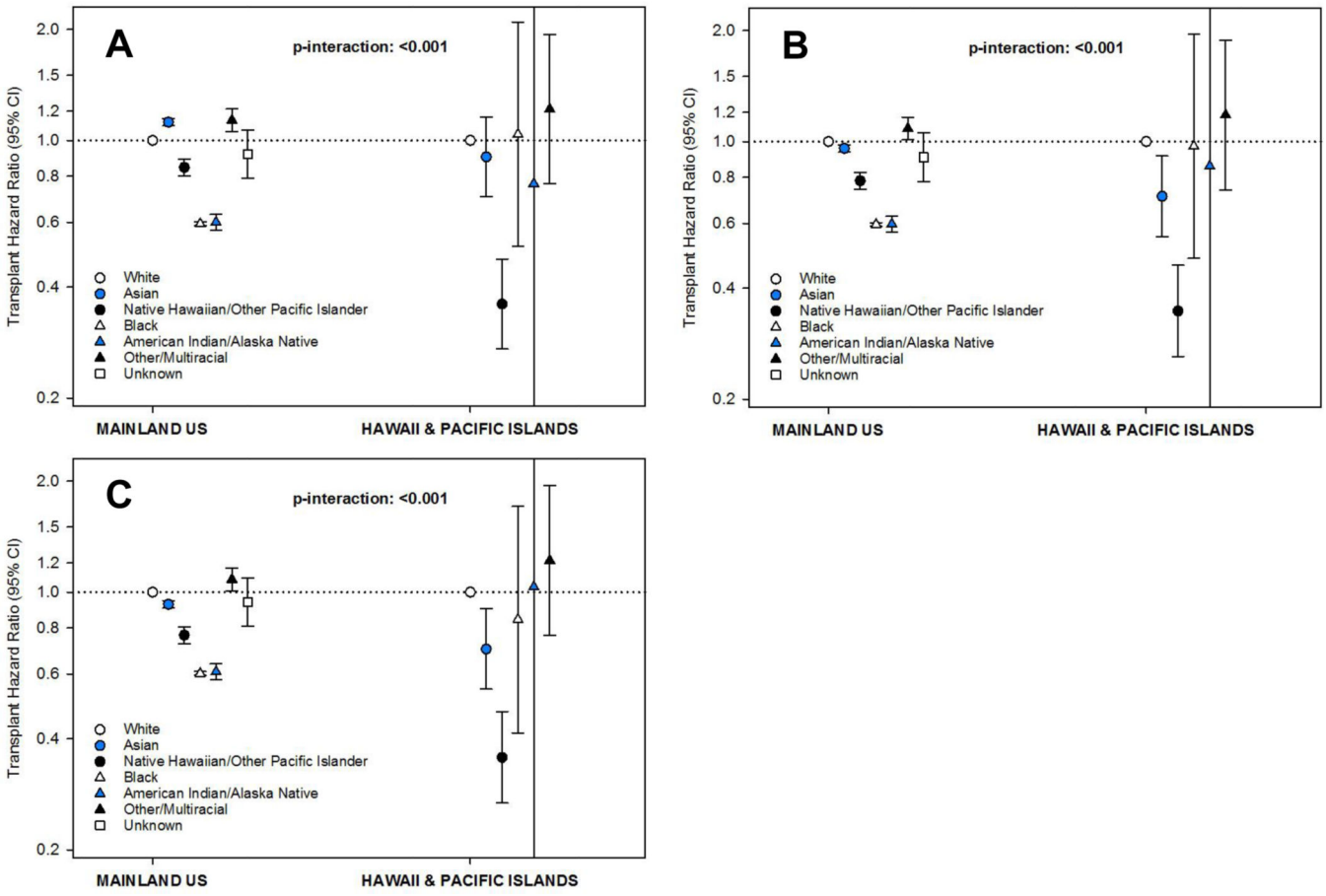

Figure 3.

Association between race and transplant across geographic residence among incident ESKD patients: Case-mix, Expanded case-mix, and Expanded casemix+laboratory adjusted model (Panels A, B, and C).

