

Incidence of Biopsy-Proven Paediatric Glomerular Disease in Southeast England: A Retrospective Cohort Study

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Abstract

Background

Biopsy-proven paediatric glomerulonephritis (GN) is an important cause of chronic kidney disease in childhood, yet UK population-level, age-stratified incidence data for biopsy-confirmed disease remain limited. This study describes the incidence and distribution of biopsy-proven paediatric glomerulonephritis (GN) in a tertiary paediatric nephrology centre in Southeast England.

Methods

Retrospective cohort study of histopathological findings and clinical data of all children undergoing native kidney biopsies between January 2023 and December 2024, in a single tertiary paediatric nephrology centre serving approximately 1.9 million children.

Results

Biopsy-proven glomerulonephritis was diagnosed in 93 children and adolescents – an annual incidence of GN of 2.45/100,000 children in those < 18 years. Lupus nephritis (22%), IgA vasculitis nephritis (15%) and IgA nephropathy (14%) together accounted for approximately half of cases. Minimal change disease and focal segmental glomerulosclerosis comprised a further 24%. Other subtypes included immune complex-mediated GN/C3 glomerulopathy (9%), ANCA-associated GN (6%), post-infectious GN (6%), membranous nephropathy (3%) and anti-GBM disease (1%).

Conclusions

This study provides a regional estimate of biopsy-proven paediatric GN, demonstrating an incidence at the upper range of previously reported registry data. We observed lupus nephritis accounted for a greater proportion of cases than typically observed in paediatric cohorts, where IgA-mediated diseases usually predominate. Our findings are likely multifactorial including regional demographic and ethnic diversity, but also potentially highlight shifting patterns in autoimmune and post-infectious diseases during childhood. These findings emphasise the value of regional surveillance and the need for nationwide collaborative studies to further clarify paediatric GN epidemiology.

Key Message

- Glomerulonephritis is an important cause of chronic kidney disease in children, however UK population-level data on biopsy-proven paediatric GN remain limited.
- This retrospective cohort study provides contemporary regional epidemiological data on biopsy-proven paediatric glomerulonephritis in Southeast England. The annual incidence of biopsy-proven paediatric glomerulonephritis was 2.45/100,000 children, with lupus nephritis accounting for a greater proportion of cases than typically described in paediatric cohorts.
- These findings support the need for ongoing regional surveillance and national collaborative studies to better define paediatric glomerulonephritis epidemiology in the UK.

BACKGROUND

Glomerular diseases represent a significant cause of chronic kidney disease (CKD) in childhood. These diseases encompass diverse underlying histopathologies that often present with overlapping clinical features and therefore kidney biopsy remains central to diagnosis, classification and assessment of disease severity. [1, 2].

Global registry data and recent publications provide limited insights into the overall incidence and prevalence of paediatric GN [3–6]. In the UK, national registries are lacking, leaving a notable absence of age-stratified incidence rates for biopsy-proven disease. Additionally, existing large-scale datasets, such as the UK Renal Registry (UKRR), are restricted to children with advanced stages of CKD and those receiving renal replacement therapy (RRT) [4, 7, 8]. As a result, population-based estimates of paediatric GN remain incomplete, and highlight the relevance of contemporary regional data to better define current disease patterns.

Furthermore, whilst international guidelines - such as those from Kidney Disease: Improving Global Outcomes (KDIGO) - outline recommendations for kidney biopsy, strict clinical thresholds have not been universally established [9]. This is reflected in the variable biopsy practices between centres, particularly for patients presenting with milder phenotypes [3, 5, 6]. Our study aimed to evaluate the incidence and histological distribution of biopsy-proven GN diagnosed over a recent two-year period at our designated regional tertiary paediatric nephrology centre serving the Southeast of England.

METHODS

We conducted a retrospective review of all native kidney biopsies performed between January 2023 and December 2024 at our centre. Our centre provides comprehensive paediatric nephrology management including acute and chronic kidney diseases, dialysis and transplantation and is the designated tertiary centre serving an estimated population of 1.9 million children and adolescents aged 0–17 years in the Southeast of England, as per the most recent 2021 UK Census data [10].

Inclusion and exclusion criteria

All children aged 0 to 17 years who underwent a native kidney biopsy at our centre during the two-year study period were included. Patients who underwent multiple procedures, repeat or follow-up biopsies were excluded to prevent the duplication of clinical diagnoses. We also excluded those with biopsy findings suggesting non-glomerular kidney diseases, inconclusive histopathological results and those performed in kidney transplants.

Data collection

Clinical and demographic data were extracted from electronic health records, including age, sex, self-reported ethnicity, primary indication for biopsy, histopathological diagnosis, and clinical features at presentation. Non-glomerular diagnoses were recorded separately. Serum creatinine and urine protein: creatinine ratio (UPCR) values obtained within ± 4 weeks of the biopsy date were recorded where available. Histopathological findings were reviewed alongside clinical findings to confirm the definitive GN diagnosis and classification into subtypes.

