

SOLITARY FUNCTIONING KIDNEY: THE HUMAN MODEL OF HYPERFILTRATION INJURY

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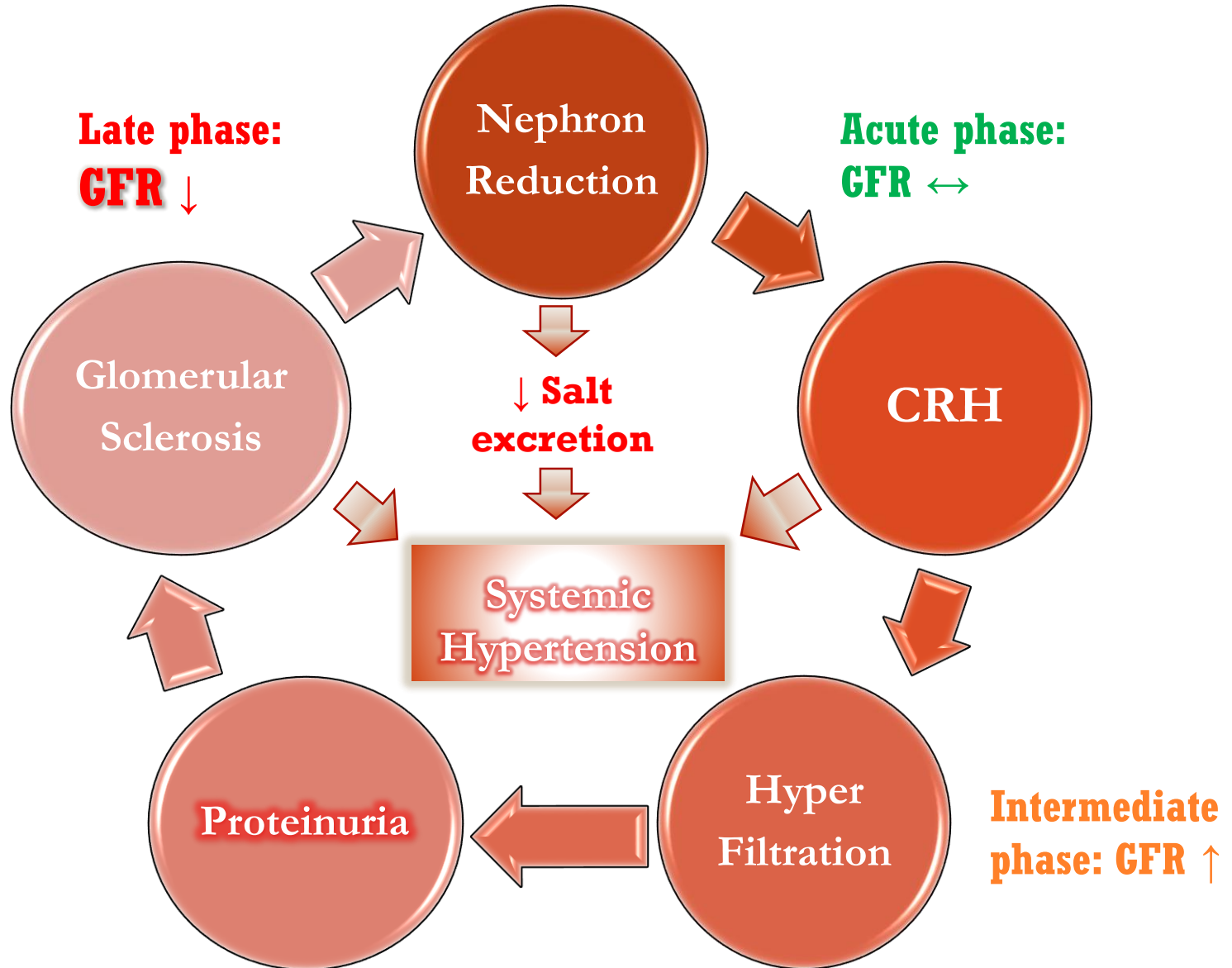
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THE HYPERFILTRATION INJURY THEORY



