

BRIEF COMMUNICATION **OPEN ACCESS**

Registry-Based Living Kidney Donor Follow-Up in Australia: An ANZLKD Analysis 2003–2021

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ABSTRACT

The Australia and New Zealand Live Kidney Donor (ANZLKD) Registry is the binational registry for recording live kidney donor outcomes in Australia and New Zealand. In this retrospective analysis, it is demonstrated that only 2.93% of living kidney donors in Australia across 2004–2021 have adequate follow-up data recorded in ANZLKD. Response rates recorded through ANZLKD gradually decline from year after donation, starting at 38% at 1 year and reaching 1.6% at 15 years. Factors associated with adequate follow-up in ANZLKD included reduced eGFR and later donation year. This is amongst the first studies to objectively assess kidney donor follow-up recorded in ANZLKD and highlights a critical gap in binationally documented donor follow-up and outcome monitoring in live kidney donors. This study highlights the urgent need to improve live kidney donor data input in ANZLKD and/or live kidney donor follow-up.

1 | Introduction

Living kidney transplantation rests upon ensuring donor as well as recipient safety as core tenets. Living kidney donors have a roughly ten times increased relative risk of kidney failure following donation, although the absolute risk remains low [1]. National follow-up data of living kidney donors are recorded by nephrologists and kidney health service staff through the Australian and New Zealand Living Kidney Donation Registry (ANZLKD). The Kidney Disease Improving Global Outcomes (KDIGO) clinical practice guideline on the evaluation and care of living kidney donors recommends at least annual post-donation follow-up [2]. Annual follow-up is essential to prevent and screen for hypertension, proteinuria and gestational hypertension/

pre-eclampsia and diabetes mellitus—all of which occur at higher rates after donor nephrectomy [3]. Recent evaluation of mortality data from ANZLKD showed that two-thirds of living kidney donor deaths were not captured in ANZLKD [4]. The follow-up rate of living kidney donors recorded by ANZLKD has not been assessed to date. This retrospective cohort study aims to define living kidney donor characteristics and follow-up rates as recorded in ANZLKD.

2 | Methods

This study was approved by the Royal Brisbane and Women's Hospital Human Research Ethics Committee (LNR/2020/

MSYN and AJM contributed equally to this work as senior authors.

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QRBW/63492) and ANZLKD (Request ID: ANZREQ-196). All ANZLKD participants have provided informed consent, and this study was conducted in adherence with the Declaration of Helsinki. The clinical and research activities being reported are consistent with the principles of the Declaration of Istanbul as outlined in the 'Declaration of Istanbul on Organ Trafficking and Transplant Tourism'. Demographic and follow-up data on living kidney donors from 2004 to 2021 were extracted from ANZLKD. Participants were categorised as having adequate or inadequate follow-up. Adequate documented follow-up in ANZLKD was defined in concordance with the 2017 KDIGO clinical practice guidelines, which recommend annual kidney donor follow-up. This was defined in this study as information recorded in the registry each year up to 31 December 2021 or date of death; whichever occurred earliest [2]. Other participants were defined as having inadequate follow-up. Demographic features including follow-up duration in years, gender, donor age, donor ethnicity, relationship with recipient, body mass index (BMI), smoking status, family history of diabetes, diabetes status, hypertension, mean number of drugs, mean systolic blood pressure, mean diastolic blood pressure, mean serum creatinine, mean estimated glomerular filtration rate (eGFR) as calculated by Chronic Kidney Disease Epidemiology Collaboration equation (CKD-EPI equation), mean urine albumin: creatinine ratio, mean 24-h proteinuria, donation year, adverse infection, adverse infection site, hospital length of stay, discharge serum creatinine and socioeconomic indexes for areas (SEIFA) between cases with adequate and inadequate follow-up were compared using chi-squared tests for discrete variables and independent sample T test for continuous variables (Table 1). Bonferroni correction was used, and the significance threshold was set at $p < 0.002$ to adjust for multiple comparisons.