Outcomes

Our primary reported study outcome was the annual incidence of biopsy-proven GN, estimated using the 2021 Census data. All incidence figures are expressed as annual incidence per 100,000 children aged < 18 years, unless otherwise noted. We also report the distribution of specific GN histological subtypes, clinical indications for biopsy, and evaluated the correlation of diagnosis with age and ethnicity, and the proportion of non-GN diagnoses. Individual clinical indications were also collated.

Statistical Analysis

Continuous variables are reported as mean $\pm$ standard deviation (SD) for normally distributed data, or as median and interquartile range (IQR) for non-normal distribution and were evaluated using Mann-Whitney U test to account for the small and uneven subgroup sizes and non-normal spread. Categorical variables were evaluated using Fisher's exact test to account for small subgroup sample sizes. A two-sided p-value < 0.05 was considered statistically significant. Statistical analyses were performed using Excel and GraphPad.

RESULTS

A total of 137 native kidney biopsies were performed during the 2-year study period. Of these, we excluded 44 native biopsies – 7 as they were second biopsies in the same patient, 14 as they yielded inconclusive histopathological results and 23 as they had non-glomerular kidney disease [see supplement].

GN was diagnosed in 93 patients. The annual incidence of biopsy-confirmed GN diagnoses was 2.45/100,000. Patients with GN had a mean age of 10.7 ± 4.2 , with 43 females (46%) and 50 males (54%). The largest recorded ethnic groups were White (35%) and Black or Black British (17%); ethnicity was not stated for 30% of patients. Median serum creatinine at biopsy was 57 $\mu\text{mol/L}$ (IQR 41–86), and median UPCR was 534 mg/mmol (IQR 125–916); UPCR was not performed in 2 patients: one biopsied for surveillance while on tacrolimus and one biopsied at the time of nephrectomy (Table 1).

Table 1
Demographic and baseline clinical characteristics of the GN cohort of n = 93
children and adolescents aged < 18 years with biopsy proven
glomerulonephritis

Characteristic	
Age, years, mean $\pm$ SD (range)	10.7 $\pm$ 4.2 (1–17)
Sex, n (%)	
Male	50 (54%)
Female	43 (46%)
Ethnicity, n (%)	
White	33 (35%)
Black or Black British	16 (17%)
Asian or Asian British	9 (10%)
Other ethnic group	6 (6%)
Mixed or Multiple ethnic groups	1 (1%)
Not stated	28 (30%)
Serum creatinine at biopsy, μ mol/L, median (IQR)	57 (41–86)
Urine protein:creatinine ratio (mg/mmol), median (IQR)	534 (125–916)
UPCR not performed, n (%)	2 (2%)

SD, standard deviation; IQR, interquartile range

Indications for biopsy

The clinical indications resulting in a kidney biopsy are shown in Table 2. The most common indication was systemic disease with suspected autoimmune or vasculitic aetiology (n = 30, 32%), predominantly suspected systemic lupus erythematosus (SLE) or IgA vasculitis. Unexplained nephritic syndrome accounted for 20% of biopsies (n = 19), presenting with a heterogeneous range of underlying pathologies including IgA nephropathy (IgAN), post-infectious GN (PIGN), and immune-complex-mediated membranoproliferative GN (IC-MPGN). Atypical or steroid-resistant nephrotic syndrome, primarily associated with focal segmental glomerulosclerosis (FSGS) or minimal change disease, accounted for 19% of biopsies (n = 18). A further 11% of biopsies (n = 10) were performed for persistent, isolated haematuria or proteinuria. The remaining indications were less frequent and included monitoring of treatment response or worsening renal function following treatment (n = 8, 9%), unexplained severe acute kidney injury (AKI) or kidney failure (n = 5, 5%), procedural indications including nephrectomy or previous sampling issues (n = 2, 2%), and unexplained progressive CKD (n = 1, 1%) (Table 2).

Table 2
Indication for renal biopsy in n = 93 children and adolescents aged < 18 years with biopsy proven glomerulonephritis

Biopsy Indication	N (%)
Systemic / suspected autoimmune or vasculitic disease	30 (32%)
Nephritic syndrome – cause unknown	19 (20%)
Nephrotic syndrome – cause unknown	18 (19%)
Persistent isolated haematuria or proteinuria	10 (11%)
Other	16 (17%)

AKI, acute kidney injury

GN subtype distribution

Among the 93 patients diagnosed with GN, Lupus Nephritis 22% (n = 20/93) was most common with an annual incidence of approximately 0.53/100,000. IgA vasculitis nephritis 15% (n = 14/93), and IgA nephropathy 14% (n = 13/93) together accounted for almost a third of all cases. Podocytopathies comprised a further 23.7% (n = 22/93). The remaining glomerulonephritides included immune-complex MPGN and C3 glomerulopathy 9% (n = 8/93), ANCA-associated GN 6% (n = 6/93), post-infectious GN 6% (n = 6/93), Membranous Nephropathy 3% (n = 3/93), and Anti-GBM disease 1% (n = 1/93) (Fig. 1).

