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STUDY ON FREQUENCY OF TYPES OF RENAL GLOMERULOPATHIES CAUSING NEPHROTIC SYNDROME IN LOCAL POPULATION

Dr Javeria Najam[1], Dr Rabbia Nazir[2], Dr Maryam Mahmood[3], Dr Kainat Farrukh[4], Dr Saima Batool[5], Dr Haseeb Ahmed khan[6], Dr Rizwan Akhtar[7]

[1]Resident Histopathology 4th year at Histopathology Department, Fatimah Memorial Hospital, javerianajam24@gmail.com
[2]Resident Histopathology 4th year at Histopathology Department, Fatimah Memorial Hospital, rabbianazir2020@gmail.com
[3]Resident Histopathology 4th year at Histopathology Department, Fatimah Memorial Hospital, maryammahmood914@gmail.com
[4]Senior Demonstrator at Histopathology Department, Fatimah Memorial Hospital, kainatabdullah34@gmail.com
[5]Assistant professor histopathology at Histopathology Department, Fatimah Memorial Hospital, saimaabbsar@gmail.com
[6]Professor Histopathology, at Histopathology Department, Fatimah Memorial Hospital, Haseeb.khan@fmhcmd.edu.pk
[7]Professor Histopathology, Fatimah Memorial Hospital Lahore, rakhtar127@gmail.com

ABSTRACT

Objective: To study the spectrum and relative frequency of kidney biopsy findings in patients undergoing kidney biopsy for nephrotic syndrome at a tertiary care centre in Lahore.

Methods: This single-centre cross-sectional study was carried out in the Department of Pathology, Fatima Memorial Hospital, Lahore, over three months (15th January, 2026 to 14th April 2026). Seventy adequate native kidney biopsies from patients presenting with clinical and biochemical features of nephrotic syndrome were included by non-probability consecutive sampling. Specimens were examined by light microscopy with haematoxylin–eosin, periodic acid–Schiff, Masson trichrome, Jones methenamine silver and Congo red stains, together with direct immunofluorescence for IgG, IgA, IgM, C3 and C1q. Each biopsy was reported independently by two consultant histopathologists. Data were analysed in SPSS version 26; continuous variables are presented as mean ± standard deviation and categorical variables as frequencies and percentages.

Results: The mean age was 35.5 ± 13.2 years (range 2–64); 38 patients (54.3%) were female and 32 (45.7%) were male. All patients had proteinuria above 3.5 g/24 h (mean 5.37 ± 0.76 g), and serum albumin was below 3 g/dL in 63 (90.0%). Of the 70 biopsies, 57 (81.4%) showed a specific glomerular diagnostic pattern, 9 (12.9%) showed non-specific glomerular changes, and 4 (5.7%) showed predominantly non-glomerular or non-diagnostic findings. Focal segmental glomerulosclerosis (FSGS) was the most frequent primary glomerular diagnosis (17, 24.3%), followed by lupus nephritis (11, 15.7%) and membranous nephropathy (7, 10.0%). Among secondary glomerular diseases, lupus nephritis was the predominant diagnosis.

Conclusion: Focal segmental glomerulosclerosis was the predominant primary glomerular diagnostic pattern in this cohort and Lupus nephritis was the predominant secondary glomerular disease. Because several patterns cannot be assigned confidently to a primary or secondary aetiology from the available data, results are presented by diagnostic certainty rather than forced primary/secondary classification.

KEYWORDS: Nephrotic syndrome; Glomerulopathy; Kidney biopsy; Histopathology; Focal segmental glomerulosclerosis; Lupus nephritis; Pakistan.