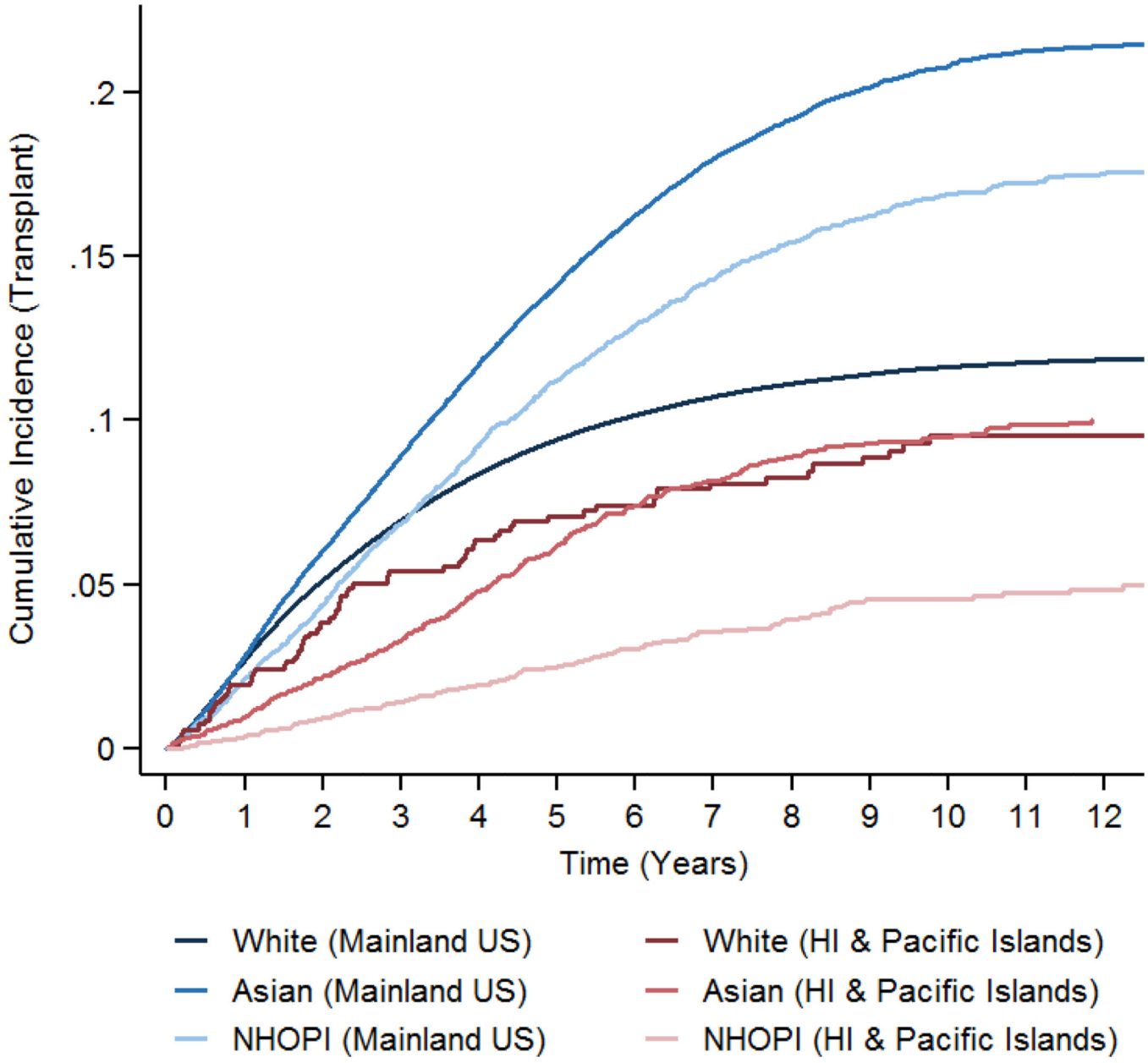

Figure 4.
Cumulative incidence curves of the association between race and geographic residence with kidney transplantation in incident ESKD patients.

Table 1.

Baseline characteristics according to race across mainland US vs. Hawaii/Pacific Islands.

