



NORMAL RENAL SIZE IN INDIAN CHILDREN - A SONOGRAPHIC STUDY

Radiodiagnosis

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ABSTRACT

INTRODUCTION: Renal size is an important parameter in evaluation of many renal diseases and is essential for diagnostic, prognostic and follow up purposes. Ultrasonography is the easiest way to assess it. Aim of this study was to establish a nomogram of renal sizes for Indian paediatric population.

MATERIALS & METHODS: Sonographic assessment of normal renal dimensions of 200 patients of age < 18 years with no evidence of renal disease and analysis of the data was performed and its dependence on age, gender & laterality was seen.

RESULTS: Overall, mean length of right kidney was 70.09 ± 14.67 mm whereas the mean length for left kidney was 72.44 ± 14.51 mm.

CONCLUSION: Our study provides values of normal renal length and width (Mean + SD) according to the age in Indian children using sonography.

KEYWORDS

Ultrasound, Renal size, Renal length.

INTRODUCTION

The renal size determination is utmost a vital parameter for renal diseases evaluation regarding diagnostic and prognostic purposes. Ultrasonography is the initial investigation of choice for measuring renal size.

There are many studies regarding renal size and its correlation with other somatic parameters in normal western paediatric population^{1,2,3} while only few studies are from Indian subcontinent^{4,5,6,7,8,9}, so it becomes imperative to have more research work on this subject. It would be useful to determine nomograms for our paediatric population using adequate sample size. The present study was undertaken to determine renal size in normal paediatric population i.e from full term newborns upto 18 years.

Ultrasound has shown to have good accuracy as well as inter-observer and intra-observer reproducibility for renal size measurement. There are a lot many fringe benefits of ultrasonography in renal size determination as it is cheap, non-invasive, fast as well as portable and includes neither ionizing radiation exposure nor radiographic magnification and has no contrast related adverse effects.

AIMS AND OBJECTIVES

The rationale for this study, therefore, is to determine the normal renal size in various age brackets of Indian children by means of ultrasonography and correlation of renal size with parameters like age, gender and laterality.

This would facilitate establishment of normal dimensions of kidney size and to appreciate deviations or alternations from normal that occur in an array of renal diseases of children. This study will also aid comparison with values reported in other studies.

MATERIALS & METHODS:

The study included patients from Indian paediatric population with ages ranging from healthy full term newborns upto 18 years, those referred for abdominal sonograms for symptoms unrelated to the urinary tract.

Renal sonograms in 200 children without apparent renal disease were evaluated prospectively i.e. 400 kidneys were examined sonographically.

This study was conducted between May 2019 to November 2019 in the Department of Radio-diagnosis, Maharani Laxmi Bai Medical College, Jhansi, Uttar Pradesh, India.

Informed parental consent was taken in all the patients included in the study.

Renal length and width were measured and correlated with age, gender and laterality, permitting preparation of nomograms.

Patients who were excluded from the study were patients with symptoms suspected for any renal pathology like flank pain/hematuria/ LUTS etc, patients with abnormal renal function tests or abnormal renal sonographic findings, premature infants, children with history of any acute or chronic renal ailment, prior abdominal surgery for urological causes, any metabolic abnormality, or apparent syndromic children.

Sonograms were obtained on a single ultrasound machine (Sono ACE X8) with a real-time mechanical scanner using 3.5MHz curvilinear and 7.5MHz linear transducer in prone, supine and lateral positions and final reading was taken whichever was more.

The criteria for measurement of renal length and width were clearly pre-determined. Renal length was defined as the longest pole to pole measurement while width was defined as the maximum dimension in transverse cross sectional image of the kidney.

Statistical analysis was then performed on the data obtained from these sonograms.

RESULTS:

A total of 400 kidneys were analysed in 200 patients out of which 112 patients were males (56%) and 88 patients were females (44%). The mean age was 8.29 ± 6.35 years ranging from full term newborns upto 18 years. The distribution of age in the study population is shown in Table 1.1.

Table 1.1 : Age distribution of study subjects

Age in years	No.	%
Upto 1 month	14	7.0
1 month-1 year	34	17.0
1-5 years	34	17.0
6-10 years	42	21.0
11-15 years	28	14.0
16-17 years	48	24.0
Total	200	100.0

Overall, mean length of right kidney was 70.09 ± 14.67 mm whereas the mean length for left kidney was 72.44 ± 14.51 mm.

Overall, mean width of right kidney was 29.64 ± 5.49 mm and the mean width of left kidney was 31.45 ± 5.75 mm.

