

# A COMPARATIVE STUDY OF RENAL SIZE IN NEWBORN BABIES

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## ABSTRACT

**Background:** In neonatal period usual presentation of renal anomalies is an increase or decrease in renal size. This study was conducted to assess renal size of normal newborn babies and to determine the best parameter against which kidney size should be associated and whether it is similar for small for gestational age and appropriate for gestational age babies.

**Material and Methods:** This was a hospital-based case-control study, conducted over six months at Jinnah Postgraduate Medical Center and National Institute of Child Health, Karachi. One hundred and twenty-eight newborn babies were included. Kidney length and depth were measured by ultrasound. Birth weight, body length and head circumference of babies were measured. Gestational age was assessed using Dubowitz method. Kidney size was compared to birth weight, length, head circumference and gestational age.

**Results:** Out of 128 children 59% were boys and 41% girls. Seventy-one (55.4%) were small for gestational age and 57 (44.6%) appropriate for gestational age. Birth weights of babies ranged from 1100-4200 grams, lengths 39-53 cm and head circumference 30-37 cm. There was a positive correlation of kidney size with birth weight, body length and gestational age, strongest in case of birth weight. Appropriate for gestational age babies had larger kidneys than small for gestational age babies.

**Conclusion:** There is a strong correlation between kidney size and birth weight of newborn babies. Small for gestational age babies have significantly smaller kidneys as compared to appropriate for gestational age babies.

**Key words:** Kidney size, Newborn, Birth weight, Gestational age.

## INTRODUCTION

The infant mortality rate in Pakistan is very high.<sup>1</sup> According to a study conducted in 1991, neonatal deaths account for 72% of the total infant mortality.<sup>2</sup> Among the causes of this very high neonatal mortality are infections, birth trauma and congenital malformations. Renal system anomalies account for about 10% of all the malformations.<sup>3</sup> In neonatal period the usual presentation of renal anomalies is an increase or decrease in the renal length or depth. Therefore, it is important to know the kidney size of normal newborn infants.

At the time of birth, various physical parameters, like birth weight, length and head circumference vary greatly from one baby to another. Similarly, the gestational age at birth is also different in different babies. In these circumstances, we can not standardize the renal size to a fixed value at birth. It is important to know the renal size at different birth weights,

body lengths, head circumferences and gestational ages.

In developing countries like Pakistan, the incidence of small for gestational age (SGA) babies is very high, as compared to the developed countries. In a study of low birth weight babies conducted in Karachi the preterm SGA babies comprised 69.1% of all the low birth weights.<sup>4</sup> In another study 30% of the term babies in Karachi were found to be SGA.<sup>5</sup>

Only few studies have been conducted regarding the measurement of renal size in neonates and most of these compared the renal sizes with birth weights and body lengths.<sup>6,7</sup> Few studies have compared the gestational age with renal size, but without any conclusive results.

In view of the high incidence of SGA babies in our population, it is important to know the differences in the kidney size between appropriate for gestational age (AGA) and SGA babies.

This study was conducted to assess the renal size of the normal new born babies by measuring the renal length and depth by ultrasound and to determine the best parameter i.e. birth weight, body length, head circumference or gestational age against which kidney size should be associated and whether it is the same for small for gestational age and appropriate for gestational age babies.

## MATERIAL AND METHODS

This was a hospital based case-control study, conducted for a period of six months from 1<sup>st</sup> January 1994 to 30<sup>th</sup> June 1994, at Jinnah Postgraduate Medical Centre (JPMC) and National Institute of Child Health (NICH) Karachi, Pakistan. These institutions are the major referral centres in Karachi for gynaecological, obstetric and child health care. The catchment area of these hospitals represents a population in excess of 10 million people living in and around Karachi. More than 5000 deliveries are conducted annually in the Obstetric Department of JPMC. The Department of Obstetrics also has 15 beds Neonatal Nursery where neonatal emergencies are dealt with. The National Institute of Child Health is a tertiary child health care centre; it has a well developed "Well Baby Clinic", where growth and development of all the babies born in Jinnah Postgraduate Medical Centre is monitored up to 5 years of age. The nurses in this clinic are specially trained to measure weight, length, and head circumference of the babies.

