

CHAPTER 10

RENAL TRANSPLANTATION

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SECTION 10.1: STOCK AND FLOW

In 2023, renal transplantation showed significant positive momentum, with the number of new transplant patients reaching 279. This reflects a sustained recovery from the previous disruptions caused by the COVID-19 pandemic, which had reduced new transplants to just 80 in 2021 and 213 in 2022 (Table 10.1.1). The steady increase in numbers highlights the resumption of elective surgeries and organ transplant programs. The increase in number was driven mainly by deceased donor program where the number increased from 43 in 2022 to 81 in 2023 (88.4% increase). There was slight increase in the number of local living donor transplants from 140 in 2022 to 168 in 2023 (20% increase). The number of overseas transplant remain relatively static. (Table 10.1.4). Local transplant centres, particularly Hospital Kuala Lumpur, have been instrumental in recovering transplant numbers, performing 110 transplants in 2023, an increase from 92 in 2022 (Table 10.1.4).

The total number of functioning allografts was recorded at 2,101 at the end of 2023, marking a 10.4% growth from 2022's figure of 1,923. This improvement not only signals an increase in the volume of transplants but also indicates improvement in donor management and post-transplant care, which are crucial for patient outcomes (Table 10.1.1).

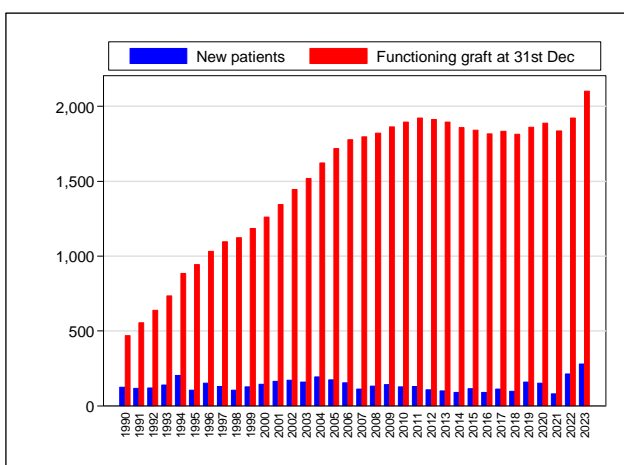
Mortality among transplant patients have decreased, dropping to 40 in 2023 from 74 in 2022 and 89 in 2021. The reduction in the number of deaths suggests better patient selection, pre-transplant evaluation and preparation, as well as post operative care (Table 10.1.1).

Allograft failures similarly decreased, from 37 in 2022 to 21 in 2023, underscoring improvements in clinical strategies and patient care (Table 10.1.1).

Table 10.1.1: Stock and flow of renal transplantation, 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New transplant patients	279	213	80	152	160	98	112	91	115	91
Died	40	74	89	58	53	45	49	49	64	65
Graft failure	21	37	36	41	37	47	28	49	52	41
Lost to Follow up	7	10	7	17	22	18	9	11	8	18
Functioning graft at 31st December	2101	1923	1835	1889	1861	1813	1834	1816	1842	1858

Figure 10.1.1: Stock and flow of renal transplantation, 1990-2023



The new transplant rate per million population (pmp) reached 8 in 2023, up from 7 in 2022, the highest rate in the last three decades (Table 10.1.2). The transplant prevalence rate also rose to 63 pmp, indicating a growing number of patients living with functioning allografts (Table 10.1.3).

Table 10.1.2: New transplant rate per million population (pmp), 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New transplant patients	279	213	80	152	160	98	112	91	115	91
New transplant rate, pmp	8	7	2	5	5	3	4	3	4	3

Figure 10.1.2: New transplant rate, 1990-2023

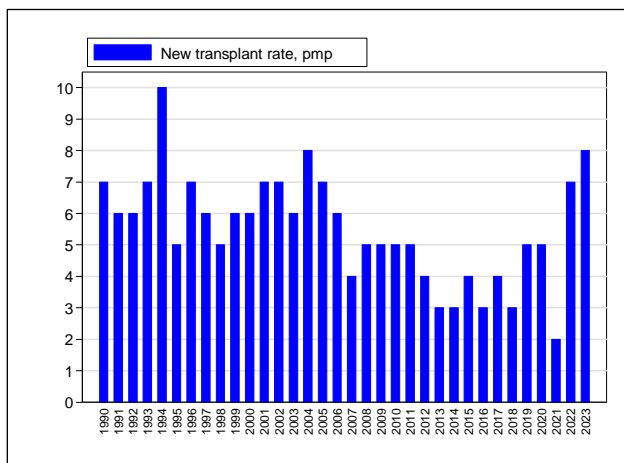


Figure 10.1.3: Transplant prevalence rate, 1990-2023

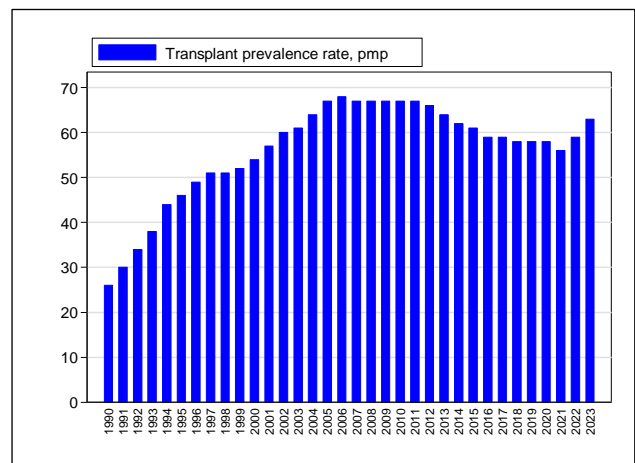


Table 10.1.3: Transplant prevalence rate per million population (pmp), 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Functioning graft at 31 st December	2101	1923	1835	1889	1861	1813	1834	1816	1842	1858
Transplant prevalence rate, pmp	63	59	56	58	58	58	59	59	61	62

Despite these positive developments, the data indicate an alarming trend in overseas transplants, with the most significant number occurring in Cambodia, where 23 transplants were reported, constituting 8.2% of total overseas transplants in 2023 (Table 10.1.4). This trend raises ethical concerns regarding commercial transplant practices, which can negatively affect patient safety and the integrity of the transplantation system.

In conclusion, 2023 presents a hopeful landscape for kidney transplantation in Malaysia. However, much work and support especially from the Ministry of Health, collaboration with private health care is required to sustain these numbers and outcome. The rise in overseas transplants necessitates immediate attention. In order to preserve the integrity of kidney transplantation in the country.

Figure 10.1.4(a): Places of transplantation, 1990-2023

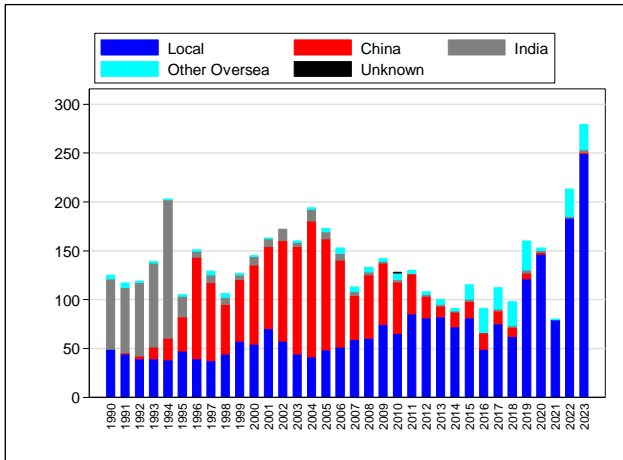


Figure 10.1.4(b): Place of transplantation within Malaysia, 1990-2023

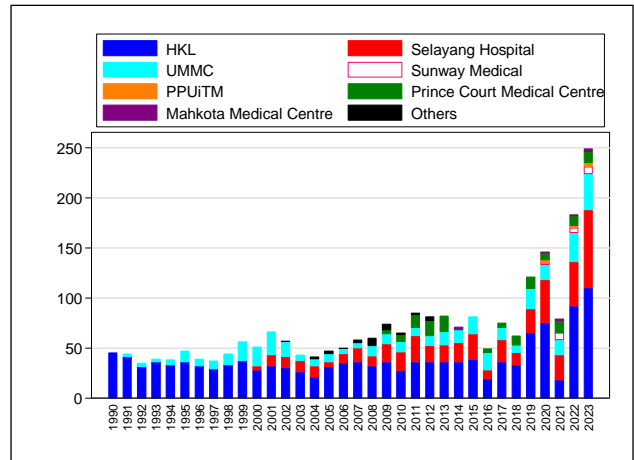


Table 10.1.4 (a): Place of local transplantation, 2014-2023

	2023		2022		2021		2020		2019		2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Deceased Donor Kidney Transplant																				
HKL	35	12.5	21	9.9	1	1.3	17	11.2	14	8.8	6	6.1	10	8.9	4	4.4	27	23.5	19	21.1
Selayang	44	15.8	22	10.3	13	16.3	20	13.2	15	9.4	4	4.1	15	13.4	4	4.4	23	20	18	20
UMMC	2	0.7	0	0	1	1.3	3	2	1	0.6	1	1	1	0.9	1	1.1	1	0.9	2	2.2
Total Deceased Donor	81	29	43	20.2	15	18.9	40	26.4	30	18.8	11	11.2	26	23.2	9	9.9	51	44.4	39	43.3
Living Donor Kidney Transplant																				
HKL	75	26.9	71	33.3	17	21.3	58	38.2	51	31.9	27	27.6	26	23.2	15	16.5	11	9.6	17	18.9
Selayang	34	12.2	22	10.3	12	15	23	15.1	9	5.6	8	8.2	7	6.3	5	5.5	3	2.6	1	1.1
UMMC	34	12.2	29	13.6	14	17.5	12	7.9	19	11.9	6	6.1	11	9.8	16	17.6	16	13.9	11	12.2
Prince Court Medical Centre	11	3.9	10	4.7	12	15	7	4.6	12	7.5	9	9.2	5	4.5	4	4.4	0	0	0	0
Sunway Medical	7	2.5	5	2.3	7	8.8	2	1.3	0	0	0	0	0	0	0	0	0	0	0	0
PPUiTM	4	1.4	2	0.9	0	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0
Mahkota Medical Centre	3	1.1	1	0.5	2	2.5	1	0.7	0	0	0	0	0	0	0	0	0	0	3	3.3
Total Living Donor	168	60.2	140	65.6	64	80.1	106	69.8	91	56.9	51	52.1	49	43.8	40	44	30	26.1	32	35.5
Local Transplant																				
HKL	110	39.4	92	43.2	18	22.6	75	49.4	65	40.7	33	33.7	36	32.1	19	20.9	38	33.1	36	40
Selayang	78	28	44	20.6	25	31.3	43	28.3	24	15	12	12.3	22	19.7	9	9.9	26	22.6	19	21.1
UMMC	36	12.9	29	13.6	15	18.8	15	9.9	20	12.5	7	7.1	12	10.7	17	18.7	17	14.8	13	14.4
Prince Court Medical Centre	11	3.9	10	4.7	12	15	7	4.6	12	7.5	9	9.2	5	4.5	4	4.4	0	0	0	0
Sunway Medical	7	2.5	5	2.3	7	8.8	2	1.3	0	0	0	0	0	0	0	0	0	0	0	0
PPUiTM	4	1.4	2	0.9	0	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0
Mahkota Medical Centre	3	1.1	1	0.5	2	2.5	1	0.7	0	0	0	0	0	0	0	0	0	0	3	3.3
Total	249	89.2	183	85.8	79	99	146	96.2	121	75.7	62	63.3	75	67	49	53.9	81	70.5	71	78.8

