

SUPPLEMENTAL MATERIAL

Table of Contents

SUPPLEMENTAL TABLE 1: Comparison of clinical and demographic features of children included in study analyses and those excluded due to missing data.	2
SUPPLEMENTARY TABLE 2: Crude and multivariable models for associations between distance and socioeconomic deprivation with late presentation ($n=2001$).	3
SUPPLEMENTARY TABLE 3: Crude and multivariable models for associations between distance and socioeconomic deprivation with pre-emptive transplantation ($n=1529$).	4
SUPPLEMENTAL TABLE 4: Sensitivity analyses: Late presentation outcome	6
SUPPLEMENTAL TABLE 5: Sensitivity analyses: Pre-emptive transplantation outcome	6
SUPPLEMENTAL FILE 1: Description of the Index of Multiple Deprivation	7

SUPPLEMENTAL TABLE 1: Comparison of clinical and demographic features of children included in study analyses and those excluded due to missing data.

	Late presentation analysis		Pre-emptive transplantation analysis	
	Included study cohort (<i>n</i> =2001)	Cohort with missing data (<i>n</i> =159)	Included study cohort (<i>n</i> =1529)	Cohort with missing data (<i>n</i> =153)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Male sex	1173 (59)	97 (61)	964 (63)	94 (61)
Socioeconomic deprivation quintile				
1	576 (29)	31 (20)	432 (28)	30 (20)
2	476 (24)	49 (31)	386 (25)	46 (30)
3	352 (18)	30 (19)	250 (16)	29 (19)
4	325 (16)	28 (18)	254 (17)	27 (18)
5	272 (14)	21 (13)	207 (14)	21 (14)
Median distance to centre (km, IQR)	26 (12-57)	35 (16-70)	26 (12-57)	35 (16-69)
Median age at KRT start (years, IQR)	10 (5-13)	13 (7-14)	10 (5-13)	13 (7-14)
Ethnicity				
Black	69 (3)	7 (5)	47 (3)	6 (4)
South Asian	324 (16)	21 (15)	249(16)	20 (15)
White	1507 (75)	98 (72)	1162 (76)	97 (72)
Other	101 (5)	11 (8)	71 (5)	11 (8)
Primary Kidney Disease				
Tubulointerstitial disease	991 (50)	65 (46)	838 (55)	65 (47)
Glomerular disease	429 (21)	32 (23)	312 (20)	31 (22)
Familial/Hereditary disease	332 (17)	16 (11)	238 (16)	16 (12)
Systematic diseases affecting kidney	84 (4)	6 (4)	56 (4)	6 (4)
Miscellaneous kidney disease	165 (8)	22 (16)	85 (6)	20 (14)
Year of KRT start				
1996-2000	427 (21)	30 (19)	326 (21)	29 (19)
2001-2005	441 (22)	55 (35)	329 (22)	55 (36)
2006-2010	521 (26)	26 (16)	393 (26)	25 (16)
2011-2016	612 (31)	48 (30)	481 (31)	44 (29)
Modality at start				
Hemodialysis	539 (30)	39 (30)	366 (27)	36 (29)
Peritoneal dialysis	723 (41)	42 (32)	503 (36)	41 (33)
Transplant	512 (29)	49 (38)	512 (37)	49 (39)
Median eGFR (IQR) at first seen date (ml/min/1.73m²)	16 (8-34)	14 (9-34)	22 (12-41)	17 (11-34)
Median eGFR (IQR) at KRT start (ml/min/1.73m²)	9 (7-12)	10 (7-15)	10 (7-13)	10 (7-15)

Abbreviations: eGFR, estimated Glomerular Filtration Rate; IQR, interquartile range; KRT, Kidney replacement Therapy.

Late presentation analysis

Study cohort: modality at start missing for $n=227$; eGFR at first nephrology review missing for $n=557$; eGFR at start missing for $n=240$.