Correlation with age, sex and ethnicity

Evaluating individual GN diseases and their distribution by age, sex and ethnicity highlighted that IgAN, LN and ANCA-associated GN were predominantly diagnosed in older patients (13.1 ± 2.6 years vs. 9.0 ± 4.3 years in the remainder of the cohort; $p < 0.0001$), while MCD/FSGS presented in those who were younger (8.0 ± 5.0 years vs. 11.5 ± 3.6 years in the remainder of the cohort; $p = 0.004$).

Female sex was more likely in those presenting with LN (70% vs 46%; $p = 0.02$) whilst IgAN and IgAVN was more common in males (89% vs 54%; $p < 0.001$). Among GN subtypes, LN was significantly more common in Black or Black British ethnicity than White patients (50% vs. 5%; $p < 0.001$), demonstrating a stark overrepresentation relative to the overall cohort baseline (17% vs. 35%). Numbers for other individual GN subtypes were too small to support meaningful comparisons and are not presented.

Discussion

In a well-characterised population presenting with kidney diseases, we report an annual incidence rate of biopsy-confirmed GN at 2.45 per 100,000 of children and young people aged < 18 years. Glomerulonephritis was diagnosed in ~ 80% of those with a precise histopathological diagnosis. Lupus Nephritis was most common with a higher incidence than that reported in recent UK paediatric reports. Further, there were differences by age and sex for various glomerulonephritides, providing current data in an evidence poor area in childhood kidney diseases.

While direct comparisons are limited by a lack of population-level data in children, our incidence is at the upper end of aggregated global paediatric registry incidence (0.2–2.9/100,000) [3], yet lower than both UK-specific and global modelled estimates from the Global Burden of Disease (GBD) 2023 study for acute GN and CKD due to GN (UK

7.4/100,000; global 14/100,000) [4]. This divergence additionally highlights the need for more directly measured, biopsy-confirmed paediatric registries, rather than reliance on modelled estimates alone. Reported incidence rates of GN in adults varied between 0.2 and 2.5/100,000 globally depending on the type of GN [3], while European registry data clusters around 3.4–9.3/100,000 [11].

Lupus nephritis accounted for almost a quarter of GN diagnoses in our cohort, corresponding to an annual incidence of approximately 0.53/100,000. A recent report from the UK and Republic of Ireland described juvenile-onset SLE incidence of between 0.36–0.46/100,000 depending on case definitions. Of those with SLE, a third had biopsy-confirmed nephritis, representing a significant disease burden in these children [12]. When considering all causes of GN in our report, those with LN were higher than reported in previously published paediatric populations, where IgA-mediated disease (IgAN and IgAVN) usually predominates [1, 3, 7].

Adult biopsy-confirmed lupus nephritis in the UK has a reported annual incidence of 0.3–0.6/100,000, consistent with the peak onset of SLE in early adulthood [13]. The comparable incidence in our paediatric cohort may reflect several factors. Regional demographics and ethnic composition may mirror known differences in prevalence [13]: UK Census data show that 10.5% of children across our region identified as Black or Black British, more than double the England and Wales average of 4.7% [14]. This regional ethnic composition may partly explain the elevated proportion of lupus nephritis in our cohort, though the association remains correlative rather than causal. Alternatively, it may reflect evolving patterns in autoimmune diseases following the COVID-19 pandemic [15], supported by recent UK data demonstrating a post-pandemic rise in post-streptococcal glomerulonephritis corresponding with increased group A streptococcal infection, and suggesting that shifts in infectious exposure may influence the epidemiology of immune-mediated glomerular disease [16]. Nonetheless, it underscores the importance of considering lupus nephritis early in children presenting with systemic symptoms and proteinuria or haematuria.

Limitations include the single centre design and the short study period. Our centre is the regional referral centre for childhood kidney diseases, with well-established referral pathways and regional network clinics. Our data estimates are, if anything, likely to underestimate the true incidence, in the case of children being referred to other paediatric nephrology centres. We also accept that the inclusion of only biopsy-confirmed cases of GN is likely to underestimate the true incidence of early GN, especially in those presenting with isolated haematuria only.

Conclusion

We report an annual glomerulonephritis incidence of 2.45/100,000 in children and adolescents aged < 18 years, with lupus nephritis seen most commonly and with a higher incidence than that reported nationally in the UK. Our report highlights the relevance of developing national collaborative studies to evaluate these trends more precisely.

