CHAPTER 4

PAEDIATRIC KIDNEY BIOPSIES

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4.1 Introduction

- Chapter 4 reports on kidney biopsies done in children and young people less than 15 years of age over a span of 15 years, from 2005-2020.
- A total of 2259 kidney biopsies were performed in 2231 children.
- The majority of kidney biopsies were performed in Ministry of Health hospitals (97.0%).
- The average number of native kidney biopsies is 120-180 per year. In 2020, we observed only 109 procedures. This acute reduction in the number of procedures could be attributed to the first wave of COVID19 pandemic in the country. *(Table and Figure 4.1.1)*
- It was the first episode of kidney biopsy in 89.6% of patients. *(Table 4.1.2)*
- Eighty-percent of the biopsies yielded 10 or more glomeruli; the minimum number deemed adequate for histopathological diagnosis. *(Table 4.1.3)*

Table 4.1.1: Number of patients from various hospitals, 2005-2020

Hospitals	2005-2009 (n=701)		2010-2014 (n=769)		2015-2019 (n=652)		2020 (n=109)		Total (n=2231)	
	n	%	n	%	n	%	n	%	n	%
Hospital Kuala Lumpur	173	24.7	159	20.7	123	18.9	3	2.8	458	20.5
Other MOH Hospitals	511	72.9	577	75.0	514	78.8	105	96.3	1707	76.5
Non MOH* Hospitals	17	2.4	33	4.3	15	2.3	1	0.9	66	3.0

* University Hospital, Army Hospital, Private Hospital

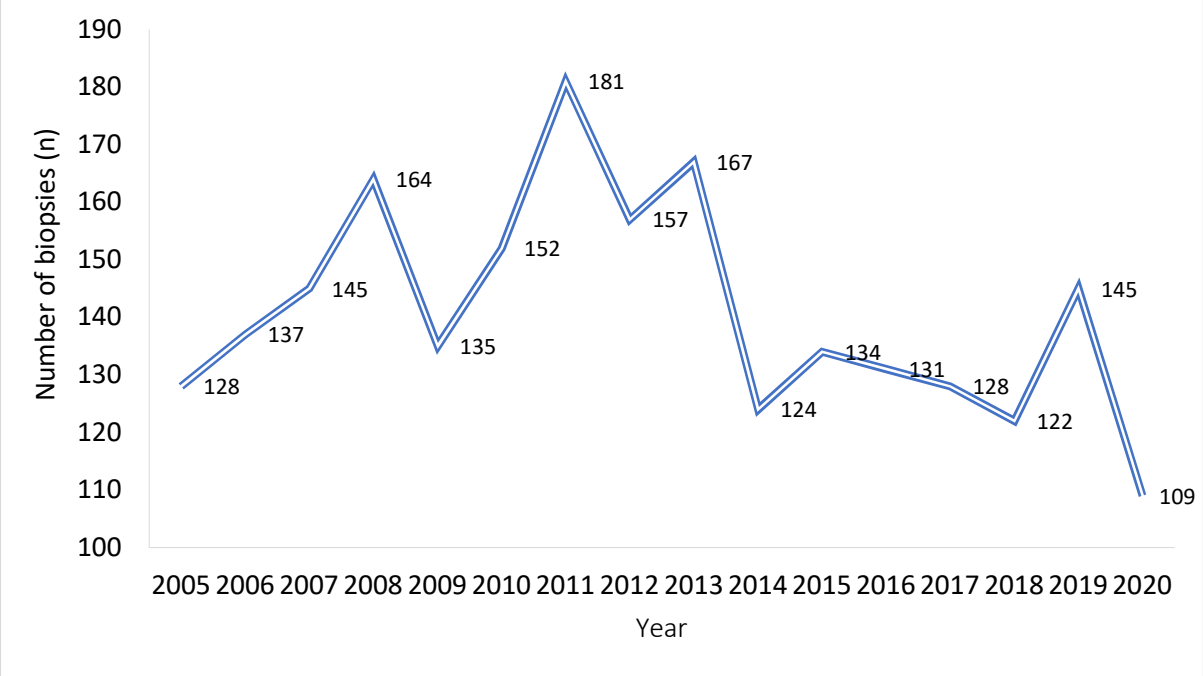

Figure 4.1.1: Number of kidney biopsies, 2005-2020

Table 4.1.2: Distribution of native kidney biopsy in patients by number of attempts, 2005-2020

Number of biopsy (s)	2005-2009 (n=701)		2010-2014 (n=769)		2015-2019 (n=652)		2020 (n=109)		Total (n=2231)	
	n	%	N	%	n	%	n	%	n	%
1st episode	605	86.3	694	90.2	595	91.3	104	95.4	1998	89.6
2nd episodes	74	10.6	64	8.3	53	8.1	5	4.6	196	8.8
3rd episodes	20	2.9	9	1.2	1	0.2	0	0.0	30	1.3
4th episodes	2	0.3	2	0.3	3	0.5	0	0	7	0.3

Table 4.1.3: Number of glomeruli obtained at each biopsy, 2005-2020

Number of glomeruli	2005-2009 (n=705)		2010-2014 (n=770)		2015-2019 (n=636)		2020 (n=106)		Total (n=2217)	
	n	%	n	%	n	%	n	%	n	%
< 10	146	20.7	168	21.8	118	18.6	9	8.5	441	19.9
≥ 10	559	79.3	602	78.2	518	81.4	97	91.5	1776	80.1

* 42 cases with missing number of glomeruli

4.2 Patient Demographics

- There was an equal male to female ratio.
- The racial distribution was Malay 65.4%, Chinese 16.7%, Indian 5.4% and others 12.4%.
- The mean age at biopsy was 9.87 years

Table 4.2.1(a): Gender and racial distribution, 2005-2020

Gender	2005-2009 (n=709)		2010-2014 (n=781)		2015-2019 (n=660)		2020 (n=109)		Total (n=2259)	
	n	%	n	%	n	%	n	%	n	%
Male	347	48.9	380	48.7	350	53.0	62	56.9	1139	50.4
Female	362	51.1	401	51.3	310	47.0	47	43.1	1120	49.6

Table 4.2.1(b): Gender and racial distribution, 2005-202

Race	2005-2009 (n=709)		2010-2014 (n=781)		2015-2019 (n=660)		2020 (n=109)		Total (n=2259)	
	n	%	n	%	n	%	n	%	n	%
Malay	426	60.1	527	67.5	449	68.0	75	68.8	1477	65.4
Chinese	145	20.5	120	15.4	94	14.2	19	17.4	378	16.7
Indian	58	8.2	34	4.4	25	3.8	6	5.5	123	5.4
Others*	80	11.3	100	12.8	92	13.9	9	8.3	281	12.4

