Nephrol Dial Transplant (2010) 25: 490–496
doi: 10.1093/ndt/gfp355
Advance Access publication 24 July 2009

An overview on frequency of renal biopsy diagnosis in Brazil: clinical and pathological patterns based on 9617 native kidney biopsies

Maria Goretti Polito[1], Luiz Antonio Ribeiro de Moura[2] and Gianna Mastroianni Kirsztajn[1]

[1]Glomerulopathy Section (Nephrology Division, Department of Medicine) and [2]Department of Pathology, Federal University of Sao Paulo, Brazil

Correspondence and offprint requests to: Gianna Mastroianni Kirsztajn; E-mail: gianna@nefro.epm.br and giannamk@uol.com.br

Abstract

Background. Studies about the prevalence of renal and particularly glomerular diseases in Brazil are still scarce.
Methods. We evaluated retrospectively the reports of 9,617 renal biopsies, analyzed by the same pathologist, from January 1993 to December 2007.
Results. The 9,617 renal biopsies performed in subjects of all ages in native kidneys. 4,619 were primary glomerulopathies (GN), the most frequent was focal segmental glomerulosclerosis (FSGS, 24.6%), followed by membranous nephropathy (MN, 20.7%), IgA nephropathy (IgAN, 20.1%), minimal change disease (MCD, 15.5%), mesangioproliferative non IgAN (nonIgAN, 5.2%), diffuse proliferative GN (DPGN, 4.7%) and membranoproliferative GN (MPGN, 4.2%). Lupus nephritis was responsible for most cases which etiology was determined, i.e., 950 out of 2,046 cases (45.5%), followed by post infectious GN (18.9%), diabetic nephropathy (8.5%), benign and malignant nephroangiosclerosis (7.3%), haemolytic–uraemic syndrome and thrombotic thrombocytopenic purpura (HUS/TTP), amyloidosis (4.8%) and vasculitis (4.7%). There was a predominance of secondary GN in the North, mostly due to lupus nephritis (LN); FSGS was very common in Northeast (27.7%), Central (26.9%) and Southeast regions (24.1%); IgAN was most frequent in South (22.8%) and MN in North (29.6%); the total prevalence of MPGN was low, and its regional distribution has not changed along the years.
Conclusion. FSGS was the most frequent primary glomerular disease, followed closely by MN and IgAN. The predominance of FSGS is in accordance with recent studies all over the world that revealed its frequency is increasing. Lupus nephritis predominated among secondary GN in most regions, a finding observed in other studies.

Keywords: epidemiology; glomerulopathy; prevalence; renal biopsy; renal diseases

Introduction

Studies about the prevalence of renal and particularly glomerular diseases in Brazil are still scarce. Epidemiological evidence obtained in the past decade show that primary glomerulopathies (GN) constitute a persistent cause of chronic renal disease in Brazil. In fact, they accounted for nearly 20% of all registered cases of end-stage renal disease (ESRD) between 1997 and 2000 [1–3]. Focal segmental glomerulosclerosis (FSGS) and membranous glomerulopathy (MN) are the leading modalities of glomerulopathy, although the importance of IgA nephropathy (IgAN) has increased in recent years, according to three recent biopsy-based studies [4–6]. On the other hand, the occurrence of postinfectious GN may have declined in larger urban areas in recent years, but it may also have an unsuspected importance as a cause of ESRD, given the recent occurrence of an outbreak in a Brazilian rural area [7], with some cases evolving to progressive nephropathies. But other renal diseases associated with poor hygienic conditions, such as the GN secondary to schistosomiasis, are now relatively less important as causes of ESRD [8].

It is known that different patterns of glomerular diseases distribution are diagnosed all over the world. In Western Europe, Australia/New Zealand and some countries in Asia [9–15], IgAN is the most common GN diagnosed by a renal biopsy. In America, data from the United States [16,17,19–21], Brazil [4–6] and Uruguay [22] show that FSGS is the most frequent GN. Additionally, the occurrence of primary membranoproliferative glomerulonephritis (MPGN) has been reported to be lower in recent decades in Europe [11,12,23] and the frequency of FSGS has been suggested to be increasing in the United States [19–21,24].

Previous studies of glomerular diseases in Brazil corresponded mainly to reports based on limited population samples from some regions of the country, and they showed a high frequency of MPGN and FSGS and a low frequency of IgAN [4–6].

Brazil exhibits some characteristics typically found in developed countries, but it is still plagued by problems more associated with poor countries, such as severe

deterioration of some urban areas, poor educational indices and high infant mortality rate [25]. It was in this unique scenario, with peculiarities determined mainly by the continental extension of the country and its endemias (malaria, HCV and HBV infections in the North, as well as schistosomiasis mansoni in the Northeast), that we outlined the frequency and eventual changes in the national pattern of renal diseases and especially of GN diagnosed by a biopsy in Brazil.

Methods

It was performed as a retrospective study of renal diseases in native kidneys diagnosed by a biopsy since January of 1993 to December of 2007, from all five regions of the country, evaluated in a single Renal Pathology Service (Hospital do Rim e Hipertensao/Kidney and Hypertension Hospital, UNIFESP, Sao Paulo) by the same pathologist, including the available clinical, laboratorial and histological parameters.