Table 10.1.4 (b): Place of overseas transplantation, 2014-2023

	2023		2022		2021		2020		2019		2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
	Overseas Transplant																			
Cambodia	23	8.2	27	12.7	0	0	3	2	28	17.5	22	22.4	17	15.2	17	18.7	5	4.3	0	0
India	3	1.1	2	0.9	0	0	2	1.3	3	1.9	2	2	2	1.8	0	0	2	1.7	1	1.1
China	1	0.4	0	0	0	0	1	0.7	6	3.8	9	9.2	13	11.6	17	18.7	17	14.8	15	16.5
Singapore	1	0.4	0	0	0	0	0	0	1	0.6	2	2	2	1.8	2	2.2	1	0.9	0	0
USA	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vietnam	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sri Lanka	0	0	1	0.5	0	0	0	0	0	0	0	0	0	0	3	3.3	2	1.7	3	3.3
Pakistan	0	0	0	0	1	1.3	0	0	0	0	1	1	0	0	1	1.1	5	4.3	0	0
Bangladesh	0	0	0	0	0	0	0	0	1	0.6	0	0	0	0	0	0	0	0	0	0
Indonesia	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0	0	0	0	0
Iraq	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0	0	0	0	0
Philippine	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0	1	0.9	0	0
Iran	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.1	0	0	0	0
Tunisia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.1	0	0	0	0
UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0
Total	30	10.9	30	14.1	1	1.3	6	4	39	24.4	36	36.6	37	33.1	42	46.2	34	29.5	19	20.9

SECTION 10.2: RECIPIENTS' CHARACTERISTICS

The mean age of the transplant recipients was 39 ± 12. Nearly 60% were male and one-fifth had diabetes mellitus. The percentage of incident transplant recipients who were hepatitis B surface antigen positive or positive hepatitis C antibodies were very low. (Table 10.2.1). Hypertension (28%) remained the most commonly reported primary renal disease but it is more likely a co-morbidity instead. Glomerular disease (24.4%) and unknown cause (24.7%) were predominant. Other causes such as autosomal dominant polycystic kidney disease (ADPKD) and obstructive uropathy resulted in less than 5% of ESKD. (Table 10.2.2)

Table 10.2.1: Renal transplant recipients' characteristics, 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Transplant Patients	279	213	80	152	160	98	112	91	115	91
Age at transplant (years), Mean	39	39	38	36	41	41	42	44	42	39
Age at transplant (years), SD	12	12	12	11	13	15	12	14	13	13
% Male	59	57	50	54	58	66	67	68	59	54
% Diabetic (co-morbid/primary renal disease)	19	15	21	26	20	17	21	22	24	24
% HBsAg positive	1	1	0	1	1	2	2	6	1	0
% Anti-HCV positive	0	0	1	0	1	1	1	1	3	5

Table 10.2.2: Primary causes of end stage renal failure, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
New transplant patients	279	100	213	100	80	100	152	100	160	100
Glomerulonephritis	68	24.4	52	24.4	16	20	50	32.9	47	29.4
Diabetes Mellitus	26	9.3	24	11.3	16	20	12	7.9	23	14.4
Hypertension	78	28	73	34.3	12	15	37	24.3	32	20
Obstructive uropathy	4	1.4	3	1.4	0	0	1	0.7	5	3.1
ADPKD	4	1.4	4	1.9	1	1.3	0	0	5	3.1
Drugs/ toxic nephropathy	1	0.4	0	0	0	0	3	2	2	1.3
Hereditary nephritis	2	0.7	0	0	2	2.5	1	0.7	2	1.3
Unknown	69	24.7	39	18.3	17	21.3	33	21.7	32	20
Others	27	9.7	18	8.5	16	20	15	9.9	12	7.5

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
New transplant patients	98	100	112	100	91	100	115	100	91	100
Glomerulonephritis	22	22.4	32	28.6	34	37.4	51	44.3	30	33
Diabetes Mellitus	19	19.4	21	18.8	16	17.6	13	11.3	9	9.9
Hypertension	29	29.6	30	26.8	17	18.7	24	20.9	18	19.8
Obstructive uropathy	3	3.1	6	5.4	0	0	4	3.5	2	2.2
ADPKD	3	3.1	5	4.5	4	4.4	3	2.6	2	2.2
Drugs/ toxic nephropathy	1	1	0	0	1	1.1	0	0	1	1.1
Hereditary nephritis	3	3.1	3	2.7	0	0	1	0.9	4	4.4
Unknown	10	10.2	10	8.9	16	17.6	17	14.8	17	18.7
Others	8	8.2	5	4.5	3	3.3	2	1.7	8	8.8

SECTION 10.3: TRANSPLANT PRACTICES**10.3.1: Type of renal transplantation**

The types of kidney transplantation in Malaysia were local living (genetically or emotionally related), local deceased, commercial living, and commercial deceased. (Table 10.3.1)

Local living donor transplantation has steadily risen for the last 5 years, with an exceptional drop in 2021 due to the COVID-19 pandemic. From 2017 onwards, Malaysia performed more than 50 living transplants yearly, with the highest number of 172 cases (61.6%) reported in 2023. Most of the living donor kidney transplants were genetically related contributing about 35.1% of all kidney transplants, and around 25% were contributed by emotionally related living donors.

Meanwhile, the local deceased donor transplant rate has demonstrated a similar pattern, with only 11 cases in 2018, and the number rose to 82 cases in 2023. This number rose significantly compared with the year before. This was partly contributed by the formation of Unit Perolehan Organ Hospital (UPOH) in 2019, which involved 16 focused hospitals in the Ministry of Health Hospitals. The number of local deceased donor transplants will likely increase with the strengthening of this dedicated team.

The proportion of commercial transplantation fluctuated over the past 10 years, with no reported cases in 2021. This was attributed to the travel restrictions imposed during the COVID-19 pandemic. This may also reflect the global stand on unethical transplant practices. However, the proportion of living commercial transplantations remained significant during the post-pandemic period, attributed to about 13.3% of the total number of kidney transplants in 2022, with a reduction in 2023 (7.5%). The peak number of commercial transplants was reported in 2018, contributing to about 27.5% of the cases.

Overall, the total number of kidney transplantations rose steadily for the last 5 years, with significant increment in 2023. This was dominated by local living donors, which contributed 60.2% (168/279) of the total transplants performed.

Table 10.3.1: Type of renal transplantation, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Live donor (genetically related)	98	35.1	94	44.1	40	50.0	64	42.1	58	36.3
Live donor (emotionally related)	72	25.8	47	22.1	25	31.3	42	27.6	34	21.3
Live donor (unknown type)	2	0.7	0	0.0	0	0.0	2	1.3	17	10.6
Deceased donor	82	29.4	43	20.2	15	18.8	40	26.3	30	18.8
Commercial deceased donor	0	0.0	0	0.0	0	0.0	1	0.7	2	1.3
Commercial live donor (living unrelated)	21	7.5	28	13.1	0	0.0	3	2.0	16	10.0
Unknown donor type	4	1.4	1	0.5	0	0.0	0	0.0	3	1.9
Total	279	100	213	100	80	100	152	100	160	100

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Live donor (genetically related)	37	37.8	36	32.1	30	33.0	23	20.0	24	26.4
Live donor (emotionally related)	17	17.3	16	14.3	13	14.3	9	7.8	9	9.9
Live donor (unknown type)	4	4.1	4	3.6	3	3.3	3	2.6	0	0.0
Deceased donor	11	11.2	26	23.2	9	9.9	51	44.3	39	42.9
Commercial deceased donor	2	2.0	2	1.8	3	3.3	1	0.9	1	1.1
Commercial live donor (living unrelated)	25	25.5	12	10.7	6	6.6	14	12.2	11	12.1
Unknown donor type	2	2.0	16	14.3	27	29.7	14	12.2	7	7.7
Total	98	100	112	100	91	100	115	100	91	100

*Commercial live donor (living unrelated) (Cambodia, China, Sri Lanka), Commercial deceased donor (China),

**Unknown donor type from overseas transplants

10.3.2: Biochemical data

Table 10.3.2 summarises the biochemical data and blood pressure for all kidney transplant recipients from 2019 to 2023. The mean serum creatinine was 128.8 ± 80.9 to 130.1 ± 83.1 $\mu\text{mol/L}$ over the last 5 years, with stable mean haemoglobin 12.6 ± 1.8 to 12.9 ± 1.9 g/dL . Serum albumin, calcium, and phosphate were within normal ranges post-transplantation.

The mean total and LDL cholesterol generally were at the upper limit of normal ranges. In the year 2023, a proportion of the patients had very high total and LDL cholesterol with maximum values of 11.0 mmol/L and 7.5 mmol/L , respectively. The trend was reducing compared to the readings recorded in the previous years.

The mean systolic blood pressure ranges between 134.7 ± 14.6 to 136.0 ± 15.2 mmHg , and the mean diastolic blood pressure ranges between 79.5 ± 9.1 to 80.8 ± 9.8 mmHg diastolic. In 2023, the highest systolic and diastolic blood pressure values were 208 and 117 mmHg , respectively. This requires special attention, as cardiovascular disease is one of the leading causes of death in post-transplant recipients.