* Inclusive of 36 foreigners and 1 not available

Table 4.2.2: Age distribution, 2005-2020

Year	2005 (n=128)	2006 (n=137)	2007 (n=145)	2008 (n=164)	2009 (n=135)	2010 (n=152)	2011 (n=181)	2012 (n=157)	2013 (n=167)
Mean	9.21	10.35	9.83	9.95	9.86	9.71	9.64	9.70	9.91
SD	4.32	3.57	3.61	3.74	3.99	3.94	4.33	4.26	3.83
Median	10.49	11.41	10.73	10.53	10.90	10.65	11.03	10.87	10.74
Minimum	0.59	1.06	2.41	0.25	0.53	0.86	0.23	0.13	0.10
Maximum	14.89	14.95	14.90	14.94	14.95	14.85	14.98	14.97	14.99

Year	2014 (n=124)	2015 (n=134)	2016 (n=131)	2017 (n=128)	2018 (n=122)	2019 (n=145)	2020 (n=109)	Total (n=2259)
Mean	9.34	10.00	10.16	10.01	9.76	10.08	10.43	9.87
SD	4.13	4.04	4.09	3.69	3.94	3.84	3.98	3.96
Median	10.27	11.09	11.50	11.32	10.58	10.67	11.72	10.86
Minimum	0.37	1.65	1.36	1.95	0.96	0.68	1.90	0.10
Maximum	14.95	14.99	14.97	14.89	14.95	14.98	14.98	14.99

4.3 Clinical Presentation

- The most frequent clinical presentation at biopsy was Nephrotic (50.3%), followed by asymptomatic urine abnormalities (19.0%), mixed nephrotic-nephritic syndrome (12.9%) and nephritic syndrome (11.2%). (Table 4.3.1)
- About two thirds (65.8%) of patients had normal kidney function at the time of biopsy and one third (28.3%) had impaired kidney function. (Table 4.3.2).
- Hypertension was found in 37.2% of patients and the most commonly used antihypertensive drugs were calcium channel blocker (56.6%) and angiotensin converting enzyme inhibitors / angiotensin receptor blocker (46.4%). (Table 4.3.3 (a) and (b))

Table 4.3.1: Clinical presentation at biopsy, 2005-2020

Clinical Presentation	2005-2009 (n=709)		2010-2014 (n=781)		2015-2019 (n=660)		2020 (n=109)		Total (n=2259)	
	n	%	n	%	n	%	n	%	n	%
Nephrotic syndrome	375	52.9	367	47.0	329	49.8	66	60.6	1137	50.3
Asymptomatic urine abnormalities	120	16.9	156	20.0	133	20.2	20	18.3	429	19.0
Nephritic -Nephrotic	67	9.4	123	15.7	94	14.2	8	7.3	292	12.9
Nephritic syndrome	90	12.7	91	11.7	62	9.4	11	10.1	254	11.2
Not Available	57	8.0	44	5.6	42	6.4	4	3.7	147	6.5

Table 4.3.2: Kidney function at biopsy, 2005-20209

Kidney function	2005-2009 (n=709)		2010-2014 (n=781)		2015-2019 (n=660)		2020 (n=109)		Total (n=2259)	
	n	%	n	%	n	%	n	%	n	%
Impaired	209	29.5	239	30.6	168	25.5	23	21.1	639	28.3
Normal	453	63.9	497	63.6	454	68.8	83	76.1	1487	65.8
Not Available	47	6.6	45	5.8	38	5.8	3	2.8	133	5.9

Table 4.3.3 (a): Hypertension at biopsy, 2005-2020oi0-p

Hypertension	2005-2009 (n=709)		2010-2014 (n=781)		2015-2019 (n=660)		2020 (n=109)		Total (n=2259)	
	n	%	N	%	n	%	n	%	n	%
Present	217	30.6	346	44.3	249	37.7	29	26.6	841	37.2
Absent	467	65.9	388	49.7	355	53.8	69	63.3	1279	56.6
Not Available	25	3.5	47	6.0	56	8.5	11	10.1	139	6.2

Table 4.3.3(b): Type of antihypertensive drugs, 2005-2020

Type of antihypertensives	2005-2009 (n=217)		2010-2014 (n=346)		2015-2019 (n=249)		2020 (n=29)		Total (n=841)	
	n	%	n	%	n	%	n	%	n	%
Calcium Channel Blocker	115	53.0	183	52.9	162	65.1	16	55.2	476	56.6
ACEI	61	28.1	177	51.2	112	45.0	15	51.7	365	43.4
ARB	7	3.2	12	3.5	6	2.4	0	0.0	25	3.0
B Blocker	33	15.2	61	17.6	29	11.6	4	13.8	127	15.1
Alpha Blocker	32	14.7	30	8.7	18	7.2	3	10.3	83	9.9
Others	18	8.3	41	11.8	17	6.8	4	13.8	80	9.5
No drug available	70	32.3	16	4.6	13	5.2	0	0.0	99	11.8

*Patients may have more than one antihypertensives drug

4.4 Diagnosis of Paediatric Kidney Biopsies

- Minimal change disease and FSGS together contribute the largest group of diagnosis, 43.5%.
- Lupus nephritis was diagnosed in 25.0%, post-infectious glomerulonephritis in 7.7%, IgA nephropathy in 7.4% and Henoch Schonlein Purpura in 3.1%. (Table 4.4)

Table 4.4: Diagnosis of paediatric kidney biopsies, 2005-2020

Diagnosis	2005-2009 (n=699)		2010-2014 (n=750)		2015-2019 (n=622)		2020 (n=110)		Total (n=2181)	
	n	%	n	%	n	%	n	%	n	%
Lupus Nephritis	176	25.2	192	25.6	152	24.4	25	22.7	545	25.0

Minimal Change	141	20.2	172	22.9	168	27.0	32	29.1	513	23.5
FSGS	176	25.2	119	15.9	118	19.0	24	21.8	437	20.0
Post Infectious GN	48	6.9	77	10.3	37	5.9	5	4.5	167	7.7
lg A nephropathy	36	5.2	66	8.8	53	8.5	7	6.4	162	7.4
Henoch Schonlein Purpura	22	3.1	14	1.9	26	4.2	5	4.5	67	3.1
Mes Prol GN-non IgA	13	1.9	22	2.9	7	1.1	2	1.8	44	2.0
Advanced GN	21	3.0	12	1.6	7	1.1	1	0.9	41	1.9
Membranous Nephropathy	9	1.3	14	1.9	11	1.8	0	0.0	34	1.6
Acute tubular necrosis	18	2.6	7	0.9	4	0.6	1	0.9	30	1.4
MPGN	8	1.1	6	0.8	1	0.2	1	0.9	16	0.7
Idiopathic Cres GN	5	0.7	2	0.3	3	0.5	1	0.9	11	0.5
Acute Interstitial Nephritis	2	0.3	9	1.2	3	0.5	0	0.0	14	0.6
Systemic vasculitis	4	0.6	1	0.1	3	0.5	0	0.0	8	0.4
Chronic Interstitial Nephritis	7	1.0	3	0.4	1	0.2	0	0.0	11	0.5
HUS / TTP	3	0.4	2	0.3	0	0.0	1	0.9	6	0.3
Crescentic ANCA	1	0.1	1	0.1	1	0.2	0	0.0	3	0.1
TBMD	1	0.1	2	0.3	1	0.2	0	0.0	4	0.2
Benign / Malignant HPT	1	0.1	1	0.1	1	0.2	0	0.0	3	0.1
Amyloidosis	0	0.0	1	0.1	0	0.0	0	0.0	1	0.0
Anti GBM disease	0	0.0	1	0.1	0	0.0	0	0.0	1	0.0
Malignancy	1	0.1	0	0.0	0	0.0	0	0.0	1	0.0
Other infection	0	0.0	0	0.0	1	0.2	0	0.0	1	0.0
Alport's syndrome	1	0.1	0	0.0	0	0.0	0	0.0	1	0.0
Other Hereditary	0	0.0	1	0.1	0	0.0	0	0.0	1	0.0
Others	3	0.4	16	2.1	14	2.3	3	2.7	36	1.7
Not Available	2	0.3	9	1.2	10	1.6	2	1.8	23	1.1