INTRODUCTION

Nephrotic syndrome is a clinical state defined by heavy proteinuria of more than 3.5 g over 24 hours, hypoalbuminaemia below 3 g/dL, hyperlipidaemia, oedema and lipiduria [1-3]. Although the worldwide annual incidence in adults is only around three per 100,000 [2,3], the condition carries a heavy burden because of its complications, which include venous thromboembolism, infection, accelerated cardiovascular disease and progression to chronic kidney disease and kidney failure [4,5]. Nephrotic syndrome may arise from a disease confined to the kidney, in which case it is termed primary, or from a systemic disorder that secondarily involves the glomerulus. Focal segmental glomerulosclerosis, membranous nephropathy and minimal change disease are the classic primary causes, whereas systemic lupus erythematosus and diabetes mellitus are the leading systemic conditions responsible for secondary disease [2,3]. Glomerular disease is also a major contributor to the rising global burden of chronic kidney disease, particularly in low- and middle-income countries [6]. The relative frequency of these lesions is not fixed. It shifts with geography, ethnicity, age structure and access to diagnostic services, and several centres have documented genuine changes in the pattern over recent decades [7,8]. Distinguishing one lesion from another matters clinically, because treatment and prognosis differ sharply between, for example, minimal change disease, membranous nephropathy and lupus nephritis [9]. Kidney biopsy remains the reference standard for this distinction [10]. Light microscopy of the glomeruli, tubules, interstitium and vessels is combined with immunofluorescence, and where available electron microscopy, to reach a precise diagnosis [11,12]. Local data describing this spectrum remain limited, and the necessary tools and expertise are

concentrated in a small number of centres [13-16]. Defining the local pattern is therefore useful both for guiding management and for benchmarking against national and regional experience. A precise histological diagnosis is essential for adequate treatment and follow-up, as clinical management varies amongst different diagnostic categories. This study will be very helpful as renal biopsy interpretation requires latest tool and expertise which are only available at selected centers in the country. The present study was undertaken to describe the spectrum and relative frequency of kidney biopsy findings in patients undergoing kidney biopsy for nephrotic syndrome at our institution.

MATERIALS AND METHODS

Study design and setting. This was a cross-sectional study conducted in the Department of Pathology, Fatima Memorial Hospital, Lahore, over a period of three months (15th January, 2026 to 14th April 2026) following approval of the study protocol.

Participants and sampling. Seventy patients were enrolled by non-probability consecutive sampling. Native kidney biopsy specimens from patients of any age and either sex who presented with clinical and biochemical features of nephrotic syndrome were eligible, provided the biopsy was adequate, defined as containing at least 10 glomeruli for light microscopic evaluation, with at least one glomerulus additionally required in the tissue submitted for immunofluorescence. Poorly preserved biopsies, those with fewer than 10 glomeruli, and patients presenting with a purely nephritic picture (active urinary sediment with haematuria) in the absence of nephrotic syndrome were excluded. A small number of biopsies that ultimately showed a proliferative, crescentic or complement-related pattern were retained because the patients met the nephrotic-range proteinuria entry threshold; this is examined further in the discussion.

Sample size. The sample size was estimated using the World Health Organization sample-size formula for a single proportion. The expected frequency of amyloidosis (17%) reported in earlier regional work was taken as the reference proportion, because amyloidosis represented one of the least frequent major diagnostic categories in that literature and therefore gave a conservative estimate of the number of biopsies needed to capture the less common lesions; with a 95% confidence level and a 9% absolute margin of error this yielded a minimum of about 67 patients, and 70 were enrolled.

