Gender differences in the dialysis treatment of Indigenous and non-Indigenous Australians

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Gender and race interact with socioeconomic factors to influence the development of chronic kidney disease (CKD), progression to end-stage kidney disease (ESKD), access to dialysis treatment and the types of treatments prescribed.[1-3] In Australia, the age-adjusted prevalence of CKD stage 4/5 in the general, predominantly non-Indigenous, population is double in women compared with men (0.37% versus 0.19%).[4] However, the incidence of those who actually receive treatment for ESKD is nearly 40% higher for men than women (98 versus 62 per 100,000 population).[3] In regards to race, the disparity between Indigenous and non-Indigenous Australians is profound: Indigenous Australian adults have eight times the age-adjusted incidence of treated ESKD than non-Indigenous adults (79 versus 10 per 100,000).[5] Treatment rates are inextricably linked to socio-economic factors with the incidence of treated ESKD decreasing with increasing area-level socio-economic advantage in both the Indigenous[6] and non-Indigenous populations.[7,8] The gradient in treatment rates from urban to remote regions is most pronounced within Indigenous Australian peoples with those living in remote areas having up to 30 times the national incidence of treated ESKD.[6] These different risk profiles suggest tailoring treatment approaches for specific patient groups may be beneficial, however an evidence base is required.

A broad and complex range of historical, social, cultural, geographical and economic factors, as well as the more commonly described proximal biomedical risk factors interact to influence racial differences in the incidence of ESKD, subsequent access to treatment and treatment patterns.[9] In Australia, access to dialysis treatment and the types of treatments prescribed differ by Indigenous status.[10,11] However, whether these racial differences in treatment patterns vary by gender is currently unknown. Acknowledging and quantifying any differences in access to and utilisation of dialysis treatment between patients on the basis of both race and gender is an important step towards optimising treatment delivery and maximising benefit for all people living with ESKD. Using a large contemporary cohort, this is the first study to examine gender differences in dialysis treatment utilisation between Indigenous and non-Indigenous Australians.

Methods

Data source and participants

This was a retrospective cohort analysis of all Indigenous (Australian Aboriginal and Torres Strait Islander peoples) and non-Indigenous

Abstract

Objective: Access to dialysis treatment and the types of treatments employed in Australia differs by Indigenous status. We examined whether dialysis treatment utilisation in Indigenous and non-Indigenous Australians also differs by gender.

Methods: Using registry data we evaluated 21,832 incident patients (aged ≥18 years) commencing dialysis, 2001-2013. Incidence rates were calculated and multivariate regression modelling used to examine differences in dialysis treatment (modality, location and vascular access creation) by race and gender.

Results: Dialysis incidence was consistently higher in Indigenous women compared to all other groups. Compared to Indigenous women, both non-Indigenous women and men were more likely to receive peritoneal dialysis as their initial treatment (non-Indigenous women RR=1.91, 95%CI 1.55-2.35; non-Indigenous men RR=1.73, 1.40-2.14) and were more likely to commence initial treatment at home (non-Indigenous women RR=2.07, 1.66-2.59; non-Indigenous men RR=1.95, 1.56-2.45). All groups were significantly more likely than Indigenous women to receive their final treatment at home.

Conclusions: Contemporary dialysis treatment in Australia continues to benefit the dominant non-Indigenous population over the Indigenous population, with non-Indigenous men being particularly advantaged.

Implications for Public Health: Treatment guidelines that incorporate a recognition of gender-based preferences and dialysis treatment options specific to Indigenous Australians may assist in addressing this disparity.

Key words: dialysis, end-stage kidney disease, gender, Indigenous population, inequalities

adults (aged ≥18 years) commencing dialysis in Australia between 1 January 2001 and 31 December 2013 according to the Australia and New Zealand Dialysis and Transplant (ANZDATA) Registry (n=21,832). ANZDATA collects observational data on all individuals receiving kidney replacement therapy in Australia and New Zealand. A pilot audit of ANZDATA indicated that data accuracy was favourable compared with other renal registry validation studies.[12] Complete details of the structure and methods of the registry are reported elsewhere.[13] This study focused on adults receiving dialysis treatment only as those receiving a kidney transplant warrant a separate, detailed investigation.

