

# Utility of Fetal Kidney Length as a Predictor of Gestational Age: A Comparative Study

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## ABSTRACT

**Background and Aim:** In today's practice of obstetrics and gynecology, one of the important components is estimation of fetal gestational age. There are various parameters available to estimate gestational age like Head Circumference, Femur length, biparietal diameter etc. but in late trimester these parameters found inaccurate to estimate gestational age. In this study we planned to estimate correlation between fetal kidney length and gestational age.

**Materials and Methods:** A prospective hospital based study was conducted between May 2019 to January 2020 on 100 singleton uncomplicated pregnancies in their late trimester who were sure of their last menstrual period. After measurement of conventional parameters, FKL was measured, and correlation was obtained with GA and its efficacy was compared with other parameters.

**Results:** In this study total 100 cases were participated, between the age group of 18 to 36 years having mean age of  $24.52 \pm 3.66$  years. Correlation coefficient between gestational age and fetal kidney length was 0.87 with a significance  $P < 0.001$ , which showed strong positive and linear correlation.

**Conclusion:** On the basis of results found we are concluding that fetal kidney length is reliable and accurate parameter to estimate gestational age and can be added with other routine parameters to know the estimated date of pregnancy.

**Keywords:** Femur length, head diameter, gestational age, fetal kidney length

## INTRODUCTION

In today's practice of any obstetrician, evaluation of the accurate gestational age (GA) of the fetus to know the expected date of delivery and to assess the growth of fetus is fundamental and one of the most critical components of prenatal care, especially in high risk pregnancies. If the gestational age is not calculated accurately, it will lead to iatrogenic prematurity or post maturity.

It will increase perinatal morbidity and mortality. During

the fetal development and just after birth also kidney are one of the important organ in the body.<sup>[1]</sup>

Fetal kidneys are very important source of amniotic fluid which is in the gestational sac where developing fetus suspended, thus evaluation of kidneys during the fetal development is indispensable.<sup>[2,3]</sup> One of the parameters to assess the development of fetal kidneys is estimation of size. As with development of any organs during fetal life there is progressive growth, similarly fetal kidneys develop progressively.

There are number of parameters used to calculate gestational age, but most commonly used by all sonologists is a composite GA obtained by BPD, HC, AC and FL in second and third trimesters.

Fetal kidney has been shown a steady growth of 1.7 mm fortnightly throughout pregnancy and is unaffected by growth abnormalities.<sup>[4]</sup>

Various studies have reported that fetal kidney length strongly correlates with the gestational age in late trimesters.

Number of studies conducted in the past shows linear co-relation between Fetal kidney length and gestational age. The present study is undertaken to validate the fetal kidney length measurement as an additional morphological measurement in estimation of gestational age.

### ***Aims and Objective:***

- To evaluate the accuracy of fetal kidney length measurement in estimating gestational age.
- To find out the most accurate parameter in estimating gestational age.

### **MATERIALS AND METHODS**

This prospective hospital based study was carried out between May 2019 to January 2020 in department of Obstetrics and Gynecology with collaboration of Department of Urology CAIMS, Karimnagar and included 100 pregnant women aged between 18 to 35 years with normal singleton pregnancies with known dates of different parity and ages were included in this study, after approved by the institutional ethical committee after explaining in detail the entire research protocol.

Procedure has applied after taking informed consent from all the patients involved in the study.

Ultrasound was performed using ultrasonographic scanner with a 3-5 MHz curvilinear transducer for measurement of kidney length (KL). Also assessment of BPD, HC, AC and FL was done.

Measurements are obtained in the sagittal plane, when full length of kidney with renal pelvis is visualized. All cases were scanned twice by ultrasound. Radiologist one determined the average gestational age using Hadlock's formula from fetal biometric indices.

### ***Inclusion Criteria:***

- Women more than 19 years of age.
- Normal antenatal pregnant women with no associated risk factors.

- No history of Diabetes Mellitus.
- Women with sure date of their last menstrual period.

### ***Exclusion Criteria:***

- Twin pregnancies
- Pregnant women with not sure with their last menstrual
- Anomalous Fetus
- Complications like IUGR, poly or oligohydramnios, maternal diabetes mellitus, unreliable LMP
- Gross maternal obesity
- Multiple gestation

All the data collected from procedures has entered in the Microsoft excel 2010 for further analysis and presentation of data.

Quantitative data were presented by using Mean and Standard Deviation. Linear regression model were used to estimate the gestational age are derived from other variables and kidney length.

Pearson's correlation were used to know the correlation between the various variables. Statistical packages for social science (SPSS) version 25 were used for statistical analysis and p-value <0.05 were considered as statistical significant.

### **RESULTS**

In this study total 100 cases were participated, between the age group of 18 to 36 years having mean age of  $24.52 \pm 3.66$  years. In 31 to 37 weeks of gestation average of 9 cases per week of gestation were observed.

