Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 10-14 | ISSN:2251-6727

Correlation of Renal Dimensions with Body Surface Area Among Indian Newborns in A Tertiary Care Hospital

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(Received: 07 October 2023 Revised: 12 November Accepted: 06 December)

KEYWORDS

BSA, Kidney size, Newborns.

ABSTRACT:

Kidney size is crucial for evaluating renal growth and abnormalities clinically. An observational study was performed on 150 newborns in a western India hospital to correlate renal dimensions (length and width via USG) with BSA of newborns. Mean renal lengths were 36.57±4.13mm and 36.944.03mm, and widths were 17.70±2.43mm and 18.41±2.84mm on the right and left sides, respectively. A strong association was observed between BSA and renal length ($p<0.001$) on both sides. Right renal width showed a statistically significant association with BSA, unlike left renal width. A positive yet weak correlation was found between BSA and renal width. In neonatal renal disorders, assessing renal length offers better clinical insights than measuring renal width.

1. Introduction

Renal dimensions are crucial in evaluating kidney disorders, serving as indicators of potential disease, making the establishment of normal reference values essential (1). Kidney size is a vital parameter in clinical evaluations of renal growth and abnormalities such as atrophy, hypoplasia, and hypertrophy in newborns, varying with different anthropometric variables (2).

There are, however, no established reference values for renal dimensions in Indian neonates, and studies conducted on western populations do not cater to the Indian demographic due to ethnic variations and differing renal dimensions (3,4,5,6).

Assessing kidney size can be conducted through various methods like X-ray, USG, CT-scan, MRI, DMSA scan, and IVP (7). For children, USG is preferable, being non-invasive, cost-effective, and safe, eliminating ionizing radiation effects.

Normal reference values, particularly in neonates relative to body surface area, are invaluable for managing neonatal renal disorders (8). Recognizing the clinical relevance of measuring both kidneys is essential, aiding in understanding the progression of renal diseases and interpreting normal renal length with age-related normograms (9).This study aims to establish the correlation between renal length & width and BSA in Indian newborns and develop a relevant equation for their calculation.

2. Materials and Methods

This observational study involved 150 newborns from a teaching hospital in western India, examining babies of 30 to 42 weeks of gestation weighing above 1.5 kg, born either by vaginal delivery or lower segment cesarean section. After receiving institutional ethical committee permission and maternal consent, babies were assessed for kidney size using USG, and cord blood samples were taken post-delivery for serum creatinine levels. Babies were screened on day 2 of life to measure the renal length (maximum cranio-caudal dimension) and width (maximum transverse dimension) of both kidneys using a Siemens Acuson X300 PE ultrasonography machine. The Body Surface Area (BSA) was calculated using the Mosteller formula. ($BSA=\sqrt{height(cm)} \times weight(kg) \div 3600$).

Inclusion Criterion:

- **Baby**

1) Cord Blood serum creatinine < 1mg/dl

2) Not Suffering from any comorbid illness

- **Mother**

1) Serum creatinine level < 1mg/dl in 3rd Trimester
2) Not suffering from any illness during antenatal period like PIH, Diabetes, Hypothyroidism or Hyperthyroidism.
3) All Mothers will be selected irrespective of their gravid status.

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Exclusion Criterion:

- **Baby**

1) All newborns diagnosed to have CAKUT (Congenital anomalies of kidney and Urinary tract).
2) All VLBW & LFD babies.

- **Mother**

1) All mothers with serum creatinine > 1 mg/dl.
2) All mothers suffering from any illness during antenatal period.

Statistical analysis was conducted using SPSS Trial version 20 for Windows statistical software package (SPSS inc, Chicago, il, USA) and Primer, presenting categorical data as numbers (percent) and quantitative data as mean and standard deviation. Chi-square test and one-way ANOVA analyzed differences in proportions and means, respectively.

Pearson's coefficient assessed relationships between variables, considering P value <0.05 as statistically significant. Linear regression developed equations estimating renal dimension. Pearson Correlation values range from -1 to +1, indicating negative or positive correlations, respectively. A correlation coefficient (r) <0.3 indicated poor, 0.3-0.5 fair, 0.6-0.8 moderately strong, and >0.8 a very strong correlation.

Observations

In this study involving 150 participants, comprising 60% males and 40% females, the majority (64.67%) had a Body Surface Area (BSA) in the 1.5 to 1.8 m² range [Table 1]. Mean renal lengths were 36.57±4.13mm (right) and 36.944.03mm (left); renal widths were 17.70±2.43mm (right) and 18.41±2.84mm (left) [Table 2].

Associations of BSA with renal dimensions revealed statistically significant correlations with right/left renal length (p<0.001) and right renal width (p=0.009), but not with left renal width (p=0.062) [Table 3].