Comparison of parameters between right and left kidney is shown in Table 1.2

Table 1.2 : Comparison of parameters of right kidney with left kidney

	Mean	SD	95% CI for Mean		P value
			Lower Bound	Upper Bound	
Length right kidney (mm)	70.09	14.67	67.90	72.16	<0.01
Length left kidney (mm)	72.44	14.51	70.35	74.48	
Width right kidney (mm)	29.64	5.49	28.94	30.36	<0.01
Width left kidney (mm)	31.45	5.75	30.70	32.26	

In male children, mean length of right kidney was 72.20 ± 13.56 mm whereas mean length of right kidney in female children was 67.41 ± 15.65 mm. Similarly, mean length of left kidney was 74.78 ± 13.42 mm in male children whereas mean length of left kidney in female children was 69.45 ± 15.34 mm.

Comparison of renal parameters between males and females in shown in Table 1.3 and Fig 1a and 1b.

Table 1.3: Association of kidney parameters with gender

	Gender	Mean	SD	95% CI for Mean		P value
				Lower Bound	Upper Bound	
Length right kidney (mm)	Male	72.20	13.56	69.58	74.82	0.03
	Female	67.41	15.65	64.11	70.61	
Width right kidney (mm)	Male	29.88	5.34	28.85	30.83	0.52
	Female	29.32	5.69	28.14	30.58	
Length left kidney (mm)	Male	74.78	13.42	72.31	77.37	0.02
	Female	69.45	15.34	66.15	72.59	
Width left kidney (mm)	Male	31.46	5.59	30.41	32.48	0.91
	Female	31.44	5.97	30.27	32.82	

Figure 1a: Graph showing relation of Right kidney length between male and female children

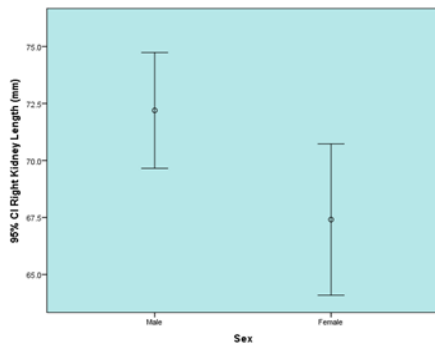
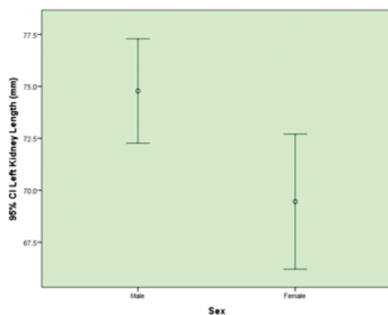


Figure 1b: Graph showing relation of Left kidney length between male and female children



Significant difference was noted in renal lengths of right and left kidneys (p value: < 0.01) and also in renal widths of right and left kidneys. (p value : <0.01)

Significant gender differences were obtained for renal lengths but not for renal widths (For right renal length, p value= < 0.03; For left renal length, p value= < 0.02; For right renal width p value= 0.52; For left renal width p value=0.91)

Table 1.4 : Association of kidney parameters with age

		Mean	SD	95% Confidence Interval for Mean		P value
				Lower Bound	Upper Bound	
				Length right kidney (mm)	Upto 1 month	
1 month-1 year	52.76	6.243	50.59		54.94	
1-5 years	64.85	7.308	62.30		67.40	
6-10 years	74.88	7.412	72.57		77.19	
11-15 years	75.64	8.512	72.34		78.94	
16-17 years	85.67	7.247	83.56		87.77	
Width right kidney (mm)	Upto 1 month	24.57	3.817	22.37	26.78	<0.001
	1 month-1 year	25.71	3.681	24.42	26.99	
	1-5 years	27.32	3.723	26.02	28.62	
	6-10 years	31.02	5.177	29.41	32.64	
	11-15 years	29.96	4.168	28.35	31.58	
	16-17 years	34.13	5.106	32.64	35.61	
Length left kidney (mm)	Upto 1 month	49.00	6.202	45.42	52.58	<0.001
	1 month-1 year	55.06	7.006	52.61	57.50	
	1-5 years	67.79	7.256	65.26	70.33	
	6-10 years	76.79	6.752	74.68	78.89	
	11-15 years	78.61	8.816	75.19	82.03	
	16-17 years	87.46	7.543	85.27	89.65	
Width left kidney (mm)	Upto 1 month	26.43	3.345	24.50	28.36	<0.001
	1 month-1 year	27.53	5.506	25.61	29.45	
	1-5 years	29.32	4.524	27.74	30.90	
	6-10 years	33.00	5.495	31.29	34.71	
	11-15 years	31.43	4.255	29.78	33.08	
	16-17 years	35.85	4.552	34.53	37.18	

Correlation between renal length and age was assessed by Pearson's correlation coefficient (r) and value of 0.87 was obtained for both the kidneys suggesting a moderate positive correlation of renal length with age. Correlation between renal width and age was also assessed and a correlation coefficient (r) of 0.64 for right kidney and 0.61 for left kidney was obtained suggesting a mild positive correlation of renal width with age. Renal parameters in all the age groups are shown in Table 1.4 and correlation between age and length of Right kidney and Left kidney are shown in Fig 2a and 2b respectively.