Declarations

Ethics approval and consent to participate:

This project was registered with and approved by the Guy's and St Thomas' NHS Foundation Trust Clinical Audit Governance Department (Reference Number: 19962). The project was assessed using the Medical Research Council/Health Research Authority (MRC/HRA) decision-making framework and was deemed not to require formal research ethics committee approval. Individual consent for participation was deemed unnecessary in line with national guidance "Using information about people in health research", as no new data were collected, and no direct

patient contact occurred beyond routine clinical care. All procedures were performed in accordance with the Declaration of Helsinki.

Consent for publication:

Not applicable

Funding:

Not applicable

Author Contribution

CH and MDS conceived and designed the study. AJ performed data collection, data analysis, and drafted the manuscript. CH and MDS provided critical revisions and contributed to subsequent drafts. All authors read and approved the final manuscript.

Data Availability

Due to the potential for patient re-identification, particularly for rare GN subtypes with small cell sizes, the anonymised dataset generated and analysed during the current study is not publicly available. Deidentified data may be made available from the corresponding author upon reasonable request and subject to institutional approval.

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Figures

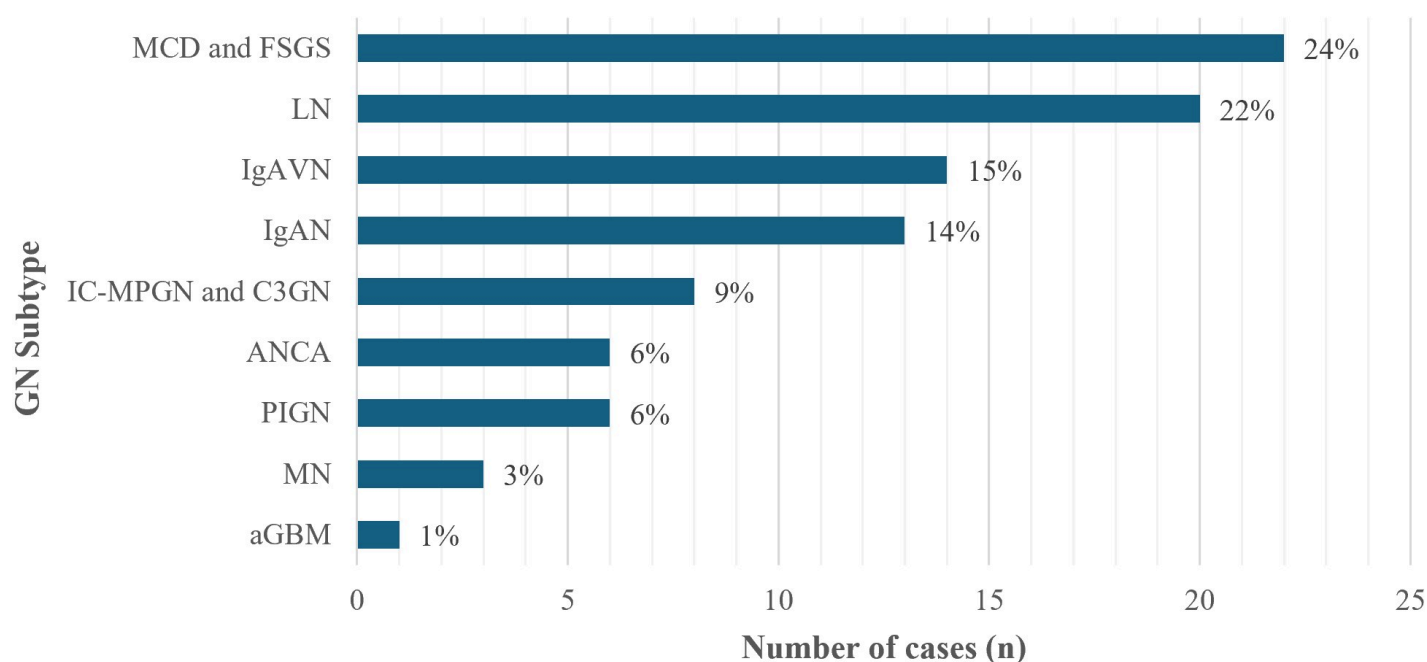


Figure 1

Differential diagnosis in n=93 children and adolescents aged <18 years with biopsy proven glomerulonephritis.*LN, Lupus Nephritis; MCD, Minimal Change Disease; FSGS, Focal Segmental Glomerular Sclerosis; IgAVN, IgA vasculitis nephritis; IgAN, IgA nephropathy; IC-MPGN, Immune-Complex-Mediated GN; C3GN, Complement-3 GN; ANCA, ANCA-associated GN; PIGN, Post-Infectious GN; MN, Membranous Nephropathy; aGBM, Anti-Glomerular Basement Membrane Disease.*

Supplementary Files

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