Renal biopsy specimens were usually processed and stained for light microscopy and immunofluorescence (using polyclonal antisera against human IgG, IgM, IgA, C3, C1q, kappa and lambda light chains). Electron microscopy (EM) was not systematically performed. Considering this limitation, membranoproliferative was not subdivided into types I, II and III, but when dense deposit disease was diagnosed by EM, it was reported.

Renal diseases were divided into five categories [26]: (i) primary GN; (ii) secondary GN; (iii) tubulointerstitial nephropathies; (iv) rare and hereditary diseases, and (v) sclerosing glomerulonephritis.

A diagnosis of primary glomerular disease was considered if there was at the time of biopsy: (i) no report of any known associated systemic disease; (ii) negative serology for hepatitis B and C, HIV and anti-nuclear antibodies, and (iii) no report of familial haematuria. It is worth noting that the distinction between primary and secondary GN was not established by a single histological approach, but by association of the morphological findings and available clinical data. The secondary glomerular diseases were divided into four groups: (i) GN associated with systemic diseases (systemic lupus erythematosus, Henoch-Schönlein purpura, antiglomerular basement membrane disease, rheumatoid arthritis, Sjögren syndrome, mixed connective tissue disease, pregnancy nephropathy, malignancies, liver diseases and multiple myeloma); (ii) GN associated with metabolic diseases (diabetic nephropathy, amyloidosis, monoclonal Ig deposit disease, mixed cryoglobulinaemia and dense deposit disease); (iii) GN associated with infectious diseases/postinfectious glomerulonephritis (endocarditis, hepatitis B and C); and (iv) glomerulopathies associated with vascular diseases [systemic vasculitis, benign/malignant nephrosclerosis, haemolytic–uraemic syndrome/thrombotic microangiopathy, systemic sclerosis and pauci-immune crescentic glomerulonephritis (CrescGN)]. Hereditary diseases corresponded to Alport and thin membrane diseases, Finnish-type nephrotic syndrome, oligomeganephronia, renal dysplasia, glomerulocystic and polycystic kidney diseases; and rare diseases were obesity-associated glomerulopathy, cast nephropathy, fibrillary and immunotactoid GN, Fabry disease, cholemic nephrosis, nephronophthisis, strange body granuloma and cortical hamartoma. Tubulointerstitial diseases included acute and chronic tubulointerstitial nephritis, acute tubular necrosis, cortical necrosis, reflux nephropathy, oxalosis and nephrocalcinosis.

Patients $\leq$19 years of age were considered as children (as named by previous studies [13], but include in fact children and adolescents), those with 20–39 years as young adults, >20 and <59 years as adults and $\geq$60 years as elderly.

To evaluate the evolution of the prevalence of native renal diseases along the time of study, we divided it into three consecutive periods (period A 1993–97; period B 1998–2002 and period C 2003–07).

Data analysis

Data were stored on a standard EXCEL database; an SPSS 10.0.6 statistics package was used for analysis. Data were reported as prevalence and were coded in contingency tables and compared by the chi square test. A *P*-value <0.05 (by two-tailed testing) was considered significant.

Table 1. Frequency of different forms of biopsy-proven nephropathies in Kidney and Hypertension Hospital/UNIFESP series (1993–2007)

Renal diseases	No. of cases	Percentage (%)
Primary glomerular diseases	4619	51.0
Secondary glomerular diseases	2109	22.6
Systemic diseases	991	10.9
Metabolic diseases	316	3.5
Vascular diseases	353	3.9
Infections	386	4.3
Sclerosing glomerulonephritis	298	3.3
Tubulointerstitial diseases	199	2.2
Hereditary and rare renal diseases	67	0.7
Extra renal tissue	181	2.0
Medullar tissue	203	2.2
Unclassified biopsies	1449	16.0
Total	9062[a]	100.0

[a]555 biopsies were not evaluated due to insufficient material.

Table 2. Frequency of different forms of biopsy-proven primary GN in the Kidney and Hypertension Hospital/UNIFESP series (1993–2007)

Primary GN	No. of cases	Percentage (%)
Minimal change disease	717	15.5
Membranous nephropathy	957	20.7
IgA nephropathy	928	20.1
FSGS	1135	24.6
MsPGN	239	5.2
DPGN	218	4.7
MPGN	193	4.2
Crescentic glomerulonephritis	80	1.7
MCD/PM/FSGS	71	1.6
Segmental proliferative GN	48	1.0
Endocapillary proliferative GN	33	0.7
Total	4619	100.0

GN, glomerulonephritis; FSGS, focal segmental glomerulosclerosis; MsPGN, mesangioproliferative GN; DPGN, diffuse proliferative GN; MPGN, membranoproliferative GN; MCD/PM/FSGS, minimal change disease/mesangial proliferation/focal segmental glomerulosclerosis.

Results

General data

We evaluated 9617 biopsies of native kidneys from all five regions of the country. The primary GN were the most frequent findings (51.0%), followed by secondary glomerulonephritis (22.6%), sclerosing glomerulonephritis (3.3%), tubulointerstitial nephropathies (2.2%) and rare and hereditary diseases (0.7%), as indicated in Tables 1–5.

The biopsies were mainly evaluated by light microscopy and immunofluorescence, with the application of EM in only 8.9% of the cases. No conclusive diagnosis was obtained in 1449 (16%) (Table 1); normal kidney was found in 806 (40.2%), renal glomerulosclerosis (focal or diffuse, segmental or multi segmental) in 375 (18.7%) and 170 (8.5%) corresponded to glomerular hypertrophy, glomerular capillary congestion, mesangial expansion or podocitary degenerative changes.