CRH: compensatory renal hypertrophy;
GFR: glomerular filtration rate

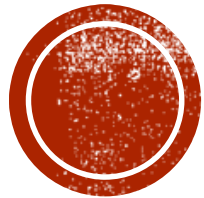


EXAMPLES OF NEPHRON REDUCTION IN HUMANS

<u>Congenital anomalies</u>	Congenital solitary functioning kidney (URA or MCDK)
	Oligomeganephronia
	Renal Hypoplasia
<u>Acquired causes</u>	Nephrectomy: <ul style="list-style-type: none">✓ Tumor;✓ Living kidney donation;✓ Complicated uropathy;
	Renal vein thrombosis
	Renal scarring (infection, inflammation, ischemia)
	Trauma
	Kidney transplantation

URA: unilateral renal agenesis; MCDK: multicystic dysplastic kidney

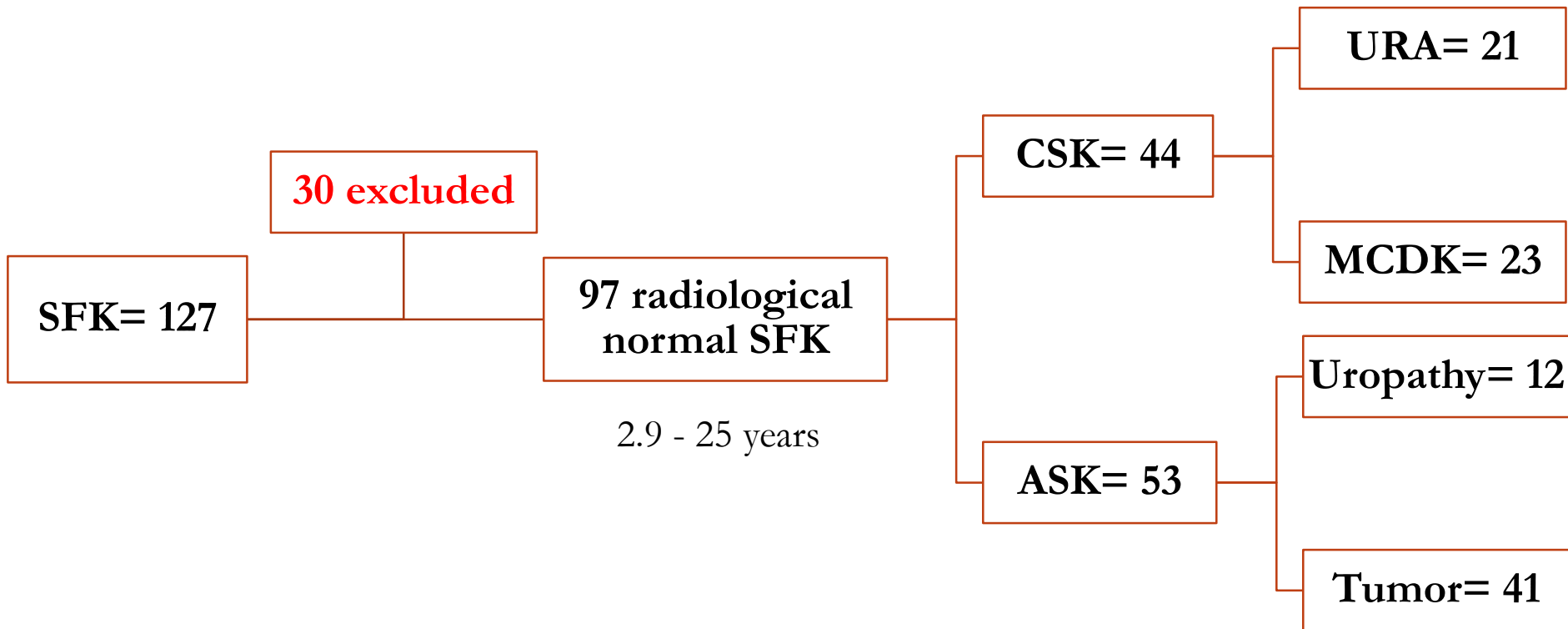




SOLITARY FUNCTIONING KIDNEY IN CHILDREN

A harmless or potentially harmful condition?

STUDY POPULATION: 1991 - 2008



Abou Jaoudé P, et al. *Nephrol Dial Transplant* 2010

SFK: solitary functioning kidney; CSK: congenital solitary kidney; ASK: acquired solitary kidney; URA: unilateral renal agenesis; MCDK: multicystic dysplastic kidney;



METHODS:

Data collected from last functional assessment;

▪ Blood Pressure (BP):

Mean value of three consecutive readings in resting state, compared with BP standards based on gender, age and height.