Table 10.3.2: Biochemical data, 2019-2023

Biochemical parameter	Summary	2023	2022	2021	2020	2019
Creatinine, $\mu\text{mol/L}$	n	2361	2084	1976	2054	1945
	Mean	130.1	130.1	131	129.6	128.8
	SD	83.1	83.4	83.3	82.2	80.9
	Median	109.7	109	109	108	109
	Minimum	42.3	43.5	41.7	40	41
	Maximum	980	821.2	970	899	964
Hb, g/dL	n	2361	2084	1976	2054	1945
	Mean	12.6	12.7	12.9	12.8	12.9
	SD	1.8	1.8	1.9	1.9	1.9
	Median	12.8	12.8	12.9	12.9	12.8
	Minimum	6	5.8	5.5	4.1	5.9
	Maximum	18.4	19.8	19.3	18.8	18.2
Albumin, g/L	n	2361	2084	1976	2054	1945
	Mean	39.5	39.5	39.8	40.3	40.6
	SD	4.1	3.9	4	4.2	4.6
	Median	39.9	39.8	40	40.5	41
	Minimum	15	20	18.5	16	16.5
	Maximum	51	51	50.8	51.3	52.5
Calcium, mmol/L	n	2361	2084	1976	2054	1945
	Mean	2.4	2.4	2.3	2.3	2.4
	SD	0.1	0.1	0.1	0.1	0.1
	Median	2.3	2.4	2.3	2.3	2.4
	Minimum	1.4	1.5	1.6	1	1.5
	Maximum	3	3	3.3	3	2.9
Phosphate, mmol/L	n	2361	2084	1976	2054	1945
	Mean	1.1	1.1	1.1	1.1	1.1
	SD	0.2	0.2	0.2	0.3	0.2
	Median	1	1.1	1.1	1.1	1.1
	Minimum	0.5	0.5	0.5	0.5	0.5
	Maximum	3.1	3	2.9	4	3

Biochemical parameter	Summary	2023	2022	2021	2020	2019
Alkaline phosphate (ALP), U/L	n	2361	2084	1976	2054	1945
	Mean	89.1	86.1	84.1	85.3	84.1
	SD	52.2	50.8	43.9	42.6	38.5
	Median	79	77.3	76	76.2	76.3
	Minimum	27	20	21	22.3	20.5
	Maximum	995.3	987	758.8	651	405
ALT, U/L	n	2361	2084	1976	2054	1945
	Mean	25.1	24.4	24	24.6	23.9
	SD	24	23.1	21.4	19.7	18.5
	Median	19.7	19.3	19.7	20	20
	Minimum	4.3	4.6	4.2	4	4
	Maximum	422.1	523	482.5	371	291
Total cholesterol, mmol/L	n	2361	2084	1976	2054	1945
	Mean	5.1	5.1	5	5.1	5.1
	SD	1	1	1	1.1	1
	Median	5.1	5.1	5.1	5.1	5.1
	Minimum	2	1.7	1.6	1.5	1.5
	Maximum	11	11.9	12.2	10.3	9.7
LDL cholesterol, mmol/L	n	2361	2084	1976	2054	1945
	Mean	2.8	2.9	2.8	2.8	2.8
	SD	0.8	0.9	0.9	0.9	0.8
	Median	2.8	2.8	2.8	2.8	2.8
	Minimum	0.9	0.9	1	0.9	0.9
	Maximum	7.5	8.7	8.4	7.3	6.7
HDL cholesterol, mmol/L	n	2361	2084	1976	2054	1945
	Mean	1.5	1.5	1.5	1.6	1.5
	SD	0.4	0.4	0.5	0.5	0.4
	Median	1.5	1.5	1.5	1.5	1.5
	Minimum	0.6	0.6	0.6	0.4	0.6
	Maximum	6.9	4.3	8	6.1	5.8
Systolic blood pressure, mmHg	n	2361	2084	1976	2054	1945
	Mean	136	135.4	134.1	135.8	134.7
	SD	15.2	14.6	15.4	15.7	14.6
	Median	135	134.7	132.4	134.8	133.3
	Minimum	88	97	89	95	91.7
	Maximum	208	209	201.7	213	204
Diastolic blood pressure, mmHg	n	2361	2084	1976	2054	1945
	Mean	80.8	80.2	79.6	80.2	79.5
	SD	9.8	9.5	9.2	9.9	9.1
	Median	81	80.5	80	80	80
	Minimum	43	44	46.9	40	47
	Maximum	117	118	115.3	115	115

10.3.3: Immunosuppression medications

Calcineurin-inhibitor-based therapy and corticosteroids remain the mainstay immunosuppressive therapy, with 90.5 % and 85.9% of patients receiving it, respectively. Antimetabolites were used in 67.4% of the patients. The use of proliferation signal inhibitors (PSI) has increased over time from 11.5% in 2019 to 18.4% in 2023. The publication of the transplant efficacy and safety outcomes with an everolimus-based regimen (TRANSFORM trial) in 2018 and 2019 could have explained the increment in its usage Table 10.3.3 (a).

Among the calcineurin inhibitors, the usage of tacrolimus has superseded cyclosporin since 2019. The proportion of patients on tacrolimus had increased from 61.5% in 2019 to 82% in 2023. Mycophenolic mofetil was the main antimetabolite used. The proportion of patients on mycophenolate mofetil was about 50% and mycophenolate sodium around 40% of total anti-metabolites used in post kidney transplant recipients. Azathioprine usage has decreased over the years, from 14.3% in year 2019 to 9.4% of all anti-metabolites used in 2023.

Table 10.3.3 (a): Immunosuppressive Medications, 2019-2023

Medication data	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All	2361		2084		1976		2054		1945	
Prednisolone	2028	85.9	1907	91.5	1772	89.7	1829	89	1470	75.6
Calcineurin inhibitors	2136	90.5	1889	90.6	1717	87	1795	87.4	1526	78.4
Antimetabolites	1593	67.4	1493	71.6	1378	69.8	1434	69.8	1327	68.3
mTOR inhibitors	433	18.4	348	16.7	319	16.2	302	14.6	224	11.5

Table 10.3.3(b): Immunosuppressive Medications, 2019-2023

Medication data	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All	2361		2084		1976		2054		1945	
Antimetabolites										
Azathioprine	149	9.4	140	9.4	147	10.7	146	10.2	190	14.3
Mycophenolate Sodium	624	39.2	613	41	555	40.3	589	41.1	477	35.9
Mycophenolic Mofetil	820	51.5	738	49.4	675	49.0	692	48.2	651	49.1
Antimetabolite – unknown type	0	0	2	0.1	1	0.1	7	0.5	9	0.7
Total	1593	100	1493	100	1378	100	1434	100	1327	100
Proliferation Signal Inhibitors										
Everolimus	422	97.5	340	97.7	310	97.2	290	96	205	91.5
Sirolimus	9	2.1	8	2.3	8	2.5	11	3.6	15	6.7
mTOR inhibitor – unknown type	2	0.5	0	0.0	1	0.3	1	0.3	4	1.8
Total	433	100	348	100	319	100	302	100	224	100
Calcineurin inhibitors										
Cyclosporine	384	18.0	423	22.4	468	27.3	517	28.8	562	36.8
Tacrolimus	1751	82.0	1465	77.6	1248	72.7	1274	71.0	938	61.5
Calcineurin inhibitor – unknown type	1	0.0	1	0	1	0.1	4	0.2	26	1.7
Total	2136	100	1889	100	1717	100	1795	100	1526	100
Prednisolone	2028	85.9	1907	91.5	1772	89.7	1829	89	1470	75.6

SECTION 10.4: TRANSPLANT OUTCOMES**10.4.1: Post transplant complications**

Hypertension remained the most common comorbidity among kidney transplant recipients before and after transplantation, at 53.1% and 33.0% respectively. Throughout the 5-year period of 2019-2023, the prevalence of pre-transplant hypertension was decremental but that of post-transplant hypertension was incremental.

Diabetes was either the primary kidney disease or a comorbidity in 11.8% of patients before kidney transplant. The incidence of post-transplant diabetes mellitus was trending lower over 5-year period from 2019 to 2023 (Table 10.4.1).

The prevalence of cardiovascular disease and cerebrovascular disease before transplant was 1.7%, and 0.8% developed cardiovascular and/or cerebrovascular disease post-transplantation. The low figure may be due to under-reporting of these comorbidities. Although cancer was rare, it was more common after transplant compared to pre-transplant, 0.5% versus 0.1% (Table 10.4.1).

Table 10.4.1: Post transplant complications, 2019-2023

	Pre transplant comorbidities									
	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All patients	2185		1965		1867		1944		1856	
Diabetes (Either as primary renal disease or comorbid)	257	11.8	235	12	232	12.4	245	12.6	242	13
Cancer	1	0	2	0.1	1	0.1	2	0.1	3	0.2
Cardiovascular disease + cerebrovascular disorder	37	1.7	32	1.6	28	1.5	30	1.5	29	1.6
Hypertension	1161	53.1	1081	55	1056	56.6	1121	57.7	1081	58.2

	Post transplant complications									
	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All patients	2185		1965		1867		1944		1856	
Diabetes (new onset)	64	2.9	69	3.5	63	3.4	78	4	92	5
Cancer	12	0.5	11	0.6	14	0.7	11	0.6	20	1.1
Cardiovascular disease + cerebrovascular disorder	18	0.8	17	0.9	17	0.9	26	1.3	34	1.8
Hypertension	721	33	643	32.7	589	31.5	564	29	531	28.6

*Hypertension: BP systolic >140 and BP diastolic >90

or have either Beta blocker/ Calcium channel blocker / ACE inhibitor / ARBs/ Other antihypertensive

10.4.2: Deaths and graft loss

The death rate of transplant recipients peaked in 2021 with 83 deaths (4.3%). Within the last decade, death rate for year 2023 was the lowest at 2% (Table 10.4.2). The excess deaths in 2021 and 2022 were driven by COVID-19 infection. Infection remained the main cause of death in 2023, similar to previous years. Cardiovascular deaths and cancer deaths in the last 5 years were stable, contributing to 12.5% and 5% of all deaths in 2023, respectively (Table 10.4.3).

The trend of death-censored allograft loss over 5-year period from 2019 to 2023 is encouraging. The overall rate of death-censored allograft loss dropped to 1.7% in 2023 (Table 10.4.2). There were 35 allograft losses in 2023. The two most common reported causes of allograft loss in 2023 were rejection (n=19, 54.3%) followed by IFTA (n=8, 22.9%). Infection, recurrent/de novo glomerular disease and technical issue accounted for two allograft losses (5.7%) each in 2023 (Table 10.4.4).

Table 10.4.2: Transplant patient death rate and graft loss, 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Number at risk	2012	1879	1862	1875	1837	1824	1825	1829	1850	1877
Transplant death	40	74	89	57	53	45	49	49	63	65
Transplant death rate %	2	3.9	4.8	3	2.9	2.5	2.7	2.7	3.4	3.5
Graft loss	35	37	37	43	37	48	28	52	54	44
Graft loss rate %	1.7	2	2	2.3	2	2.6	1.5	2.8	2.9	2.3
Acute rejection	19	11	5	7	12	13	4	20	24	28
Acute rejection rate %	0.9	0.6	0.3	0.4	0.7	0.7	0.2	1.1	1.3	1.5
All losses	75	111	126	100	90	93	77	101	117	109
All losses rate %	3.7	5.9	6.8	5.3	4.9	5.1	4.2	5.5	6.3	5.8

*Graft loss=graft failure

*All losses=death / graft loss (acute rejection happens concurrently with graft failure / death)