Ninety-three percent of the biopsies came from adults, 4.3% from children and 2.2% from elderly patients. The prevalence of a renal biopsy was similar in all regions of

Table 3. Frequency of different forms of biopsy-proven secondary glomerulonephritis associated with metabolic diseases

Glomerulonephritis associated with metabolic diseases	No. of cases	Percentage (%)
Diabetic nephropathy	174	55.1
Amyloidosis	99	31.3
Monoclonal Ig deposit disease	26	8.2
Mixed cryoglobulinaemia	17	5.4
Total	316	100.0

Ig, immunoglobulin.

Table 4. Frequency of different forms of biopsy-proven secondary glomerulonephritis associated with vascular diseases

Renal lesion-associated vascular disease	No. of cases	Percentage (%)
Benign and malignant nephroangiosclerosis	148	41.9
Haemolytic–uraemic syndrome/thrombotic thrombocytopaenic purpura	99	28.0
Vasculitis	98	27.8
Esclerodermia	5	1.4
Ischaemic nephropathy	3	0.8
Total	353	100.0

Table 5. Frequency of different forms of biopsy-proven Tubulointerstitial nephropathies

Tubulointerstitial nephropathies	No. of cases	Percentage (%)
Acute tubular necrosis	76	38.4
Acute tubulointerstitial nephritis	53	26.8
Chronic tubulointerstitial nephritis	44	22.2
Cortical necrosis	12	6.0
Reflux nephropathy	5	2.5
Oxalosis	5	2.5
Nephrocalcinosis	3	1.5
Total	198	100.0

the country by 100 000 habitants. Forty-seven percent of the cases came from the Southeast, 23% from the Northeast, 16% from the South, 7% from the Midwest and 7% from the North regions. Considering the cases with information relative to race/ethnia, most of them were Caucasians (72%), followed by mulattos (17%), Afro descents (7.9%) and Asian descents (3%).

Table 2 shows primary GN: FSGS was the most frequent diagnosis, and together with MN, IgAN and other variants of idiopathic nephrotic syndrome constituted 51% of all biopsies. Type III was the most frequent form of CrescGN (51%). Among secondary GN, lupus nephritis was the most frequent form (42.4%), followed by infectious GN (20.4%), diabetic nephropathy (10.1%), nephroangiosclerosis (benign and malignant) (8%), haemolytic–uraemic syndrome and thrombotic thrombocytopaenic purpura, (HUS/TTP) amyloidosis (6.2%) and vasculitis (3.6%) (Figure 1).

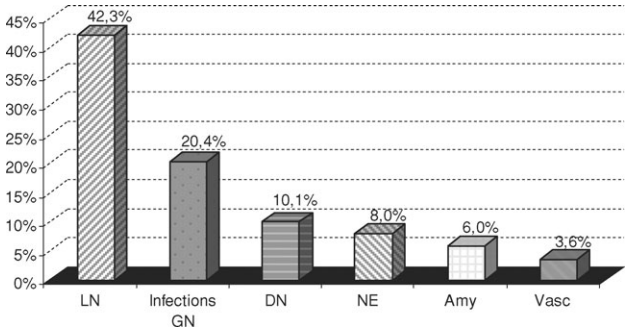

Fig. 1. Frequency of different forms of biopsy-proven secondary GN in Kidney and Hypertension Hospital/UNIFESP series. LN, lupus nephritis; infectious GN, infections glomerulonephritis; DN, diabetes nephropathy; NE, benign and malignant nephroangiosclerosis; Amy, amyloidosis and Vasc, vasculitis.

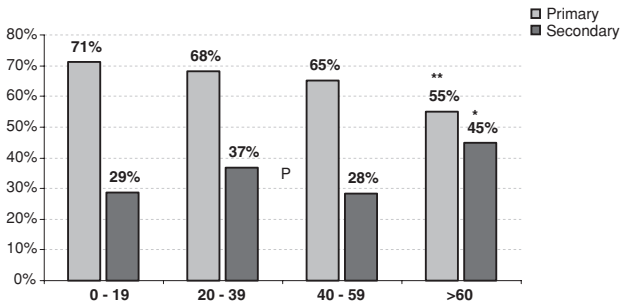

Fig. 2. Frequency of different forms of biopsy-proven primary and secondary GN in Kidney and Hypertension Hospital/UNIFESP series, according to the age groups ($^{**}P < 0.05$ and $^{*}P < 0.001$).

Clinical data

The gender distribution was balanced, when considered all diagnoses together (female in 51%), but male sex was more frequent among primary GN (54%) ($P < 0.001$), except in case of CrescGN types I and II, DPGN and endocapillary proliferative glomerulonephritis, and female sex predominated among secondary GN (62.1%), particularly due to the elevated number of cases of lupus nephritis (46.5%) ($P < 0.001$).

The mean age of the general population was 35.07 ± 18.65 years. In addition, the mean age increased from 31.93 ± 18.22 years in the period A to 35.74 ± 18.41 years in the period C. It is of note that primary GN were not statistically different between the groups of age <59 years ($P = 0.335$), but as age increased a significant decrease was observed in the percentage of patients with primary GN, and increase of those with secondary GN ($P < 0.001$), as indicated in Figure 2.