4.5 Nephrotic Syndrome

- A total of 1109 kidney biopsies were performed in children with nephrotic syndrome.
- The common diagnosis was MCD (40.0%), FSGS (33.8%) and lupus nephritis (12.8%) (Table 4.5.1)
- The commonest histological finding for steroid resistant nephrotic syndrome remained as FSGS (40.9%) followed by MCD (39.5%). (Table 4.5.2)

Table 4.5.1: Kidney histopathology diagnosis of children presenting with nephrotic syndrome, 2005-2020

Diagnosis	2005-2009 (n=374)		2010-2014 (n=351)		2015-2019 (n=319)		2020 (n=65)		Total (n=1109)	
	n	%	n	%	N	%	n	%	n	%
MCD	116	31.0	152	43.3	147	46.1	29	44.6	444	40.0
FSGS	152	40.6	108	30.8	96	30.1	19	29.2	375	33.8
Lupus nephritis	58	15.5	43	12.3	34	10.7	7	10.8	142	12.8
IgA nephropathy	9	2.4	9	2.6	12	3.8	2	3.1	32	2.9
Mesangial prol GN non-IgA	5	1.3	10	2.8	1	0.3	2	3.1	18	1.6
Post-infectious GN	4	1.1	5	1.4	3	0.9	1	1.5	13	1.2
Others**	30	8.0	24	6.8	26	8.2	5	7.7	85	7.7

**Patients may have more than 1 diagnosis classification (nephrotic n=1137 but report conclusive for nephrotic n=1099)*

*** Others – Henoch Schonlein Purpura, HUS/TTP, Systemic vasculitis, Malignancy, Membranous nephropathy, Membranoproliferative, Idiopathic crescentic GN, Acute interstitial nephritis, Acute tubular necrosis, Chronic interstitial nephritis, Heredity (others), Advance GN, Others, Not available*

Table 4.5.2: The histopathological profile in different steroid response categories (nephrotic syndrome), 2005-2020

Diagnosis	Steroid resistant (n=574)		Steroid sensitive (n=257)		Not available (n=34)		Total (n=865)	
	n	%	n	%	n	%	n	%
FSGS	235	40.9	130	50.6	8	23.5	373	43.1
Minimal Change	227	39.5	62	24.1	4	11.8	293	33.9
Lupus Nephritis	43	7.5	37	14.4	14	41.2	94	10.9
Membranous nephropathy	14	2.4	5	1.9	1	2.9	20	2.3
lg A nephropathy	17	3.0	1	0.4	0	0.0	18	2.1
Mesangial Proliferative GN -non-IgA	6	1.0	7	2.7	0	0.0	13	1.5
Others**	32	5.6	15	5.8	7	20.6	54	6.2

**Patients may have more than 1 diagnosis classification*

*** Others – Henoch Schonlein Purpura, Membranoproliferative, Idiopathic crescentic GN, Acute interstitial nephritis, Acute tubular necrosis, Chronic interstitial nephritis, Post Infectious GN, Heredity (others), Advance GN, Others, Not available*

4.6 Nephritic Syndrome

- In children presenting with nephritic syndrome; the commonest diagnosis was post-infectious GN (27.3%). Lupus nephritis (26.1%) and IgA nephropathy (10.4%) were the other two common biopsy-proven diagnoses for the presentation of nephritic syndrome in children**.**

Table 4.6.1: Kidney histopathology diagnosis of children presenting with nephritic syndrome, 2005-2020

Diagnosis	**2005-2009 (n=94)**		**2010-2014 (n=87)**		**2015-2019 (n=57)**		**2020 (n=11)**		**Total (n=249)**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Post-infectious GN	21	22.3	30	34.5	14	24.6	3	27.3	68	27.3
Lupus nephritis	24	25.5	21	24.1	15	26.3	5	45.5	65	26.1
IgA nephropathy	7	7.4	9	10.3	9	15.8	1	9.1	26	10.4
Henoch Schonlein Purpura	5	5.3	1	1.1	4	7.0	1	9.1	11	4.4
FSGS	8	8.5	4	4.6	5	8.8	1	9.1	18	7.2
MCD	7	7.4	0	0.0	5	8.8	0	0.0	12	4.8
Mesangial prol-non lgA	3	3.2	3	3.4	1	1.8	0	0.0	7	2.8
Acute tubular necrosis	9	9.6	2	2.3	0	0.0	0	0.0	11	4.4
Others**	10	10.6	17	19.5	4	7.0	0	0.0	31	12.4

**Patients may have more than 1 diagnosis classification (nephritic n=254 but report conclusive for nephrotic n=244)*

*** Others –Systemic vasculitis, Membranoproliferative, Idiopathic crescentic GN, Heredity, Advance GN, Others, Not available*

4.7 Causes of Severe Kidney Failure (Needed Dialysis Therapy)

- At the time of biopsy, 184 children (8.2%) needed dialysis therapy.
- Common histological findings in patients presented with severe kidney injury (requiring dialysis) were post-infectious GN (20.7%), lupus nephritis (19.6%) and advanced glomerulosclerosis (10.9%) (Table 4.7.1)

Table 4.7.1: Histology finding of children who had severe kidney failure (needed dialysis therapy) who underwent kidney biopsy, 2005-2020

Diagnosis	2005-2009 (n=40)		2010-2014 (n=74)		2015-2019 (n=46)		2020 (n=4)		Total (n=184)	
	n	%	n	%	n	%	n	%	n	%
Post-infectious GN	5	12.5	22	29.7	10	25.0	1	25.0	38	20.7
Lupus nephritis	9	22.5	16	21.6	9	22.5	2	50.0	36	19.6
FSGS	3	7.5	3	4.1	2	5.0	0	0.0	8	4.3
Advanced glomerulosclerosis (advance GN)	9	22.5	7	9.5	4	10.0	0	0.0	20	10.9
HUS/TTP	0	0.0	2	2.7	0	0.0	1	25.0	3	1.6
Acute tubular necrosis	5	12.5	4	5.4	3	7.5	0	0.0	12	6.5
MCD	0	0.0	0	0.0	1	2.5	0	0.0	1	0.5
Acute interstitial nephritis	0	0.0	5	6.8	1	2.5	0	0.0	6	3.3
IgA nephropathy	1	2.5	5	6.8	0	0.0	0	0.0	6	3.3
Others	8	20.0	10	13.5	10	25.0	0	0.0	28	15.2

