International Journal of Research in Medical Sciences
*Gangdev AN et al. Int J Res Med Sci. 2026 Sep;14(9):3941-3946*
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20263110

**Original Research Article**

# Clinicopathological spectrum of glomerular disorders in adult versus elderly patients: a prospective observational study from a tertiary care centre in North India

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**Received:** 13 July 2026
**Accepted:** 14 August 2026

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## ABSTRACT

**Background:** The clinicopathological spectrum of glomerular disorders differs between adult and elderly populations, yet comparative biopsy-based data from India are limited. We aimed to compare and characterise the histopathological profile, clinical presentation, and procedural safety of native kidney biopsy in adult (≤59 years) and elderly (≥60 years) patients at a tertiary care centre in north India.
**Methods:** A prospective observational study was conducted at AIIMS Rishikesh from October 2025 to February 2026. A total of 168 patients who underwent native kidney biopsy were enrolled and stratified into two age groups: adults (≤59 years, n=145) and elderly (≥60 years, n=23). Demographic, clinical, laboratory, histopathological, and post-procedural complication data were collected. Statistical analysis was performed using Chi-square/Fisher's exact test for categorical variables and independent samples t-test for continuous variables.
**Results:** In adults, IgA nephropathy (14.4%), focal segmental glomerulosclerosis (FSGS, 13.1%), and membranous nephropathy (MN, 13.1%) predominated, while in elderly, MN (26.1%), diabetic kidney disease (DKD, 21.7%), pauci-immune crescentic glomerulonephritis (17.4%), and myeloma-related disorders (MGRS/LCCN, 17.4%) were most common. Hypertension (56.5% vs 28.3%; p=0.007), anuria (26.1% versus 7.6%; p=0.015), and serum urea (127.52 versus 82.08 mg/dl; p=0.004) were significantly higher in the elderly. ANA positivity was significantly higher in adults (55.0% versus 20.0%; p=0.040). Post-biopsy perinephric haematoma was significantly more frequent in the elderly (34.8% versus 11.0%; p=0.034).
**Conclusions:** Distinct age-specific differences in glomerular disease patterns were observed. The spectrum shifted from immune-mediated glomerulonephritis (IgAN, FSGS, lupus nephritis) in adults to metabolic, vascular, and paraprotein-related pathologies (MN, DKD, ANCA-GN, MGRS) in the elderly. Age alone should not preclude kidney biopsy, though heightened post-procedural vigilance is warranted in elderly patients.

**Keywords:** ANCA-associated vasculitis, elderly, Glomerular disease, IgA nephropathy, India, Membranous nephropathy, Renal biopsy

## INTRODUCTION

The global demographic transition towards an older population carries significant implications for nephrology practice. Aging is associate with renal function decline and structural changes in kidney. With increasing geriatric age population, elderly peoples living with renal disease increases.

The elderly population (≥60 years) increased from 7.6% in the year 2000 to 10.1% of the total population in the year 2021 and is further likely to increase to 13.1% in 2031 as

per Government of India (GOI) published population in vital statistics in elderly in India. This epidemiological transition necessitates a thorough understanding of age-specific differences in glomerular pathology to enable accurate diagnosis and appropriate therapeutic decision-making.

Glomerular diseases are group of disorders affecting the glomerular filtration barrier and one of the major causes of chronic kidney disease (CKD) and end-stage renal disease (ESRD) worldwide. The clinicopathological spectrum of these conditions varies considerably between geographic regions, age and sex groups. While much of literature on glomerulonephritis has focused on younger adults, there is growing recognition that glomerular disorders in the elderly (conventionally defined as individuals aged ≥60 years) carry a distinct pathological profile, clinical presentation, and prognosis.

The elderly and younger individuals are affected by the same types of kidney diseases, but their clinical course and morphological manifestation may be different.

The incidence of glomerular disease in elderly varies in different population from 5 to 20%. Clinical presentation often atypical due to comorbid illness and blunted immune response in elderly population. Renal biopsy is the gold standard for diagnosing glomerular disease, yet less than 15% renal biopsies were from age more than 60 years.[1]

In general, physicians avoid doing renal biopsy in elderly patients. because of the fear of complications. Age should not be considered as a barrier to kidney biopsy. It is considered to be a safe procedure even in the elderly and gives valuable information regarding diagnosis and prognosis. As per recent data, kidney biopsy in the elderly has led to a modification in treatment in up to 40-70% of patients.[2]

In India, the studies on geriatric nephrology are limited and on glomerular disease very limited studies are available. This prospective study from AIIMS Rishikesh was designed to compare the clinical presentation, histopathological spectrum, immunological profile, and post-biopsy complications between adult (≤59 years) and elderly (≥60 years) patients undergoing native kidney biopsy.