Figure 10.4.2(a): Transplant recipient death rate, 1990-2023

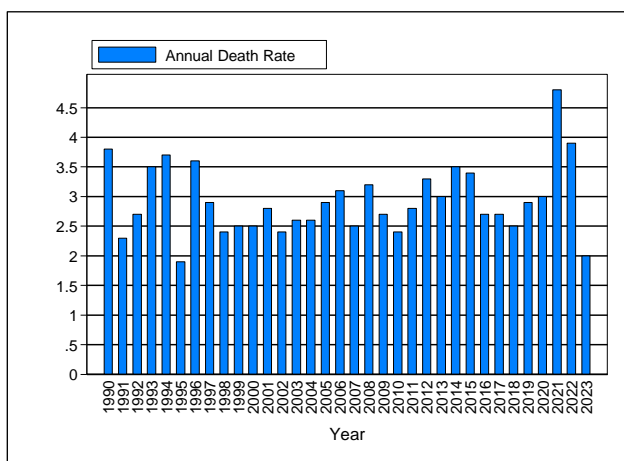


Figure 10.4.2(b): Transplant recipient allograft loss rate, 1990-2023

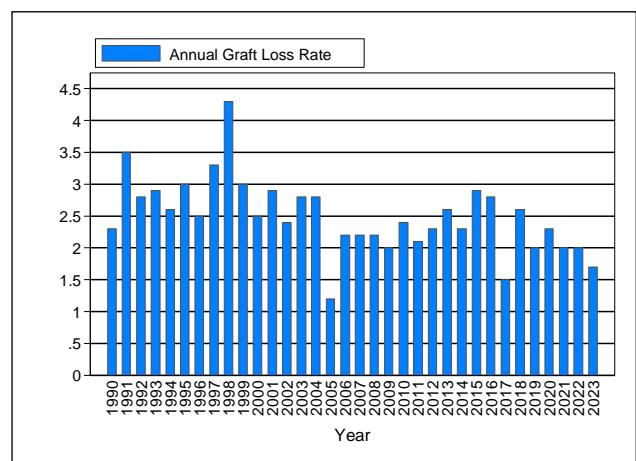


Table 10.4.3: Causes of death in transplant recipients, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	5	12.5	11	14.9	11	12.4	6	10.5	11	20.8
Died at home	4	10	1	5.4	12	13.5	3	5.3	5	9.4
Infection	13*	32.5	40*	54.1	50*	56.2	27	47.4	17	32.1
Cancer	2	5	8	10.8	6	6.7	6	10.5	11	20.8
Liver disease	0	0	1	1.4	0	0.0	1	1.8	0	0
Accidental death	1	2.5	0	0	0	0.0	1	1.8	0	0
Others	14	35	7	9.5	5	5.6	8	14	6	11.3
Unknown	1	2.5	3	4.1	5	5.6	5	8.8	3	5.7
Total	40	100	74	100	89	100	57	100	53	100

*Death due to COVID-19: 1 in 2023, 16 in 2022, 28 in 2021

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	4	8.9	6	12.2	13	26.5	16	25.4	14	21.5
Died at home	5	11.1	4	8.2	5	10.2	4	6.3	4	6.2
Infection	20	44.4	22	44.9	13	26.5	28	44.4	31	47.7
Cancer	9	20.0	6	12.2	5	10.2	8	12.7	5	7.7
Liver disease	1	2.2	1	2.0	0	0	1	1.6	1	1.5
Accidental death	0	0.0	0	0.0	2	4.1	0	0	0	0
Others	6	13.3	6	12.2	2	4.1	0	0	3	4.6
Unknown	0	0.0	4	8.2	9	18.4	6	9.5	7	10.8
Total	45	100	49	100	49	100	63	100	65	100

Table 10.4.4: Causes of graft failure, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Rejection	19	54.3	11	29.7	5	13.5	7	16.3	12	32.4
Calcineurin inhibitor toxicity	0	0	1	2.7	0	0	2	4.7	1	2.7
Other drug toxicity	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	0	0
Infection	2	5.7	2	5.4	2	5.4	2	4.7	0	0
Vascular causes	0	0	0	0	0	0	0	0	0	0
Recurrent/ de novo renal disease	2	5.7	1	2.7	3	8.1	0	0	2	5.4
Chronic allograft nephropathy / IFTA	8	22.9	16	43.2	8	21.6	15	34.9	10	27
Technical problem	2	5.7	0	0	0	0	0	0	0	0
Others	1	2.9	4	10.8	14	37.8	10	23.3	7	18.9
Unknown	1	2.9	2	5.4	5	13.5	7	16.3	5	13.5
Total	35	100	37	100	37	100	43	100	37	100

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Rejection	13	27.1	4	14.3	20	38.5	24	44.4	28	63.6
Calcineurin inhibitor toxicity	1	2.1	2	7.1	4	7.7	2	3.7	0	0
Other drug toxicity	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	0	0
Infection	0	0	1	3.6	2	3.8	1	1.9	2	4.5
Vascular causes	1	2.1	0	0	3	5.8	3	5.6	2	4.5
Recurrent/ de novo renal disease	2	4.2	1	3.6	4	7.7	3	5.6	2	4.5
Chronic allograft nephropathy / IFTA	13	27.1	3	10.7	9	17.3	6	11.1	1	2.3
Technical problem	0	0	0	0	1	1.9	0	0	0	0
Others	7	14.6	3	10.7	1	1.9	2	3.7	2	4.5
Unknown	11	22.9	14	50	8	15.4	13	24.1	7	15.9
Total	48	100	28	100	52	100	54	100	44	100

SECTION 10.5: PATIENT AND ALLOGRAFT SURVIVAL

10.5.1: Patient survival

Patient survival rates have shown significant improvement over the decade (from 2014 to 2023). The survival rate post-kidney transplantation is 97% at 1 year, 92% at 5 years, and 84% at 9 years post transplantation. (Table and Figure 10.5.1(a)).

The analysis identified several risk factors that significantly impact patient survival in kidney transplant recipients. These factors include diabetes mellitus and age of ≥ 40 years and above and kidney transplantation done in the year 2014 till 2018. The mortality of kidney transplantation recipients done in the year 2019 till 2023 has a better outcome comparing to transplantation performed in the year 2014 till 2019. This may reflect better patient selection, and pre- transplant preparation of the recipients.

Interestingly, in previous analysis, recipients with positive hepatitis B and C status, autosomal dominant polycystic kidney disease (ADPKD) and recipients of deceased donor kidney transplants exhibited a higher risk of mortality which are no more significant now.

Table 10.5.1(a): Patient survival, 2014-2023

Interval (years)	n	% Survival	SE
0	1416	100	
1	1038	97	0
2	805	97	1
3	702	96	1
4	537	94	1
5	379	92	1
6	290	90	1
7	194	89	1
8	119	85	2
9	53	84	2
10	1		

*n=Number at risk SE=standard error

Figure 10.5.1(a): Patient survival, 2014-2023

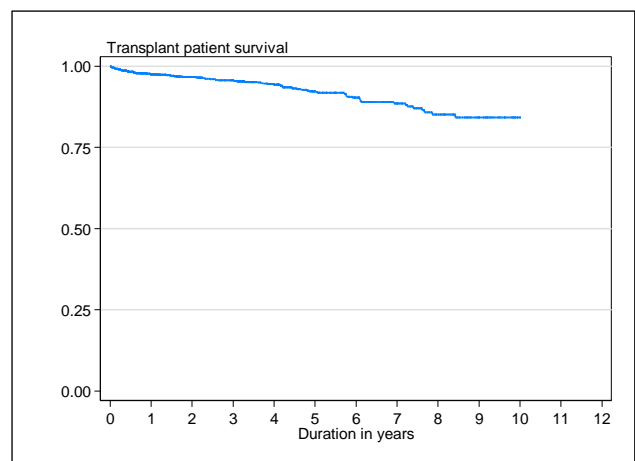


Table 10.5.2(a): Allograft survival, 2014-2023

Interval (years)	n	% Survival	SE
0	1416	100	
1	1038	97	0
2	805	96	1
3	702	95	1
4	537	94	1
5	379	92	1
6	290	91	1
7	194	90	1
8	119	86	2
9	53	85	2
10	1		

*n=Number at risk SE=standard error

Figure 10.5.2(a): Allograft survival, 2014-2023

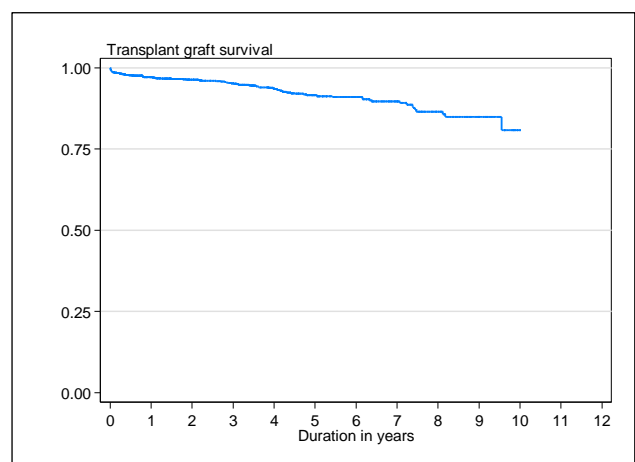


Table 10.5.1(b): Risk factors for transplant recipient mortality 2014-2023

Factors	n	Hazard Ratio	95% CI	P value
Year of transplant				
2014-2018 ^(ref*)	496	1.00		
2019-2023	872	0.58	(0.34, 0.986)	0.044
Age at transplant				
20-39 ^(ref*)	700	1.00		
40-54	594	2.26	(1.348, 3.793)	0.002
>=55	112	3.92	(2.017, 7.605)	<0.001
Gender				
Male ^(ref*)	873	1.00		
Female	608	1.19	(0.769, 1.829)	0.439
Primary diagnosis				
Unknown primary ^(ref*)	298	1.00		
Diabetes mellitus	180	2.07	(1.01, 4.237)	0.047
GN/SLE	410	1.12	(0.56, 2.221)	0.757
Polycystic kidney	32	1.69	(0.476, 5.99)	0.417
Obstructive nephropathy	28	0.62		
Others	530	1.01	(0.501, 2.027)	0.983
Type of transplant				
Commercial deceased donor ^(ref*)	18	1.00		
Commercial living donor	146	2.13	(0.278, 16.416)	0.466
Living donor	835	0.91	(0.122, 6.829)	0.929
Deceased donor	374	2.48	(0.335, 18.366)	0.374
HBsAg				
Negative ^(ref*)	1338	1.00		
Positive	20	2.38	(0.578, 9.777)	0.23
Anti-HCV				
Negative ^(ref*)	1332	1.00		
Positive	10	1.71	(0.235, 12.435)	0.596

10.5.2 Allograft survival

The allograft loss rates provided below were not censored for death. The allograft survival rates post-kidney transplantation were 97% at 1 year, 92% at 5 years, and 85% at 9 years post-transplantation. Notably, kidney allograft survival rates have shown significant improvement since 2019.

Table 10.5.2(b): Risk factors for allograft loss 2014-2023

Factors	n	Hazard Ratio	95% CI	P value
Year of transplant				
2014-2018 (ref*)	496	1.00		
2019-2023	872	0.64	(0.446, 0.921)	0.016
Age at transplant				
20-39 (ref*)	700	1.00		
40-54	594	1.31	(0.94, 1.834)	0.111
>=55	112	1.60	(0.948, 2.712)	0.078
Gender				
Male (ref*)	873	1.00		
Female	608	1.07	(0.792, 1.456)	0.646
Primary diagnosis				
Unknown primary (ref*)	298	1.00		
Diabetes mellitus	180	1.10	(0.648, 1.855)	0.732
GN/SLE	410	0.90	(0.57, 1.41)	0.636
Polycystic kidney	32	0.68	(0.208, 2.239)	0.529
Obstructive nephropathy	28	0.75		
Others	530	1.06	(0.683, 1.644)	0.795
Type of transplant				
Commercial deceased donor (ref*)	18	1.00		
Commercial living donor	146	0.95	(0.28, 3.253)	0.941
Living donor	835	0.80	(0.249, 2.554)	0.703
Deceased Donor	374	1.62	(0.507, 5.2)	0.415
HBsAg				
Negative (ref*)	1338	1.00		
Positive	20	0.93	(0.229, 3.748)	0.915
Anti-HCV				
Negative (ref*) ^p	1332	1.00		
Positive	10	2.06	(0.655, 6.5)	0.216

10.5.3: Patient survival according to type of transplant

Patient survival following local living renal transplants were 98% at 1 year and 96% at 5 years post transplantation. Local deceased donor recipients survival had improved at 1-year from 92% in 2017 (24th MDTR report) to 96% in 2023 and at 5 -years, from 85% (24th MDTR report) to 87% in 2023. (Table & Figure 10.5.3).