**Patients may have more than 1 diagnosis classification*

*** Others – HUS/TTP, Anti GBM disease, Advance GN, Systemic vasculitis, Membrano-proliferative, Idiopathic crescentic GN, Acute interstitial nephritis, Crescentic ANCA, Chronic interstitial nephritis, Alport's syndrome, Mesangial Proliferative GN-non IgA, Other infection, Heredity, Malignancy, Others, Not available (needed dialysis therapy n=169 but report conclusive, n=154).*

4.8 Paediatric Focal Segmental Glomerulosclerosis And Minimal Change Disease

- Children with FSGS were older, had hypertension and lower eGFR compared to MCD. (Table 4.8.1)
- Patient survival was lower for children with FSGS; the survival rate at 5 years was 91% for FSGS compared to 97% for MCD. (Table & Figure 4.8.2)
- Children with FSGS showed a much poorer kidney survival compared to MCD; 87% versus 94% and 78% versus 92% at 3 and 5 years respectively.

Table 4.8.1 Clinical characteristics of children with steroid resistant nephrotic syndrome, 2005-2020

Clinical characteristics		**FSGS**		**MCD**		***p value***
		N=227	**%**	**N=235**	**%**	
Age/year (mean (SD))		7.7	3.90	6.8	3.97	0.002[a]
Age/year (median (IQR))		7.4	6.90	5.9	6.61	
Race	Malay	158	69.6	174	74.0	0.390[b]
	Chinese	25	11.0	24	10.2	
	Indian	15	6.6	18	7.7	
	Others	29	12.8	19	8.1	
Gender	Male	142	62.6	168	71.5	0.040[d]
	Female	85	37.4	67	28.5	
Gross haematuria	Present	6	2.6	4	1.7	0.538[e]
	Absent	221	97.4	231	98.3	
Hypertension	Present	98	43.2	73	31.1	0.007[f]
	Absent	129	56.8	162	68.9	
Family history	Yes	7	3.1	7	3.0	0.947[g]
	No	220	96.9	228	97.0	
eGFR ml/min/1.73m²	< 30	9	4.0	2	0.9	<0.001[h]
	30-60	22	9.7	4	1.7	
	60-90	22	9.7	17	7.2	
	≥90	144	63.4	161	68.5	
	Not available	30	13.2	51	21.7	

Dialysis required	Yes	14	6.2	1	0.4	0.117[i]
	No	213	93.8	234	99.6	

b, d, f,g,h Chi-square test
e, i, Fisher's exact test

Table 4.8.2: Patient survival by focal segmental glomerulosclerosis and minimal change disease, 2005-2020

Interval (months)	Minimal Change Disease			Focal Segmental Glomerulosclerosis		
	n	% Survival	SE	n	% Survival	SE
0	513	100	-	437	100	-
12	471	99	0.005	396	98	0.007
24	422	98	0.007	368	96	0.010
36	388	98	0.007	336	95	0.011
48	362	98	0.007	310	93	0.013
60	322	97	0.008	275	91	0.015

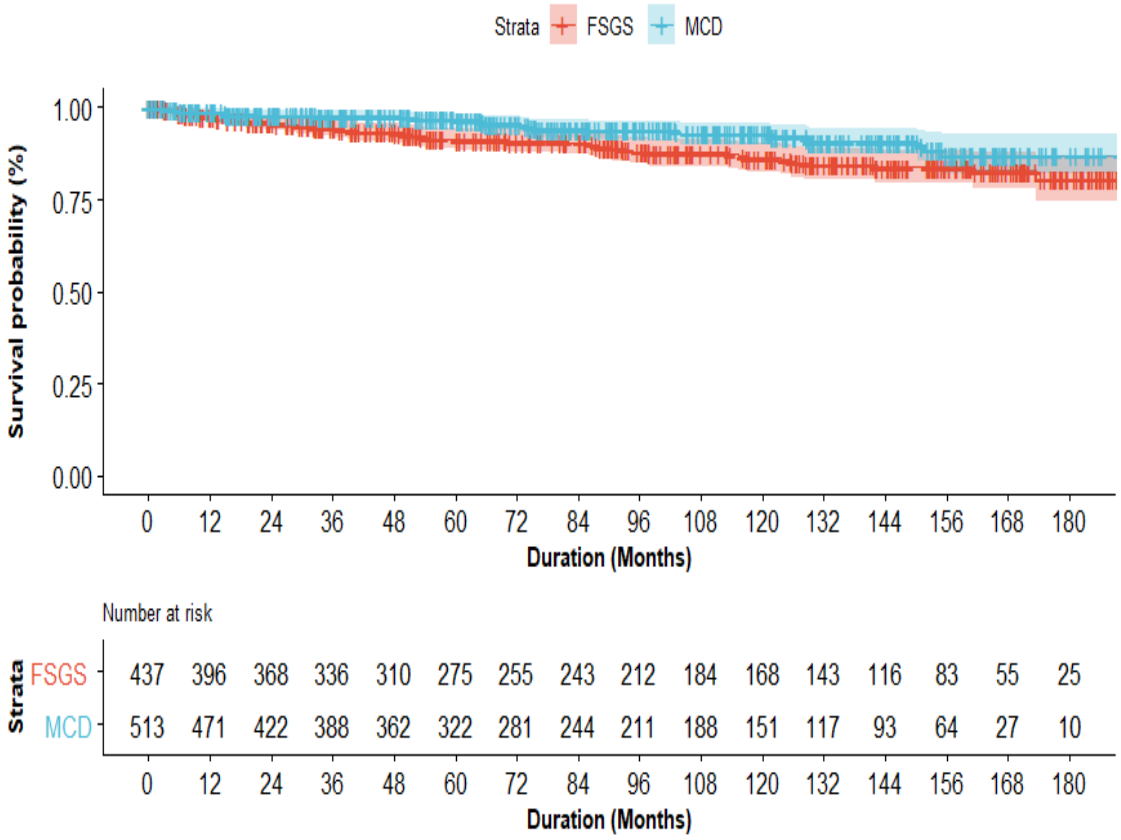

Figure 4.8.2: Patient survival by focal segmental glomerulosclerosis and minimal change disease, 2005-2020

Table 4.8.3: Kidney survival by focal segmental glomerulosclerosis and minimal change disease, 2005- 2020

Interval (months)	Minimal Change Disease			Focal Segmental Glomerulosclerosis		
	n	% Survival	SE	n	% Survival	SE
0	513	100	-	437	100	-
12	471	100	0.003	396	94	0.012
24	422	98	0.006	368	91	0.014
36	388	94	0.012	336	87	0.017
48	362	93	0.013	310	82	0.020
60	322	92	0.014	275	78	0.022