Data collection. The study was approved by the Institutional Review Board / Ethics Committee of Fatima Memorial Hospital, Lahore, and was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained and demographic details were recorded. Tissue was fixed in 10% formalin for light microscopy and placed in cold normal saline for immunofluorescence. Consecutive 2–3 μm sections were stained with haematoxylin–eosin, periodic acid–Schiff, Masson trichrome and Jones methenamine silver, and Congo red was used to demonstrate amyloid. Direct immunofluorescence was performed with fluorescein isothiocyanate–conjugated antisera against IgG, IgA, IgM, C3 and C1q. To limit interobserver variation, every biopsy was reported independently by two consultant histopathologists, with a third opinion sought in case of disagreement. The final histopathological category was assigned using standard operational definitions, with lupus nephritis classified according to the International Society of Nephrology/Renal Pathology Society system [17] and systemic lupus erythematosus defined by the 2019 EULAR/ACR criteria together with full-house immunofluorescence [18]. The clinical records of all patients with biopsy features of lupus nephritis were reviewed to confirm that they fulfilled the 2019 EULAR/ACR classification criteria for systemic lupus erythematosus. Focal segmental glomerulosclerosis required segmental sclerosis of part of the capillary tuft in at least one glomerulus; biopsies showing only global sclerosis of a proportion of glomeruli, without a definite segmental lesion or a specific immune pattern, were recorded as global or chronic sclerosing glomerulonephritis and are reported separately from focal segmental glomerulosclerosis. Membranous nephropathy, minimal change disease and amyloidosis were defined by their conventional light-microscopic, immunofluorescence and special-stain features. Nodular glomerulosclerosis denotes the Kimmelstiel–Wilson-type nodular mesangial sclerosis, which is most often diabetic but can occur without diabetes (idiopathic nodular glomerulosclerosis, associated with smoking and hypertension); the term diabetic nephropathy was reserved for this pattern occurring in a patient with documented diabetes. Because the available manuscript data did not establish the aetiology of every biopsy case, diagnoses were not forced into primary or secondary categories. Instead, biopsies were grouped as clearly established secondary diseases, specific glomerular diagnoses of uncertain primary/secondary status, chronic or non-specific glomerular patterns, and non-glomerular or non-diagnostic findings. Biopsies in which no specific glomerular lesion could be identified were grouped as non-specific glomerular changes, and those showing predominantly tubular, interstitial or obstructive pathology without a glomerular diagnosis were grouped as non-glomerular or non-diagnostic.

Statistical analysis. Data were entered and analysed in SPSS version 26. Continuous variables such as age, proteinuria, serum albumin, serum creatinine and blood urea nitrogen are summarised as mean ± standard deviation with range. Categorical variables, including sex, comorbidities and histopathological type, are presented as frequencies and percentages, with 95% confidence intervals for the main diagnostic categories calculated by the Wilson method. The protocol had specified stratification by age and sex with the chi-square test applied after stratification; inferential testing was not performed, however, because several diagnostic categories contained only a few patients, which would have limited the statistical validity of formal hypothesis testing, and the results are therefore reported descriptively. This departure from the registered analysis plan is noted for transparency.

RESULTS

Seventy patients with biopsy-proven nephrotic syndrome were studied. Their baseline demographic, clinical and laboratory characteristics are shown in Table 1. The mean age was 35.5 ± 13.2 years, with a median of 36.5 years and a range from 2 to 64 years; the cohort was therefore predominantly adult, although four patients were under 18 years of age, including one young child aged 2 years. Thirty-eight patients (54.3%) were female and 32 (45.7%) were male, giving a female-to-male ratio of about 1.2 to 1.

Hypertension was present in half of the patients (35, 50.0%) and diabetes mellitus in 11 (15.7%). A history of autoimmune disease or a positive autoimmune serological marker was documented in 24 patients (34.3%), antinuclear antibody was positive in all 24 of these patients, and one further patient was ANCA positive. As expected from the entry criteria, all 70 patients had proteinuria above 3.5 g/24 h, with a mean of 5.37 ± 0.76 g, and serum albumin was below 3 g/dL in 63 patients (90.0%). Mean serum creatinine was 1.54 ± 0.42 mg/dL and mean blood urea nitrogen was 22.96 ± 5.38 mg/dL; serum creatinine exceeded 1.2 mg/dL in 52 patients (74.3%).

Table 1. Baseline demographic, clinical and laboratory characteristics of the study population (n = 70).