Missing cohort: ethnicity missing for $n=22$; primary kidney disease missing for $n=18$; modality at start missing for $n=29$; eGFR at first nephrology review missing for $n=143$; eGFR at start missing for $n=122$.

Pre-emptive transplantation analysis

Study cohort: modality at start missing for $n=148$; eGFR at first nephrology review missing for $n=461$; eGFR at start missing for $n=172$.

Missing cohort: ethnicity missing for $n=19$; primary kidney disease missing for $n=15$; modality at start missing for $n=27$; eGFR at first nephrology review missing for $n=141$; eGFR at start missing for $n=119$.

SUPPLEMENTARY TABLE 2: Crude and multivariable models for associations between distance and socioeconomic deprivation with late presentation ($n=2001$).

Crude	Total	Direct
-------	-------	--------

	effect ¹		effect ²	
	odds ratio	95% CI	odds ratio	95% CI
Distance (per 10km)	1.01	(0.98,1.03)		
Socioeconomic deprivation (per quintile higher)	1.00	(0.93,1.08)	1.05	(0.96,1.15)
Male sex			0.62	(0.49,0.79)
Age at first nephrology review				
≤2 years			Ref	Ref
≤4 years			2.18	(1.35,3.50)
≤8 years			2.96	(2.02,4.34)
≤12 years			5.90	(4.14,8.41)
≤16 years			19.02	(13.26,27.29)
Primary Kidney Disease				
Tubulointerstitial disease			Ref	Ref
Glomerular disease			1.41	(1.03,1.92)
Familial/Hereditary disease			1.89	(1.35,2.64)
Systemic diseases affecting the kidney			3.34	(1.94,5.76)
Miscellaneous renal disease			4.33	(2.87,6.52)
Period of KRT start				
1996-2000			Ref	Ref
2001-2005			1.22	(0.85,1.74)
2006-2010			1.16	(0.82,1.64)
2011-2016			0.99	(0.70,1.41)
Ethnicity				
White			Ref	Ref
Black			1.55	(0.83,2.90)
South Asian			0.99	(0.70,1.41)
Other			2.14	(1.27,3.60)
Transplanting base centre				1.29 (0.85,1.95)

Abbreviations: CI, confidence interval; KRT, kidney replacement therapy.

¹Model represents total effect of socioeconomic deprivation on outcome; because distance to centre and whether base nephrology unit is a transplanting centre are thought to mediate any deprivation-outcome association, these are omitted from the multivariable model.

²Multivariable model looks at direct effect of exposure on outcome: variables included in model are distance (per 10km) socioeconomic deprivation, sex, age-group, ethnic group, primary kidney disease, period of KRT start and whether base nephrology unit is a transplanting centre.

SUPPLEMENTARY TABLE 3: Crude and multivariable models for associations between distance and socioeconomic deprivation with pre-emptive transplantation (*n*=1529).