3 | Results

Only 2.93% (125/4264) of living kidney donors in Australia had adequate follow-up as recorded through ANZLKD. Response rates recorded through ANZLKD gradually decline from year after donation, starting at 38% at 1 year and reaching 1.6% at 15 years (Figure 1). Donors with inadequate follow-up had an average of 6.37 years (SD 4.52 years) since the last response, compared to donors with adequate follow-up of 4.43 years (SD 3.26 years) ($p < 0.001$). Donors with adequate follow-up were more likely to have a later donation period ($p < 0.001$), lower eGFR ($p < 0.002$) and lower mean 24-h proteinuria ($p < 0.002$, Table 1). One-year follow-up rates for people donating kidneys in 2003–2008, 2009–2014 and 2015–2020 were 37.8%, 48.9% and 26.1%, respectively ($p < 0.0001$). Two-year follow-up rates for people donating kidneys in 2003–2008, 2009–2014 and 2015–2020 were 27.9%, 34.9% and 18.6%, respectively ($p < 0.0001$). Five-year follow-up rates reduced from 23.6% for those donating in 2003–2008 to 23.0% for those donating in 2009–2014 ($p = 0.70$). There were no donors with documented kidney failure in ANZLKD.

4 | Discussion

This is the first study to demonstrate that the majority of Australians living kidney donors do not have annual follow-up

documented through ANZLKD. These results concur with the findings of an ANZLKD-National Death Register data linkage study identifying that only 31% of live kidney donor deaths were recorded in ANZLKD [4].

Australian documented living kidney donor follow-up rates in ANZLKD are lower than international rates of 41% two years post-donation in Canada, 58% two years post-donation in South Korea, 84% two years post-donation in Japan and 61% one year post-donation in Japan and 61% one year post-donation in the United States of America [5–8]. The former two studies were single centre studies with access to medical record data—potentially improving observed response rates. Strategies to improve living kidney donor follow-up are urgently needed. In 2013, the United States of America, implementation of national policy that mandated timely follow-up data collection at 6 months, 1 year and 2 years post living kidney donation. This improved the proportion of donors with data collection to 54% post-policy compared to 33% pre-policy [9]. Improving early post-donation follow-up is associated with better long-term follow-up [5, 10]. Completing a 6 month follow-up is associated with completing a 12 month follow-up, and early guideline-concordant follow-up in the first two years post-donation is associated with improved follow-up at 5 and 10 years post-donation [5, 10]. Within the United Kingdom, annual lifelong follow-up can be arranged through a donor's primary care provider, with additional transplant centre reviews as clinically required [11]. Donor factors affecting adherence to guideline-concordant follow-up such as attitudes towards follow-up and its' financial burden also need to be addressed [10, 12].

Similar to our study, adequate follow-up after kidney donation was associated with a lower eGFR and later donation period but not proteinuria in 460 live kidney donors across Alberta, Canada [5]. In that study, higher age at kidney donation, increased distance from the transplant centre, reduced physician visits in the year prior to donation and a lower number of albuminuria measurements in the year prior to donation were also associated with the absence of early guideline-concordant care. Secondary analysis of medical record data from a single centre in South Korea identified that being a current smoker and follow-up completed by a kidney specialist, but not age at donation, were linked with inadequate kidney donor follow-up [6]. Notably, smoking status was not associated with follow-up adequacy in our study; however, current smokers comprised a small proportion of live kidney organ donors (1%–4%). These results confirm that factors correlated with the adequacy of follow-up post kidney donation vary between jurisdictions due to demographic, socioeconomic and health system factors; necessitating registries to track local follow-up rates [13].

This study identified significant gaps in live kidney donor follow-up data in ANZLKD. A weakness of this study includes the inability to differentiate between different reasons for low response rates to ANZLKD, such as decreased actual follow-up, donor travel outside of Australia, a shift towards general practitioner follow-up and/or reduced reporting to ANZLKD. Data entry in ANZLKD is primarily facilitated by kidney specialists; however, donor follow-up can also occur via primary care doctors. To access actual kidney donor follow-up, data linkage could be used to assess the frequency of

TABLE 1 | Demographic factors.