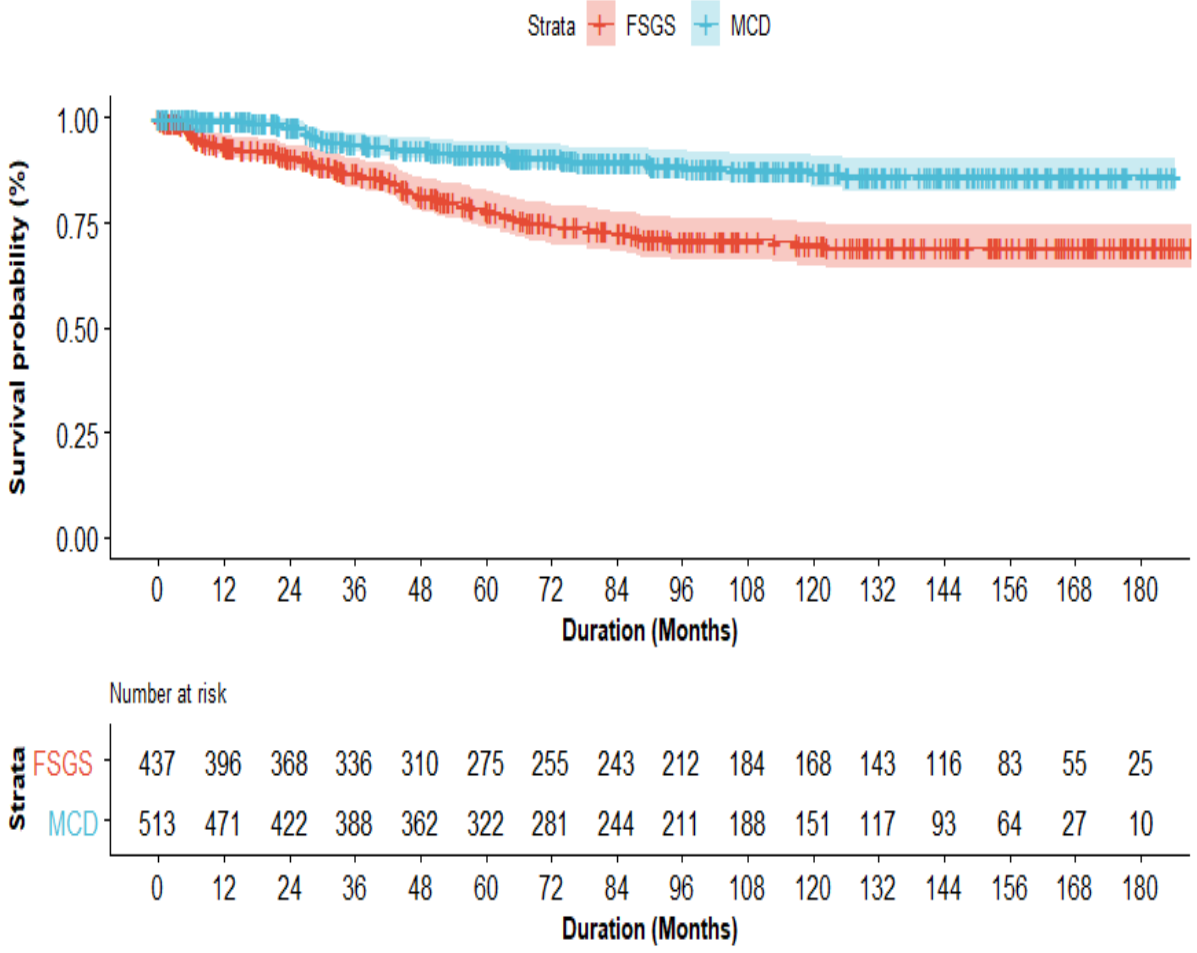

Figure 4.8.3: Kidney survival by focal segmental glomerulosclerosis and minimal change disease, 2005- 2020

4.9 Paediatric Lupus Nephritis

- There were a total of 511 kidney biopsies performed for children with lupus nephritis. (Figure 4.9.1)
- Majority of children (86.0%) with lupus received only one kidney biopsy. Seventy-one (14.0%) had repeat biopsies. (Table 4.9.2)
- The female: male ratio was 5.1:1. (Table 4.9.3)
- The racial distribution was Malay (67.1%), Chinese (20.9%), Indian (2.7%). (Table 4.9.3)
- Mean age at the time of the biopsy was 11.9 years. (Table 4.9.4)
- About 6.5% of patients had severe kidney failure and needed dialysis support while 43.1% had hypertension. (Table 4.9.5 and Table 4.9.6)
- The most frequent clinical presentation at biopsy was urinary abnormalities (34.8%) followed by nephrotic syndrome (27.0%) (Table 4.9.7)
- The common extra kidney manifestations were cutaneous features (malar rash 43.4%, photosensitivity 22.1%, discoid rash 9.0%), haematological involvement (58.1%), arthritis (27.0%) and oral ulcer (25.6%) (Table 4.9.8 (a))
- Seventy-three percent of patients fulfilled 4 or more ARA criteria. (Table 4.9.8 (b))
- For patients who did not require dialysis therapy, the histology class was proliferative GN (Class III/ III+V and IV/ IV+V) in 83.5% of biopsies. For those who needed dialysis, proliferative GN reported in 75.8%. (Table 4.9.9)
- The patient survival was 91% at 3 years and 88 % at 5 years from the time of diagnosis of lupus nephritis. (Table and Figure 4.9.10)
- The kidney survival for lupus nephritis was 94% 3 years and 92% at 5 years. (Table and Figure 4.9.11)

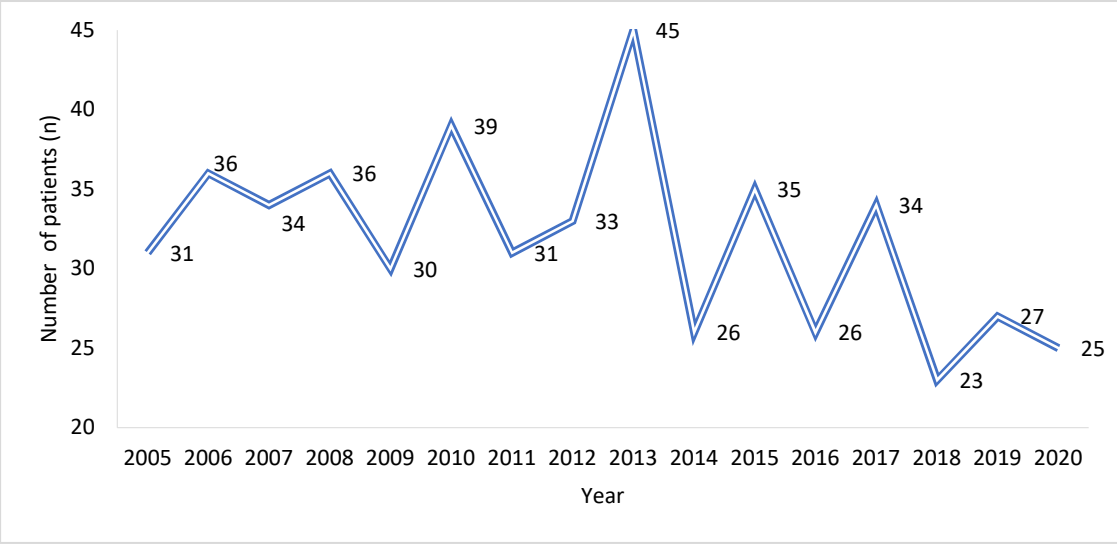

Figure 4.9.1: Total number biopsies (SLE), 2005-2020

Table 4.9.2: Distribution of kidney biopsy in patient with lupus by number of episodes, 2005-2020

