Original Article

Average Kidney Size in Local Pediatric Population by Ultrasonography

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ABSTRACT

Objective: To determine the average renal size in local pediatric population by ultrasonography.
Study Design: Cross- sectional, descriptive study
Place and Duration of Study: This study was conducted at the Department of Radiology, Kuwait Teaching Hospital, Peshawar, over a 6 months period from 1st July 2024 to 31 December 2024.
Methods: Total 217 patients were included. The sample size was calculated using WHO calculator, for mean and SD of renal length =6.7cm+/-0.6, absolute precision is 8%, relative precision is 0.011% and confidence level is 95%.
Results: Mean and SD for age was recorded as 7.76±1.93 years. Mean and SD for kidney length was recorded as 8.64±0.96 cm and for renal width, Mean and SD was recorded as 3.4±0.12 cm. The frequency of male pediatric patients were recorded as 111 (51.15%), and female patients were 106 (48.84%).
Conclusions: Age did not significantly affect renal width or length. When looking at potential renal disease, normal ranges of renal parameters are crucial for comparison.

Key Words: Renal disease, Sonography, Renal length, Kidney, Mean, SD

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INTRODUCTION

In order to evaluate renal disorders for both prognostic and diagnostic purposes, renal size assessment is crucial[1]. About 20–30% of the malformations found during the prenatal period are congenital kidney and urinary system abnormalities. Due to its ease of measurement, kidney length is the most crucial factor. Distinguishing acute insult from chronic renal disease is helpful[2]. Renal length is primarily measured by serial sonography to determine whether the kidneys are growing normally; abnormal renal growth suggests that the kidney may be experiencing recurrent or chronic insults[3]. Due to their undeveloped local defense mechanism, infants under two months old are more likely than older children to get a UTI[4].

Renal growth is tracked in patients with chronic issues such vesicoureteric reflux, renal tumor, and recurrent UTIs since many renal illnesses are linked to changes in kidney size. The most crucial quantitative indicator of kidney size for comparison with accepted norms is renal length.

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A significant criterion in the diagnosis of renal disorders is a deviation in renal size from normal values, which indicates a change in normal renal growth[5]. Compared to children born full term, those born preterm with extremely low birth weight (ELBW) have been shown to have smaller kidneys[6].

Ultrasonography is widely used to determine the interior structures of the body because the examination is real time, three dimensional and independent of organ function. Without doing surgery, it enables a physician to view inside a patient[7]. The first-line imaging method for a number of pediatric diseases is ultrasound. It is appropriate due to children's often small body habitus and reduced fat percentage. Its reproducibility, absence of ionization, and application of nephrotoxic substances are further benefits. MRIs and CT scans are costly and have restrictions for children. Compared to traditional ultrasonography, CEUS, a supplementary ultrasound technology, has several benefits[8].

Because ultrasonography is readily available and non-invasive, it has become the standard imaging modality in the study of renal disorders. It provides great anatomical details, doesn't expose the patient to radiation or contrast chemicals, is easily accessible, and doesn't require any specific patient preparation[9].

Ultrasound is also valuable in assessment of solitary functioning kidney (SFK) which can result from unilateral Multicystic Dyslastic Kidney (MCDK) and unilateral renal agenesis[10].

This study is simple in concept but is powerful in information. Since many conditions affect kidney size like congenital anomalies, urinary tract diseases,

systemic diseases, neoplasia, etc. so to assess any abnormality in kidney size, we need to have knowledge about standardized values for normal renal dimensions. The information available in the west cannot be extrapolated to our population because the kidney size differs in various ethnic groups. The purpose of this study is to establish the standards of kidney size by ultrasonography in healthy local children, as no such study has been done previously and we are lacking local data regarding normal kidney size of our local children. The results of this study will be shared with all health professionals and guidelines will be given regarding necessary modifications in management principles of patients in conditions in which kidney size is affected.

METHODS

This Cross- sectional, descriptive study was carried out at Department of Radiology, Kuwait Teaching Hospital, Peshawar, over a 6 months period (1st July 2024 to 31 December 2024). Total 217 patients were included. The sample size was calculated using WHO calculator, for mean and SD of renal length =6.7cm+/-0.6[1], absolute precision is 8%, relative precision is 0.011% and confidence level is 95%.

Children's aged 05–12-year-old of either gender, visiting Radiology department of Kuwait Teaching Hospital with their parents for repeat radiographs of fractures, or for sonographic evaluation of common conditions like abdominal colic, intussusceptions etc and children accompanying their parents or siblings who are visiting radiology department for x ray were included in the study.