Nephrotic syndrome was the main clinical indication of a renal biopsy in the whole population of the present study (39%), followed by asymptomatic urinary abnormalities in children (16%) and in adults (20.7%), acute and chronic renal failures in the elderly (16.8%) (Table 6). Acute renal failure was present in 14.4% of patients, while chronic renal failure occurred in 11% of the cases. Figure 3 shows the frequencies of such syndromes in the primary and in the main secondary GN separately.

Table 6. Clinical syndromes at the time of a renal biopsy (given as a percentage of all renal biopsies) according to age groups

Clinical syndromes	Age groups		
	Children (%)	Adults (%)	Elderly (%)
Nephrotic syndrome	44.6	34.3	41.3
Asymptomatic urinary abnormalities	16.0	20.7	8.4
Nephritic syndrome	8.8	8.7	7.1
Acute renal failure	12.2	14.7	16.8
Chronic renal failure	7.5	11.2	16.8
Macroscopic haematuria	4.1	2.8	1.3
Hypertension	0.7	4.5	7.1
Nephrotic/nephritic syndrome	6.1	3.1	1.2
Total	100.0	100.0	100.0

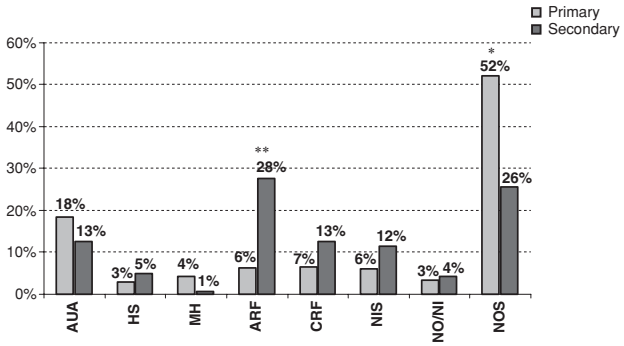

Fig. 3. Frequency of different forms of biopsy-proven primary and secondary GN in Kidney and Hypertension Hospital/UNIFESP series, according to the clinical syndromes (*$P < 0.001$ and **$P < 0.05$). AUA, asymptomatic urinary abnormalities; HS, hypertension; MH, macroscopic haematuria; ARF, acute renal failure; CRF, chronic renal failure; NIS, nephritic syndrome; NO/NI, nephrotic/nephritic syndrome and NOS, nephrotic syndrome.

Among those with nephrotic proteinuria, FSGS (27%), MCD (20.7%) and MN (18.6%) were the most frequent diagnoses, while IgAN occurred only in 4.2% (Table 7).

Comparing clinical syndromes at the time of renal biopsy between primary and secondary GN, it was found that in primary GN macroscopic haematuria and nephrotic syndrome predominated, while acute and chronic renal failures and nephritic syndrome were the main manifestations in secondary GN ($P < 0.05$) (Figure 3). Nephrotic syndrome was the main clinical syndrome of the primary glomerular diseases (52%) and acute renal failure (28%) of secondary GN ($P < 0.05$) (Figure 3). There was an increase in both acute and chronic renal failures with increasing age, as indicated in Table 7.

When the presentation of the renal disease was chronic renal failure, lupus nephritis was the predominant diagnosis in young adults (20.5%) followed by FSGS and MCD (18.2%); and lupus nephritis (11.5%) predominated also in adults, followed by FSGS and IgAN (9.2%); in the elderly, diabetic nephropathy occurred in 19.2% (Figure 4).

Along the three periods of the study (A, B and C), asymptomatic urinary abnormalities were increasingly implicated amongst indications of renal biopsy (from 12.1% to 19.7%, $P < 0.05$).

Histopathological data and regional distribution

Primary glomerular disease was predominant across age groups ($P = 0.335$); however, secondary glomerular diseases and non-glomerular renal diseases were more common in adults and in the elderly ($P < 0.001$) (Figure 2).

In our country, FSGS was the main cause of primary glomerulopathy by renal biopsy reports (corresponding to 24.6%), followed by MN (20.7%) and IgAN (20.1%), as shown in Table 2.

In children, the most frequent renal diseases were FSGS (23.5%), MCD (17.0%) and lupus nephritis (14.3%). In adults, the most common diseases were FSGS (14.6%), followed by NIgA (13.2%). In the elderly, the most frequent diagnoses were MN (13.1%), FSGS (12.1%), amyloidosis (9.8%), diabetic nephropathy (7.5%) and benign and malign nephroangiosclerosis (6.1%) (Figure 7).

Comparing the three periods of our study (A 1993–97, B 1998–2002, C 2003–07), there was no statistically

Table 7. Clinical/pathological correlations observed in main primary and secondary glomerular diseases

Histopathological diagnoses	NOS (%)	AUA (%)	NIS (%)	ARF (%)	CRF (%)	MH (%)
IgAN	4.2	23.3	15.8	5.3	9.2	38.6
MN	18.6	8.1	3.9	1.2	1.1	1.8
MCD	20.7	9.8	0.0	1.2	1.6	0.0
FSGS	27	12.2	10.2	6.1	13.5	7.0
CrescGN	0.0	0.0	3.1	3.7	1.6	1.8
MPGN	1.9	0.7	4.7	3.7	3.8	1.8
MsPGN	1.0	1.0	2.3	0.4	1.6	7
Lupus nephritis	8.2	13.2	14.2	20.1	10.8	1.8
Amyloidosis	5.1	0.3	0.0	0.8	1.1	0.0
Infectious GN	1.1	1.0	17.2	11.1	1.1	1.8
Diabetic nephropathy	5.3	1.9	0.8	2.9	4.9	0
No conclusive diagnoses	0.8	14.6	2.5	4.4	4.3	19.3
Others	6.1	13.9	25.3	39.1	45.4	19.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