Year	2005-2009 (n=167)		2010-2014 (n=172)		2015-2019 (n=143)		2020 (n=25)		Total (n=507)	
	n	%	n	%	n	%	n	%	n	%
1st episode	145	86.8	143	83.1	124	86.7	24	96.0	436	86.0
2nd episodes	19	11.4	24	14.0	18	12.6	1	4.0	62	12.2
3rd episodes	3	1.8	5	2.9	0	0.0	0	0.0	8	1.6
4th episodes	0	0.0	0	0.0	1	0.7	0	0.0	1	0.2

Table 4.9.3 (a): Gender distribution of paediatric lupus nephritis, 2005-2020

Gender	2005-2009 (n=167)		2010-2014 (n=174)		2015-2019 (n=145)		2020 (n=25)		Total (n=511)	
	n	%	n	%	N	%	n	%	n	%
Male	24	14.4	25	14.4	30	20.7	5	20.0	84	16.4
Female	143	85.6	149	85.6	115	79.3	20	80.0	427	83.6

Table 4.9.3 (b): Racial distribution of paediatric lupus nephritis, 2005-2020

	2005-2009 (n=167)		2010-2014 (n=174)		2015-2019 (n=145)		2020 (n=25)		Total (n=511)	
Race	n	%	n	%	N	%	n	%	n	%
Malay	102	61.1	117	67.2	105	72.4	19	76.0	343	67.1
Chinese	43	25.7	34	19.5	27	18.6	3	12.0	107	20.9
Indian	7	4.2	3	1.7	2	1.4	2	8.0	14	2.7
Others*	15	9.0	20	11.5	11	7.6	1	4.0	47	9.2

Table 4.9.4: Age distribution of paediatric lupus nephritis, 2005-2020

Year	2005 (n=31)	2006 (n=36)	2007 (n=34)	2008 (n=36)	2009 (n=30)	2010 (n=39)	2011 (n=31)	2012 (=33)	2013 (n=45)
Mean	12.46	12.08	12.24	11.16	11.34	11.76	12.08	11.53	11.34
SD	2.20	2.44	2.03	3.27	3.77	2.51	3.67	3.88	3.35
Median	13.16	12.93	12.65	11.70	11.89	12.19	13.22	12.80	12.36
Minimum	4.89	6.63	7.30	0.25	0.53	1.46	0.23	0.27	0.10
Maximum	14.80	14.76	14.89	14.94	14.95	14.82	14.98	14.97	14.97

Year	2014 (n=26)	2015 (n=35)	2016 (n=26)	2017 (n=34)	2018 (n=23)	2019 (=27)	2020 (n=25)	Total (n=511)
Mean	11.40	12.31	12.34	12.00	12.00	11.78	13.42	11.92
SD	2.74	2.15	2.71	2.18	2.43	3.19	2.05	11.92
Median	12.62	12.54	13.46	12.31	12.84	12.61	14.09	12.83
Minimum	4.08	6.15	3.14	6.22	7.15	2.23	6.48	0.10
Maximum	14.78	14.95	14.90	14.89	14.95	14.98	14.92	14.98

Table 4.9.5: Dialysis therapy for paediatric lupus nephritis at the time of biopsy, 2005-2020

Needed dialysis therapy	2005-2009 (n=167)		2010-2014 (n=174)		2015-2019 (n=145)		2020 (n=25)		Total (n=511)	
	n	%	n	%	n	%	n	%	n	%
Yes	8	4.8	14	8.0	9	6.2	2	8.0	33	6.5
No	124	74.3	147	84.5	127	87.6	23	92.0	421	82.4
Not available	35	21.0	13	7.5	9	6.2	0	0.0	57	11.2

Table 4.9.6: Presence of hypertension of paediatric lupus nephritis, 2005-2020

Hypertension	2005-2009 (n=167)		2010-2014 (n=174)		2015-2019 (n=145)		2020 (n=25)		Total (n=511)	
	n	%	n	%	n	%	n	%	n	%
Present	64	38.3	79	45.4	69	47.6	8	32.0	220	43.1
Absent	94	56.3	84	48.3	67	46.2	10	40.0	255	49.9
Not Available	9	5.4	11	6.3	9	6.2	7	28.0	36	7.0

Table 4.9.7: Clinical presentation at biopsy of paediatric lupus nephritis, 2005-2020

Clinical Presentation	2005-2009 (n=167)		2010-2014 (n=174)		2015-2019 (n=145)		2020 (n=25)		Total (n=511)	
	n	%	n	%	n	%	n	%	n	%
Asymptomatic urine abnormalities	47	28.1	67	38.5	56	38.6	8	32.0	178	34.8
Nephrotic syndrome	57	34.1	41	23.6	33	22.8	7	28.0	138	27.0
Nephritic - Nephrotic	22	13.2	37	21.3	30	20.7	3	12.0	92	18.0
Nephritic syndrome	23	13.8	19	10.9	15	10.3	5	20.0	62	12.1
Not Available	18	10.8	10	5.7	11	7.6	2	8.0	41	8.0

Table 4.9.8(a): ARA criteria at presentation, 2005-2020

ARA criteria	2005-2009 (n=167)		2010-2014 (n=174)		2015-2019 (n=145)		2020 (n=25)		Total (n=511)	
	n	%	n	%	n	%	n	%	n	%
Malar rash	80	47.9	71	40.8	63	43.4	8	32.0	222	43.4
Photosensitivity	41	24.6	40	23.0	27	18.6	5	20.0	113	22.1
Arthritis	50	29.9	56	32.2	32	22.1	0	0	138	27.0
Cerebral	15	9.0	23	13.2	14	9.7	1	4.0	53	10.4
Kidney	139	83.2	149	85.6	113	77.9	20	80.0	421	82.4
Haematological	99	59.3	105	60.3	78	53.8	15	60.0	297	58.1
Discoid rash	9	5.4	19	10.9	17	11.7	1	4.0	46	9.0
Serositis	22	13.2	24	13.8	24	16.6	4	16.0	74	14.5
Oral ulcers	45	26.9	50	28.7	30	20.7	6	24.0	131	25.6
ANF* Positive	157	94.0	140	80.5	111	76.6	18	72.0	426	83.4
At least (1) positive in other labs*	112	67.1	115	66.1	116	80.0	20	80.0	363	71.0