Measures

Socio-demographic and clinical information routinely reported to ANZDATA by treating nephrology units across Australia at the commencement of treatment include age, gender, race, state of residence, postcode, height, weight, smoking history, medical comorbidities, primary cause of kidney disease, late referral, dialysis access preparation, initial treatment modality and treatment modality at last follow-up. Race was based on self-report and dichotomised as Indigenous (Australian Aboriginal and Torres Strait Islander peoples) and non-Indigenous. Late referral was defined as first nephrology referral occurring <3 months prior to initiation of treatment. Initial dialysis modality and location was classified as that in use 90 days after treatment entry. Dialysis access preparation (prepared dialysis access

being the use of an arteriovenous graft (AVG) or arteriovenous fistula (AVF) at initiation of haemodialysis; unprepared access being the use of a central venous catheter at dialysis initiation) was routinely recorded only from 1 October 2003 thereby restricting this section of the analysis to those who commenced dialysis in October 2003. Body mass index (BMI) was calculated from height and weight and categorised according to standard cut-points.[14] Estimated glomerular filtration rate (eGFR) at initial dialysis was calculated using the CKD-EPI equation.[15,16] Each postcode was assigned a remoteness index (Very Remote/Remote, Inner Regional, Outer Regional, Major Cities) using the Australian Standard Geographical Classification – Remoteness Areas systems.[17]

Treatment characteristics comprised dialysis treatment modality (peritoneal dialysis versus hemodialysis) and location (home versus in-center) at commencement of treatment and at last follow-up, and the type of vascular access (AVG/AVF versus catheter) used at commencement of hemodialysis.

Statistical analysis

The annual incidence of dialysis was calculated as the number of incident women and men receiving dialysis divided by population estimates of the Indigenous and non-Indigenous population from the 2006 Australian Census.[18] These estimates are based on place of usual residence and are adjusted for net Census undercount and non-response to the Census question regarding Indigenous status.

Sociodemographic, clinical and treatment characteristics were compared between Indigenous women, Indigenous men, non-Indigenous women and non-Indigenous men using the Student t test or chi-square test, where appropriate. Using Indigenous women as the reference group, differences in treatment utilisation were examined between groups using Poisson regression with robust variance estimates for dichotomous outcomes.[19] Differences in treatment utilisation between groups were also examined by remoteness area. For this analysis, Very Remote and Remote categories were combined due to the relatively small number of people living in these areas compared to other areas. Effect modification between gender and race was examined by including a two-way interaction term in each regression model. Potential covariates were selected based on a bivariate association at $p<0.25$ and/or clinical relevance. Covariates included in final models are displayed in table footnotes. Clustering (overdispersion) by initial treatment facility was adjusted for using the Taylor-series approximation. Analyses were performed using Stata/IC version 12.1 (Statacorp, 2011) with statistical comparisons treated as significant at α=0.05 (two-tailed).

Results

A total of 1,380 (56%) Indigenous women and 1,088 Indigenous men commenced dialysis from 2001 to 2013. Overall, 638 women and 501 men (46.2% vs 46.0%) died, four women and two men recovered renal function (survival of >30 days following the cessation of dialysis) and no patients were lost to follow-up.

A total of 7,374 (38%) non-Indigenous women and 11,990 non-Indigenous men commenced dialysis from 2001 to 2013. Overall, 3,890 women and 6,445 men died (52.8% vs 53.8%), 68 women and 82 men recovered renal function (survival of >30 days following the cessation of dialysis) and 14 women and 26 men were lost to follow-up.

Figure 1 displays the incidence rates (per million population) of Indigenous and non-Indigenous women and men receiving dialysis treatment in Australia from 2001 to 2013. Results confirm the consistently higher incidence of dialysis treatment in Indigenous Australians compared to non-Indigenous Australians. In terms of gender, incidence was consistently higher in Indigenous women (513 per million population) compared to