NOS, nephrotic syndrome; AUA, asymptomatic urinary abnormalities; NIS, nephritic syndrome; ARF, acute renal failure; CRF, chronic renal failure; MH, macroscopic haematuria; IgAN, IgA nephropathy; MN, membranous nephropathy; MCD, minimal change disease; FSGS, focal segmental glomerulosclerosis; CrescGN, crescentic GN; MPGN, membranoproliferative GN; MsPGN, mesangioproliferative GN.

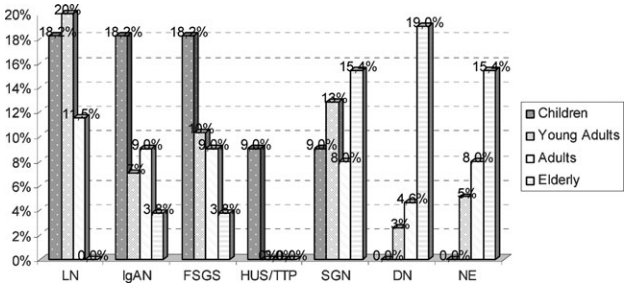

Fig. 4. Chronic renal failure at the time of a renal biopsy according to age groups: children, young adults, adults and elderly. LN, lupus nephritis; IgAN, IgA nephropathy; FSGS, focal segmental glomerulosclerosis; HUS/TTP, Haemolytic–uraemic syndrome/thrombotic thrombocytopaenic purpura; SGN, sclerosing glomerulonephritis; DN, diabetes nephropathy; NE, benign and malignant nephroangiosclerosis.

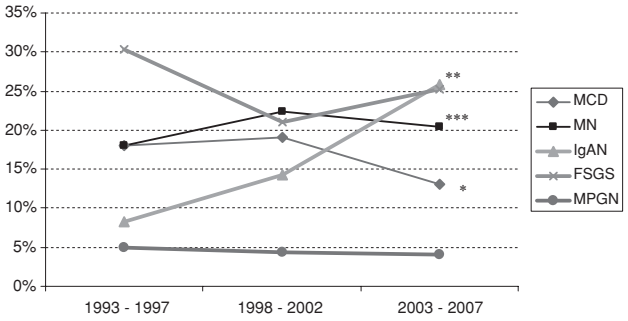

Fig. 5. Distribution of most common primary GN (MCD, MN, IgAN, FSGS and MPGN) in the three periods of study (*,**$P < 0.05$ and ***$P < 0.05$).

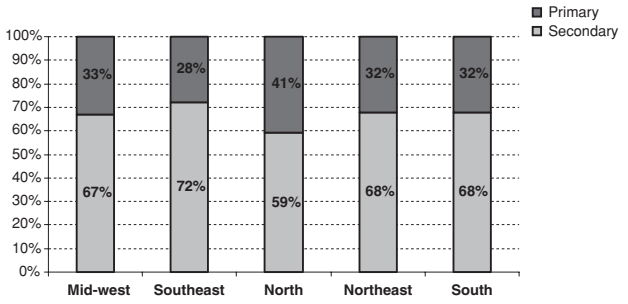

Fig. 6. Distribution of glomerulopathies according to the Brazilian geographical regions ($P < 0.001$).

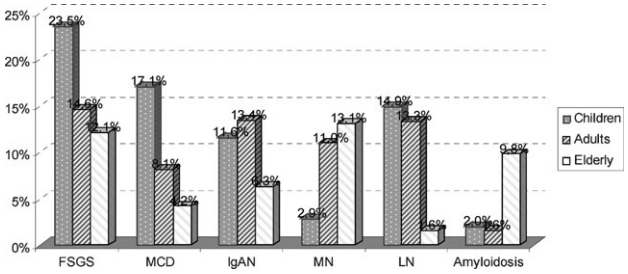

Fig. 7. Distribution of focal segmental glomerulosclerosis (FSGS), minimal change disease (MCD), IgA nephropathy (IgAN), membranous nephropathy (MN), lupus nephritis (LN) and amyloidosis according to age groups.

significant association between the type of GN (primary or secondary) and the biopsy period ($P = 0.069$), but an association was observed between the type of primary glomerular diseases and the period of a renal biopsy ($P < 0.001$): MCD had a significant percentage decrease in period C, when compared with A and B ($P < 0.05$); NM did not present expressive variation along the three periods ($P > 0.05$); the percentage of IgAN increased along the periods of study ($P < 0.05$), and FSGS decreased from period A to B ($P < 0.05$) and A to C, but increased from B to C ($P < 0.05$); there was no significant variation in MPGN ($P > 0.05$) (Figure 5). Additionally, the last diagnosis was very uncommon in the general population evaluated.

The renal diseases submitted to a renal biopsy in Brazil presented different distribution in the geographical regions of the country ($P < 0.001$) (Figure 6).