Characteristic	Value
Age, years — mean ± SD	35.5 ± 13.2
Age, years — median (range)	36.5 (2–64)
Female — n (%)	38 (54.3)
Male — n (%)	32 (45.7)
Hypertension — n (%)	35 (50.0)
Diabetes mellitus — n (%)	11 (15.7)
Autoimmune disease / SLE feature — n (%)	24 (34.3)
ANCA positive — n (%)	1 (1.4)
24-hour proteinuria, g — mean ± SD (range)	5.37 ± 0.76 (3.88–6.92)
Proteinuria > 3.5 g/24 h — n (%)	70 (100)
Serum albumin, g/dL — mean ± SD (range)	2.64 ± 0.26 (2.05–3.23)
Serum albumin < 3 g/dL — n (%)	63 (90.0)
Serum creatinine, mg/dL — mean ± SD (range)	1.54 ± 0.42 (0.78–2.57)
Blood urea nitrogen, mg/dL — mean ± SD (range)	22.96 ± 5.38 (12.3–38.5)

The frequency of each histopathological type, with 95% confidence intervals, is given in Table 2 and displayed in Figure 1. When biopsies were classified strictly, focal segmental glomerulosclerosis (FSGS) was identified in 17 patients (24.3%). These biopsies demonstrated definite segmental sclerosis involving a subset of glomeruli and fulfilled established histopathological criteria for FSGS. By contrast, global or chronic sclerosing glomerulonephritis was noted in only 3 patients (4.3%); these cases showed predominantly global sclerosis of a proportion of glomeruli, sometimes accompanied by mesangial expansion or vascular changes, but lacked a definite segmental lesion or a specific immune pattern. Accordingly, these two entities are reported separately. Of the 70 biopsies, 57 (81.4%) showed a specific glomerular diagnostic pattern, 9 (12.9%) showed non-specific glomerular changes, and 4 (5.7%) showed predominantly non-glomerular or non-diagnostic findings. FSGS was the most frequent primary glomerular diagnosis (17, 24.3%), followed by lupus nephritis (11, 15.7%) and membranous nephropathy (7, 10.0%). Nodular glomerulosclerosis / Diabetic nephropathy was seen in 5 patients (7.1%); all 5 patients had documented diabetes. Proliferative glomerulonephritis, amyloidosis and minimal change disease each accounted for 3 patients (4.3%). IgA nephropathy and IgA-dominant proliferative glomerulonephritis accounted for 1 patient each (1.4%), crescentic glomerulonephritis accounted for 2 patients (2.9%), and a single case of C3 glomerulopathy was identified (1.4%).

Table 2. Frequency distribution of biopsy findings in patients with nephrotic syndrome (n = 70).

Glomerulopathy type	n	%	95% CI
Global / chronic sclerosing glomerulonephritis[1]	3	4.3	1.5–11.9
Focal segmental glomerulosclerosis (FSGS)[2]	17	24.3	15.8–35.5
Lupus nephritis	11	15.7	9.0–26.0
Non-specific glomerular changes[3]	9	12.9	6.9–22.7
Membranous nephropathy	7	10.0	4.9–19.2
Nodular glomerulosclerosis[4]	5	7.1	3.1–15.7
Non-glomerular / non-diagnostic[5]	4	5.7	2.2–13.8
Proliferative glomerulonephritis	3	4.3	1.5–11.9
Amyloidosis	3	4.3	1.5–11.9
Minimal change disease	3	4.3	1.5–11.9
IgA nephropathy	1	1.4	0.3–7.7
IgA-dominant proliferative GN	1	1.4	0.3–7.7
Crescentic glomerulonephritis	2	2.9	0.8–9.8