	Mainland US									Hawaii and Pacific Islands								
	Race									Race								
	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p
N (%)	1790051	1190377 (67)	55395 (3)	12450 (0.7)	505963 (28)	18329 (1)	6215 (0.4)	1362 (0.08)	N/A	12735	1084 (9)	5753 (45)	5412 (43)	96 (0.8)	13 (0.1)	374 (3)	3 (0.02)	N/A
Age mean±SD, yr	64±15	66±15	64±16	61±15	59±15	58±14	61±15	52±15	<0.001	62±14	65±14	66±15	57±13	57±13	54±13	61±13	50±11	<0.001
Female (%)	44	42	44	46	49	50	45	40		44	37	43	48	19	31	43	100	<0.001
Cause ESKD (%)									<0.001									<0.001
Diabetes	45	45	48	58	43	73	49	9		65	47	60	74	45	69	68	33	
Hypertension	29	26	27	23	37	10	22	5		17	20	20	14	27	8	13	0	
GN	8	8	13	9	8	8	9	2		9	11	11	6	8	8	8	0	
Cystic kidney	2	2	2	1	1	1	2	0.4		1	3	1	1	1	0	2	0	
Other urologic	1	2	1	1	1	1	1	0.2		1	2	1	1	3	0	1	0	
Other cause	10	11	5	5	7	5	9	3		5	13	5	3	13	8	5	0	
Unkn/ Miss.	4	5	5	3	4	3	8	80		2	4	2	1	3	8	3	67	
Dialysis modality (%)									<0.001									<0.001
HD	92	91	88	91	94	93	92	92		93	93	92	95	83	92	95	100	
PD	7	8	11	9	6	6	8	6		6	7	8	5	17	8	5	0	
Home HD	0.31	0.32	0.20	0.20	0.30	0.10	0.42	1.25		0.05	0.09	0.05	0.06	0	0	0	0	

	Mainland US									Hawaii and Pacific Islands								
	Race									Race								
	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p
Center Self HD	0.15	0.17	0.15	0.10	0.09	0.08	0.13	0.07		0.06	0.18	0.09	0.02	0	0	0	0	
Unknown	0.14	0.16	0.17	0.12	0.09	0.09	0.18	0.44		0.03	0.18	0.03	0	0	0	0	0	
Comorbidities (%)																		
Alcohol dependence	2	1	0.4	1	2	4	1	1	<0.001	1	1	0.3	1	2	0	2	0	<0.001
Malignancy	7	8	4	3	5	4	5	1	<0.001	3	6	4	3	8	8	4	0	<0.001
CHF	32	33	24	25	29	29	30	7	<0.001	31	32	29	33	28	31	36	33	0.001
COPD	9	11	3	4	6	6	6	1	<0.001	3	8	3	3	3	0	3	33	<0.001
CVA/TIA	9	9	8	7	10	7	8	1	<0.001	8	9	8	8	5	15	9	0	0.38
DM	54	54	54	63	53	75	54	15	<0.001	68	54	64	76	52	85	73	33	<0.001
Drug dependence	1.2	0.7	0.1	0.3	2.6	1.4	1.6	0.3	<0.001	0.5	1.3	0.2	0.5	1.0	7.7	1.3	0	<0.001
HTN	84	82	85	86	87	86	78	25	<0.001	90	86	92	88	85	77	91	33	<0.001
Other cardiac disease	13	15	10	11	10	9	8	1	<0.001	9	10	8	10	15	0	13	0	0.002
PVD	13	15	6	7	9	17	12	2	<0.001	12	15	11	13	7	38	17	0	<0.001
Active tobacco use	6	6	2	3	7	7	4	1	<0.001	5	6	3	7	6	8	6	0	<0.001
CAD	21	24	16	16	14	19	21	4	<0.001	21	21	23	19	11	46	22	0	<0.001
Arrhythmia	2	2	1	1	1	1	3	1	<0.001	2	2	3	2	0	0	2	0	0.24