Discussion

This work reports on a 15-year retrospective epidemiological study of renal diseases that started in January 1993 and involves biopsies from all Brazilian geographical regions. The results confirm that FSGS is the most common primary glomerular disease, not only among the patients biopsied due to primary glomerular diseases, but also in the general population. Additionally, in this area it is the most frequent primary GN in children, adolescents, young adults and adults, while MN predominated in the elderly. The most frequent clinical syndrome at any age was the nephrotic syndrome, followed by asymptomatic urinary abnormalities in children and adults and acute and chronic renal failures in the elderly. Among those with nephrotic proteinuria, FSGS (27%), MCD (20.7%) and MN (18.6%) were the most frequent diagnoses, while IgAN occurred only in 4.2%; this is in accordance with other experiences [11–13,27]. IgAN was present in a similar percentage of adult nephrotic syndrome patients (14%) in the report of Haas *et al*. [21], while others found lower frequencies, 8% [17] and 2.4% [12]. This may be because IgAN patients often undergo a renal biopsy at a more advanced stage of disease [28]. These findings are in accordance with a Japanese study in which nephrotic syndrome is the most frequent clinical manifestation among 1850 cases [10]. As expected, the prevalence of acute or chronic renal failure increased significantly with age. Conversely, in the Italian registry, asymptomatic urinary abnormalities are more common than nephrotic syndrome, perhaps expressing a tendency to biopsy asymptomatic haematuria or proteinuria [10,12]. IgAN was the disease diagnosed predominantly in this group (23.3%), similar to data from Italy (29.8%); however, in our study, the next most common diagnosis was lupus nephritis (13.2%), a pattern quite different from that of Italy (28.2%). Among those patients with nephritic syndrome, the glomerular diseases associated with infections were observed in 17.2%, IgAN in 15.8% and lupus nephritis in 14.2%. The Italian experience [12] was very different, as IgAN represented 14.0% of patients presenting with nephritic syndrome, lupus nephritis corresponded to 20.1 and endocapillary proliferative GN to 16.1%.

In only 8.9% of cases was EM available, although it is a crucial diagnostic tool in some circumstances, then histological diagnoses as thin membrane disease were certainly subdiagnosed.

It is known that the renal pathology pattern can be different between age groups, and thus, we have separately analysed data according to the age ranges. In children, the primary glomerular disease predominated, whereas in adults and in the elderly, the frequency of primary GN decreased, with an increase of secondary forms and non-glomerular diseases, renal sclerosis and unclassified diseases of the kidney [11]. In children, the most frequent diagnoses in our study were FSGS in 23.5%, MCD in 17% and IgAN in 11%, as previously reported [29,30]. In this age group, we were able to confirm the high prevalence of lupus nephritis (14.3%) in secondary GN.

In adults, as repeatedly established by others, idiopathic FSGS was the most frequent diagnosis. These data are similar to those previously described by Cruz *et al*. [4], Oliveira *et al*. [5] and Malafronte *et al*. [6] in Brazil.

The second highest cause of renal disease in the present series was MN. The prevalence of MN remained similar throughout the study, while that of IgAN increased slightly. It is necessary to remember that factors inherent to the continued education or technical improvement can influence results in analyses conducted for a long period by a single pathologist. However, such a progressive increase during the last decade has also been suggested in other recent studies [31–33], and could be interpreted as the consequence of the increase in average lifetime and also the possible role of some environmental factors such as drugs [34] or solvents [35].

The prevalence of IgAN is higher amongst young adults (aged from 20 to 39 years) than in the elderly. In contrast, MN is more frequent in the elderly than in adults [36,37].

The third cause of renal disease of the present series was IgAN, a pattern different from those found in Italy [12,23], Japan [10] and Victoria in Australia [32], where IgAN constitutes the most frequent diagnosis. However, its prevalence is significantly lower in the Registries of Kentucky [38], New Caledonia in Australia [39] and previous reports from Brazil [4–6]. Among adults, our frequency of IgAN was similar to that observed in the study of Nair and Walker [40] as they have reported an increase in IgAN incidence; it was the most frequent primary glomerular disease and the most common cause of ESRD in young adult Caucasians in the USA. There was a significant increase in the frequency of IgAN along the three periods of this study.

In our country, the prevalence of MPGN in the whole population evaluated was low and remained constant since the first period. The general prevalence was low (4.2%), although it was higher in some Brazilian States (e.g. 9.8% in Alagoas). It is possible that this prevalence is associated with regional endemic diseases. One of the most important progressive nephropathies associated with tropical diseases in Brazil is the schistosomal glomerulopathy. Patients at risk are mainly those suffering from the advanced hepatosplenic and hepatointestinal forms of the disease [41], 4.5% of whom may develop schistosomal nephropathy [25]. The most common histological forms of disease are MPGN, mesangial proliferative glomerulonephritis and FSGS [8].

The frequency of GN in Brazil has also presented a variation in the different Brazilian States, with a higher prevalence of IgAN in the States of Santa Catarina (50.6%) and Minas Gerais (24.3%), sites with higher per capita income and lower indexes of poverty, where the main biopsy indications were nephrotic syndrome (40% and 43.1%) followed by asymptomatic urinary abnormalities (25% and 15%, respectively). FSGS presented a higher prevalence in the Northeast States, particularly in Maranhão (37.7%), a State with lower per capita income and higher indexes of poverty (as low birth weight and child subnutrition). MN was the predominant diagnosis in the States of Pernambuco (25.8%) and Pará (31.3%).