In comparison, Patients who received commercial live donor kidney transplants exhibited similar survival rates to local living program.

Overall, patient survival for commercial deceased donor kidney transplantations was the lowest among all transplant types after 6 years post kidney transplantation. The reason for this was probably likelihood of recipients underlying co-morbidities. However, the number is too small to make a firm conclusion.

10.5.4: Allograft survival according to type of transplant

The allograft survival rates reported were not censored for death. Local living donor allograft survival at 1-year, and 3-years, was 97% and 96% respectively. The allograft survival of commercial living donor and commercial deceased donor transplant were similar to that of local living transplant. Local deceased transplant had the worst allograft survival; 95% at 1 year and 89% at 3 years. (Table 10.5.4)

Table 10.5.3: Unadjusted patient survival by type of transplant, 2014-2023

Type of Transplant Interval (years)	Commercial Deceased Donor			Commercial Living Donor			Local Living Donor			Local Deceased Donor		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	19	100		152	100		862	100		387	100	
1	16	100	0	112	98	1	584	98	1	239	96	1
2	15	100	0	83	98	1	443	98	1	186	94	1
3	15	100	0	79	96	2	372	98	1	168	92	2
4	13	100	0	71	94	2	266	97	1	124	91	2
5	8	100	0	55	89	4	180	96	1	93	87	3
6	7	100	0	37	87	4	128	95	1	80	84	3
7	4	75	22	23	85	5	82	95	1	57	82	3
8	3	75	22	20	85	5	42	91	3	46	77	4
9	3	75	22	11	79	7	21	91	3	17	77	4
10	1			1			1			1		

*n=number at risk SE=standard error

Figure 10.5.3: Patient survival by type of transplant, 2014-2023

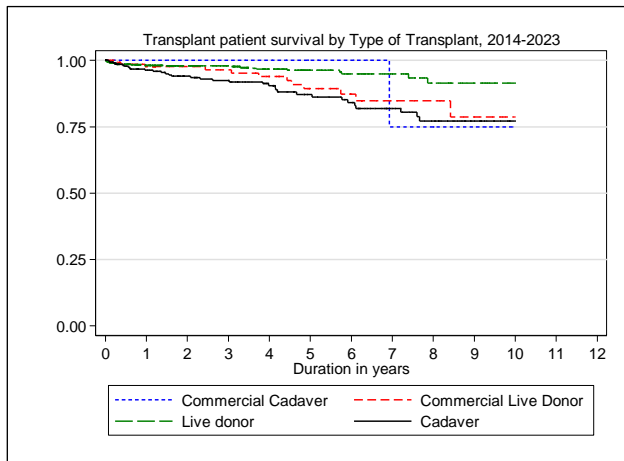


Figure 10.5.4: Graft survival by type of transplants, 2014-2023

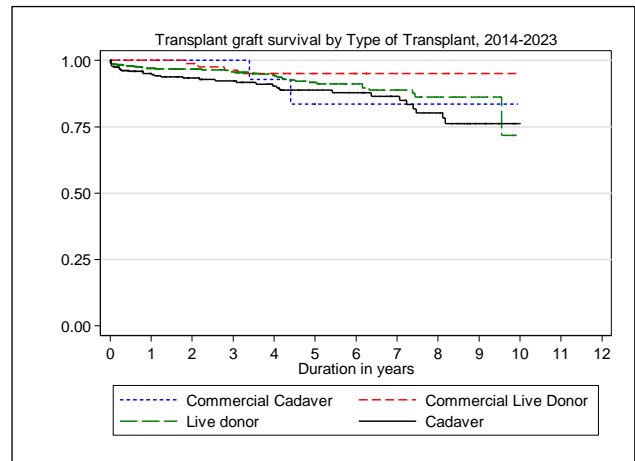


Table 10.5.4: Allograft survival by type of transplant, 2014-2023

Type of Transplant Interval (years)	Commercial Deceased Donor			Commercial Living Donor			Living Donor			Deceased Donor		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	19	100		152	100		862	100		387	100	
1	16	100	0	112	100	0	584	97	1	239	95	1
2	15	100	0	83	99	1	443	97	1	186	93	1
3	15	100	0	79	96	2	372	96	1	168	92	2
4	13	93	7	71	95	2	266	94	1	124	90	2
5	8	84	11	55	95	2	180	92	1	93	89	2
6	7	84	11	37	95	2	128	91	2	80	88	2
7	4	84	11	23	95	2	82	89	2	57	87	3
8	3	84	11	20	95	2	42	86	3	46	80	4
9	3	84	11	11	95	2	21	86	3	17	76	5
10	1			1			1			1		

*n=Number at risk SE=standard error

10.5.5: Outcome of living donor kidney transplantation

Patient survival of local living donor kidney transplant appeared to be similar in those transplanted in 2014-2018 compared to those transplanted in 2019-2023. However, allograft survival (not censored for death) was better for the cohort that had transplantation done from 2019-2023 (Table & Figure 10.5.5 (a)&(b)).

Table 10.5.5(a): Patient survival by year of transplant (Living related transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	211	100		586	100	
1	197	98	1	388	98	1
2	196	98	1	248	98	1
3	194	98	1	179	98	1
4	189	98	1	78	95	2
5	179	97	1	2		
6	128	96	2	2		
7	82	96	2	2		
8	42	92	3	2		
9	21	92	3	2		
10	1			2		

*n=number at risk SE=standard error

Table 10.5.5(b): Allograft survival by year of transplant (Living related transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	211	100		596	100	
1	197	95	1	388	98	1
2	196	95	1	248	97	1
3	194	95	2	179	96	1
4	189	93	2	78	95	1
5	179	90	2	2		
6	128	90	2	2		
7	82	87	2	2		
8	42	85	3	2		
9	21	85	3	2		
10	1			2		

*n=number at risk SE=standard error

Figure 10.5.5(a): Patient survival by year of transplant (Living related transplant, 2014-2023)

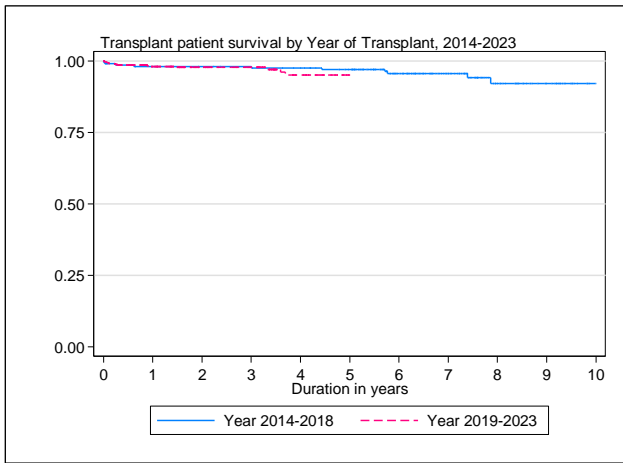
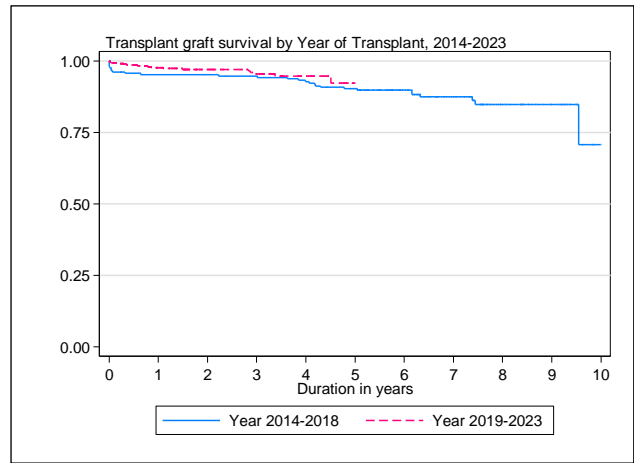


Figure 10.5.5(b): Allograft survival by year of transplant (Living related transplant, 2014-2023)



10.5.6 Outcome of commercial deceased donor transplantation

Patient and allograft survival (not censored for death) of commercial deceased donor transplant appeared to be better only the first 5-6 years and 4-5 years post kidney transplantation for 2014-2018 and 2019-2023 cohort respectively. However, the small number of commercial renal transplants in the cohort may have skewed the result (Table& Figure 10.5.6 (a &b)).

Table 10.5.6(a): Patient survival by year of transplant (Commercial deceased donor transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	11	100		6	100	
1	11	100	22	6	100	11
2	10	100	22	6	100	10
3	10	100	22	6	100	10
4	10	100	22	4	100	10
5	8	100	22	1		8
6	7	100	22	1		7
7	4	75	22	1		4
8	3	75	22	1		3
9	3	75	22	1		3
10	1			1		1

*n=number at risk SE=standard error

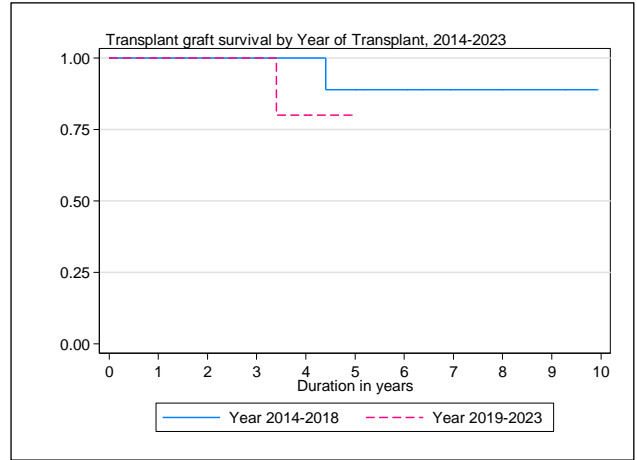
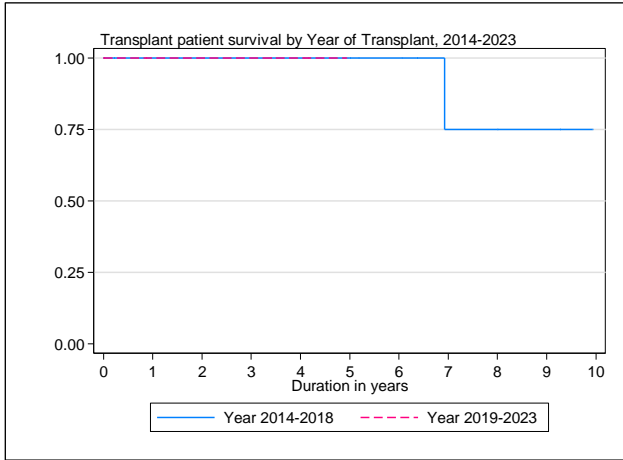
Table 10.5.6(b): Allograft survival by year of transplant (commercial deceased donor transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	11	100	10	6	100	18
1	11	100	10	6	100	18
2	10	100	10	6	100	18
3	10	100	10	6	100	18
4	10	100	10	4	80	18
5	8	89	10	1		
6	7	89	10	1		
7	4	89	10	1		
8	3	89	10	1		
9	3	89	10	1		
10	1			1		

*n=number at risk SE=standard error

Figure 10.5.6(a): Patient survival by year of transplant (Commercial deceased donor, 2014-2023)

Figure 10.5.6(b): Allograft survival by year of transplant (Commercial deceased donor, 2014-2023)



SECTION 10.6: CARDIOVASCULAR RISK IN RENAL TRANSPLANT RECIPIENTS

10.6.1: Risk factors for ischaemic heart disease (IHD)

The prevalence of hypertension among renal transplant recipients stood at 87.2% in 2023, while 16.8% were diagnosed with diabetes and 49.6% had chronic kidney disease (CKD) stage III and above. Notably, 5.2% of these patients had all three major risk factors for cardiovascular disease (CVD). Although hypertension appears to be on the rise, the prevalence of CKD, diabetes, and composite major risk factors for CVD has shown a declining trend in recent years.