*Anti-Nuclear Factor

**dsDNA, ssDNA, Anti-cardiolipin antibody, Anti-phospholipid antibody, Histone, Nucleo, Ro, La or Sm

Table 4.9.8(b): ARA criteria at presentation, 2005-2020

ARA criteria	2005-2009 (n=167)		2010-2014 (n=174)		2015-2019 (n=145)		2020 (n=25)		Total (n=511)	
	n	%	n	%	n	%	n	%	n	%
<4	39	23.4	48	27.6	41	28.3	8	32.0	136	26.6
≥4	128	76.6	126	72.4	104	71.7	17	68.0	375	73.4

Table 4.9.9: Classification of paediatric lupus nephritis, 2005-2020

Needed dialysis										
WHO/ISN /RPS Class	2005-2009 (n=8)		2010-2014 (n=14)		2015-2019 (n=9)		2020 (n=2)		Total (n=33)	
	n	%	n	%	n	%	n	%	n	%
Class II	1	12.5	1	7.1	0	0.0	0	0.0	2	6.1
Class III or III + V	0	0	3	21.4	2	22.2	0	0.0	5	15.2
Class IV or IV + V	4	50	9	64.3	6	66.7	1	50.0	20	60.6
Class V or II + V	1	12.5	0	0.0	1	11.1	0	0.0	2	6.1
Class VI	2	25	0	0.0	0	0.0	0	0.0	2	6.1
Not Available	0	0	1	7.1	0	0.0	1	50.0	2	6.1
Not needed dialysis										
WHO/ISN /RPS Class	2005-2009 (n=159)		2010-2014 (n=160)		2015-2019 (n=136)		2020 (n=23)		Total (n=478)	
	n	%	n	%	n	%	n	%	n	%
Class I	0	0.0	4	2.5	2	1.5	0	0.0	6	1.3
Class II	12	7.5	15	9.4	10	7.4	1	4.3	38	7.9
Class III or III + V	27	17.0	44	27.5	50	36.8	8	34.8	129	27.0
Class IV or IV + V	111	69.8	83	51.9	63	46.3	13	56.5	270	56.5
Class V or II + V	9	5.7	11	6.9	6	4.4	0	0.0	26	5.4
Not Available	0	0.0	3	1.9	5	3.7	1	4.3	9	1.9

Table 4.9.10: Patient survival in lupus nephritis, 2005-2020

Interval (months)	Patients with Lupus Nephritis		
	n	% Survival	SE
0	511	100	-
12	466	96	0.009
24	423	94	0.011
36	389	91	0.013
48	352	90	0.014
60	319	88	0.016

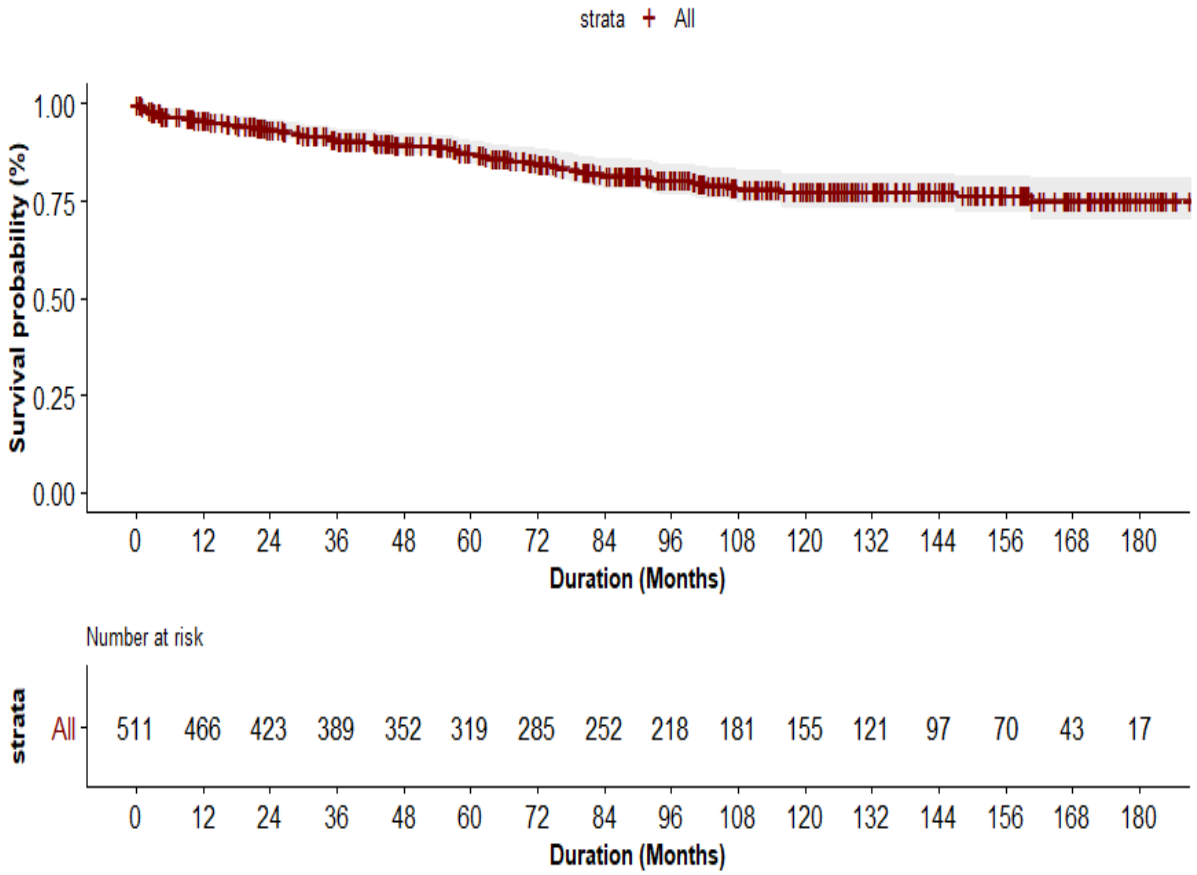

Figure 4.9.10: Patient survival in lupus nephritis, 2005-2020

Table 4.9.11: Death-censored kidney survival of patient with lupus nephritis, 2005-2020

Interval (months)	**Patients** with Lupus Nephritis		
	n	**% survival**	**SE**
0	511	100	-
12	469	97	0.007
24	431	97	0.008
36	399	94	0.011
48	362	93	0.012
60	334	92	0.013