➤ **Hypertension:**

- ✓ Systolic and/or diastolic BP \geq 95th percentile for age, sex and height;
Task force fourth report. *Pediatrics* 2004
- ✓ Use of antihypertensive drugs.

▪ Glomerular filtration rate (GFR):

Determined by Inulin clearance (continuous infusion technique);

- Normal GFR \geq 80 mL/min/1.73 m² BSA.



METHODS (2):

▪ Microalbuminuria:

Measured by immunoturbidometry in a second voided morning urine sample, expressed as urinary albumin-to-creatinine ratio (alb/crea)

➤ Normal alb/crea ≤ 2 mg/mmol;

Gibb DM, et al. *Pediatr Nephrol* 1989

▪ Kidney ultrasound:

Available data on renal length not reliable for analyse.



RESULTS: PATIENTS' CHARACTERISTICS

Table 2. Patient clinical and functional characteristics

	SK	CSK	ASK	P (CSK vs. ASK)
<i>n</i>	97	44	53	
Gender (male/female)	54/43	30/14	24/29	0.02
Age (years)	10.3 ± 4.3	8.3 ± 3.2	12.0 ± 4.5	<0.001
Follow-up time ^a (years)	8.7 ± 3.9	8.3 ± 3.2	9.1 ± 4.4	NS
Height (SDS)	0.3 ± 1.5	0.5 ± 1.1	0.2 ± 1.7	NS
BMI (percentile)	57.5 ± 31.7	58.8 ± 30.5	56.4 ± 33.0	NS
Systolic BP (percentile)	43.4 ± 27.9	41.9 ± 28.7	44.6 ± 27.4	NS
Diastolic BP (percentile)	57.8 ± 25.4	57.8 ± 25.8	57.8 ± 25.4	NS
GFR (mL/min/1.73 m ²)	100.6 ± 15.0	107.2 ± 13.4	95.2 ± 14.1	<0.001
Alb/crea (mg/mmol)	2.3 ± 4.6	1.8 ± 1.7	2.8 ± 6.0	NS