Participants with a history of urologic surgery, upper urinary tract abnormalities, vesicoureteric reflex, cancer, steroids, premature delivery, or kidney abnormalities such as hydronephrosis, dysplastic kidney, or solitary kidney were excluded from the study.

The research and ethics committees gave their approval. Children who met the inclusion criteria and were referred to the KTH radiology department were contacted. All children's parents or other accompanying caregivers provided written, informed consent. Every child's name, age, and gender were entered into a standardized Proforma as baseline data. To the closest whole month, the age was reported.

After collecting the baseline information, the children underwent ultrasonographic assessment of each kidney by standard method stated above. These radiologic examinations carried out by single experience radiologist fellow of CPSP. For a specific child, an average of three readings were obtained. Every piece of information listed above was documented in a pre designed proforma. To prevent bias and confounders from influencing the study's findings, strict exclusion criteria were followed. SPSS version 23.0 was used for the statistical analysis (SPSS Inc., Chicago, IL). For numerical factors such as age and kidney width and length, the mean and standard deviation were computed. For numerical variables like gender, frequency and percentages were computed. To observe its impact alteration, the mean kidney size was stratified by the child's age. Tables and graphs were used to display each result. Statistical significance was defined as a P value of ≤ 0.05.

RESULTS

The Mean ± SD for age was recorded as 7.76±1.93 years. Mean ± SD for kidney length was recorded as 8.64±0.96 cm and for renal width, Mean ± SD was recorded as 3.4±0.12 cm. Table -1

The frequency of male pediatric patients were recorded as 111 (51.15%), and females patients were 106 (48.84%) Table-2

Stratification of mean kidney size with respect to age and gender can be seen at Table 3 & 4 respectively.

Table No.1: Descriptive Statistics of Study Variables (n = 217)

Variable	Mean	± SD
Age (years)	7.76	±1.93
Kidney length(cm)	8.64	±0.96
Kidney width(cm)	3.40	±0.12

Table No.2: Gender Distribution

Gender	Frequency	Percentage
Male	111	51.15%
Female	106	48.84%

Table No.3: Stratification of Mean Kidney Size with Respect to Age

Age Group	Mean Length (cm)	Mean Width (cm)	P-Value
5–8 Years	7.80 ± 0.60	3.38 ± 0.13	0.000
9–12 Years	9.47 ± 0.41	3.43 ± 0.11	0.000

Figure No.1: Ultrasound image of a 6year old girl with right renal size of 8.4*2.8 cm (L*W) and left renal size of 8.3*2.7cm (L*W)

Table No.4: Stratification of Mean Kidney Size with Respect to Gender

Gender	Mean Length (cm)	Mean Width (cm)	P-Value
Male	8.61 ± 0.98	3.42 ± 0.12	0.000
Female	8.67 ± 0.94	3.39 ± 0.12	0.000

Figure No.2: Ultrasound image of a 8year old boy with right kidney size of 6.8*2.9cm (L*W) and left renal size of 7.2*2.7cm (L*W)

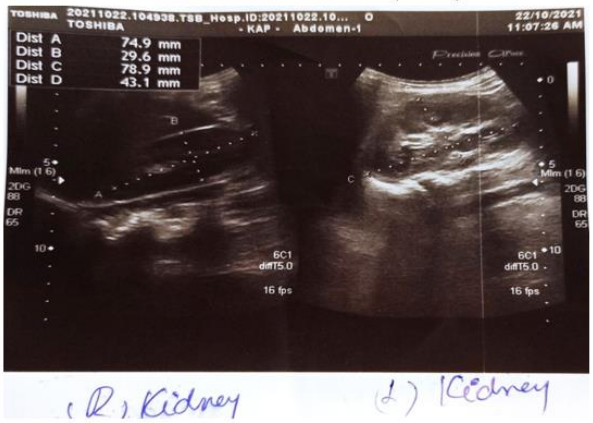

Figure No.3: Ultrasound image of a 10year old boy with right renal size of 7.5*2.9cm(L*W) and left renal size of 7.9*4.3cm(L*W)