C3 glomerulopathy	1	1.4	0.3–7.7
Total	70	100.0	—

[1] Predominantly global sclerosis of a proportion of glomeruli, with or without mesangial expansion or vascular change, and without a definite segmental lesion or a specific immune deposit. [2] Definite segmental sclerosis of part of the capillary tuft in at least one glomerulus. [3] Minor or non-diagnostic glomerular abnormalities only (for example mild mesangial prominence, occasional global sclerosis, synechiae or scanty immune deposits) without a single specific glomerular diagnosis. [4] Kimmelstiel–Wilson-type nodular mesangial sclerosis; only 1 of the 5 cases had documented diabetes, and diabetic nephropathy should not be assigned to the remaining cases without clinical verification. [5] Predominantly tubulointerstitial or obstructive change without a definite glomerular lesion. CI, confidence interval (Wilson method); FSGS, focal segmental glomerulosclerosis; GN, glomerulonephritis.

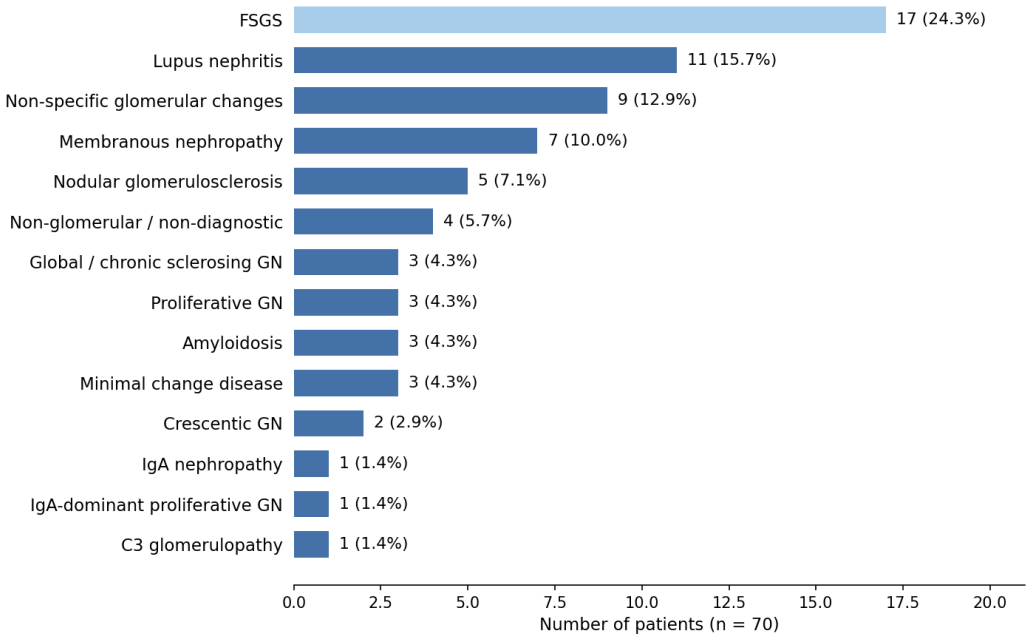


Figure 1. Frequency of biopsy-proven diagnostic categories in patients with nephrotic syndrome (n = 70; percentages are of the whole cohort). FSGS, focal segmental glomerulosclerosis; GN, glomerulonephritis.

Of the 70 biopsies, 57 (81.4%) showed a specific glomerular diagnostic pattern, 9 (12.9%) showed non-specific glomerular changes, and 4 (5.7%) showed predominantly non-glomerular or non-diagnostic findings. FSGS was the most frequent primary glomerular diagnosis (17, 24.3%), followed by lupus nephritis (11, 15.7%) and membranous nephropathy (7, 10.0%). Primary or secondary status could not be assigned confidently to every specific glomerular diagnosis from the available data, particularly for FSGS, membranous nephropathy, proliferative GN and crescentic GN. Among clearly established secondary glomerular diseases, lupus nephritis was the predominant diagnosis. The distribution is summarised in Table 3.

Table 3. Recommended grouping of biopsy findings by diagnostic certainty (n = 70).