Abdominal ultrasound of all the cases and controls was performed within 72 hours of birth and the kidney sizes measured. Babies with obvious congenital malformations or any major illness were excluded from the study.

The birth weight of all the babies was estimated on the following day by a qualified nurse. All the babies were referred to the "Well Baby Clinic" next morning. We recorded their birth weights ourselves, accompanied by a trained nurse. Lengths of the babies were measured on an infantometer twice for each baby and the mean was taken. An ordinary non-stretchable plastic measuring tape was used for measuring the head circumference. Head circumference was measured thrice and the maximum was taken.

Gestational maturity of all the babies was assessed first by Parkin's method of rapid scoring, which is an easy and rapid method of finding the gestational age.<sup>8</sup> This was reassessed and confirmed by the more reliable Dubowitz method of assessing gestational age.<sup>9</sup> Gestational age was recorded with birth weights. Using this data, infants were divided in the following categories by the chart of Lubchenco.<sup>10</sup>

1. Small for gestational age (SGA): Babies with weight below the 10<sup>th</sup> centile for their gestational age.
2. Large for gestational age (LGA): Babies with weight above the 90<sup>th</sup> centile for their gestational age.
3. Appropriate for gestational age (AGA): Babies with weight between the 10<sup>th</sup> and 90<sup>th</sup> centile for their gestational age.

Babies were taken for ultrasound on the same day to Radiology Department of NICH and returned back to their mothers in the Obstetrics ward.

The scale and measuring tape were checked from time to time and error excluded after data collection and recording. A health statistician was consulted for data analysis. Statistical significance and probability were determined.

The AGA babies were taken as controls and SGA babies as cases. An ALOKA.SSD-256 mechanical sector scanner using 5 MHz medium focus transducer with a focal length of 4-8 cm {M. (ASU-32.H-5)} was used to visualize the kidneys. Scanning was done by a senior radiographer within 72 hours of birth. Babies were scanned in prone or lateral positions, usually within one hour after taking a feed, so that they were soothed.

The maximum length (superior to inferior parameter) and depth (superficial to deep parameter) of each kidney were measured. Several sections of kidneys were made in each plane to determine the maximum length and depth of each kidney and each kidney was measured twice in each dimension. All the observations were made by the same radiographer.

The dependent variables were kidney length and depth. The independent variables were birth weight, gestational age, length of baby and the head circumference.

## RESULTS

During the study a total of 260 mothers were asked for permission to examine their babies. Out of them, 108 mothers refused examination of their babies because of various reasons. The commonest reason given was that they can not allow any investigation without permission of elders of the family. One hundred and fifty-two babies were examined. Two babies with hydronephrosis, one with polycystic kidneys and three babies with only one kidney were excluded from the study. Eighteen other babies were also excluded because of various reasons. A total of 128 newborn babies were included in the study; out of these 59% were boys and 41% girls. 71 (55.4%) of them were SGA (cases) and 57 (44.6%) AGA (controls). Birth weights of

babies ranged from 1100 to 4200 grams, lengths ranged from 39 to 53 cm and head circumference from 30 to 37 cm.

A comparison of kidney size between AGA and SGA babies was made; the AGA babies (controls) had significantly larger kidneys than SGA babies (cases). (Table-1)

Kidney size was independently correlated with the birth weight, body length, head circumference and gestational age. There was a positive correlation of kidney size with birth weight, body length and gestational age, which was statistically significant. (Table 2)

Although there was positive correlation between the kidney size and all the four independent

variables, it was the strongest between the kidney size and the birth weight. (Figure-1)

We used EPI-INFO Version 5.0 Package for data feeding and analysis. For the qualitative data like breakdown of kidney length and depth in cases and control we used  $\chi^2$  test. We used Student's t test for the quantitative data. Student's t test was also used for significance of correlation.