Finally, this study shows the prevalence of glomerular diseases based on the reports of 9617 renal biopsies and includes material from all regions of the country. It is worth noting that the distinction between primary and secondary GN was not established by a single histological approach, but by association with the morphological findings and available clinical data. Considering both aspects, FSGS was the most frequent primary glomerular disease, followed closely by MN and IgAN. The predominance of FSGS is in accordance with recent studies all over the world that revealed its frequency is increasing. Lupus nephritis predominated among secondary GN in most regions, a finding observed in several studies, and it was the second highest cause of renal disease in young adults. In the elderly, the predominant renal diseases were idiopathic MN, followed by FSGS and amyloidosis, as observed by the majority of the elderly registries [11]. There were regional differences in the prevalence of the several glomerular diseases and they are possibly explained by the clinical and laboratorial criteria utilized to indicate a biopsy. However, there is a weak chance that a true variation is related to some specific conditions of each region.

Conclusion

Our study gives information about a large sample of the Brazilian population, including biopsies of all geographical regions. It demonstrates that the two major primary glomerular diseases are currently FSGS and MN, and that the IgAN is the GN whose prevalence presents the highest increase along the last 15 years in Brazil, possibly related to changes in the biopsy indication profile, favouring asymptomatic urinary abnormalities.

Sampling bias is an inherent limitation of the type of registry presented here; on the other hand, this is an initial step in the understanding of the epidemiology of renal diseases in Brazil as a whole, providing data for comparison among its geographical regions as well as with other countries.

Acknowledgement. This study was supported by a grant of CNPq (National Counsel of Technological and Scientific Development, Brazil).

Conflict of interest statement. None declared.

(See related article by F. Pesce and F. P. Schena. Worldwide distribution of glomerular diseases: the role of renal biopsy registries. *Nephrol Dial Transplant* 2010; 25: 334–336.)