## METHODS

### *Study design and population*

This was a prospective observational study conducted in the department of nephrology, AIIMS Rishikesh, Uttarakhand. Patients who underwent native kidney biopsy between October 2025 and February 2026 were consecutively enrolled. The study was approved by the institutional ethics committee and written informed consent was obtained from all participants.

### *Inclusion and exclusion criteria*

Patients aged ≥18 years presenting with nephrotic syndrome, nephritic syndrome, acute kidney disease (AKD)/acute kidney injury (AKI), or isolated proteinuria requiring kidney biopsy were eligible. Biopsy specimens with glomerular pathology on histopathological evaluation were included for analysis. Patients aged <18 years, pregnant women, and those who declined consent were excluded.

### *Clinical assessment*

Detailed demographic, anthropometric, and clinical data were recorded using a structured proforma. All patients underwent comprehensive laboratory evaluation including complete blood count, renal and liver function tests, coagulation profile, fasting lipid profile, urinalysis (spot urine protein:creatinine ratio, dipstick, urinary microscopy, 24-hour urinary protein), and targeted immunological investigations (ANA, anti-dsDNA, anti-GBM, ANCA, serum complement levels C3/C4, anti-PLA2R by ELISA, serum protein electrophoresis) as clinically indicated. Renal ultrasound was performed in all patients prior to biopsy.

### *Kidney biopsy technique*

All biopsies were performed under real-time ultrasound guidance under local anaesthesia using an 18-gauge automated biopsy gun. Two cores of renal tissue were obtained: one in 10% formalin for light microscopy (hematoxylin-eosin, periodic acid-Schiff, Masson's trichrome stains) in Michel's transport medium for immunofluorescence (IgG, IgM, IgA, C3, C1q, kappa, and lambda). Congo red staining for amyloidosis and anti-PLA2R immunohistochemistry were performed when indicated. Electron microscopy was performed when indicated.

### *Post-biopsy monitoring*

Patients were monitored for at least 24 hours post-procedure with hemodynamic assessment and renal ultrasound in cases of persistent hematuria, flank pain, or haemodynamic instability. Post-biopsy complications were perinephric hematoma, gross hematuria, and hemodynamic shock.

### *Statistical analysis*

Data were analysed using SPSS version 25.0. Normality was assessed by the Shapiro-Wilk test. Continuous data are reported as mean±standard deviation (SD) and compared using the independent samples t-test. Categorical data are reported as frequency (percentage) and compared using Chi-square or Fisher's exact test as appropriate. A p value ≤0.05 was considered statistically significant.

## RESULTS

### *Baseline demographic and comorbidity profile*

A total of 168 patients were enrolled, comprising 145 adults (≤59 years) and 23 elderly patients (≥60 years). Males constituted 57.1% of the overall cohort. Gender distribution did not differ significantly between age groups (p=0.400). As shown in Table 1, hypertension was significantly more prevalent in the elderly (56.5% versus 28.3%; p=0.007). Diabetes mellitus was more common in the elderly (30.4% versus 15.2%), though this did not reach significance (p=0.072). SLE was exclusively observed in the younger cohort (20.0% of those with additional comorbidities), while malignancy (carcinoma tongue) and cerebrovascular disease were noted only in the elderly.

**Table 1: Baseline demographic characteristics and major comorbidities.**

| Comorbidities | Category | ≤59 years (n=145) (%) | ≥60 years (n=23) (%) | P value |
|---|---|---|---|---|
| **Gender** | Male | 81 (55.9) | 15 (65.2) | 0.400 |
| | Female | 64 (44.1) | 8 (34.8) | |
| **Diabetes mellitus (DM)** | Yes | 22 (15.2) | 7 (30.4) | 0.072 |
| | No | 123 (84.8) | 16 (69.6) | |
| **Hypertension (HTN)** | Yes | 41 (28.3) | 13 (56.5) | 0.007 |
| | No | 104 (71.7) | 10 (43.5) | |

**Table 2: Clinical presentation (syndromic diagnosis) across age groups.**

| Diagnosis at admission | ≤59 years (n=145) (%) | ≥60 years (n=23) (%) | Total (n=168) (%) | P value |
|---|---|---|---|---|
| **Acute kidney disease** | 73 (50.3) | 17 (73.9) | 90 (53.6) | 0.098 |
| **Nephrotic syndrome** | 16 (11.0) | 0 (0.0) | 16 (9.5) | |
| **Nephritic syndrome** | 49 (33.8) | 5 (21.7) | 54 (32.1) | |
| **Isolated proteinuria** | 7 (4.8) | 1 (4.3) | 08 (4.8) | |