	Crude	Total	Direct
--	-------	-------	--------

			effect ¹		effect ²	
	odds ratio	95% CI	odds ratio	95% CI	odds ratio	95% CI
Socioeconomic deprivation (per quintile higher)	1.21	(1.12,1.31)	1.21	(1.10,1.32)	1.20	(1.10,1.31)
Distance (per 10km)	1.04	(1.01, 1.06)			1.02	(0.99,1.05)
Male sex			1.38	(1.07,1.78)	1.37	(1.07,1.77)
Age at KRT start						
≤2 years			0.06	(0.03,0.12)	0.06	(0.03,0.12)
≤4 years			0.58	(0.38,0.88)	0.58	(0.38,0.88)
≤8 years			0.90	(0.65,1.25)	0.91	(0.65,1.26)
≤12 years			0.77	(0.57,1.03)	0.77	(0.57,1.04)
≤16 years			Ref		Ref	
Primary Kidney Disease						
Tubulointerstitial disease			Ref		Ref	
Glomerular disease			0.07	(0.04,0.12)	0.07	(0.04,0.12)
Familial/Hereditary disease			0.60	(0.44,0.83)	0.60	(0.43,0.83)
Systemic diseases affecting the kidney			0.74	(0.41,1.31)	0.73	(0.41,1.31)
Miscellaneous renal disease			0.47	(0.28,0.80)	0.47	(0.28,0.80)
Period of KRT start						
1996-2000			Ref		Ref	
2001-2005			0.93	(0.64,1.34)	0.93	(0.64,1.35)
2006-2010			1.40	(0.99,1.99)	1.38	(0.97,1.96)
2011-2016			1.35	(0.96,1.90)	1.36	(0.96,1.91)
Ethnicity						
White			Ref		Ref	
Black			0.30	(0.12,0.77)	0.31	(0.12,0.80)
South Asian			0.50	(0.35,0.72)	0.52	(0.36,0.76)
Other			0.62	(0.34,1.13)	0.64	(0.35,1.18)
Transplanting base centre					1.10	(0.75,1.60)

Abbreviations: CI, confidence interval; KRT, kidney replacement therapy.

¹Model represents total effect of socioeconomic deprivation on outcome; because distance to centre and whether base nephrology unit is a transplanting centre are thought to mediate any deprivation-outcome association, these are omitted from the multivariable model.

²Multivariable model looks at direct effect of exposure on outcome: variables included in model are distance (per 10km) socioeconomic deprivation, sex, age-group, ethnic group, primary kidney disease, period of KRT start and whether base nephrology unit is a transplanting centre.

SUPPLEMENTAL TABLE 4: Sensitivity analyses: Late presentation outcome

Exposure variable	Multivariable model OR: Including comorbidity data (95% CI) n=670	Multivariable model OR: White patients only n=1507	Multivariable model OR: Late presentation definition of 180 days (95% CI) n=2001	Multivariable model OR: Late presentation definition of 365 days (95% CI) n=2001
Socioeconomic deprivation (per quintile higher)^a	1.08 (0.92, 1.27)	1.10 (0.99, 1.21)	1.08 (0.99, 1.17)	1.07 (0.99, 1.16)
Distance to centre (per 10km)	0.96 (0.91, 1.02)	1.00 (0.98, 1.03)	1.00 (0.98, 1.02)	1.00 (0.97, 1.02)
Urban location^b	-	1.09 (0.78, 1.54)	0.90 (0.67, 1.22)	0.88 (0.66, 1.17)

Abbreviations: CI, confidence interval; OR, odds ratio.

Direct effect estimates reported for each sensitivity analysis; ethnicity is included as a binary variable (White/non-White) in the comorbidity analysis.

^aSocioeconomic deprivation is parameterised as an ordinal variable, as this offered the best goodness of fit. Odds ratios represent unit change in odds for each higher quintile of deprivation (or higher area affluence).

^bDue to small sample size, comorbidity sensitivity analysis is not conducted for urban location exposure. *n*=1448 included in White patients only model; *n*=1942 for analyses of alternative time-based definitions of late presentation.

SUPPLEMENTAL TABLE 5: Sensitivity analyses: Pre-emptive transplantation outcome

Exposure variable	Multivariable model OR: Including comorbidity data (95% CI) n=527	Multivariable model OR: Excluding ≤2 years (95% CI) n=1358	Multivariable model OR: White patients only n=1162
Socioeconomic deprivation (per quintile higher)^a	1.27 (1.08, 1.49)	1.21 (1.10, 1.32)	1.21 (1.09, 1.33)
Distance to centre (per 10km)	1.02 (0.97, 1.07)	1.02 (0.99, 1.05)	1.02 (0.99, 1.05)
Urban location^b	-	1.13 (0.80, 1.58)	1.13 (0.80, 1.58)

Abbreviations: CI, confidence interval; OR, odds ratio.