Figure 2a: Correlation between age and length of Right kidney

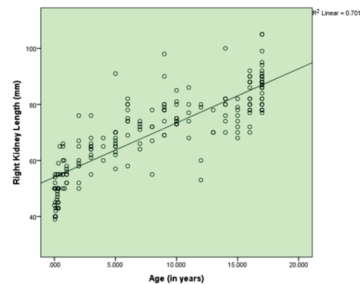
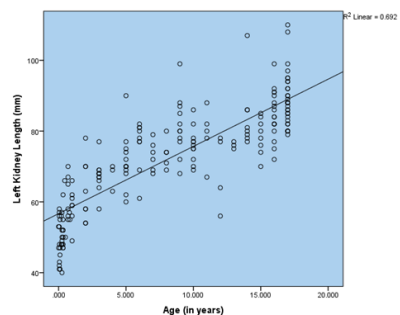


Figure 2b: Correlation between age and length of Left kidney



DISCUSSION:

Before ultrasound was used for measuring renal size, Hodson et al. ¹⁴ in 1962, reported the renal size of 393 children based on excretory urography and presented a graph of renal length vs. age. The potential of renal sonography in children was outlined by Lyons et al. in 1972 ¹¹ and was further established by subsequent reports ^{12,13}. In contrast to

radiographic techniques, ultrasound has no magnification, no contrast related adverse effects and no exposure to ionising radiation. It is the safest and simplest way to assess renal size in children as it also well tolerated by children. CT and MRI provide possibility of more reliable assessment of renal size and volume. Despite this, sonographic renal size estimation remains popular due to its availability, ease of performance, cost effectiveness, portability, repeatability and without any administration of contrast or ionizing radiation.

In our study, we chose to compare renal size in children with age as it is the easiest and most practical approach. Many studies also included other somatic variables like height, weight, body surface area etc.

In our study, renal size correlated positively with the age of the patient. For both the kidneys we obtained a correlation coefficient (r) of 0.87 for renal lengths suggesting moderately positive correlation with age. Similarly for renal widths correlation coefficient (r) of 0.64 for right kidney and 0.61 for left kidney with age suggesting positive correlation. Using ANOVA and Posthoc test, p -value was obtained among all the age groups and significant increment in renal length and width was noted upto 6 years of age thereafter it was noted that only a slight increment is there in renal length and width upto 15years thereafter which a mean renal length of 85.67 ± 7.24 mm for right kidney (Range: 75mm-124mm) and 87.46 ± 7.54 mm for left kidney (Range : 77mm- 125mm) was obtained in 16-17 years age group.

On sonography, the renal length in Indian children was less as compared to the children in America with respect to age, probably due to the larger body parameters of their American counterparts.³

This difference would have been less apparent had we compared renal sizes with height, weight or BSA of the children.

Like most of the studies^{5,8,15} we found out that the left renal length was longer than the right with a statistical significance (p value < 0.01) unlike studies which showed no difference in size between left and right kidneys⁹. This difference in laterality of renal length was noted regardless of sex and age. In our study left renal width also came out to be more than the right renal width. (p value < 0.01)

Similarly, like few studies^{7,24} we also noted renal length was more in male children as compared to female children with a statistical difference (p value < 0.03 for right kidney and p value < 0.02 for left kidney) unlike some studies which showed no significant gender variations^{5,8,9}. No significant difference (p value- 0.52 for right kidney and p value - 0.91 for the left kidney) was noted in renal width between males and female patients.

Limitations of our study were: Subjects included were patients with non-renal diseases and not healthy children and thus we need to have data for renal nomograms in healthy Indian children. Inter-observer variation occurred in our study and it needs to be considered however intra-observer variation was minimised by taking multiple readings for a patient¹⁰. Our data was collected from a single hospital in India and our present sample population is small and we need to have a study for renal nomograms across the country with large sample size to extrapolate the data for future use. We did not include other somatic variables like height, weight, BMI, BSA, etc in our study and therefore a more detailed study is needed to correlate these parameters with renal size in Indian children.

CONCLUSION:

The renal size norms developed by this study provides normal kidney size range for Indian children according to age. It provides values of normal renal length and width (Mean + SD) in Indian children. Kidney size as measured by ultrasonography is a simple, quick, practical and quite accurate way which is widely accepted to monitor renal size & growth routinely and as a key tool in analysing renal length in number of clinical conditions which affects renal size.

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