RESULTS (2): RENAL DYSFUNCTION

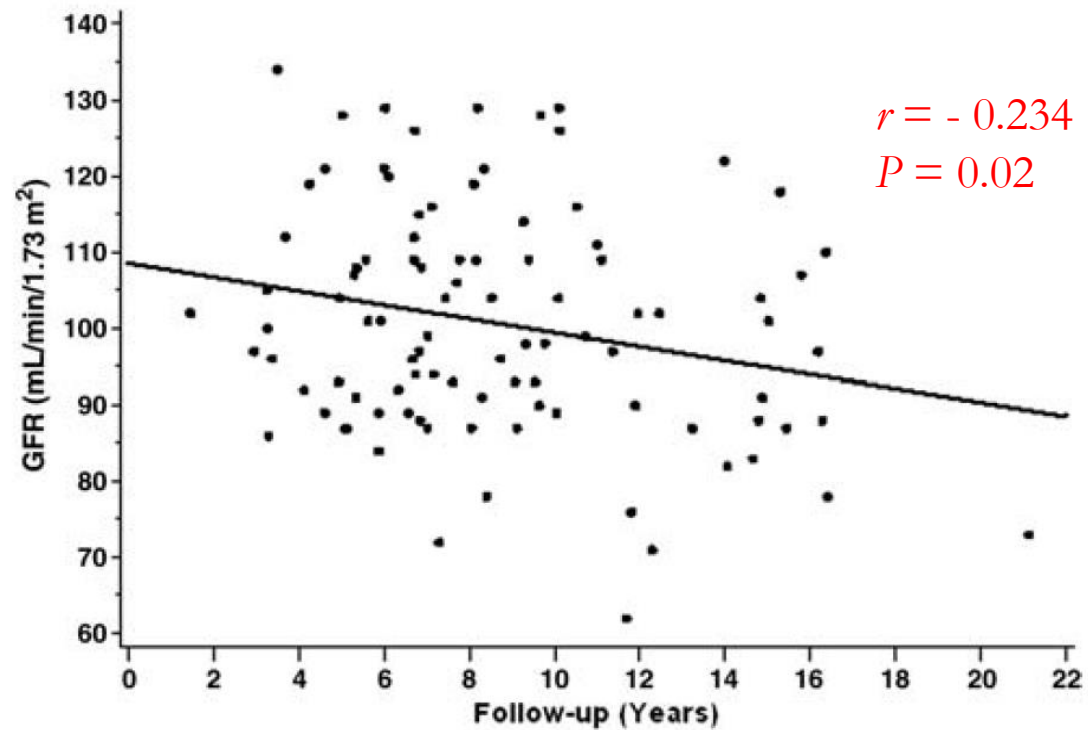
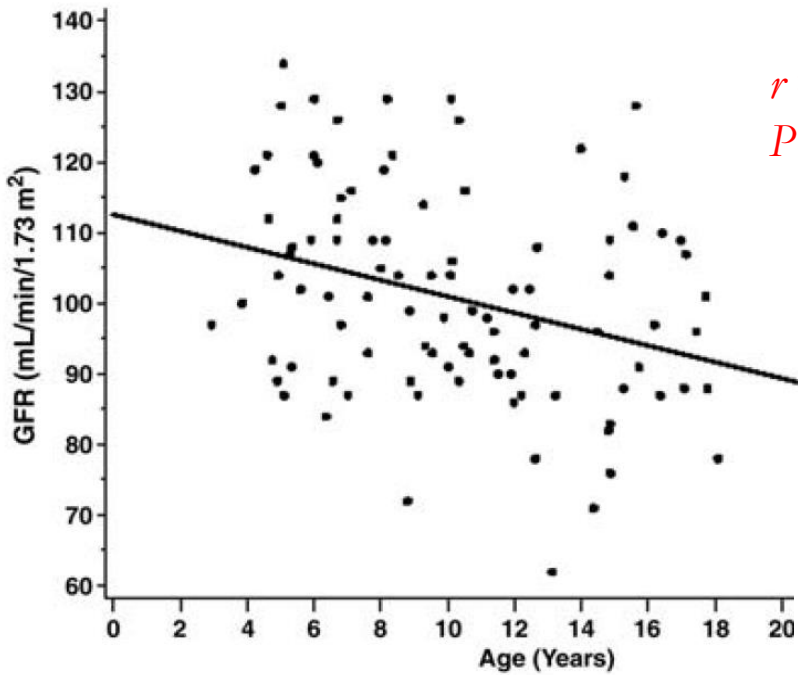
Table 3. Hypertension, microalbuminuria and renal impairment in children with solitary kidney

	<u>SK</u>	<u>CSK</u>	<u>ASK</u>	P
<i>n</i>	97	44	53	(CSK vs. ASK)
Hypertension ^a	2	1	1	NS
Alb/crea >2 mg/mmol	17	8	9	NS
GFR <80 mL/min/1.73 m ²	7	0	7	0.02
Total anomalies ^b	21	9	12	NS