Figure 1: Annual incidence of dialysis (per million population) in Australia by race and gender (2001-2013).
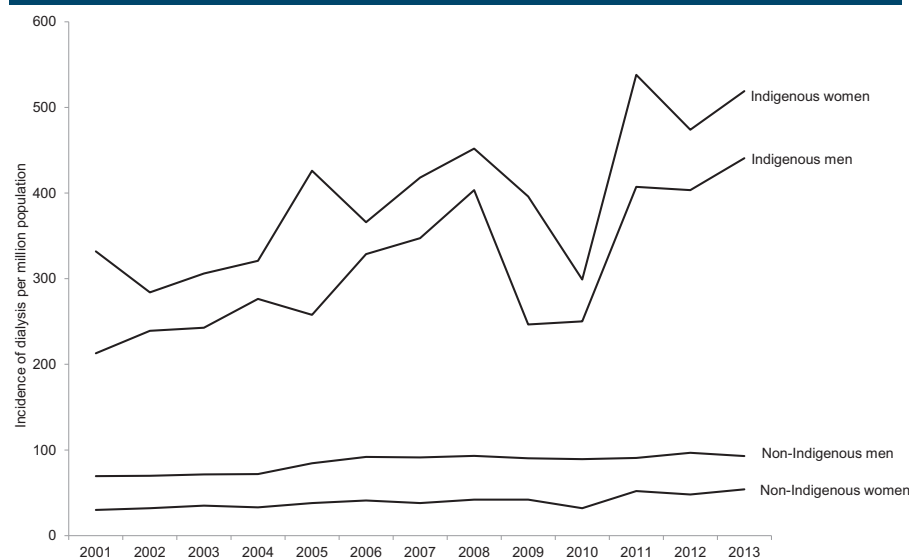
The annual incidence of dialysis was calculated as the number of incident women and men receiving dialysis divided by population estimates of the Indigenous and non-Indigenous population from the 2006 Australian Census[18]

Indigenous men (406 per million population). Conversely, incidence was consistently higher in non-Indigenous men (110 per million population) compared to non-Indigenous women (52 per million population). While there was a suggestion of a downward trend in incident rates among Indigenous Australians from 2009 to 2010, this should be viewed with caution, as there may be issues with the ascertainment of an appropriate denominator in this patient cohort. There are a number of factors which contribute to incident numbers of renal replacement therapy (among both Indigenous and non-Indigenous people). It is unknown whether this stabilisation reflects the underlying rates of diabetes, rates of disease progression, referral patterns or other diseases.[20,21]

The baseline sociodemographic and clinical characteristics of each patient group are displayed in Table 1.

Overall, a significantly higher proportion of non-Indigenous men (62%) commenced dialysis treatment during the study period ($p<0.001$) and initiated treatment with a higher eGFR than the other patient groups ($p<0.001$). The age distribution is notable for the high proportion of non-Indigenous patients aged 60 and older compared to Indigenous patients (73% versus 25%) commencing dialysis treatment. In regards to remoteness area, over 70% of non-Indigenous adults receiving treatment were residing in major cities compared to only 14% of Indigenous adults. A significantly higher proportion of Indigenous men were current or former smokers (75%) and were referred late to nephrology treatment (31%) (both $p<0.001$). As previously observed, diabetic nephropathy was diagnosed as the primary cause of kidney disease in 70% and comorbid diabetes mellitus observed in 82% of all Indigenous dialysis patients (both $p<0.001$). All comorbid conditions, except for diabetes mellitus, were diagnosed in a higher proportion of non-Indigenous men than the other patient groups (all $p<0.01$).

The treatment characteristics of each patient group are displayed in Supplementary Table 1. In summary, a higher proportion of both non-Indigenous women and men commenced treatment with peritoneal dialysis rather than hemodialysis compared to Indigenous women and men (31% versus 22%, $p<0.001$). Of those who received hemodialysis, a higher proportion of non-Indigenous men (42%) received prepared vascular access (AVG/AVF) rather than a

Table 1. Demographic and clinical characteristics of incident dialysis patients (n=21,832) by race and gender (2001-2013).