The correlation between BSA and renal lengths was fairly positive, with values of 0.439 and 0.505 for right and left renal length, respectively [Table 4, Graph 1]. However, the correlation with right and left renal width was positive but strength was poor with correlation values of 0.287 and 0.236. [Table 4, Graph 2] . Linear regression allowed the formulation of equations to estimate single renal dimension using single baby parameters.

Table1: Distribution of the cases according to BSA

BSA(m2)	Number	Percentage (%)
1.20 to1.50	40	26.67
1.50 to1.80	97	64.67
>1.80	13	8.67
Total	150	100.00

Table 2: Descriptive Statistics of the renal dimension on USG

Renal dimension on USG (mm)	Mean	SD
Length (mm)		
Right	36.57	4.13
Left	36.94	4.03
Width (mm)		
Right	17.7	2.43
Left	18.41	2.84

Table 3: Association between BSA and Renal Dimension

BSA (m2)		L Right	L Left	W Right	W Left
1.20 to1.50 (n=40)	Mean	34.52	34.56	16.73	17.51
	SD	3.46	3.76	1.93	2.45
1.50 to1.80 (n=97)	Mean	37.01	37.61	17.98	18.76
	SD	4.06	3.73	2.64	3.01
>1.80 (n=13)	Mean	39.55	39.28	18.53	18.58
	SD	3.97	4.03	1.04	2.11
P Value		<0.001	<0.001	0.009	0.062

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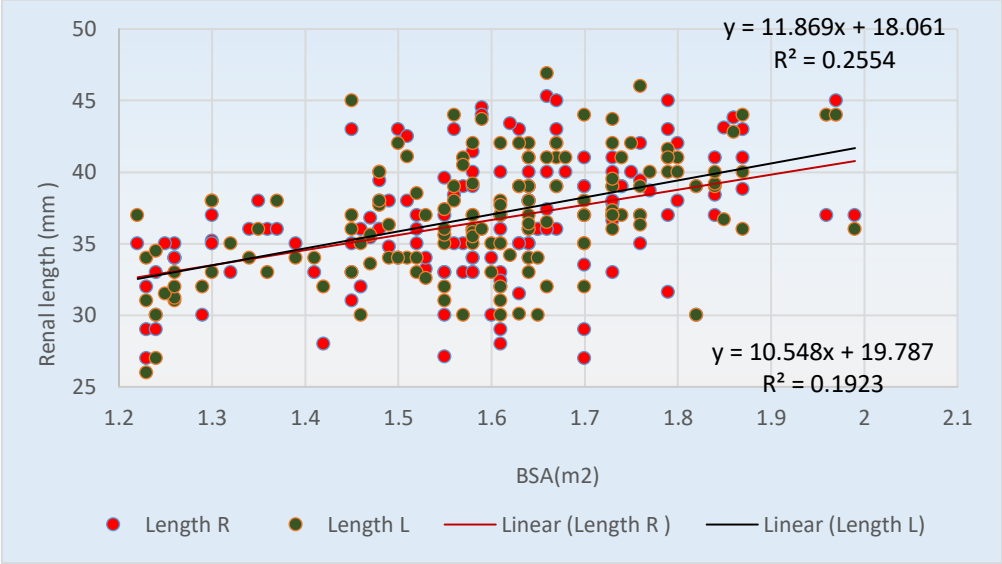
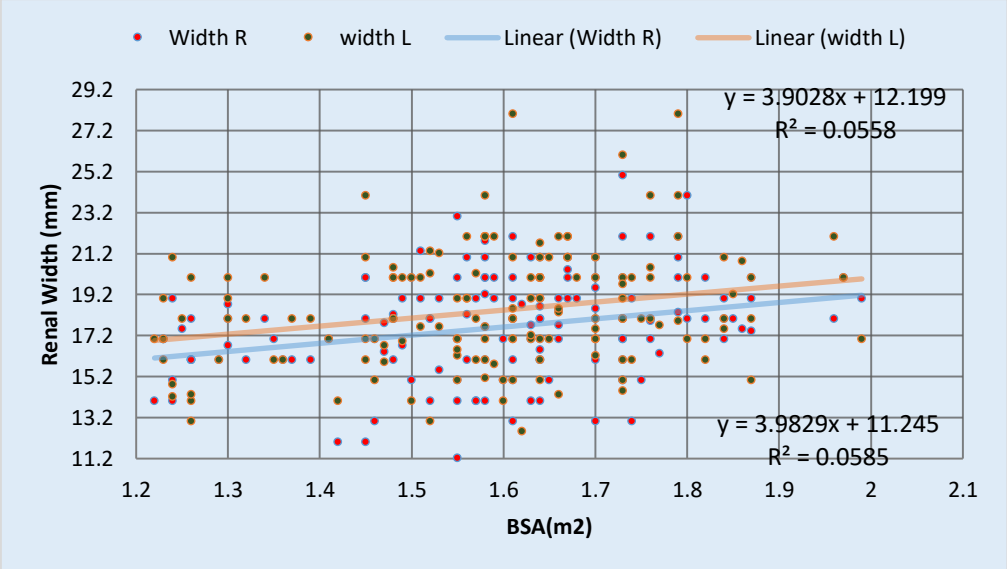
Table 4: Correlation between BSA with Renal Dimension