Donor characteristic	Inadequate follow-up (n = 4139)	Adequate follow-up (n = 125)	p-value
Follow-up in years (SD)	6.37 (4.52)	4.43 (3.26)	< 0.001
Gender			0.80
Female	2369 (57.2)	73 (58.4)	
Male	1770 (42.8)	52 (41.6)	
Missing	0 (0)	0 (0)	
Age			0.59
18–44	1231 (29.3)	36 (28.8)	
45–54	1334 (32.2)	46 (36.8)	
55–64	1202 (29.0)	30 (24.0)	
65+	389 (9.4)	13 (10.4)	
Missing	1 (0.02)	0 (0)	
Ethnicity			0.14
White	3619 (87.4)	113 (90.4)	
Asian	175 (4.2)	1 (0.8)	
ATSI	80 (1.9)	1 (0.8)	
Māori	11 (0.3)	1 (0.8)	
Other	254 (6.1)	9 (7.2)	
Recipient relationship			0.013
1° related	2096 (50.6)	52 (41.6)	
2° or 3° related	200 (4.8)	2 (1.6)	
Unrelated	1843 (44.5)	71 (56.8)	
BMI, kg/m ²			0.15
25–29.9	1382 (33.4)	46 (36.8)	
30	1770 (42.8)	58 (46.4)	
30	737 (17.8)	19 (15.2)	
Missing	250 (6.0)	2 (1.6)	
Smoking at donation			0.17
Current	176 (4.3)	2 (1.6)	
Former	1409 (34.0)	37 (29.6)	
Never	2456 (59.3)	85 (68.0)	
Missing	98 (2.4)	1 (0.8)	
Family history of diabetes			0.021
No	3117 (75.3)	104 (83.2)	
Yes	656 (15.8)	18 (14.4)	
Unknown	272 (6.6)	1 (0.8)	
Missing	94 (2.3)	2 (1.6)	
Diabetes			0.070
No	4044 (97.7)	123 (98.4)	

(Continues)

TABLE 1 | (Continued)

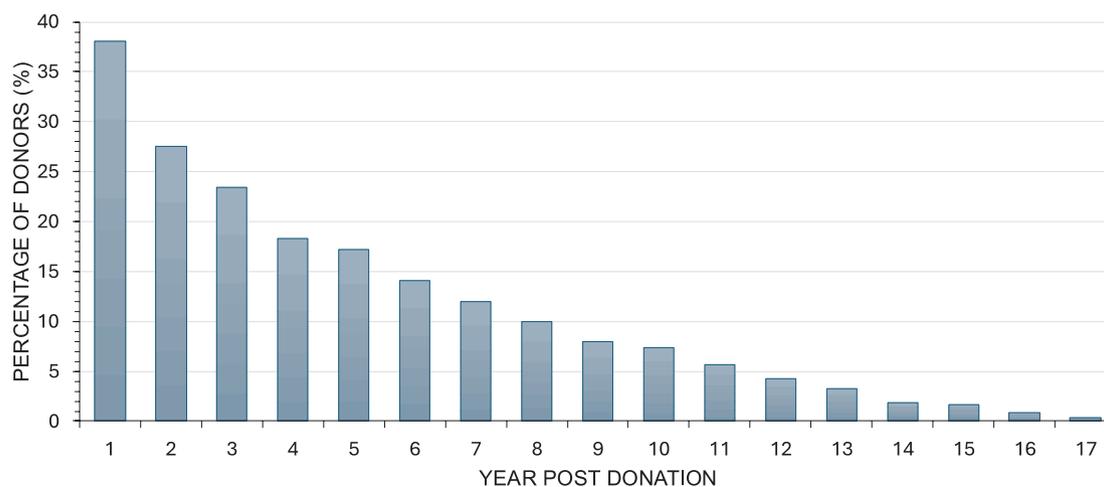
Donor characteristic	Inadequate follow-up (n = 4139)	Adequate follow-up (n = 125)	p-value
Yes	9 (0.2)	0 (0)	
Gestational	12 (0.3)	2 (1.6)	
Missing	74 (1.8)	0 (0)	
Hypertension			0.038
No	3606 (87.1)	102 (81.6)	
Yes	473 (11.4)	23 (18.4)	
Missing	60 (1.4)	0 (0)	
Mean number of drugs (SD)	1.25 (0.51)	1.22 (0.51)	0.76
Missing	3678	102	
Mean systolic BP (SD)	123.68 (12.89)	126.45 (13.15)	0.021
Missing	171	6	
Mean diastolic BP (SD)	74.32 (8.54)	73.96 (7.54)	0.65
Missing	172	6	
Mean serum creatinine (SD)	73.65 (7.54)	72.27 (14.08)	0.30
Missing	54	0	
Mean GFR (SD)	110.18 (22.86)	103.50 (23.38)	0.00162
Missing			
Mean albumin: creatinine ratio (SD)	1.65 (5.81)	1.35 (2.69)	0.70
Missing	3126	65	
Mean 24 h proteinuria (SD)	87.21 (84.0)	56.2 (59.30)	0.00179
Missing	1449	52	
Donation year			<0.001
2003–2008	1301 (31.4)	9 (7.2)	
2009–2014	1528 (36.9)	26 (20.8)	
2015–2020	1310 (31.7)	90 (72.0)	
Missing	0 (0)	0 (0)	
Adverse infection			0.057
No	3888 (93.9)	121 (96.8)	
Yes	186 (4.5)	1 (0.8)	
Missing	65 (1.6)	3 (2.4)	
Adverse infection site			0.63
Lung	65 (1.6)	0 (0)	
Urine	41 (1.0)	0 (0)	
Wound	49 (1.2)	1 (0.8)	
Other	26 (0.6)	0 (0)	
Missing	3958 (95.6)	124 (99.2)	
UTI organism			0.49
<i>E. coli</i>	42 (1.0)	1 (0.8)	