Characteristic	Indigenous		Non-Indigenous		p value
	Women	Men	Women	Men	
Patients, n (%)	1,380 (55.9)	1,088 (44.1)	7,374 (38.1)	11,990 (61.9)	<0.001
Age category, n (%)					
18-39 years	188 (13.6)	179 (16.5)	387 (5.3)	510 (4.3)	
40-59 years	814 (59.0)	668 (61.4)	1,668 (22.6)	2,631 (21.9)	
60+ years	378 (27.4)	241 (22.2)	5,319 (72.1)	8,849 (73.8)	<0.001
Remoteness area, n (%)					
Very remote	418 (30.3)	284 (26.1)	18 (0.2)	21 (0.2)	
Remote	286 (20.7)	209 (19.2)	66 (0.9)	100 (0.8)	
Outer regional	358 (25.9)	325 (29.9)	571 (7.7)	921 (7.7)	
Inner regional	122 (8.8)	116 (10.7)	1,402 (19.0)	2,344 (19.6)	
Major cities	196 (14.2)	152 (14.1)	5,317 (72.1)	8,604 (71.8)	<0.001
BMI, n (%)					
BMI<20 kg/m^2	98 (7.1)	80 (7.4)	817 (11.1)	593 (5.0)	
BMI 20.0-24.9 kg/m^2	342 (24.8)	297 (27.3)	2,021 (27.4)	3,478 (29.0)	
BMI 25-29.9 kg/m^2	391 (28.3)	327 (30.1)	1,989 (27.0)	4,332 (36.1)	
BMI ≥30 kg/m^2	535 (38.8)	368 (33.9)	2,491 (33.8)	3,492 (29.1)	<0.001
Current/former smoker, n (%)	766 (55.1)	811 (74.6)	2,811 (38.1)	7,872 (65.7)	<0.001
Late referral, n (%)	388 (28.1)	336 (30.9)	1,720 (23.3)	2,784 (23.2)	<0.001
Primary kidney disease, n (%)					
Glomerulonephritis	159 (11.5)	134 (12.3)	1,350 (18.3)	2,366 (19.7)	
Diabetic nephropathy	989 (71.7)	738 (67.9)	2,339 (31.7)	4,156 (34.7)	
Renal vascular disease/hypertension	78 (5.7)	86 (7.9)	1,154 (15.7)	2,395 (20.0)	
Reflux/Analgesic/Polycystic kidney disease	36 (2.6)	23 (2.1)	1,082 (14.7)	759 (6.3)	
Other/Unknown	118 (8.6)	106 (9.8)	1,449 (19.7)	2,314 (19.3)	<0.001
Number of comorbidities, mean ± SD	1.94 ± 1.21	2.00 ± 1.27	1.67 ± 1.31	2.00 ± 1.38	<0.001
Comorbid conditions					
Diabetes mellitus, n (%)	1,159 (84.0)	876 (80.6)	3,272 (44.4)	5,691 (47.5)	<0.001
Chronic lung disease, n (%)	278 (20.1)	211 (19.4)	1,286 (17.4)	2,383 (19.9)	<0.001
Coronary artery disease, n (%)	578 (41.9)	502 (46.2)	2,970 (40.3)	6,392 (53.3)	<0.001
Peripheral vascular disease, n (%)	409 (29.6)	366 (33.7)	1,895 (25.7)	3,963 (33.1)	<0.001
Cerebrovascular disease, n (%)	158 (11.5)	157 (14.4)	1,275 (17.3)	2,274 (19.0)	<0.001
Cancer ever diagnosed, n (%)	96 (7.0)	60 (5.5)	1,626 (22.1)	3,302 (27.5)	<0.001
eGFR, (ml/min/per 1.73m2, mean ± SD)	5.9 ± 3.5	6.3 ± 3.8	7.3 ± 3.9	7.9 ± 4.4	<0.001
[range]	[1.0-41.9]	[0.9-69.0]	[0.9-59.9]	[1.1-116.7]	
Serum creatinine, μmol/L, mean ± SD	786 ± 341	955 ± 460	592 ± 254	686 ± 288	<0.001

Abbreviations: BMI, body mass index; eGFR, estimated glomerular filtration rate; SD, standard deviation.

Smoking status (former or current) was at commencement of treatment and late referrals are patients who commenced treatment <3 months of being referred to a nephrologist. eGFR at first dialysis calculated using the CKD-EPI equation.15,16

catheter compared to the other patient groups ($p<0.001$). At final follow-up, around 30% of both non-Indigenous women and men received dialysis treatment at home compared to 21% of Indigenous men and only 13% of Indigenous women ($p<0.001$).

Figure 2 shows the adjusted relative risks (RR) and 95% confidence intervals (CI) for dialysis treatment utilisation in each patient group. Significant interactions between gender and race were observed for all treatment characteristics; initial treatment modality ($p<0.001$); location of initial dialysis treatment ($p<0.001$); access in use at first hemodialysis ($p<0.01$) and location of dialysis treatment at last follow-up ($p<0.05$) (data not shown).