Table 10.6.1: Risk factors for IHD in renal transplant recipients at year 2019-2023

	2019	2020	2021	2022	2023
Diabetes	46 (2.8)	46 (2.6)	25 (1.4)	31 (1.7)	38 (1.9)
Hypertension**	656 (39.3)	723 (40.6)	722 (41.6)	733 (40.1)	812 (39.7)
CKD	141 (8.4)	145 (8.2)	129 (7.4)	132 (7.2)	201 (9.8)
Diabetes + Hypertension**	164 (9.8)	166 (9.3)	160 (9.2)	178 (9.7)	178 (8.7)
Diabetes + CKD	25 (1.5)	20 (1.1)	19 (1.1)	20 (1.1)	20 (1.0)
CKD + Hypertension**	524 (31.4)	568 (31.9)	567 (32.6)	629 (34.4)	687 (33.6)
Diabetes + CKD + Hypertension**	113 (6.8)	111 (6.2)	115 (6.6)	104 (5.7)	107 (5.2)

**Hypertension: BP systolic > 140 and BP diastolic > 90 OR have either Beta blocker / Calcium channel blocker / ACE inhibitor / AIIIRB / Other antihypertensive drugs
 eGFR (ml/min/1.73m2) = 41.3 * (height (cm) / 100 / (Creatine in umol/L) / 88.4) if age<18
 CKD-EPI Cr Equation (2021) is used if age>=18 CKD stage III-GFR, 30-60 CKD stage IV-GFR, 15-30 CKD stage V-GFR, <15

Figure 10.6.1(a): Venn diagram for pre and post-transplant complications (in %) at year 2019

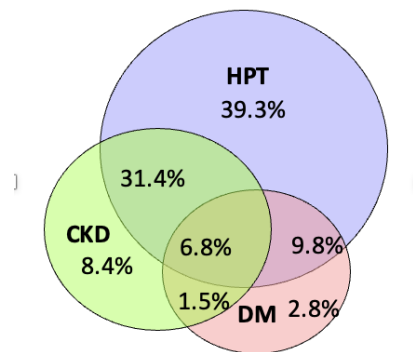


Figure 10.6.1(b): Venn diagram for pre and post-transplant-complications (in %) at year 2020

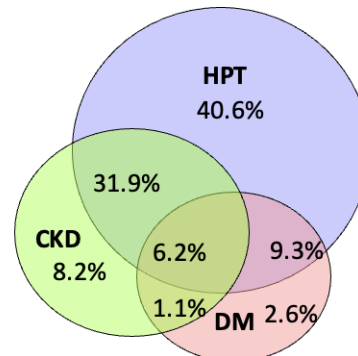


Figure 10.6.1(c): Venn diagram for pre and post-transplant complications (in %) at year 2021

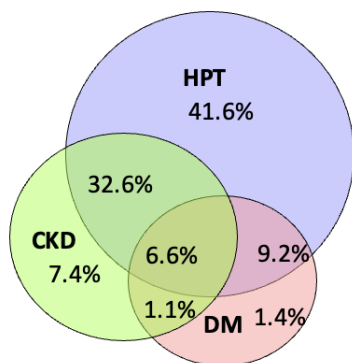


Figure 10.6.1(d): Venn diagram for pre and post-transplant complications (in %) at year 2022

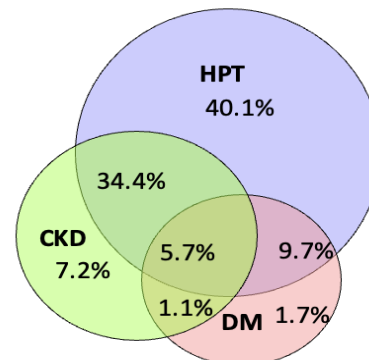
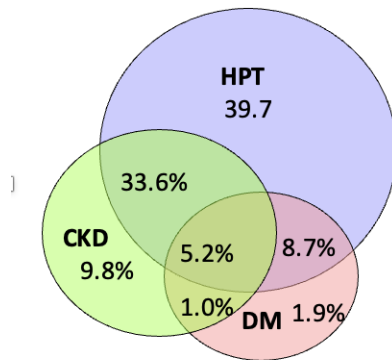


Figure 10.6.1(e): Venn diagram for pre and post-transplant complications (in %) at year 2023



10.6.2: Blood Pressure

Despite the increasing prevalence of hypertension among renal transplant recipients, their blood pressure has remained stable over the last 5 years. In 2023, 35.7% of recipients had a systolic blood pressure of ≥ 140 mmHg, and 17.1% had a diastolic blood pressure of ≥ 90 mmHg.

Table 10.6.2(a): Systolic BP, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<120	287	12.3	264	12.8	296	15.3	282	13.9	239	12.5
120-129	494	21.2	459	22.2	551	28.5	455	22.5	477	25
130-139	716	30.7	629	30.5	495	25.6	533	26.3	554	29
140-159	672	28.8	593	28.7	468	24.2	616	30.4	537	28.1
160-179	136	5.8	104	5	104	5.4	111	5.5	89	4.7
≥ 180	25	1.1	14	0.7	18	0.9	26	1.3	14	0.7

Figure 10.6.2(a): Systolic BP, 2019-2023

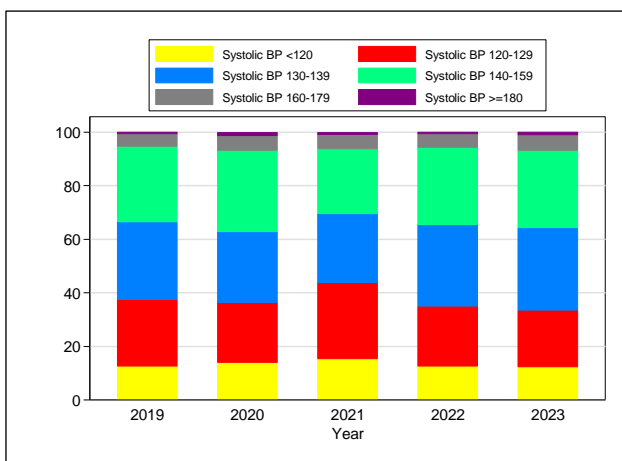


Figure 10.6.2(b): Diastolic BP, 2019-2023

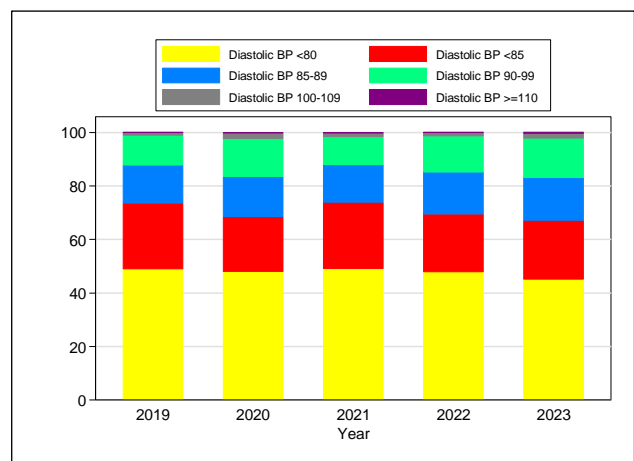


Table 10.6.2(b): Diastolic BP, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<80	1045	45	982	47.9	953	49	973	48	939	48.9
80-84	510	22	442	21.5	482	24.8	415	20.5	472	24.6
85-89	370	15.9	321	15.6	274	14.1	302	14.9	272	14.2
90-99	344	14.8	276	13.5	202	10.4	288	14.2	215	11.2
100-109	41	1.8	27	1.3	30	1.5	42	2.1	22	1.1
>=110	11	0.5	4	0.2	3	0.2	6	0.3	1	0.1

10.6.3: Blood pressure control

The proportion of renal transplant recipients receiving treatment for hypertension has remained consistent over the past 5 years. Approximately three-quarter of renal transplant recipients received treatment for hypertension in 2023, including 38% who required two or more antihypertensive agents. Seven percent of patients had a systolic blood pressure of ≥ 160 mmHg and 17% had a diastolic blood pressure of ≥ 90 mmHg despite being on treatment.

Table 10.6.3(a): Treatment for hypertension, 2019-2023

Year	n	% on anti-hypertensives	% on 1 antihypertensive drug	% on 2 antihypertensives	% on 3 antihypertensives
2019	1945	73	32	27	11
2020	2054	74	34	29	9
2021	1976	77	34	30	11
2022	2084	77	35	30	10
2023	2361	73	34	28	10

Table 10.6.3(b): Distribution of systolic BP without antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 160 mmHg
2019	517	131.1	15.6	130	121.3	139.9	4
2020	530	130.8	16.3	129	120	139	5
2021	437	128.9	15.6	127	119	136.3	5
2022	482	131	16	130	121	139.3	5
2023	631	132.3	15.1	132.3	122.3	140	5

Table 10.6.3(c): Distribution of diastolic BP without antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 90 mmHg
2019	517	79.3	8.9	79.8	73	85	12
2020	530	79.6	9.7	80	72.5	86.3	15
2021	437	79.3	9.1	80	73.3	85.3	10
2022	482	80.2	9.8	80	74	87	16
2023	631	80.4	10	80.3	74	87	18

Table 10.6.3(d): Distribution of systolic BP on antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2019	1413	136.1	14	135	127	144.3	6
2020	1518	137.6	15.2	136.7	128	146.8	7
2021	1519	135.5	15.1	134	125.3	144	7
2022	1594	136.8	14	135.6	127.8	145	6
2023	1728	137.4	15	135.5	128	145.3	7

Table 10.6.3(e): Distribution of diastolic BP on antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 90 mmHg
2019	1413	79.5	9.2	80	73.8	85.3	13
2020	1518	80.3	10	80.3	74	87	17
2021	1519	79.8	9.4	80	74	85.5	13
2022	1594	80.2	9.5	80.6	74	86.3	15
2023	1728	81	9.7	81	74.9	87.3	17

10.6.4: Allograft function

Prevalence of CKD in renal transplant recipients according to CKD stage over the last 5 years was similar. In 2023, 35.5% had CKD stage III and 7.7 % had CKD stage IV and above.