**DISCUSSION**

Some data are available on kidney growth rate in the premature and mature infants. With the increased use of real time ultrasound in the neonatal period, the knowledge of normal standard for kidney length and depth is clearly important in

**Table-1: Comparison of kidney size between SGA (cases) and AGA babies (controls).**

	CASES (n = 71)		CONTROLS (n = 57)		p- value
	Range	Mean + SD	Range	Mean + SD	
<b>RIGHT KIDNEY:</b>					
Length (cm)	2.1 - 5.8	3.4 + 0.5	2.5 - 4.8	3.4 + 0.5	< 0.01
Depth (cm)	1.0 - 2.2	1.6 + 0.3	1.3 - 2.7	1.9 + 0.3	< 0.01
<b>LEFT KIDNEY:</b>					
Length (cm)	2.7 - 5.4	3.6 + 0.4	2.7 - 4.8	4.0 + 0.4	< 0.01
Depth (cm)	1.1 - 2.7	1.6 + 0.3	1.2 - 2.6	1.8 + 0.3	< 0.01

**Table-2: Comparison of kidney size in relation to birth weight, length and head circumference.**

Parameter	RIGHT KIDNEY		LEFT KIDNEY	
	Length	Depth	Length	Depth
Birth weight	r = 0.62 p < 0.01	r = 0.52 p < 0.01	r = 0.65 p < 0.01	r = 0.59 p < 0.01
Crown-to-heel measurement	r = 0.33 p < 0.01	r = 0.26 p < 0.01	r = 0.35 p < 0.01	r = 0.28 p < 0.01
Head circumference	r = 0.16 p < 0.01	r = 0.16 p < 0.01	r = 0.16 p < 0.01	r = 0.16 p < 0.01
Gestational age	r = 0.41 p < 0.01	r = 0.29 p < 0.01	r = 0.41 p < 0.01	r = 0.36 p < 0.01

r = Coefficient of correlation

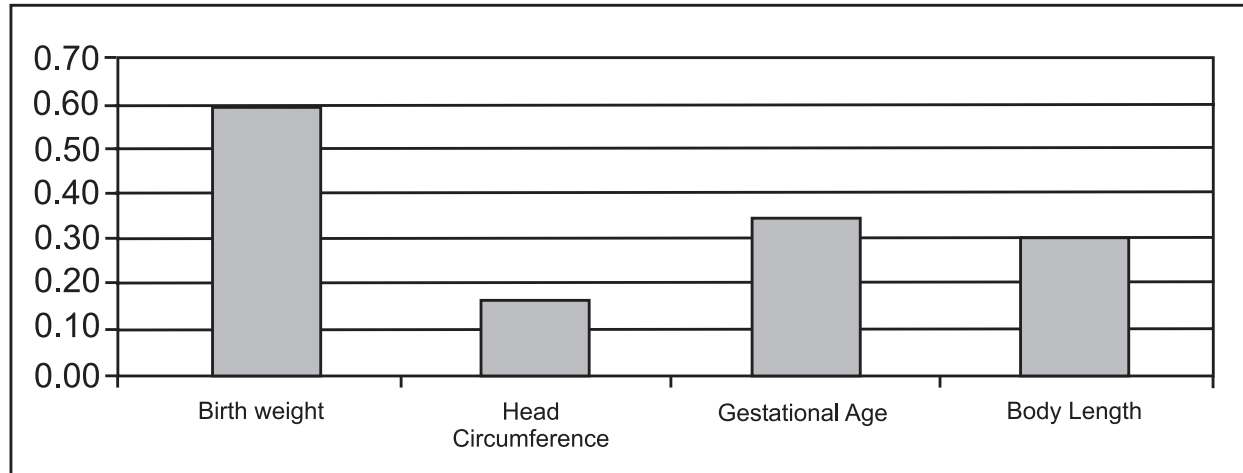


Fig. 1: Comparative correlation of kidney size with the independent variables.

the evaluation of a patient with an acquired or congenital disorder that increases or decreases kidney size. Examples of such conditions include Polycystic kidney disease, renal hypoplasia or dysplasia, renal vein thrombosis and hydronephrosis. The technique of ultrasonography is simple but some experience is necessary before kidney measurements are made reliably.