In regards to initial treatment modality, non-Indigenous women were 91% (RR=1.91; 95% CI 1.55-2.35, $p<0.001$) and non-Indigenous

men 73% (RR=1.73; 1.40-2.14, $p<0.001$) more likely to receive peritoneal dialysis than hemodialysis than Indigenous women after adjustment. For patients receiving hemodialysis, non-Indigenous men were 17% more likely (RR=1.17; 1.05-1.29, $p<0.01$) than Indigenous women to receive prepared access rather than a catheter. In regards to treatment location, non-Indigenous women (RR=2.07; 1.66-2.59, $p<0.001$) and men (RR=1.95; 1.56-2.45, $p<0.001$) were both around twice as likely to receive initial treatment at home rather than in a hospital or satellite facility compared to Indigenous women. Further, both non-Indigenous women (RR=2.70; 1.91-3.83, $p<0.001$) and men (RR=2.92; 2.10-4.06, $p<0.001$) were more than 2.5 times more likely and Indigenous men were 63% (RR=1.63; 1.17-2.26, $p<0.001$)

more likely than Indigenous women to receive dialysis treatment at home at last follow-up. Figure 2 indicates that differences in relative risks for modality and vascular access were greater between non-Indigenous women and men than between Indigenous women and men.

Adjusted relative risks (RR) and 95% confidence intervals (CI) for dialysis treatment utilisation in each patient group stratified by remoteness area are displayed in Supplementary Figure 1. Overall, differences between groups were generally similar irrespective of remoteness area. Non-Indigenous women in all areas and both non-Indigenous women and men living in Inner Regional and Major Cities were significantly more likely to receive peritoneal dialysis than hemodialysis compared to Indigenous women (all $p<0.05$). Only Indigenous men living in Outer Regional areas were significantly more likely than Indigenous women to receive prepared access rather than a catheter (RR=1.21; 1.04-1.42, $p<0.05$). Both non-Indigenous women and men were significantly more likely to receive initial treatment at home rather than in a hospital or satellite facility compared to Indigenous women, irrespective of remoteness area (all $p<0.05$). Finally, all other groups living in Very Remote/Remote and Outer Regional areas were significantly more likely than Indigenous women to receive dialysis treatment at

home at last follow-up (all $p<0.05$) with non-Indigenous men being significantly more likely to receive dialysis treatment at home, irrespective of remoteness area.
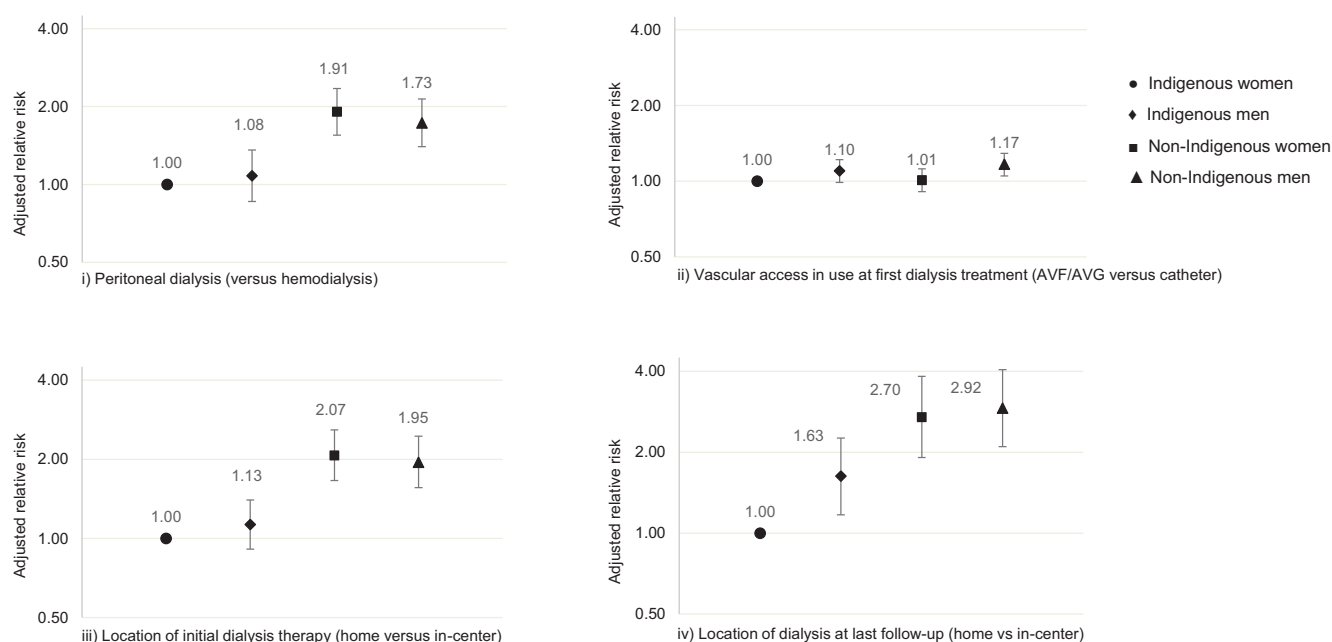
Discussion