**Table 3: Comparison of laboratory parameters between age groups.**

| Parameters | ≤59 years (n=145) Mean±SD | ≥60 years (n=23) Mean±SD | P value |
|---|---|---|---|
| **Hemoglobin (Hb) (gm/dl)** | 10.06±2.40 | 9.17±1.83 | 0.090 |
| **Total leukocyte count (TLC) (thousand/cumm)** | 8.59±4.82 | 7.68±3.29 | 0.382 |
| **Platelets (thousand/cumm)** | 231.97±112.29 | 243.61±159.34 | 0.665 |
| **Urea (mg/dl)** | 82.08±66.70 | 127.52±84.95 | 0.004 |
| **Creatinine (mg/dl)** | 3.53±3.83 | 5.06±3.51 | 0.073 |
| **Albumin (gm/dl)** | 2.39±0.85 | 2.46±0.65 | 0.720 |
| **24-hour urinary protein (gm/day)** | 5.71±4.46 | 5.62±3.70 | 0.946 |

*P<0.05 (statistically significant). TLC = total leucocyte count.

### *Clinical presentation*

AKD was the most frequent biopsy indication in both groups, more so in the elderly (73.9% versus 50.3%). Nephrotic syndrome was more common in younger adults (33.8% versus 21.7%), while nephritic syndrome was entirely absent in the elderly (0% versus 11.0%). These distributional differences did not achieve statistical significance (p=0.098), likely due to limited power from the small elderly subgroup (Table 2).

Oedema (84.8% versus 91.3%) and frothuria (~30% in both groups) were the most common symptoms across age groups. Anuria was significantly more frequent in the elderly (26.1% versus 7.6%; p=0.015), reflecting a higher proportion of severe AKD with advanced cortical injury. Gross hematuria was observed exclusively in younger patients (4.8%), consistent with the lower prevalence of proliferative glomerulonephritis in the elderly

### *Laboratory parameters*

Key laboratory parameters are presented in Table 3. Serum urea was significantly higher in the elderly (127.52±84.95 versus 82.08±66.70 mg/dl; p=0.004), reflecting greater severity of renal impairment at presentation. Serum creatinine was also higher in the elderly (5.06±3.51 versus 3.53±3.83 mg/dl; p=0.073), though the difference was not

statistically significant, potentially due to reduced muscle mass underestimating true GFR impairment in this group. Serum albumin and 24-hour urinary protein were comparable between groups, indicating similar degrees of proteinuria at presentation.

### *Immunological profile*

ANA positivity was significantly higher in younger patients (55.0% versus 20.0%; p=0.040), reflecting the predominance of SLE-associated nephritis in this group. C3 and C4 hypocomplementemia were exclusively observed in younger patients (32.8% versus 0%), approaching significance (p=0.052). Anti-PLA2R positivity was 80.0% in adult MN patients and 57.1% in elderly MN patients (p=0.334), suggesting a higher proportion of secondary PLA2R-negative MN in the elderly. MPO-ANCA positivity showed a non-significant trend towards greater frequency in the elderly (22.2% versus 10.5%). M-spike on serum protein electrophoresis was present in 50.0% of elderly patients tested (2/4) versus none of the younger patients tested.

**Table 4: Histopathological diagnosis spectrum across age groups.**

| Diagnosis | ≤59 years (n=145) (%) | ≥60 years (n=23) (%) | Total (n=168) (%) |
|---|---|---|---|
| **Acute cortical necrosis** | 3 (2.1) | 0 (0.0) | 3 (1.8) |
| **ATN** | 10 (6.9) | 1 (4.3) | 11 (6.6) |
| **DKD** | 13 (9.0) | 5 (21.7) | 18 (10.7) |
| **FSGS** | 19 (13.1) | 1 (4.3) | 20 (11.3) |
| **Global glomerulosclerosis** | 6 (4.1) | 0 (0.0) | 6 (3.6) |
| **IgA nephropathy** | 21 (14.4) | 2 (8.7) | 23 (13.6) |
| **Lupus nephritis** | 18 (12.4) | 0 (0.0) | 18 (10.7) |
| **MCD** | 15 (10.3) | 0 (0.0) | 15 (8.9) |
| **Membranous nephropathy** | 19 (13.1) | 6 (26.1) | 25 (14.9) |
| **MPGN** | 11 (7.6) | 0 (0.0) | 11 (6.5) |
| **MGRS/LCCN** | 3 (2.1) | 4 (17.4) | 7 (4.2) |
| **Pauci-immune crescentic GN** | 4 (2.8) | 4 (17.4) | 8 (4.8) |
| **Thrombotic microangiopathy** | 3 (2.1) | 0 (0.0) | 3 (1.8) |

