Advanced Chronic Kidney Disease among UK children

AUTHORS

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ABSTRACT

The UK Renal Registry currently collects information on UK children with kidney failure requiring long-term kidney replacement therapy (KRT), which supports disease surveillance and auditing of care and outcomes, however data is limited on children with CKD not on KRT.

Methods

In March 2020, all UK Paediatric Nephrology centres submitted data on children aged <16 years with severely reduced kidney function as of December 2019, defined as an estimated glomerular filtration rate <30ml/min/1.73m^2.

Results

In total, 1,031 children had severe CKD, the majority of whom (80.7%) were on KRT. The overall prevalence was 81.2 (95% Confidence Interval, 76.3, 86.3) per million of the age-related population.

Conclusions

The prevalence of severe CKD among UK children is largely due to a high proportion of children on long-term KRT. Expanding data capture to include children with CKD before reaching failure will provide greater understanding of the CKD burden in childhood.

INTRODUCTION

With chronic kidney disease (CKD) predicted to be one of the leading non-communicable causes of death worldwide by 2040(1), understanding the epidemiology of this condition is essential for planning health services. In children, much of our understanding is derived from a limited number of studies, which are often single-centre or reflect a selected cohort of children with access to specialist care. It is unclear to what extent these estimates are generalisable.

The UK Renal Registry collects, analyses, and reports data from UK nephrology centres on patients with kidney failure requiring long-term (>90 days) kidney replacement therapies (KRT) such as dialysis or transplantation, to support audit and research of care and outcomes. This includes 'static' demographic (e.g., sex, ethnicity) and clinical (e.g., primary kidney disease diagnosis, date of KRT start) data, as well as 'dynamic' data, including blood pressure, haematological, biochemical, and anthropometric measurements, which are received on a quarterly basis. Internationally, the UK Renal Registry is recognised as a robust, representative national dataset, benefitting from close collaboration with clinical and Information Technology leads at each of the thirteen British Association for Paediatric Nephrology (BAPN) centres across the constituent nations to ensure complete data capture for affected children under their care. In recent years, data capture has expanded to include patients with lesser stages of CKD not on KRT, although currently these data are submitted by few centres. At the beginning of the COVID-19 pandemic, in response to concerns that children with advanced CKD would be at higher risk of serious infection, the UKRR, in conjunction with the BAPN, accelerated data capture of prevalent children across the UK primarily to support COVID-19 disease surveillance. We present the findings from this initiative, which has enabled us to report the prevalence of advanced CKD among UK children, and to compare patient and clinical characteristics by KRT status.

METHODS

In March 2020, the UKRR asked each of the 13 BAPN centres to report any children under the age of 18 years who, as of 31st December 2019, had an estimated glomerular filtration rate (eGFR) of less than 30ml/min/1.73m^2, which is defined by the Kidney Disease Improving Global Outcomes consortium as 'severely reduced' function. As information is already routinely collected by the UKRR on children who receive long-term KRT, centres were asked to send information for patients not currently captured in the registry's kidney failure dataset, including those with CKD stages 4 (eGFR 15-29ml/min/1.73m^2) and 5 (<15ml/min/1.73m^2 not on KRT). Data including NHS number, date of birth, sex, ethnicity, and primary kidney disease were collated; last height and serum creatinine values at the end of 2019 were requested for eGFR calculation using the updated Schwartz formula(2). Primary kidney disease was grouped using the 2012 European Renal Association-European Dialysis and Transplant Association Registry classification(3).Young people aged 16-18 years may be managed in either adult or paediatric nephrology settings; as a result, this report focused on the description and prevalence of children under 16 years with severely reduced kidney function for whom more complete capture of data was expected.

RESULTS

The UKRR received data from all 13 BAPN centres, totalling 385 patients. Based on height and creatinine data, 199 had an eGFR of less than 30ml/min/1.73m^2 and were not on KRT. Twenty-seven children were excluded due to missing essential data, while the remainder (*n*=159) were excluded because they had a calculated eGFR of ≥30ml/min/1.73m^2 or were reported as being on KRT. The UKRR kidney failure dataset identified 832 children prevalent to KRT at the same timepoint. Therefore at the end of 2019, a total of 1,031 children under 16 years of age were considered to have advanced CKD (table 1); using mid-year population estimates from the Office of National Statistics, this equated to a prevalence of 81.2 (95% Confidence Interval, CI, 76.3, 86.3) per million of the age-related population (pmarp): separately, the prevalence of stages 4, 5 (non-KRT) and failure

requiring long-term KRT were 9.5 (95% CI 7.9, 11.4), 6.2 (95% CI 4.9, 7.7), and 65.6 (95% CI 61.2, 70.2)pmarp, respectively. Children with stage 4 CKD accounted for most of the pre-KRT group (60.8%). Most children receiving KRT had a functioning kidney transplant (78.7%). Sex distributions were similar across both groups; children in the pre-KRT group were generally younger, with a median age of 9.8 (IQR 5.4-12.3) compared to 10.9 (IQR 7.4-13.8) years for the KRT cohort. A higher percentage of children of Asian, Black, or 'Other' ethnicity was noted in the pre-KRT group. Overall, children with severely reduced kidney function were overrepresented in poorer areas, with 27.8% living in the most deprived 20% of UK neighbourhoods, while 13.7% lived in the least deprived 20%. A higher proportion of glomerular disease was seen among children requiring long-term KRT, while congenital anomalies of the kidneys and urinary tract accounted for a higher percentage of the pre-KRT group.