Using a large contemporary cohort, we examined the influence of gender and race on dialysis treatment utilisation in Australia, a country with universal access to healthcare. While Indigenous status remains the key driver of differences in contemporary dialysis treatment in Australia, gender is influential. The current analysis highlights a consistently higher incidence of dialysis treatment in Indigenous women compared to Indigenous men across the study period. This pattern is different from that seen in non-Indigenous patients where incidence is consistently higher for men compared to women. The excess of ESKD in Indigenous Australians is well documented,[5,6] with higher rates of albuminuria observed during early adulthood in both urban and remote communities.[22,23] Microalbuminuria is a predictor of progressive kidney and cardiovascular disease in individuals with and without diabetes. Within Indigenous Australians, the higher incidence of dialysis treatment in Indigenous women is likely due to the higher rates of albuminuria observed in this group.[24] While the causal pathways

are complex and multifactorial, factors that potentially contribute to the higher rates of albuminuria in Indigenous women compared to Indigenous men include increased rates of post-streptococcal glomerulonephritis during infancy and early childhood, genetic predisposition involving lower nephron numbers, and increased rates of obesity and metabolic syndrome in adolescence and adulthood leading to insulin resistance and early onset of type 2 diabetes.[24-26] These risk factors are exacerbated by inequalities in access to mainstream services including primary healthcare as well as the lower standard of health-related infrastructure in some Indigenous communities (e.g. housing, food safety, water quality, refuse and sanitation) compared to other Australians.[27] Limited access to educational and employment opportunities, increasing carer responsibilities, and exposure to violence combine to make women in some Aboriginal and Torres Strait Islander communities particularly vulnerable to disparities in access to and utilisation of health services.[27]

Compared with Indigenous women, both non-Indigenous women and men were more likely to receive peritoneal dialysis as their initial treatment modality and more likely to receive their initial and final treatment within their own home. Compared with in-centre dialysis, home based treatments including peritoneal dialysis are associated with

Figure 2: Adjusted relative risks for treatment characteristics in incident dialysis patients (n=21,832) by race and gender (2001-2013).

i) Peritoneal dialysis (versus hemodialysis)

ii) Vascular access in use at first dialysis treatment (AVF/AVG versus catheter)

- ● Indigenous women
- ◆ Indigenous men
- ■ Non-Indigenous women
- ▲ Non-Indigenous men

iii) Location of initial dialysis therapy (home versus in-center)

iv) Location of dialysis at last follow-up (home vs in-center)

Relative risks adjusted for age category, late referral, primary kidney disease, number of medical comorbidities, smoking, body mass index, remoteness area and clustering by initial treatment facility. Error bars display 95% confidence intervals.

improved survival, health-related quality of life, and reduced healthcare costs.[28,29] While timely patient education and support for informed decision-making has been shown to improve the uptake of home dialysis therapies[30] beliefs, attitudes and preferences towards dialysis education and decision-making are not well understood. Decision-making reflects differences in culture, medical attitudes, resource availability, health care funding, clinical appropriateness and patient preferences.[1] Patient preferences may also be influenced by life expectancy, number of hospital visits per week, ability to travel, hours per treatment, treatment time of day, subsidised transport service, and flexibility of treatment schedule.[31]

The different geographical locations, whereby nearly half of the Indigenous patients live in remote or very remote areas compared to one percent of the non-Indigenous men and women also suggests itself as a cause. Preferences, especially for the Indigenous patients, are likely highly constrained by the geographic proximity to a major dialysis centre and the increased need for home resources associated with home hemodialysis (e.g. costs of home utilities and suitable water supply). The cost of hemodialysis extends beyond fiscal to the impact on patients, families, and communities of the dislocation and emotional, physical and spiritual suffering caused.[32] Indigenous patients and their healthcare providers have stressed the importance of community renal nurse support in enabling more patients to access dialysis at home.[33] Home dialysis for remote Indigenous patients has in turn been shown to increase compliance and self-care, leading to enhanced quality of life and treatment outcomes.[34,35]