Diagnostic grouping	Diagnosis	n	% of cohort
A. Clearly established secondary glomerular diseases	Lupus nephritis	11	15.7
	Amyloidosis	3	4.3
	Nodular glomerulosclerosis/ Diabetic nephropathy	5	7.1
	Subtotal	19	27.1
B. Specific glomerular diagnoses; primary/secondary status uncertain	**FSGS**	**17**	**24.3**
	Membranous nephropathy	7	10.0
	Proliferative GN	3	4.3
	Minimal change disease	3	4.3
	IgA nephropathy	1	1.4

	IgA-dominant proliferative GN	1	1.4
	Crescentic GN	2	2.9
	C3 glomerulopathy	1	1.4
	Subtotal	**35**	**50**
C. Chronic/non-specific glomerular patterns	Global/chronic sclerosing GN	3	4.3
	Non-specific glomerular changes	9	12.9
	Subtotal	**12**	**17.1**
D. No definite glomerular diagnosis	Non-glomerular / non-diagnostic	4	5.7
	Total	**70**	**100.0**

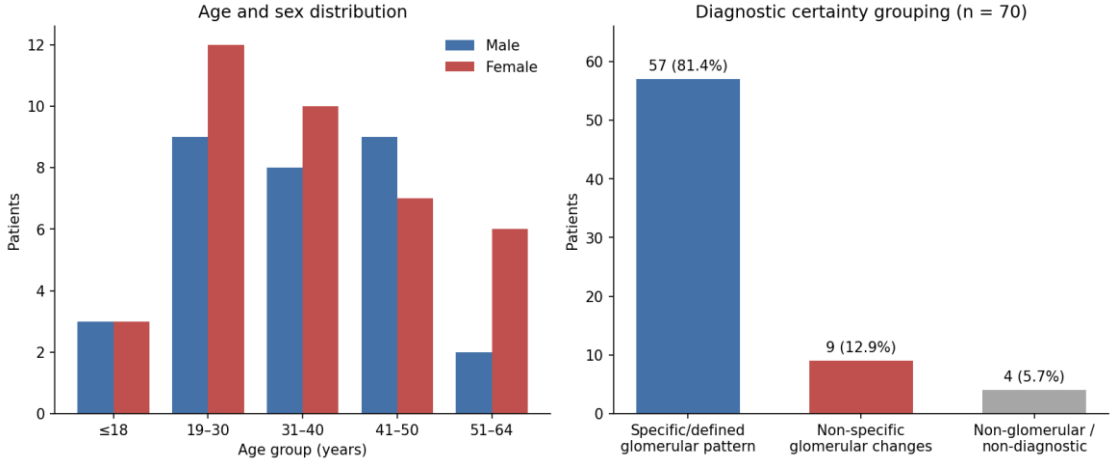


Figure 2. Age and sex distribution of the cohort (left) and diagnostic certainty grouping — specific/defined glomerular pattern, non-specific glomerular changes, and non-glomerular/non-diagnostic findings — (right; n = 70).

Several patterns emerged when the major diagnoses were examined by age and sex. Across the sclerosing biopsies as a whole—the 3 global or chronic sclerosing cases together with the 17 cases of focal segmental glomerulosclerosis, age ranged widely (18 to 64 years, mean 37.4 years) and the sexes were fairly evenly distributed (11 male, 9 female). Membranous nephropathy presented at a similar mean age of 39.4 years and was more common in women (5 of 7). Lupus nephritis was characterised by younger age at presentation, with a mean of 29.7 years and a strong female predominance (9 of 11 patients female). Of note, antinuclear antibody was recorded as positive in all patients of these 11 biopsy-proven lupus nephritis cases, with one further patient ANCA positive, and in every case the diagnosis was confirmed against the 2019 EULAR/ACR criteria supported by full-house immunofluorescence. The oldest mean ages were seen in amyloidosis (50.7 years) and nodular glomerulosclerosis (45.5 years), while minimal change disease and proliferative glomerulonephritis clustered in younger patients (mean 23.7 and 26.0 years respectively).