DISCUSSION

This report describes the prevalence of severe stages of CKD (stages 4, 5 and on KRT) in UK children, which was achieved through UKRR-BAPN collaboration. Though data collection was driven by a public health need, this has enabled, for the first time, reporting of demographic and clinical features of children with stages 4 and 5 CKD not on long-term KRT on a national level. These findings highlight that most children with severely reduced kidney function have kidney failure which is managed with a kidney transplant. The relatively low prevalence of stage 5 (non-KRT) CKD suggests most children who survive are treated with KRT.

At 81.2pmarp, the prevalence of severely reduced kidney function in UK children is generally higher than estimates from other nations(4). This may be partly explained by more comprehensive data capture and universal access to specialist care. A previous single-centre UK study estimated the prevalence of CKD (defined as an eGFR <60ml/min/1.73m^2, excluding children with functioning kidney transplant) to be 90pmarp(5), though at least half of the cohort comprised of children with

stage 3 CKD (eGFR 30-60ml/min/1.73m^2), who were not included in this study. Based on stages 4, 5 and KRT (including transplant), we found a prevalence of 81.2pmarp; once milder stages are accounted for the prevalence may be higher. The overall high prevalence of severely reduced kidney function seen in this study is predominantly due to the high proportion of children on long-term KRT, which at 65.3pmarp is higher than most European estimates(6). The observation that higher proportions of children with advanced CKD lived in more deprived areas is concerning and warrants further investigation to determine whether this finding influences their kidney disease course and/or outcomes.

As children with severely reduced kidney function are primarily managed by paediatric nephrology teams, this cohort is expected to be broadly representative. There are however limitations. This group represents children with CKD *known* to specialist care. A population-level Turkish study of children aged 5-18 years reported a prevalence of severely reduced eGFR (<30ml/min/1.73m^2) of 0.06%(7); applying these estimates to the UK cohort would mean up to 6,600 children are affected. Exclusion of patients with insufficient data to discern CKD stage may result in underestimation of the true prevalence of stage 4 and 5 (non-KRT) CKD. Due to incomplete capture of young people in both adult and paediatric settings, estimates for those aged 16-18 years were imprecise and therefore excluded from analysis.

Expansion of the data held by the UKRR and linkages to other health datasets (such as NHS Digital) provide an opportunity to describe the epidemiology and outcomes of this cohort. Moreover, a planned merger of the UKRR paediatric and adult datasets will enable longitudinal appraisal of disease. With increasing public concern over the misuse of patient data, it is important to highlight the thorough governance processes the UKRR maintains to securely hold and analyse patient-level data, described below.

There is increasing evidence that factors early in life confer a risk of subsequent kidney disease and failure(8). It is therefore imperative that we, as paediatricians, can identify children with kidney

disease that may benefit from earlier intervention. This would enable access to treatments that support optimal growth and development, delay progression to failure, and allow timely consideration of transplantation. This must be supported by robust data collection, to monitor disease progression and identify factors and interventions that confer health and economic benefits, in childhood and beyond. This UKRR-BAPN initiative has shown we can rise to this challenge, which will support healthcare planning for all ages.

ETHICAL APPROVALS

The UK Renal Registry has a legal basis to collect and analyse data under section 251 support for audit and research in England and Wales. Data from Scotland is provided by the Scottish Renal Registry, and Northern Ireland by Department of Health and Social Care for Northern Ireland.

DISCLOSURES

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Table 1: Demographic and clinical characteristics of UK children with advanced CKD, stratified by KRT status (*n*=1260).

Variable	CKD (not KRT) Cohort 0-18 years (N=199) N (%)		KRT Cohort 0-18 years (N=832) N (%)	
Male sex	128	64.3	518	62.3
Age band (years)				
0-5	57	28.6	143	17.2
6-10	60	30.2	276	33.2
11-15	82	41.2	413	49.6
Ethnicity				
White	114	57.3	570	68.5
Asian	47	23.6	149	17.9
Black	9	4.5	41	4.9
Other	17	8.5	53	6.4
Missing	12	6.0	19	2.3
Area-level deprivation quintile *(using country-adjusted indices of multiple deprivation)*				
1 - least deprived	25	12.6	116	13.9
2	30	15.1	143	17.2
3	34	17.1	155	18.6
4	46	23.1	183	22.0
5 - most deprived	61	30.7	226	27.2
Missing	3	1.5	9	1.1
CKD Stage or KRT modality				

Stage 4	121	60.8		
Stage 5	78	39.2		
Haemodialysis			87	10.5
Peritoneal dialysis			90	10.8
Kidney transplantation			655	78.7
Primary Kidney Disease category				
Familial / hereditary nephropathies	27	13.6	105	12.6
Glomerular disease	13	6.5	155	18.6
Hypertension/Renal vascular disease	2	1.0	0	0.0
Miscellaneous renal disorders	13	6.5	78	9.4
Systemic diseases affecting the kidney	11	5.5	38	4.6
Tubulointerstitial disease	129	64.8	425	51.1
- Of which congenital anomalies of the kidney and urinary tract (CAKUT)	129	100.0	415	97.6
- Non congenital anomalies	0	0.0	10	2.4
Missing	4	2.2	41	4.0

Abbreviations: CKD, Chronic Kidney Disease; KRT, Kidney Replacement Therapy