BSA	Length		Width	
	Right	Left	Right	Left
Pearson Correlation	.439**	.505**	.287**	.236**
P value	<.001	<.001	<.001	.004

Graph-1: Correlation between body surface (BSA) and right Renal Length (LTH.RT) and left renal length (LTH.LT)



Graph-2: Correlation between body surface area and right renal width (W.RT) and left renal width(W.LT)



3. Discussion

Kidneys are vital organs necessary for survival. Knowing about renal dimensions can be helpful in early diagnosis of various abnormalities. It can form integral part in evaluating renal diseases for both diagnostic and prognostic purposes (9).

In our study mean right renal length was 36.57±4.13mm and mean left renal length was 36.94±4.03mm simiar to the study of Malshe N et al (10) where mean length of the right and left kidney were 38.6 ± 2.2 mm and 38.9 ± 2.2 mm, respectively. Mean right renal length was 39.22±4.32 and mean left renal length was 38.36±4.30 in a study conducted by Sultana et al (11). Mean right and left renal length was on higher side as 44.9 ± 3.2 mm vs.

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44.4 ± 3.5 mm respectively in study of Adeyekun AA et al (12) which was conducted in apparently healthy neonates at the University of Benin Teaching Hospital, Nigeria. Ogbe P et al (14) also conducted a study in a tertiary health care facility in central Nigeria to determine renal size by ultrasound measurement in term neonates and found that the mean renal length was 4.09±0.37 cm and 4.08±0.36 cm for right and left respectively.

The renal width obtained on right side was 17.70±2.43mm and for left side the mean renal width was 18.41±2.84mm in our study. Malshe N et al (10) observed mean right renal width was 20.8 ± 1.0 mm and left renal width was 20.2 ± 1.0 mm. Study of Adeyekun AA et al (12) observed right and left renal width was 23.0 ±.5.0 and 22.9 ± 2.4mm respectively and this is again on higher side. Ogbe P et al (14) in their study in central Nigeria found that mean renal width was 2.11±0.22 cm and 2.08±0.23 cm for right and left kidneys in that order.

To summarize renal length in our study showed a fair correlation with BSA of baby. Our results are similar to the study conducted by Gupta A.K et.al (13) on ultrasound evaluation of kidney dimensions in neonates in Safdarjung hospital New Delhi. The study stated that a significant positive correlation was observed between renal dimensions and BSA and on step-wise multiple regression when renal length was kept as a dependent variable, the first variable that was selected highly correlated to renal length was BSA followed by G.A(14). Kidney length was correlated with BSA ($r= +0.223$, $p<0.05$) in study of Sultana et al (11) also in agreement with study of Otiv A et al (9) where the renal size correlated well with body surface area. There was a significant positive correlation between all the renal dimensions and the BSA of the subjects at birth in study of Ogbe P et al (14) depicting correlation between right renal length and BSA ($r= 0.178$, $p=0.012$), left renal length and BSA ($r= 0.206$, $p=0.003$), right renal width and BSA ($r= 0.14$, $p=0.049$), left renal width and BSA ($r= 0.229$, $p=0.001$).

We observed that BSA had statistically insignificant association with left renal width, whereas statistically significant association was found with right renal width, right and left renal length. Above findings suggest that there was a likely error in assessment of left renal width probably due to diffuse hilar margins in neonatal kidneys, because ideally statistically significant or insignificant association should be commonly present between baby parameters and both sides of kidney. It is very unlikely that a baby parameter has a strong significant association with one side kidney and insignificant association with another side kidney width. Thus, we can state that though renal width has statistically significant association with baby parameters but they are poorly correlated with these parameters indicating that the contribution of studied parameters in change with renal width is not appreciable.

4. Conclusion

In our study, we find that Positive correlation was found between BSA and renal dimensions (renal length and width) but strength was poor between BSA and renal width. This suggests that there is a clinically appreciable difference in renal length with changing baby parameters but renal width is not much affected. Therefore, in neonatal renal disorders, assessment of renal length would have better clinical implications than the measurement of renal width.

Previously very few studies have been conducted all over the world on our studied topic and therefore data is very sparse. Our study also needs to be validated through large studies and can be used as a pilot study for these large studies.

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