References

1. Sesso R, Anção MS, Madeira SA. Epidemiologic aspects of the dialysis treatment in Grande Sao Paulo. *Rev Assoc Med Bras* 1994; 40: 10–14
2. Brazilian Ministry of Health. Medical assistance to the chronic renal failure patient [Portuguese]. Brasilia, Brazil, Brazilian Ministry of Health, 1997
3. Brazilian Ministry of Health. Brazilian epidemiological study on renal replacement therapy [Portuguese]. Brasilia, Brazil, Brazilian Ministry of Health, 2002
4. Bahiense-Oliveira M, Saldanha LB, Mota EL *et al*. Primary glomerular diseases in Brazil (1979–1999): is the frequency of focal and segmental glmerulosclerosis increasing? *Clin Nephrol* 2004; 61: 90–97
5. Mazzarolo CHM, Cruz J, Silva AL *et al*. Prevalence of adult primary glomerular diseases: retrospective analysis of 206 kidney biopsies (1990–1993). *Rev Hosp Clin Fac Sao Paulo* 1996; 51: 3–6
6. Malafronte P, Mastroianni-Kirsztajn G, Betônico GN *et al*. Brazilian glomerulonephritis registry: analysis of a regional multicentre study in State of Sao Paulo. *J Am Soc Nephrol* 2001; 12: 115A–115A
7. Pinto SW, Sesso R, Vasconcelos E *et al*. Follow-up of patients with epidemic poststreptococcal glomerulonephritis. *Am J Kidney Dis* 2001; 38: 249–255
8. Andrade ZA, Rocha H. Schistosomal glomerulopathy. *Kidney Int* 1979; 16: 23–29
9. Maisonneuve P, Agodoa L, Gellert R *et al*. Distribution of primary renal diseases leading to end-stage renal failure in the United States, Europe and Australia/New Zealand: results from an International Comparative study. *Am J Kidney Dis* 2000; 35: 157–165
10. Research Group on Progressive Chronic Renal Disease 1999 Nationwide and long-term surgery of primary glomerulonephritis in Japan as observed in 1850 biopsied cases. *Nephron* 1999; 82: 205–213
11. Rivera F, López-Gómez JM, Pérez-García R. Papel del Registro de Glomerulonefritis de la Sociedad Espanola de Nefrología: pasado, presente y futuro. *Nefrología* 2000; 20(Suppl 5): 41–44
12. Schena FP and the Italian Group of Renal Immunopathology. Survey of the Italian Registry of Renal Biopsies. Frequency of the renal diseases for 7 consecutive years. *Nephrol Dial Transplant* 1997; 12: 418–426
13. Simon P, Ramee MP, Autuly V *et al*. Epidemiology of primary glomerular diseases in a French region. Variations according to period and age. *Kidney Int* 1994; 46: 1192–1198
14. Tiebosch AT, Wolters J, Frederik PFM *et al*. Epidemiology of idiopathic glomerular disease: a prospective study. *Kidney Int* 1987; 32: 112–116
15. Woo KT, Chiang GS, Pall A *et al*. The changing pattern of glomerulonephritis in Singapore over the past two decades. *Clin Nephrol* 1999; 52: 96–102
16. D'Agati VD. The many masks of focal segmental glomeruloesclerosis. *Kidney Int* 1994; 46: 1223–1241
17. Korbet SM, Genchi RM, Borok RZ *et al*. The racial prevalence of glomerular lesions in nephrotic adults. *Am J Kidney Dis* 1996; 27: 647–651
18. Pontier PJ, Pate1 TG. Racial differences in the prevalence and presentation of glomerular disease in adults. *Clin Nephrol* 1994; 42: 79–84
19. Braden GL, Mulhern JG, O'Shea MH *et al*. Changing incidence of glomerular diseases in adults. *Am J Kidney Dis* 2000; 35: 878–883
20. Haas M, Spargo BH, Coventry S. Increasing incidence of focal-segmental glomerulosclerosis among adult nephropathies: a 20-year renal biopsy study. *Am J Kidney Dis* 1995; 26: 740–750
21. Haas M, Meehan SM, Karrison TG *et al*. Changing etiologies of unexplained adult nephrotic syndrome: a comparison of renal biopsy findings from 1976–1979 and 1995–1997. *Am J Kidney Dis* 1997; 30: 621–631
22. Mazzuchi N, Di Martino LA. Epidemiología de las glomerulopatias primárias en el Uruguay. *Arch Med Interna (Montevideo)* 1997; 19: 21–26
23. Stratta P, Segoloni GP, Canavese C *et al*. Incidence of biopsy proven primary glomerulonephritis in an Italian province. *Am J Kidney Dis* 1996; 27: 631–639
24. Dragovic D, Rosenstock JL, Wahl SJ *et al*. Increasing incidence of focal segmentar glomerulosclerosis and an examination of demographic patterns. *Clin Nephrol* 2005; 63: 1–7
25. Noronha IL, Schor N, Coelho SN *et al*. Nephrology, dialysis, transplantation in Brazil. *Nephrol Dial Transplant* 1997; 12: 2234–2243
26. Li LS, Liu ZH. Epidemiologic data of renal diseases from a single unit in China: analysis based on 13519 renal biopsies. *Kidney Int* 2004; 66: 920–923
27. Heaf J, Okkegaard H, Larsen S. The epidemiology and prognosis of glomerulonephritis in Denmark 1985–1997. *Nephrol Dial Transplant* 1999; 14: 1889–1897
28. Rychlík I, Jancová E, Tesar V *et al*. The Czech registry of renal biopsies. Occurrence of renal diseases in the years 1994–2000. *Nephrol Dial Transplant* 2004; 19: 3040–3049
29. Coppo R, Gianoglio B, Porcellini MG *et al*. Group of Renal Immunopathology of the Italian Society of Pediatric Nephrology and Group of Renal Immunopathology of the Italian Society of Nephrology. Frequency of renal diseases and clinical indications for renal biopsy in children (report of the Italian National Registry of Renal Biopsies in Children). *Nephrol Dial Transplant* 1998; 13: 293–297
30. Briganti EM, Dowling J, Finlay M *et al*. The incidence of biopsy-proven glomerulonephritis in Australia. *Nephrol Dial Transplant* 2001; 16: 1364–1367
31. Jungers P, Nochy D, Geffriaud C *et al*. Epidemiology of primary glomerulonephritis (ON) in a French urban area. *XIIth International Congress of Nephrology*. Jerusalem: Israel, 13–18 June, 1993, p 77
32. Abdulmassih Z, Makdassi R, Boe N *et al*. Epidémiologie des glomérulonephrites primitives en Picardie. *Ann Med Intern* 1990; 141: 129–133
33. Gorrie M, Nicholls SA. The impact of membranous nephropathy in a defined population: a nine-year audit (abstract). *XIIth International Congress of Nephrology*. Jerusalem, Israel, June 13–18, 1993, p 76
34. Fillastre JP, Druet P, Mery JP. Protein uric nephropathies associated with drugs and substances of abuse. In: Cameron JS, Glassock RJ (eds). *The Nephrotic Syndrome.* New York: Marcel Dekker, 1988, 697–744
35. Cristofini P, Pairon JC, De Palmas J *et al*. Etude cas-témoins sur Ia relation entre gbomérulonephnte chronique et exposition aux sobvants. *Arch Mal Prof* 1987; 48: 320–323
36. Simon P, Autuly YV, Fauchet R *et al*. Associations entre maladies glomérulaires primitives et alleles HLA dans une population française d'origine caucasienne. *Néphrologie* 1993; 14: 59
37. Autuly V, Simon P, Cam G *et al*. The nephrotic syndrome in the elderly: epidemiological data. In: Andreucci YE, Del Canton A (eds). *New Therapeutic Strategies in Nephrology*. Boston: Kluwer, 1991, 37–40
38. Wyatt RJ, Julian BA, Baehler RW *et al*. Epidemiology of IgA nephropathy in central and eastern Kentucky for the period 1975 through 1994. Central Kentucky Region of the South-Eastern United States IgA Nephropathy DATABANK Project. *J Am Soc Nephrol* 1998; 9: 853–858.
39. Painter D, Clouston D, Ahn E *et al*. The pattern of glomerular disease in New Caledonia: preliminary findings. *Pathology* 1996; 28: 32–35
40. Nair P, Walker PD. Is IgA nephropathy the commonest primary glomerulopathy among adults in the USA? *Kidney Int* 2006; 60: 1455–1458
41. Abensur H, Nussenzweig I, Saldanha LB *et al*. Nephrotic syndrome associated with hepatointestinal schistosomiasis. *Rev Inst Med Trop Sao Paulo* 1992; 34: 273–276

Received for publication: 7.1.09; Accepted in revised form: 29.6.09