DISCUSSION

This study describes the histopathological spectrum of nephrotic syndrome in 70 patients biopsied at a single tertiary centre in Lahore. The two principal findings are that focal segmental glomerulosclerosis (FSGS) was the most frequent primary glomerular diagnostic pattern overall, accounting for 24.3% of cases, and that lupus nephritis was the predominant secondary diagnosis and the dominant diagnosis in younger women. In contrast, chronic sclerosing lesions were relatively uncommon, comprising only 4.3% of biopsies. Because several categories are morphologic patterns rather than etiologically established diseases, the results are best interpreted using the diagnostic-certainty grouping in Table 3 rather than a forced primary/secondary split. The prominence of glomerulosclerosis echoes much of the regional literature, where focal segmental glomerulosclerosis is repeatedly reported among the leading patterns of adult nephrotic syndrome. Earlier Pakistani series from a large transplant and nephrology centre identified focal segmental glomerulosclerosis as a leading pattern in adults with nephrotic syndrome [13,14], and several Indian centres have reported it among their commonest causes of adult glomerular disease [19,20]. Our data should nonetheless be interpreted with the limitations of light microscopy in mind: FSGS was diagnosed only where a definite segmental lesion was identified in at least one glomerulus, and the absence of routine electron microscopy may still have limited the confident distinction of early or subtle FSGS from other causes of segmental scarring. A recent two-centre study from Central India found lupus nephritis to be the single most frequent biopsy diagnosis, followed by membranous nephropathy and minimal change disease [19], which mirrors the high rank of lupus nephritis in the present cohort. A 2026 tertiary-centre study likewise