Improving the cultural competence of non-Indigenous health care providers within renal services may also improve service provision for Indigenous people with ESKD. For example, the presence of Indigenous health workers within mainstream health services is known to enhance engagement and rapport with healthcare professionals and improve treatment outcomes for Indigenous patients.[36,37] Indigenous health workers assist in communication barriers between patients and individual clinicians, act as a patient advocate and provide a cultural bridge between patients and their families, and healthcare providers.[38] Indigenous health workers, especially those able to work within patient's home communities, can also assist

with the requisite lifestyle requirements and the rigours and difficulty of complying with treatment regimens away from larger health care settings. Such support is particularly important for Indigenous women. Many women are likely to have substantial childcare responsibilities, often caring for more children than their own, alongside responsibilities for older people within their communities. Within the high level and frequency of these daily obligations, the opportunity and urgency to prioritise their own health needs can become diminished.

Therefore, while gender influences dialysis treatment utilisation, the key explanatory in the current analysis is Indigenous status. ESKD encompasses both social and cultural determinants. All on the database were diagnosed with the same disease, in the same nation, but from there a multi-faceted lived experience gap emerges. The disparity in age at diagnosis; the very different patterns of geographic location, and what that means for treatment options; the size of the excess rates of ESKD for Indigenous patients; the differences in co-morbidities, treatment modality and treatment location access suggest different worlds of disease experience. Differing ESKD experience patterns also have socio-cultural dimensions. The relatively young age of the Indigenous men and women suggest, in contrast to the non-Indigenous group that the highest impact is among those bearing significant familial responsibilities as grandparents and in prime age for leadership roles within their communities.

Data from the current research cannot provide clear explanations for the experience gap. At least a partial explanation, however, is likely intricately bound into the differing frame of Indigenous life circumstances. The high level, embedded, persistent and long standing socio-economic disadvantage of Indigenous Australian lives manifests in poor housing conditions, over-crowding, poor-functioning amenities, whole of community poverty, low literacy, poor food supplies and health knowledge for a substantial proportion of the Aboriginal and Torres Strait Islander population.[39] Such circumstances raise the likelihood of experiencing ESKD and circumscribe choice and the capacity to enact those preferences once disease is diagnosed. Further research is required to explain how patient preferences and treatment options are interacting at the level of lived experience.

This is the first comprehensive analysis of differences in dialysis treatment utilisation between Indigenous and non-Indigenous women and men in Australia. Strengths of the study include its large sample size, national coverage, completeness of follow-up (only 48 of 21,627 patients were lost to follow-up), lack of missing data and long follow-up period. However, these strengths should be balanced against several limitations. These include possible selection bias introduced through analysis of a cohort who actually commenced dialysis and potential confounding from unmeasured factors. For example, markers of socioeconomic status including data regarding household income, education and private health insurance are not collected by ANZDATA. Further, while the analysis was adjusted for number of co-morbidities, severity may be a better indicator of medical suitability for different treatments. ANZDATA does not currently collect data regarding severity, however the number of comorbidities recorded in ANZDATA has been found to be a strong predictor of mortality in Indigenous and non-Indigenous dialysis patients.[40] The accuracy of Indigenous identification is also an important source of potential bias. However, a recent pilot audit found 100% agreement between the audit result and ANZDATA in regards to racial origin, providing some reassurance.[12] The extent to which selection bias may have occurred cannot be determined as it is unknown what processes occurred at the primary-care level (e.g. deciding who to refer to a nephrologist) or after referral to a nephrologist (e.g. deciding who should be offered dialysis). Importantly, likely determinants of initial treatment such as health literacy, patient motivation, medical suitability for home dialysis, distance from home to treatment centre, and attitudes to self-management are not recorded in ANZDATA.

In summary, the current analysis confirms that contemporary dialysis treatment in Australia continues to benefit the dominant non-Indigenous population over the Indigenous population, with non-Indigenous men being particularly advantaged. Ecological studies such as this are an important step in acknowledging and quantifying differences in access to and utilisation of healthcare. Results confirm the disparity in the delivery of renal care in Australia and the consequences are not just different treatment outcomes but reflect, and likely reinforce disparities in socio-economic outcomes and life chances.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary Table 1: Treatment characteristics of incident dialysis patients (N=21,832) by race and gender (2001-2013).

Supplementary Figure 1: Adjusted relative risks for treatment characteristics in incident dialysis patients (N=21,832) by remoteness area (2001-2013).