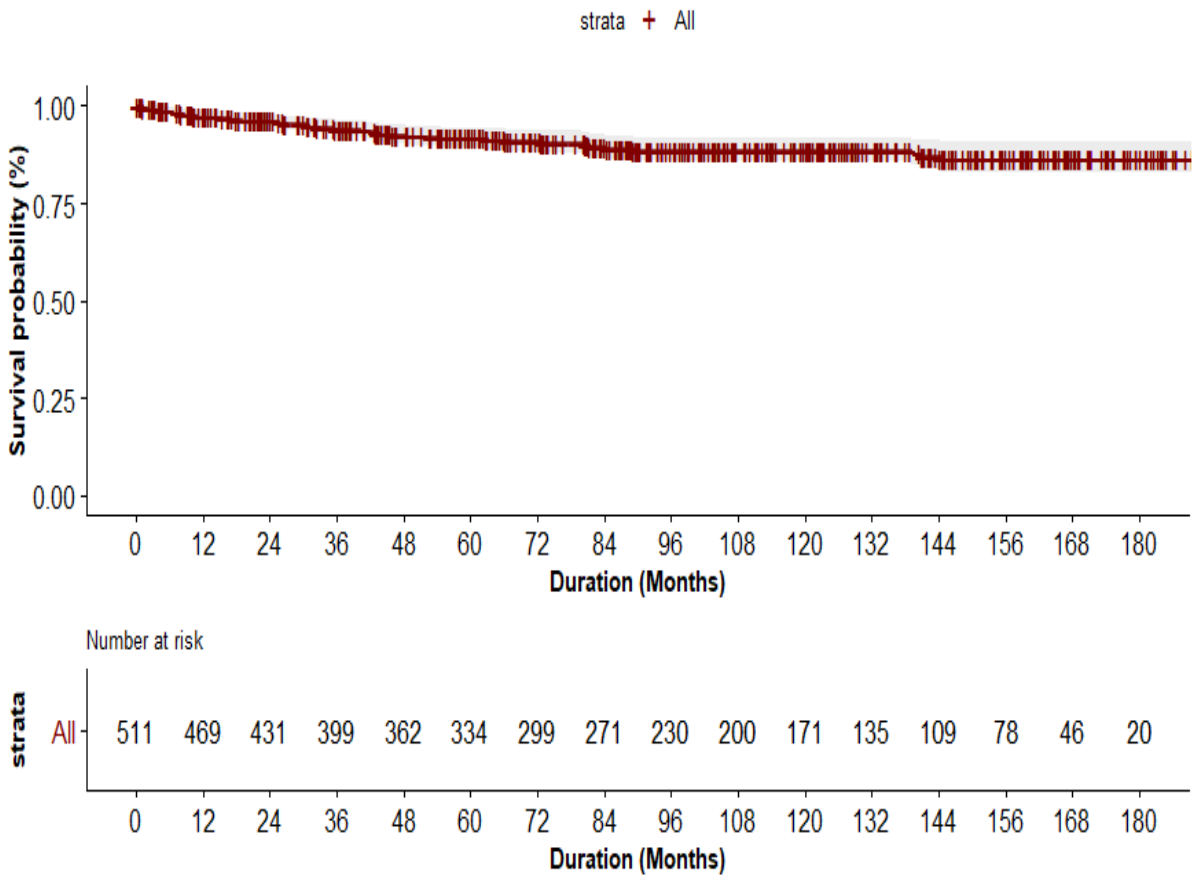

Figure 4.9.11: Death-censored kidney survival in lupus nephritis, 2005-2020

4.10 Overall Kidney Outcome

- Of the 2231 patients biopsied, 326 (14.6%) of these children were reported to the Malaysian Dialysis and Transplant Registry with End Stage Kidney Disease (ESKD). (Table 4.10.1).
- FSGS was the most common cause of ESKD accounting for 30.7%.
- Other causes of ESKD in children were lupus nephritis (16.6%), MCD (14.1%), Advanced GN (8%) and IgA nephropathy (6.1%).

Table 4.10.1: Causes of end stage kidney disease in children who underwent Kidney biopsy, 2005-2020

Causes	**n=326**	**%**
FSGS	100	30.7
Lupus Nephritis	54	16.6
Minimal Change	46	14.1
Advanced GN	26	8.0
lg A nephropathy	20	6.1
Post Infectious GN	10	3.1
Chronic interstitial nephritis	7	2.1
Idiopathic Crescentic GN	5	1.5
Membranous nephropathy	5	1.5
Mesangial Proliferative GN-non IgA	5	1.5
Henoch Schonlein Purpura	5	1.5
Systemic vasculitis	4	1.2
Crescentic ANCA	2	0.6
Membrano-proliferative	2	0.6
Acute interstitial nephritis	2	0.6
Acute tubular necrosis	2	0.6
HUS / TTP	1	0.3
Other infection	1	0.3
Alport's syndrome	1	0.3
Benign / Malignant Hypertension	1	0.3
Others	10	3.1
Not Conclusive	25	7.7

*Patients may have more than one cause of end stage kidney disease

4.11 Biopsy Failure and Complications

- Complication rate for the biopsy procedure was reported 3.2%. (Table 4.11.1)
- The overall risk of bleeding was 2.7% mainly gross hematuria.
- The overall risk of perinephric collection was 0.5%.
- The risk of complications post kidney biopsy was higher in those less than 2 years of age, those with low GFR <60ml/min /1.72m^2 and in those needing dialysis therapy at time of biopsy. (Table 4.11.2)

Table 4.11.1: Frequency of complication, 2005-2020

Causes		**n**	**%**
Total number of biopsies		2259	
Total number of complications		73	3.2
	Bleeding	61	83.6
	- Gross haematuria	51	69.9
	- Haematoma	11	15.1
	Perirenal collection	11	15.1
	Arteriovenous malformation	1	1.4
	Hypotension	3	4.1

Table 4.11.2: Risk factors associated with complications of paediatric kidney biopsy

Factors		n	Number of complications	Odds ratio	95% CI	*p*-value
Age (years)	<2	67	5	2.98	1.12,7.88	0.028
	>2-≤5	298	12	1.55	0.79,3.03	0.201
	>5-≤10	605	22	1.39	0.80,2.40	0.234
	>10 (ref*)	1289	34	1.00	-	-
Calculated GFR ml/min/1.73m²	<15	88	8	3.61	1.60,8.16	0.002
	15-<30	113	9	3.12	1.44,6.78	0.004
	30-<60	205	12	2.24	1.13,4.48	0.022
	60- <90	268	12	1.70	0.85,3.36	0.133
	> 90 (ref*)	1076	29	1.00	-	-
	Unknown	509	3	-	-	-
Kidney failure	Needed dialysis	169	15	3.31	1.82,6.01	<0.000
	Not needed dialysis(ref*)	1855	53	1.00	-	-
	Unknown	235	5	-	-	-
Needle size	14G	188	13	1.08	0.58,2.02	0.808
	16G (ref*)	886	57	1.00	-	-
	18G	412	3	0.11	0.03,0.34	<0.001
	Unknown	773	0	-	-	-
Haemoglobin (Hb) level g/dl	<8	40	2	1.71	0.40,7.30	0.467
	>8≤10	357	17	1.63	0.93,2.86	0.090
	≥11 (ref*)	1677	50	1.00	-	-
	Unknown	185	4	-	-	-

- (ref*) Reference category
- CI-confidence interval
- Unknown = No information