Table 10.6.4: CKD stages, 2019-2023

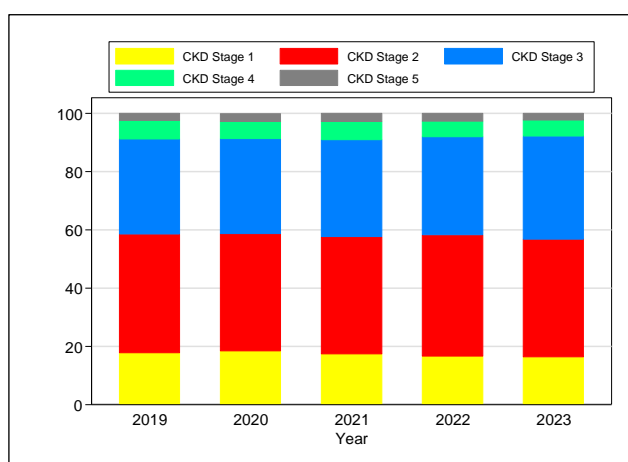
Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Stage 1	390	16.5	353	16.9	338	17.1	372	18.2	335	17.3
Stage 2	949	40.2	848	40.7	804	40.8	833	40.7	801	41.3
Stage 3	838	35.5	704	33.7	651	33	660	32.2	631	32.5
Stage 4	130	5.5	124	5.9	120	6.1	125	6.1	131	6.8
Stage 5	52	2.2	57	2.7	59	3	59	2.9	41	2.1

$eGFR (ml/min/1.73m^2) = 41.3 * (height (cm) / 100) / (Creatinine in umol/L) / 88.4$ if age < 18

CKD-EPI Creatinine Equation (2021) is used if age ≥ 18

CKD stage I-GFR, 90-130 CKD stage II-GFR, 60-90 CKD stage III-GFR, 30-60 CKD stage IV-GFR, 15-30 CKD stage V-GFR, <15

Figure 10.6.4: CKD stages by year



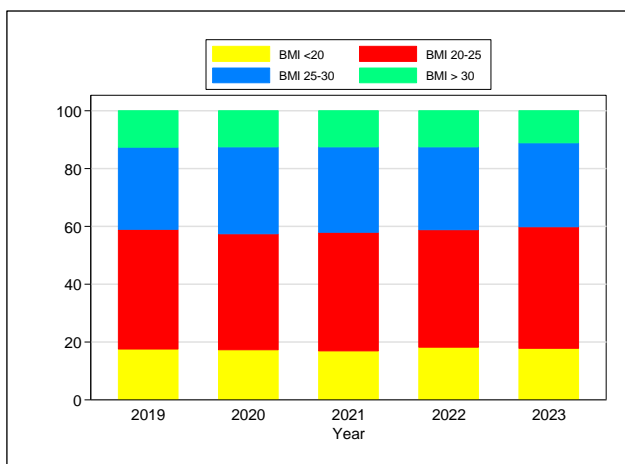
10.6.5: Body mass index (BMI)

The body mass index (BMI) of renal transplant recipients in the recent 5 years remains static. In 2023, more than a third were overweight and 10.9% were obese.

Table 10.6.5: BMI, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<20	315	17.5	287	18.6	244	16.9	283	17.2	264	17.4
20-25	764	42.5	628	40.8	587	40.8	669	40.6	616	40.7
25-30	522	29	426	27.7	427	29.7	495	30	440	29.1
> 30	196	10.9	198	12.9	182	12.6	202	12.2	193	12.8

Figure 10.6.5: BMI, 2019-2023



10.6.6: LDL cholesterol

The latest data reveals a concerning trend in the lipid profile of renal transplant recipients, with a worsening of lipid parameters between 2019 and 2023. In 2023, 62.1% of these recipients had LDL ≥ 2.6mmol/L, while 11.4% had total cholesterol >6.2mmol/L and 5.6% had HDL <1mmol/L.

Table 10.6.6(a): LDL, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
< 2.6	897	37.9	724	34.7	850	43	851	41.4	686	35.3
2.6-3.4	990	41.8	883	42.3	721	36.5	800	38.9	940	48.3
>= 3.4	481	20.3	481	23	405	20.5	403	19.6	319	16.4

Table 10.6.6(b): Total cholesterol, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<4.1	335	14.1	292	14	346	17.5	351	17.1	287	14.8
4.1-5.1	1123	47.4	924	44.3	848	42.9	874	42.6	973	50
5.1-6.2	642	27.1	602	28.8	548	27.7	565	27.5	461	23.7
6.2- 7.2	198	8.4	198	9.5	178	9	192	9.3	163	8.4
> 7.2	70	3	72	3.4	56	2.8	72	3.5	61	3.1

Table 10.6.6(c): HDL, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<1	132	5.6	119	5.7	124	6.3	118	5.7	134	6.9
1-1.3	533	22.5	562	26.9	503	25.5	483	23.5	434	22.3
>1.3	1703	71.9	1407	67.4	1349	68.3	1453	70.7	1377	70.8

Figure 10.6.6(a): LDL, 2019-2023

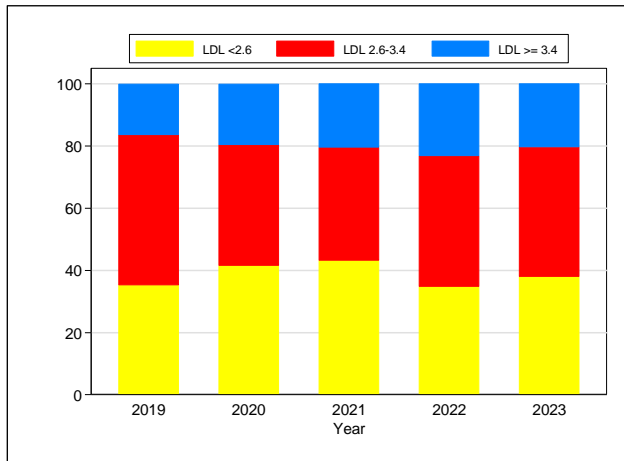


Figure 10.6.6(b): Total cholesterol, 2019-2023

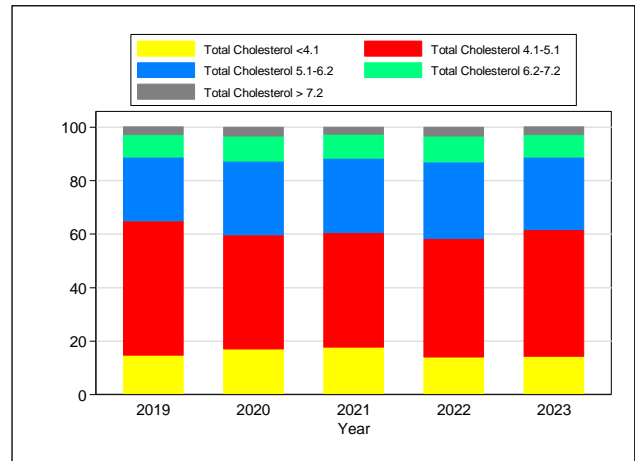
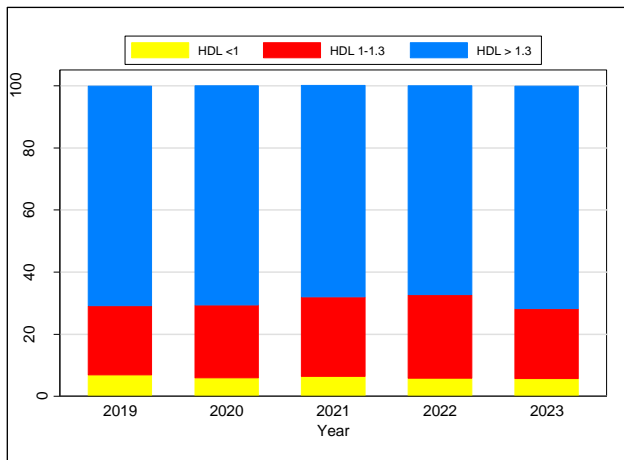


Figure 10.6.6(c): HDL, 2019-2023



SECTION 10.7: QOL INDEX SCORE IN KIDNEY TRANSPLANT RECIPIENTS

The Spitzer QoL index scores of 1165 kidney transplant recipients, who underwent transplantation between 2014 and 2023, were high. At least 95% of all kidney transplant recipients reported QoL index score of 10 (Table & Figure 10.7.1). Further analysis revealed no significant differences in QoL index scores between diabetics and non-diabetics (Table & Figure 10.7.2), gender (Table & Figure 10.7.3), or age groups (Table & Figure 10.7.4). Kidney transplant recipients aged 60 years old and above had the same median QoL index score of 10 as their younger counterparts. Importantly, the excellent QoL index scores have remained consistent over the last decade (Table & Figure 10.7.5).

Table 10.7.1: Cumulative distribution of QoL-Index score of all kidney transplant recipients 2014-2023

Dialysis modality	QoL score
Number of patients	1165
Centile	
0	0
0.05	9
0.1	10
0.25 (LQ)	10
0.5 (median)	10
0.75 (UQ)	10
0.9	10
0.95	10
1	10

Table 10.7.2: Cumulative distribution of QoL-Index score stratified to diabetes mellitus status among kidney transplant recipients 2014-2023

Diabetes mellitus	No	Yes
Number of patients	1103	62
Centile		
0	0	0
0.05	9	9
0.1	10	10
0.25 (LQ)	10	10
0.5 (median)	10	10
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 10.7.1: Cumulative distribution of QoL-Index score of all kidney transplant recipients 2014-2023

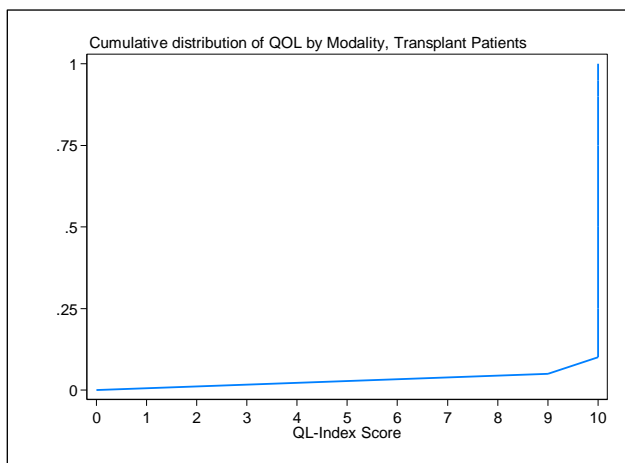


Figure 10.7.2: Cumulative distribution of QoL-Index score stratified to diabetes mellitus status among kidney transplant recipients 2014-2023