(Continues)

TABLE 1 | (Continued)

Donor characteristic	Inadequate follow-up (n = 4139)	Adequate follow-up (n = 125)	p-value
<i>Klebsiella</i> sp.	11 (0.3)	0 (0)	
<i>Enterococcus</i> sp.	18 (0.4)	0 (0)	
Other	34 (0.8)	2 (1.6)	
Not isolated	11 (0.3)	1 (0.8)	
Missing	4023 (97.2)	121 (96.8)	
Days in hospital (SD)	4.64 (1.52)	4.55 (1.74)	0.51
Missing	77	3	
Discharge serum creatinine (SD)	108.68 (24.90)	110.93 (24.94)	0.39
Missing	102	4	
SEIFA decile at donation			
Disadvantage	1005.53 (67.12)	1010.65 (55.46)	0.32
Advantage	1005.25 (74.91)	1011.62 (61.24)	0.26
Economic resources	1003.92 (62.85)	1007.54 (56.12)	0.53
Education + occupation	1004.69 (83.10)	1010.77 (65.53)	0.32
Missing	198	1	
Region			0.17
Major city	2704 (65.3)	90 (72.0)	
Regional	1183 (28.6)	33 (26.4)	
Remote	57 (1.4)	1 (0.8)	
Missing	195 (4.7)	1 (0.8)	

Abbreviations: BMI = body mass index, SD = standard deviation, SEIFA = socioeconomic indexes for areas, UTI = urinary tract infection.



Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
F/up	1623	1171	997	778	731	601	511	425	339	312	242	181	139	77	68	34	14
Total	4264	4261	4258	4256	4253	4251	4248	4245	4243	4240	4237	4236	4235	4235	4235	4234	4233

FIGURE 1 | Living kidney donor response rates (per year since donation) as recorded through ANZLKD.

blood tests, primary care physician and kidney specialist reviews after kidney donation.

Increased ANZLKD awareness and access to the ANZLKD platform (e.g., enabling general practice physician data entry)

may improve data reporting for the latter two scenarios. Further developments (e.g., dedicated clinics or mandated national policy, similar to the current kidney replacement therapy policy) to facilitate annual lifelong follow-up post-donation are required to improve long-term live kidney donor follow-up and data

collection. The acquisition of national long-term follow-up data is essential to improve our understanding of local living kidney donors for benchmarking and resource allocation.

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Conflicts of Interest

The authors do not have any relevant conflicts to declare.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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