FSGS=focal segmental glomerulosclerosis; DKD=diabetic kidney disease; MCD=minimal change disease; MPGN=membranoproliferative glomerulonephritis; ATN=acute tubular necrosis; MGRS=monoclonal gammopathy of renal significance; LCCN=light chain cast nephropathy; TMA=thrombotic microangiopathy.

**Table 5: Post-biopsy complications across age groups.**

| Complications | Adult ≤59 years (n=145) (%) | Elderly ≥60 years (n=23) (%) | Total (n=168) (%) | P value |
|---|---|---|---|---|
| **No complication** | 126 (86.9) | 15 (65.2) | 141 (83.9) | |
| **Perinephric hematoma** | 16 (11.0) | 8 (34.8) | 24 (14.3) | 0.034 |
| **Gross hematuria** | 2 (1.4) | 0 (0.0) | 2 (1.2) | |
| **Hemodynamic shock** | 1 (0.7) | 0 (0.0) | 1 (0.6) | |

### *Histopathological spectrum*

The biopsy diagnosis spectrum is detailed in Table 4. In adults, the leading diagnoses were IgA nephropathy (14.4%), membranous nephropathy (13.1%), FSGS (13.1%), lupus nephritis (12.4%), and MCD (10.3%). In the elderly, the spectrum was markedly different: membranous nephropathy (26.1%), DKD (21.7%), pauci-immune crescentic GN (17.4%), and MGRS/LCCN (17.4%) were the dominant diagnoses. Lupus nephritis, MCD, MPGN, TMA, and global glomerulosclerosis were entirely absent in the elderly. Despite the striking distributional differences, Fisher's exact test did not demonstrate a statistically significant association between diagnosis and age group (p>0.05), attributable to limited statistical power from the small elderly subgroup.

On clinicopathological correlation, membranous nephropathy accounted for 37.0% of nephrotic syndrome cases and pauci-immune crescentic GN presented exclusively as AKD. Lupus nephritis accounted for 43.7% of all nephritic syndrome presentations. IgA nephropathy was the leading diagnosis among AKD presentations overall (18.8%).

### *Post-biopsy complications*

The overall complication rate was 16.1%. Perinephric haematoma was the predominant complication and was significantly more frequent in the elderly (34.8% versus 11.0%; p=0.034), as shown in Table 5. Gross hematuria occurred in 2 younger patients, and hemodynamic shock in one younger patient. No elderly patient developed gross

haematuria or shock. All complications were managed conservatively; no patient required angiographic embolisation or surgical intervention.

## DISCUSSION

In this prospective study, 168 patients who underwent native kidney biopsy at a north Indian tertiary care centre were observed a distinct age-related shift in the clinicopathological spectrum of glomerular disorders. Adults were predominantly affected by immune-mediated nephritis like IgA nephropathy, FSGS, lupus nephritis, and MCD, while the elderly cohort was dominated by metabolic, vascular, and paraprotein-related pathologies including membranous nephropathy, DKD, pauci-immune crescentic GN, and myeloma-related disorders. These findings are consistent with published biopsy series from India and internationally.[3-6]

The proportion of elderly patients in our cohort (13.7%) is comparable to reports from other Indian centres, reflecting a persisting under-representation of the elderly in biopsy series. This is clinically important since biopsy-proven diagnosis modifies management in 40-70% of elderly patients, as established by Yoon et al and Moutzouris et al.[7,8] Our findings reinforce that age alone is not a contraindication to renal biopsy.