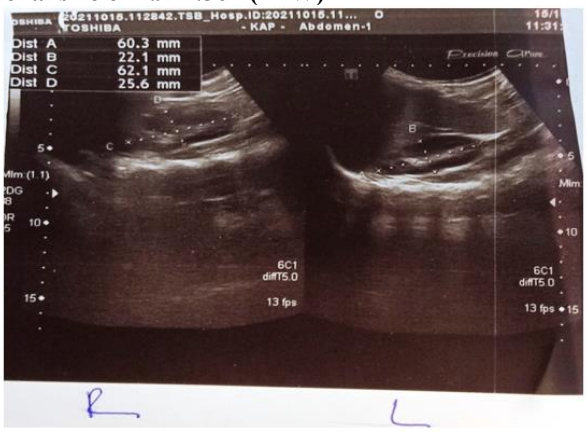

Figure No.4: Ultrasound image of a 5 year old girl with right renal size of 6.2*2.5cm(L*W) and left renal size of 6.0*2.2cm(L*W)

DISCUSSION

The purpose of this study is to use ultrasonography to evaluate the length and width of the kidneys in children aged 5 to 12 and to link these measurements with gender and age. We found that the average renal length was 8.64±0.96 cm and the average renal width was 3.4±0.12 cm. These values are little higher than reported in a local study by Raza et al[11], who reported the mean renal length as 8.2±0.7 cm in the same age group. This difference may be due to regional anthropometric variation or differences in sample size and methods. The sample size of our study (n=217) was relatively larger, as all the scans were performed by a single radiologist thus minimized inter-observer variability.

According to another study by Mittal et al[12] on renal size conducted in India, the length of the kidneys expanded gradually from 4.3cm at one month to 8.6cm at 12 years of age. These results are consistent with the mean renal volume, which rose from 9.7ml at 1 month to 61ml at 12 years.

In our study the mean age was 7.76±1.93 years and the gender was distributed equally (male: 51.15% female: 48.84%). The kidney size stratified by age demonstrated a statistically significant increase in renal length and renal width with age (P=0.000). The latter finding is in line with the results by Mohtasib et al[13], showing a linear increase in renal size with age in a large population of children 0 to 17 years of age. Similarly, Gilarska et al[14] in their study stated that there is a gradual increase in renal size during childhood and adolescence as a result of different growth associated factors which include increase in body surface area and increase in muscle mass.

Gender-stratified data revealed that the mean renal width was greater in males (3.42±0.12 cm vs. 3.39±0.12 cm in females), while the mean renal length was larger in females (8.67±0.94 cm) than in males (8.61±0.98 cm). Both differences were statistically significant (P=0.000). It is debatable, nevertheless, if this slight variation even has any bearing on clinical relevance. According to earlier research, such as Leong et al[15] and Coombs et al[16], there is little to no change in renal size between CRT and non-pecific, including gender. The few variations seen in our study, however, might be the result of sampling variations or other exclusions between anthropometric variables, such as height and weight.

The concordance of our results with the previous literature adds weight to the utility of ultrasound as a non-invasive approach to renal morphology assessment. In addition, the age-dependent enlargement of the kidney recognizes the already described scope of somatic growth[17-19]. On the other hand, the non-significantly differences between genders lead us to the assumption of further study with stratification of the sex

along the height, weight and body surface area which unfortunately were not achieved in the present study.

Strengths of our study include the fact that it was conducted in a relatively large and well defined pediatric sample with strict adherence to exclusion criteria to minimise the risk of confounders and the use of a single experienced radiologist to reduce observer bias. However, the study has some limitations as well. For example, it did not record anthropometric parameters (height, weight, and body surface area), which could have provided more information about kidney size based on more recent morphological evaluation. Additionally, the study only included one center, and the findings might not be generalizable to the pediatric population.

CONCLUSION

Local reference values of renal dimensions in children aged 5–12 years are defined by presenting a statistically significant increase in kidney length and width with age in both genders at this age group, which is less prominent between the genders. The typical renal width (3.40 ± 0.12 cm) and length (8.64 ± 0.96 cm), along with their corresponding means, offer crucial baseline information for evaluating renal size in healthy young populations. This emphasizes the necessity of using age-adjusted metrics in the clinic to differentiate between pathological alteration and normal growth in order to manage renal problems and begin early restaging. Localized reference standards, for instance, lower misdiagnosis, particularly in ethnically diverse settings where extrapolated data from overseas sources might not be as trustworthy.

Recommendations: Further randomized, multi-center studies with extended follow-up are recommended to validate and generalize these findings.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Ambareen Muhammad, Abdul Majid, Zeenat Adil
Drafting or Revising Critically:	Rida Saleem, Aziz Zia
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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