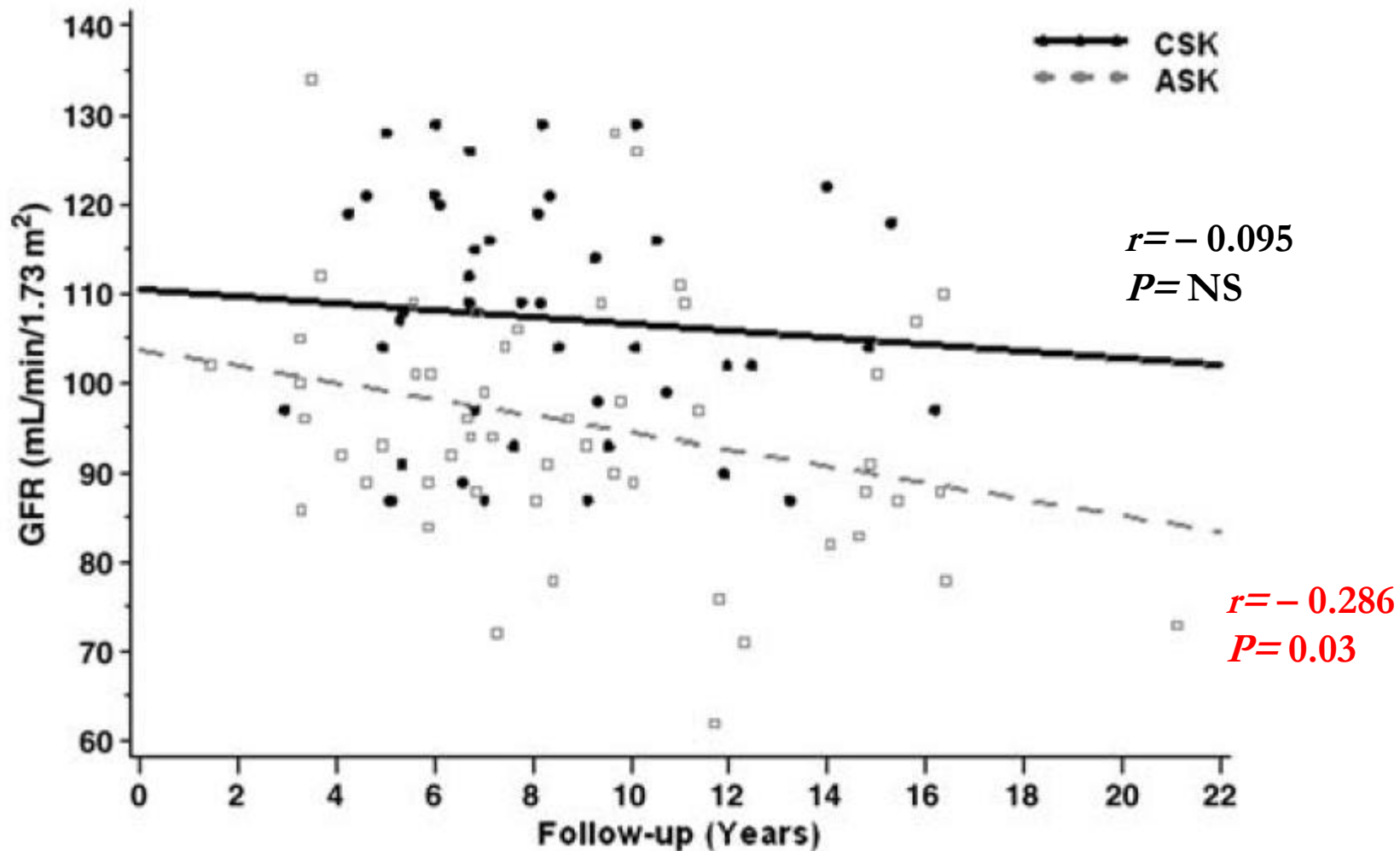
^a confirmed by means of 24-hour ambulatory blood pressure monitoring; ^b any kind of renal injury (hypertension and/or microalbuminuria and/or low GFR)



RESULTS (3): CORRELATIONS



RESULTS (4): CORRELATIONS



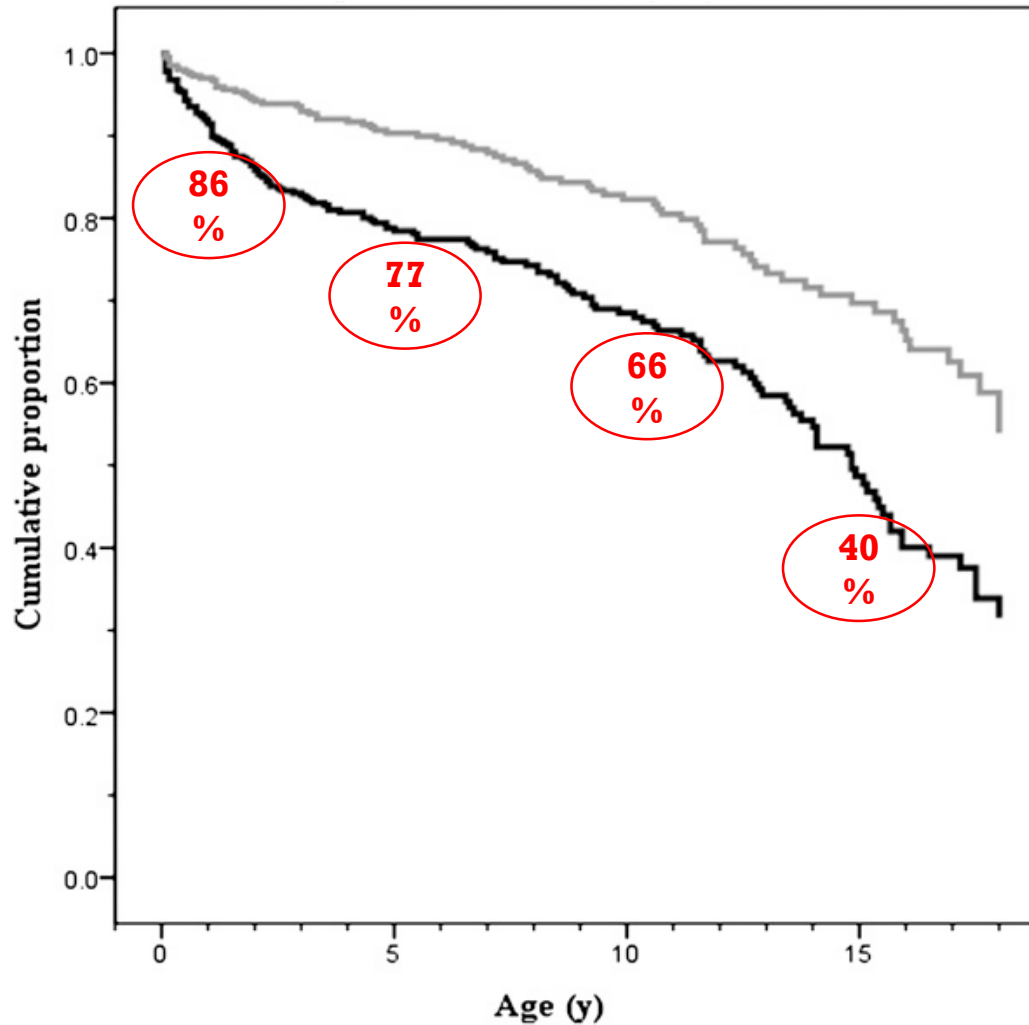
THE KIMONO (KIDNEY OF MONOFUNCTIONAL ORIGIN) STUDY