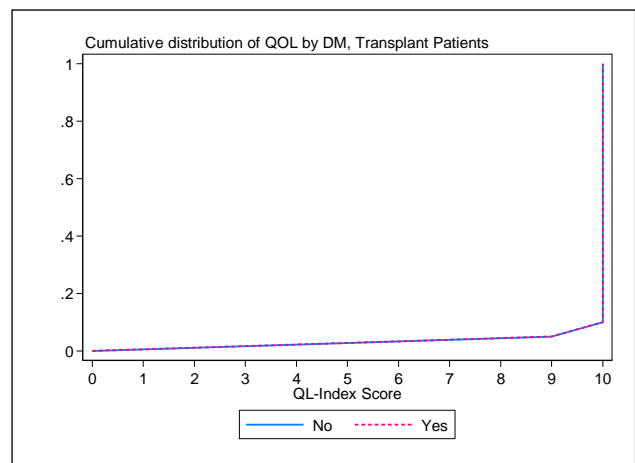


Table 10.7.3: Cumulative distribution of QoL-Index score stratified to gender among kidney transplant recipients 2014-2023

Gender	Male	Female
Number of patients	677	488
Centile		
0	0	0
0.05	10	9
0.1	10	10
0.25 (LQ)	10	10
0.5 (median)	10	10
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 10.7.3: Cumulative distribution of QoL-Index score stratified to gender among kidney transplant recipients 2014-2023

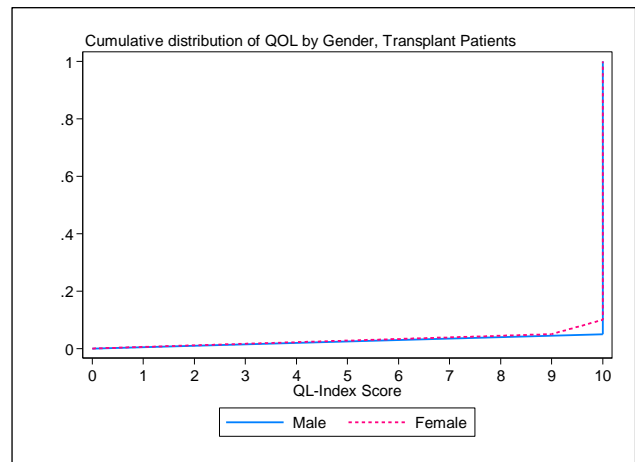


Table 10.7.4: Cumulative distribution of QoL-Index score stratified to age groups among kidney transplant recipients 2014-2023

Age group (years)	<20	20-39	40-59	>=60
Number of patients	58	583	448	76
Centile				
0	0	0	0	0
0.05	7	10	9	8
0.1	9	10	10	9
0.5 (median)	10	10	10	10
0.75 (UQ)	10	10	10	10
0.9	10	10	10	10
0.95	10	10	10	10
1	10	10	10	10

Figure 10.7.4: Cumulative distribution of QoL-Index score stratified to age groups among kidney transplant recipients 2014-2023

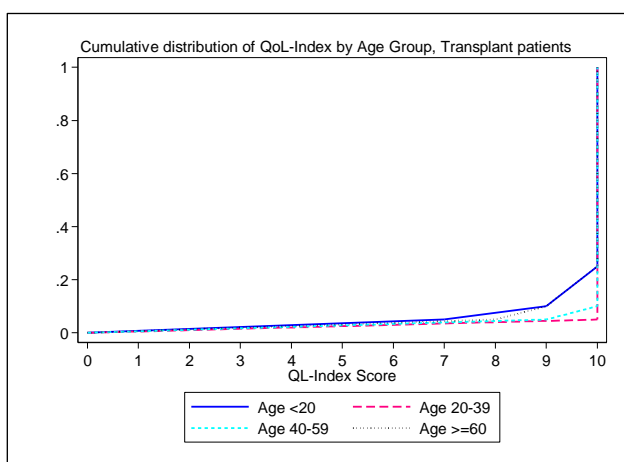
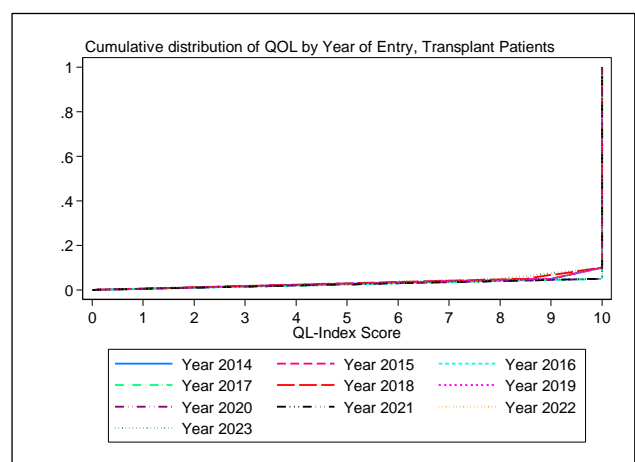


Figure 10.7.5: Cumulative distribution of QoL-Index score stratified to year of entry among kidney transplant recipients 2014-2023



SECTION 10.8: DONOR PROFILE

Total of 621 living kidney donation occurred from 2017 to 2023 (Table 10.8.1). Annual number of living kidney donors in Malaysia increased over the period 2017-2023. Highest recorded number of living kidney donors annually was in year 2023 (n = 164). From 2017 to 2023, living donors are predominantly female (n = 382, 61.5%).

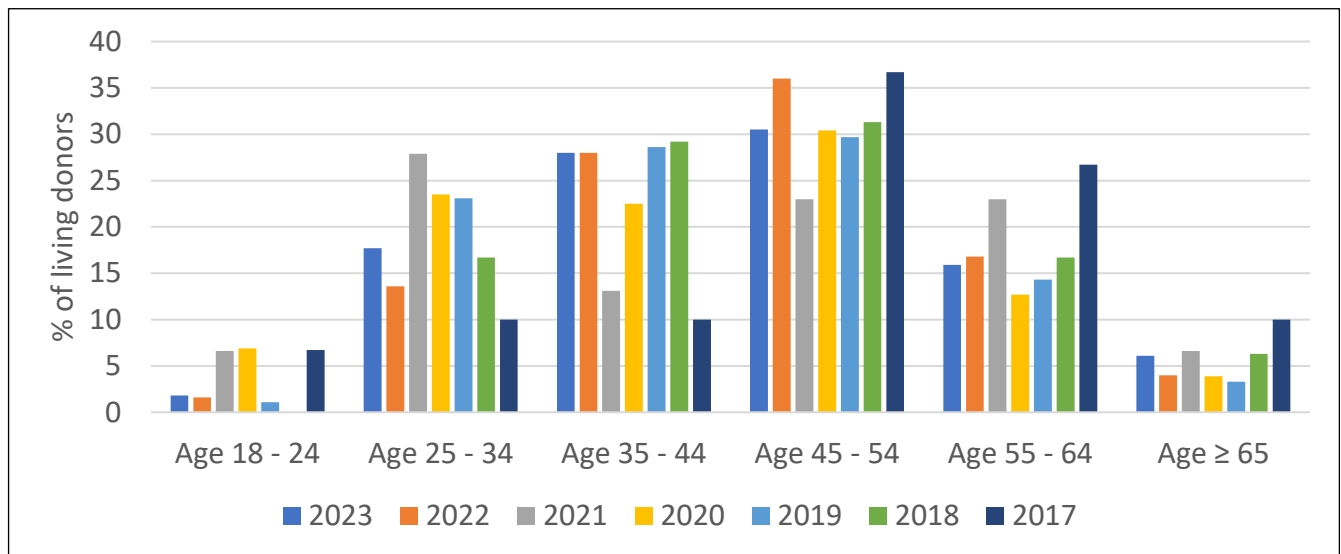
In 2023, the mean age of living kidney donors is 45.2 years old, and 19.5% of living kidney donors were aged 18-34 years old. Ten elderly persons (age ≥ 65 years old) donated their kidneys in 2023, representing 6.1% of all living kidney donors that year. The trend for donor age remains consistent throughout the period 2017- 2023. Living kidney donation trend across different ethnicities in Malaysia is stable from year 2017-2023.

Table 10.8.1: Living Donors of transplants done within Malaysia, 2017-2023

Year of Entry	2023		2022		2021		2020		2019		2018		2017	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Number	164		125		61		102		91		48		30	
Gender														
Male	56	34.1	47	37.6	29	47.5	44	43.1	34	37.4	22	45.8	7	23.3
Female	108	65.9	78	62.4	32	52.5	58	56.9	57	62.6	26	54.2	23	76.7
Age at Donation														
Age 18 - 24	3	1.8	2	1.6	4	6.6	7	6.9	1	1.1	0	0.0	2	6.7
Age 25 - 34	29	17.7	17	13.6	17	27.9	24	23.5	21	23.1	8	16.7	3	10.0
Age 35 - 44	46	28.0	35	28.0	8	13.1	23	22.5	26	28.6	14	29.2	3	10.0
Age 45 - 54	50	30.5	45	36.0	14	23.0	31	30.4	27	29.7	15	31.3	11	36.7
Age 55 - 64	26	15.9	21	16.8	14	23.0	13	12.7	13	14.3	8	16.7	8	26.7
Age ≥ 65	10	6.1	5	4.0	4	6.6	4	3.9	3	3.3	3	6.3	3	10
Mean age (years)	45.2		46		44.3		42.6		43.5		45.2		49.5	
SD	11.2		10.5		13.4		12		11		10.6		13.2	
Median age (years)	45		47		45		43.5		44		45.5		51.5	
Min	23		23		21		21		24		25		20	
Max	71		70		73		70		67		67		74	
Ethnicity														
Malay	85	51.8	68	54.4	31	50.8	55	53.9	51	56.0	24	50.0	16	53.3
Chinese	66	40.2	39	31.2	25	41.0	34	33.3	26	28.6	21	43.8	12	40.0
Indian	9	5.5	13	10.4	5	8.2	8	7.8	6	6.6	3	6.3	2	6.7
Bumiputra Sabah	0	0.0	3	2.4	0	0.0	3	2.9	5	5.5	0	0.0	0	0.0
Bumiputra Sarawak	3	1.8	2	1.6	0	0.0	1	1.0	2	2.2	0	0.0	0	0.0
Other Malaysian	1	0.6	0	0.0	0	0.0	1	1.0	1	1.1	0	0.0	0	0.0

**None of the donors have passed away or progressed to end-stage kidney disease (ESKD), as of December 31, 2023. (Based on the presence of the donor's IC in the MDTR database.)*

Figure 10.8.1: Age distribution among living donors, 2017 to 2023



Malay is the predominant ethnicity among living kidney donors, representing 50.0% - 56.0% of all living donors each year. Living donor among Chinese ranges 28.6% to 43.8%, which is a higher percentage in comparison to population distribution in Malaysia. Based on the statistics in 2023, Chinese constitutes 22-23% of the Malaysian population. Percentage of Indian living donors ranges between 5.5 to 10.8% with an average of 7.4% per year which commensurate with the Indian population distribution. Living donors among Bumiputra Sabah and Sarawak were extremely low suggesting access to living donor kidney transplantation is low in these areas.