Direct effect estimates reported for each sensitivity analysis; ethnicity is included as a binary variable (White/non-White) in the comorbidity analysis.

^aSocioeconomic deprivation is parameterised as an ordinal variable, as this offered the best goodness of fit. Odds ratios represent unit change in odds for each higher quintile of deprivation (or higher area affluence).

^bDue to small sample size, comorbidity sensitivity analysis is not conducted for urban location exposure. *n*=1313 for rural urban analysis excluding ≤2 years; *n*=1113 for White patients only model.

SUPPLEMENTAL FILE 1: Description of the Index of Multiple Deprivation
Modified from <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015> and section 3.1.1 of the technical report:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/464485/English_Indices_of_Deprivation_2015_-_Technical-Report.pdf

The Index of Multiple Deprivation is a routinely used ecological relative measure based on census data and produced by the Government. The construction of the Indices of Deprivation 2015, including the Index of Multiple Deprivation broadly consists of the following seven stages.

1. Dimensions (referred to as domains) of deprivation are clearly identified (see below).
2. Indicators are chosen which provide the best possible measure of each domain of deprivation.
3. 'Shrinkage estimation' is used to improve reliability of the small area data.
4. Indicators are combined to form the domains, generating separate domain scores. These can be regarded as indices in their own right – the domain indices.
5. Domain scores are ranked and the domain ranks are transformed to a specified exponential distribution.
6. The exponentially transformed domain scores are combined using appropriate domain weights to form an overall Index of Multiple Deprivation at small area level. This stage completes the construction of the Indices of Deprivation 2015 at Lower-layer Super Output Area (LSOA) level.
7. The overall Index of Multiple Deprivation, the domains and the supplementary indices are summarised for higher level geographical areas such as local authority districts.

The Indices of Deprivation 2015 provide a set of relative measures of deprivation for small areas (Lower-layer Super Output Areas, LSOA) across England, based on seven domains of deprivation which are as follows:

- The **Income Deprivation** domain measures the proportion of the population experiencing deprivation relating to low income. The definition of low income used includes both those people that are out-of-work, and those that are in work but who have low earnings (and who satisfy the respective means tests).
- The **Employment Deprivation** domain measures the proportion of the working-age population in an area involuntarily excluded from the labour market. This includes people who would like to work but are unable to do so due to unemployment, sickness or disability, or caring responsibilities.
- The **Education, Skills and Training Deprivation** domain measures the lack of attainment and skills in the local population. The indicators fall into two sub-domains: one relating to children and young people and one relating to adult skills.
- The **Health Deprivation and Disability** domain measures the risk of premature death and the impairment of quality of life through poor physical or mental health. The domain measures morbidity, disability and premature mortality but not aspects of behaviour or environment that may be predictive of future health deprivation.

- The **Crime** domain measures the risk of personal and material victimisation at local level.
- The **Barriers to Housing and Services** domain measures the physical and financial accessibility of housing and local services. The indicators fall into two sub-domains: 'geographical barriers', which relate to the physical proximity of local services, and 'wider barriers' which includes issues relating to access to housing such as affordability.
- The **Living Environment Deprivation** domain measures the quality of the local environment. The indicators fall into two sub-domains. The 'indoors' living environment measures the quality of housing; while the 'outdoors' living environment contains measures of air quality and road traffic accidents.

This is then calculated for LSOAs which are small areas designed to be of a similar population size, with an average of approximately 1,500 residents or 650 households. There are 32,844 LSOAs in England. They were produced by the Office for National Statistics for the reporting of small area statistics.

The domains were combined using the following weights to produce the overall Index of Multiple Deprivation:

- Income Deprivation (22.5%)
- Employment Deprivation (22.5%)
- Education, Skills and Training Deprivation (13.5%)
- Health Deprivation and Disability (13.5%)
- Crime (9.3%)
- Barriers to Housing and Services (9.3%)
- Living Environment Deprivation (9.3%)