TABLE 3 Renal Injury According to Type of SFK

Mean age of 6.4 years	SFK (<i>N</i> = 407)	Congenital-SFK Group (<i>n</i> = 223)	Acquired-SFK Group (<i>n</i> = 184)	<i>P</i>
Renal injury	151 (37)	68 (31)	83 (45)	.002
Hypertension	107 (26)	49 (22)	58 (32)	.04
Proteinuria	79 (19)	29 (13)	50 (27)	<.001
eGFR <60 mL/min/1.73 m ²	25 (6)	9 (4)	16 (9)	.05
Renoprotective medication	80 (20)	37 (17)	43 (23)	.09

Data are presented as No. of patients (%). *P* values represent differences between congenital SFK and acquired SFK.





Kaplan-Meier curves showing the cumulative proportion to remain free from renal injury (black line) or to remain free from renoprotective medication (gray line) for children with an SFK.



TABLE 4 Univariate Analysis of Risk Factors for Renal Injury in Children With an SFK

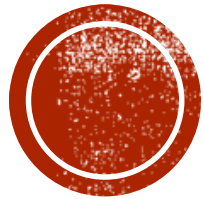
	SFK (N = 357)	
	OR (95% CI)	P
Female sex	0.89 (0.57–1.39)	.89
Age, y	1.10 (1.06–1.14)	<.001
Acquired SFK	1.93 (1.26–2.95)	.002
Ipsilateral CAKUT	1.93 (1.25–2.99)	.003
Left-sided SFK	0.95 (0.62–1.44)	.80
Prenatal diagnosis	0.44 (0.29–0.69)	<.001
Birth weight <2500 g	2.35 (1.17–4.70)	.02
BMI SDS	1.05 (0.90–1.23)	.51
Urinary tract infections	2.04 (1.31–3.20)	.002
Renal length SDS	0.90 (0.82–0.98)	.01



TABLE 5 Multivariate Analysis of Risk Factors for Renal Injury in Children With an SFK

	SFK (N = 357)	
	OR (95% CI)	P
Female sex	0.73 (0.44–1.22)	.23
Age, y	1.09 (1.04–1.13)	<.001
Ipsilateral CAKUT	1.66 (1.02–2.69)	.04
Birth weight <2500 g	2.08 (0.96–4.51)	.07
Urinary tract infections	1.56 (0.94–2.58)	.08
Renal length SDS	0.91 (0.83–1.00)	.04





CONCLUSIONS:

- ✓ Solitary functioning kidney may not always be a benign condition;
- ✓ Confirmed risk of developing renal injury, irrespective of the type of SFK;
- ✓ Careful follow-up warranted throughout childhood;