Reports available on measurements of kidney size in newborns and their association with birth weight, head circumference, crown to heel measurements and gestational age vary considerably.

In 1983, the kidney lengths of 100 newborn infants, ranging in gestational age from 26-42 weeks were measured.<sup>6</sup> In 20 of these infants, the ratio of kidney length to crown-to-heel measurements was calculated. It was found that kidney length remained in proportion to the length of infant, irrespective of whether the infant was small or appropriate for gestational age. In the same year, in another study of 36 newborn infants, no correlation of kidney length with crown-to-heel measurement was found.<sup>11</sup> In 1987 a poor correlation was found between kidney length and body length measured in 52 pre-term, appropriate for gestational age (AGA) infants.<sup>12</sup> It was thought that body length measurements are inaccurate in the newborn period because of the infant's flexed posture and this may be the reason of this poor correlation.

Our study showed that the kidney length correlates positively with body length, but this correlation is not as strong as that of birth weight. This finding was consistent with the findings in some studies<sup>12</sup> but in contrast to some others.<sup>6, 11</sup>

In our study, we found that both the length and depth of the kidney have an excellent correlation with the birth weight of the infant. Kidney length correlates better than the kidney depth, findings similar to some previous studies.<sup>7</sup> No correlation of kidney length or depth with the birth weight was found by scientists in Germany.<sup>11</sup>

Gestational age was plotted against kidney lengths and a cross-sectional centile chart was formed. There was a weak correlation of kidney length with gestational age.<sup>6</sup> In a comprehensive study of 560 newborn infants, gestational age was used as one of the parameters for comparison against kidney length. It was found that this association of gestational age was similar to that of birth weight but generally weaker, and association was difficult to detect and likely to confuse the analysis, so it was abandoned as an independent variable.<sup>7</sup>

In our study the correlation coefficient of kidney length versus gestational age was intermediate between that of kidney length versus body length, and kidney length versus birth weight.

The most interesting aspect of our study was the comparison of the kidney size of small for gestational age infants and appropriate for gestational age infants. In our study, we had 71 SGA babies and 57 AGA babies. We found that the kidneys of AGA babies are longer and thicker than those of SGA babies. Although this association was statistically significant with p-value of  $< 0.01$  but this increased kidney size of AGA babies may be a reflection of higher birth weights of AGA babies as compared to SGA babies. After screening the literature, we were unable to find any study showing comparison of kidney sizes between appropriate

for gestational age and small for gestational age infants.

Another significant finding of our study was a very poor correlation of kidney size with head circumference. In a previous study, a strong association of head circumference with kidney size has been reported. This study shows this correlation to be almost as strong as that of birth weight.<sup>7</sup> This is totally different from our study. Other problems with measurement of head circumference are that in asymmetrical intrauterine growth retardation, the head may be disproportionately large as compared to the kidney size.

Our study showed that kidney length and depth of males was significantly more than that of females. Scot et al (1990) have very interesting observations regarding to the kidney size in males and females. They found that the kidneys of male babies are longer than female ones in all dimensions, but their rate of increase differs. Kidney length of males increased faster with increasing birth weights and head circumferences than females, but the kidney depth increased at similar rate in both males and females.

It has been reported that left kidneys were significantly longer and thinner than the right.<sup>7</sup> Our study also shows this. Although the difference in kidney depth was very small (0.4 cm) it was statistically significant. In a study conducted in 1987, no difference in the measurements of the right and the left kidney were found.<sup>12</sup> This study included only 52 infants, which were divided in 25 groups. The possible errors in such a small number might have obscured the difference in length between the left and the right kidneys.

The babies included in our study were limited to infants of less than 72 hours age, because gestational age was one of the independent variable we were studying and gestational age can be assessed reliably only during the first 72 hours of life. Furthermore, there is a normal initial loss of weight in the newborn babies which returns to the birth weight at 10 to 14 days.

## CONCLUSION

There is a strong correlation between the kidney size and birth weight of newborn babies. Small for gestational age babies have significantly smaller kidney size as compared to the appropriate for gestational age babies.

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