The significantly higher prevalence of hypertension in the elderly (56.5% versus 28.3%; p=0.007) is attributable to age-related arterial stiffness, declining nephron mass, and reduced baroreceptor sensitivity. This vascular burden contributes to glomerulosclerosis and chronicity on biopsy, as previously documented by Perkowska-Ptasinska et al.[3] The higher diabetes prevalence in the elderly, though not statistically significant, translates to a significantly greater burden of DKD on biopsy (21.7% versus 9.0%), consistent with findings from Mittal et al.[6] and Beniwal et al.[4,6]

Membranous nephropathy was the most common glomerular diagnosis in the elderly (26.1%), consistent across Indian and international registries. The lower anti-PLA2R positivity rate in elderly MN patients (57.1% versus 80.0%) suggests a higher proportion of PLA2R-negative secondary MN in this age group, likely malignancy-associated. In our cohort, one elderly MN patient had carcinoma of the tongue and two had M-spike on SPEP, supporting the recommendation for systematic malignancy screening (chest radiograph, abdominal ultrasound, PSA/mammography, and SPEP) in all elderly patients with MN.[9]

Pauci-immune crescentic glomerulonephritis was four-fold more prevalent in the elderly (17.4% versus 2.8%), consistent with the well-established epidemiological predilection of ANCA-associated vasculitis for the seventh and eighth decades. The significantly higher anuria rate in the elderly (26.1% versus 7.6%; p=0.015) combined with markedly elevated serum urea underscores the critical importance of early biopsy in elderly patients presenting with AKD or rapidly progressive renal failure to enable timely immunosuppressive induction. Rituximab-based induction preferred over cyclophosphamide in elderly patients, as established by EUVAS trials due to its favourable toxicity profile.[10]

Myeloma-related disorders (MGRS/LCCN) were strikingly more prevalent in the elderly (17.4% versus 2.1%), consistent with the age-related rise in MGUS and plasma cell dyscrasias.[11,12] M-spike positivity in 50% of elderly patients tested further supports the incorporation of serum protein electrophoresis and immunofixation in the workup of all elderly patients presenting with AKD or nephrotic-range proteinuria.

IgA nephropathy was more common in adults (14.4% versus 8.7%), consistent with global registries.[3,13] The absence of lupus nephritis, MCD, MPGN, and TMA in the elderly group, and the exclusive occurrence of hypocomplementemia in younger patients (p=0.052), reflects the predominance of complement-consuming immune-mediated conditions in younger adults.

Post-biopsy complications were significantly more frequent in the elderly (34.8% versus 13.1%; p=0.034), with perinephric haematoma being the dominant complication. The higher complication rate is attributable to the multiple risk factors: higher hypertension prevalence, greater azotaemia, higher comorbidity burden and potential use of antiplatelet or anticoagulant agents. These findings are consistent with Moutzouris et al and the systematic review by Corapi et al, reporting higher complication rates in patients aged >75 years.[8,14] The higher procedural risk in the elderly necessitates rigorous pre-biopsy optimisation of blood pressure control, review of antiplatelet/anticoagulant agents and correction of coagulopathy. Extended post-procedure monitoring and a low threshold for ultrasound or CT imaging for perinephric haematoma advised. however, this higher complication rate should not discourage biopsy, given the high diagnostic yield and impact on management.

The principal limitation of this study is the small elderly cohort (n=23), which reduces statistical power for detecting significant differences in less prevalent diagnoses. As a single-centre referral study, selection bias may limit generalisability. The absence of follow-up data precludes renal survival analysis and treatment response assessment across age groups. Future multicentre prospective studies with larger elderly cohorts and longitudinal follow-up are warranted.

Current study has several limitations. The elderly cohort was relatively small (n=23) which limits the statistical power for detection of significant differences in less common diagnoses. Being a single centre study and referral centre, there may be limited generalisability due to inherent selection bias. The absence of follow up data limits renal survival analysis, remission rate and treatment

response across age groups. Future multicentric, prospective studies with longer follow up are warranted to define age specific outcomes in glomerular disease in the Indian population.

## CONCLUSION

In this study from AIIMS Rishikesh shows different clinicopathological spectrum of glomerular disorders between adult (<59 years) and elderly (≥60 years) patients. In adults, lupus nephritis, IgA nephropathy, FSGS and MCD were more prevalent. MN, DKD, pauci immune crescentic GN and myeloma related disorders predominated in the elderly patients. Elderly patients presented with significantly more hypertension, higher azotemia and higher oliguria-anuria rates. Post biopsy complication rate were high in elderly patients. These findings validate the need for age specific diagnostic algorithms, individualised immunosuppressive strategies and enhanced post biopsy surveillance protocols for elderly patients with glomerular disease in the Indian context. Age alone must not be considered a contraindication to native kidney biopsy.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Gangdev AN, Kandari S, Kant R, Dhoot DK, Garg S, Cheriyan A, et al. Clinicopathological spectrum of glomerular disorders in adult versus elderly patients: a prospective observational study from a tertiary care centre in North India. Int J Res Med Sci 2026;14:3941-6.