reported focal segmental glomerulosclerosis as the leading lesion in adults, ahead of IgA nephropathy and amyloidosis [12]. IgA nephropathy itself, one of the commonest primary glomerulonephritides worldwide, was infrequent in this nephrotic cohort, which fits its more usual nephritic presentation [22]. Differences in the exact ordering between centres are expected and reflect referral patterns, the age mix of the population biopsied, and whether electron microscopy is routinely available. The demographic profile of our patients is consistent with contemporary data. The mean age of about 35 years and the modest female preponderance are close to figures from eastern Indian and Pakistani series, where mean ages in the early to mid-thirties are typical [15,21]. A recent prospective Pakistani study of 180 biopsies reported a comparable mean age of 36.8 years, a male-to-female ratio of 1.2 to 1, and nephrotic syndrome as the leading biopsy indication; that study found primary glomerulopathies in 63.9% and secondary disease in 29.4%, with hypertension in 42.5% and diabetes in 9.2% of patients [16]. Our cohort showed slightly higher rates of hypertension (50%) and diabetes (15.7%) than that comparison series, plausibly explained by differences in case mix and referral patterns. We do not compare primary and secondary proportions because the available manuscript data do not establish aetiology case-by-case. It is also worth noting that the 11 patients with diabetes were distributed across several biopsy patterns, and that nodular glomerulosclerosis was seen in five biopsies, of which all patients were documented to have diabetes in the manuscript. Lupus nephritis deserves particular comment. It accounted for 15.7% of all cases and nearly four-fifths (11 of 14) of clearly established secondary disease, presenting in younger, mostly female patients, a profile that fits the known epidemiology of systemic lupus erythematosus. Thee diagnosis in these patients rested on the characteristic biopsy appearances and full-house immunofluorescence, with fulfilment of the 2019 EULAR/ACR classification criteria confirmed on review of the clinical records, rather than on serology alone [17,18]. This underlines why tissue diagnosis, supported by immunofluorescence, remains indispensable and cannot be replaced by serological screening [10]. A notable feature of this series is the relatively large proportion of biopsies classified as non-specific glomerular changes (12.9%), alongside a group reported as tubulointerstitial disease (5.7%). These categories capture biopsies in which light microscopy and a limited immunofluorescence panel did not permit a single specific glomerular diagnosis, for example specimens showing only mild mesangial change, synechiae or interstitial inflammation. Their frequency is best understood as a real-world limitation rather than a distinct disease entity, and it is consistent with reports emphasising that electron microscopy materially improves diagnostic precision and is often unavailable in resource-limited settings [11,12]. The small number of patients younger than 18 years (four cases) and the low frequency of minimal change disease (4.3%) are both expected in a predominantly adult cohort, since minimal change disease is far more common in children than in adults [2]. Taken together, the descriptive pattern is coherent: a young-to-middle-aged cohort, near-universal nephrotic-range proteinuria and hypoalbuminaemia by design, FSGS as the leading specific glomerular pattern, a substantial non-specific category, and clearly established secondary disease dominated by lupus nephritis. Because several diagnostic categories contained only a handful of patients, formal inferential testing across all subgroups would have limited statistical power, and the findings are therefore presented as frequencies and proportions. Even so, the consistency of these proportions with larger contemporary series strengthens confidence in the overall picture. Several limitations should be kept in mind. This was a single-centre study with a modest sample of 70 patients collected over six months, so the estimates carry wide confidence intervals and may not represent the wider population. Sampling was consecutive and non-probability based, and the centre is a referral facility, which can skew the case mix. Electron microscopy was not used routinely, which contributed to the sizeable group of non-specifically classified biopsies and may have led to under-recognition of conditions such as early membranous nephropathy or specific patterns of mesangial disease. The study was cross-sectional, so clinical outcomes and treatment responses were not assessed. The cohort spanned all ages, and although it was predominantly adult, the inclusion of a small number of paediatric biopsies (four patients) alongside adults is a limitation, since the spectrum of nephrotic syndrome differs substantially between children and adults. Formal interobserver agreement (for example a kappa statistic) was not calculated, so although every biopsy was reported independently by two consultants, the degree of diagnostic concordance was not quantified. A small number of biopsies showed proliferative, crescentic or C3-related patterns that are more often associated with a nephritic presentation; these were included on the basis of nephrotic-range proteinuria, so some overlap between nephrotic and nephritic features is present in the cohort. A larger, multicentre study with full ultrastructural evaluation and follow-up would refine these estimates.

CONCLUSION

Among patients undergoing kidney biopsy for nephrotic syndrome at this tertiary care centre, focal segmental glomerulosclerosis (FSGS) was the most frequent primary glomerular diagnostic pattern, while lupus nephritis was the leading secondary glomerular disease, particularly among younger women. Of the 70 biopsies, 57 showed a specific glomerular pattern, 9 showed non-specific glomerular changes, and 4 showed predominantly non-glomerular or non-diagnostic findings. A smaller group showed global or chronic sclerosing change without a definite segmental lesion and was reported separately from FSGS. Because several biopsy categories represent morphologic patterns whose primary or secondary aetiology cannot be assigned confidently from the available data, diagnostic-certainty grouping is more defensible than a forced primary/secondary classification. Wider access to electron microscopy and complete clinical correlation would sharpen aetiologic assignment and reduce the proportion of biopsies that cannot be assigned a specific diagnosis.

DECLARATIONS

Ethics approval. Approved by the Institutional Review Board / Ethics Committee of Fatima Memorial Hospital, Lahore CPSP/REU/HSP-2023-060-946 dated January 15, 2026. The study followed the Declaration of Helsinki.
Consent. Written informed consent was obtained from all participants or their guardians.
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Conflicts of interest. The authors declare no competing interests.
Author contributions. JN conceived the study, collected and analysed the data, and drafted the manuscript. SB supervised the work, contributed to histopathological reporting and study design, and critically revised the manuscript. Both authors approved the final version.

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