	Mainland US									Hawaii and Pacific Islands								
		Race									Race							
	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p
EA use (%)									<0.001									<0.001
Yes	24	25	27	24	21	25	25	6		35	36	43	26	31	38	43	0	
No	56	56	51	54	58	60	59	21		51	50	46	57	52	62	45	33	
Unknown/ Miss.	20	19	22	22	21	16	17	73		14	14	12	17	17	0	13	67	
Dialysis access (%)									<0.001									<0.001
AVF	10	10	11	11	9	10	6	1		15	16	20	11	13	8	15	0	
AVG	2	2	2	2	3	1	2	0.2		3	3	3	2	2	8	3	0	
Catheter	52	52	52	54	53	50	35	7		50	48	43	58	47	46	49	0	
Other	0.5	0.5	0.4	0.3	0.4	0.2	0.7	0.1		0.4	0.6	0.5	0.4	0	0	0.3	0	
Unknown/ Miss.	35	35	34	33	35	38	57	92		32	32	34	29	39	46	32	100	
Pre-ESKD nephrology care (%)									<0.001									<0.001
Yes	42	43	45	43	38	40	25	3		50	51	57	41	50	38	54	0	
No	19	19	18	19	21	19	14	3		19	17	13	25	16	15	15	0	
Unknown	39	38	37	37	41	40	61	93		32	31	30	34	34	46	31	100	
BMI (kg/ m^2), median (IQR)	27 (23, 33)	27 (23, 33)	24 (21, 27)	26 (23, 31)	28 (24, 34)	28 (24, 34)	26 (22, 31)	25 (22, 28)	<0.001	27 (23, 33)	27 (23, 33)	25 (22, 30)	29 (25, 35)	28 (23, 33)	31 (25, 34)	28 (24, 33)	45 (45, 45)	<0.001
Laboratory Values Median (IQR)																		

	Mainland US									Hawaii and Pacific Islands								
	Race									Race								
	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p	Overall	White	Asian	Native Hawaiian/ Other Pacific Islander	Black/ African American	American Indian/ Alaska Native	Other/ Multiracial	Unknown	p
Serum albumin (g/dl)	3.2 (2.7, 3.6)	3.2 (2.7, 3.6)	3.3 (2.8, 3.7)	3.2 (2.7, 3.6)	3.1 (2.6, 3.6)	2.9 (2.4, 3.3)	3.1 (2.6, 3.6)	3.1 (2.6, 3.6)	<0.001	3.2 (2.7, 3.6)	3.3 (2.8, 3.7)	3.3 (2.8, 3.7)	3.0 (2.5, 3.5)	3.3 (2.8, 3.7)	2.7 (2.4, 3.3)	3.2 (2.6, 3.6)	2.7 (2.7, 2.7)	<0.001
eGFR	8.6 (6.4, 11.7)	8.8 (6.4, 12.0)	7.7 (5.5, 10.5)	7.5 (5.3, 10.3)	8.1 (5.8, 11.2)	8.0 (5.7, 10.8)	7.5 (5.4, 10.7)	6.9 (4.8, 9.8)	<0.001	6.5 (4.6, 8.9)	6.9 (5.0, 9.5)	6.6 (4.7, 8.9)	6.2 (4.3, 8.8)	6.2 (4.5, 9.2)	6.3 (4.9, 9.3)	6.4 (4.8, 9.3)	7.7 (7.7, 7.7)	<0.001
Hemoglobin (g/dl)	9.7 (8.6, 10.8)	9.8 (8.8, 10.9)	9.7 (8.6, 10.8)	9.6 (8.6, 10.8)	9.4 (8.3, 10.6)	9.5 (8.5, 10.7)	9.6 (8.5, 10.8)	9.5 (8.4, 10.7)	<0.001	9.7 (8.6, 10.8)	9.8 (8.6, 10.9)	9.8 (8.8, 10.9)	9.5 (8.4, 10.7)	9.4 (8.2, 10.8)	9.1 (8.4, 9.6)	9.8 (8.8, 10.9)	12.0 (12.0, 12.0)	<0.001

Abbrev.: ESKD, end-stage kidney disease; GN, glomerulonephritis; HD, hemodialysis; PD, peritoneal dialysis; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; TIA, transient ischemic attack; DM, diabetes; HTN, hypertension; PVD, peripheral vascular disease; CAD, coronary artery disease; ESA, erythropoietin stimulating agent; AVF, arteriovenous fistula; AVG, arteriovenous grant; BMI, body mass index; eGFR, estimated glomerular filtration rate.

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