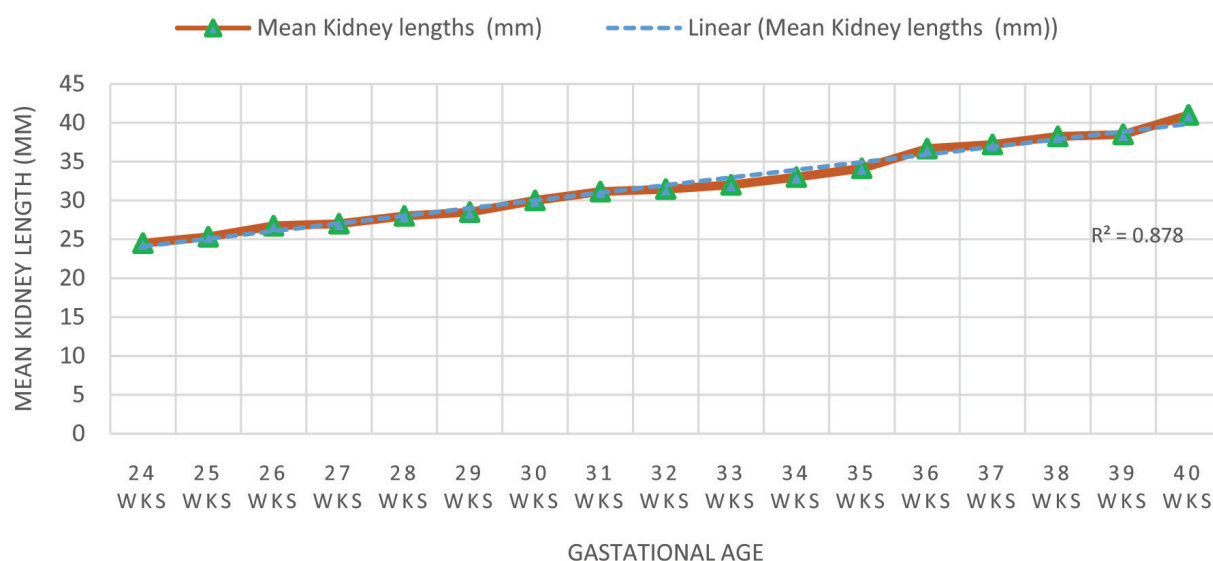
Minimum 2 cases were enrolled in 24<sup>th</sup> and 40<sup>th</sup> weeks of gestation and maximum 12 cases observed in 36<sup>th</sup> week of gestation followed by 11 cases in 32<sup>nd</sup> week and 10 cases in 37<sup>th</sup> week.

In this study mean kidney length measured from  $24.50 \pm 0.7$  at 24<sup>th</sup> week to  $41.0 \pm 1.41$  at 40<sup>th</sup> week of gestation. In this study it was found that as the weeks of gestation progresses the fetal kidney length also increased, it means that there was linear correlation between gestational age and fetal kidney length were found with R value = 0.937 this R-value tells that there is positive and strong linear correlation between FKL and GA, also dispersion in fetal kidney length were increased as the gestational age increased (Table. 1, Figure.1).

In the present study, an equation was found based on the regression coefficient; i.e., GA in weeks (Y) =  $0.993 \times X$  (FKL in mm) + 0.095 (Where slope m = 0.993 and constant = 0.095) and this coefficient value is significant at 5% level of Significance

**Table 1: Distribution of various Gestational ages showing kidney Lengths (mm)**

Gestational Week	Number of Cases	Mean Kidney lengths (mm)	SD	Median
24 weeks	2	24.50	0.7	24.50
25 weeks	3	25.33	0.577	25.00
26 weeks	4	26.75	0.957	26.50
27 weeks	3	27.00	0	27.00
28 weeks	5	28.00	1	28.00
29 weeks	4	28.50	1.29	28.50
30 weeks	4	30.00	0.816	30.00
31 weeks	8	31.13	1.808	31.00
32 weeks	11	31.45	1.57	32.00
33 weeks	7	32.00	1.732	33.00
34 weeks	9	33.00	1.225	34.00
35 weeks	8	34.13	2.415	35.00
36 weeks	12	36.67	1.557	36.00
37 weeks	10	37.20	1.317	37.00
38 weeks	4	38.25	0.5	38.00
39 weeks	4	38.50	0.577	38.50
40 weeks	2	41.00	1.414	41.00


**Figure 1: Correlation between Gastational Age and Fetal Kidney Length (mm)**
**Table 2: Linear regression between Gestational ages showing kidney Lengths (mm)**

Model	B	Std. Error		t-value	Significance
CGA	0.993	0.037	0.937	26.553	<0.001**

Note: \*\*p-value<0.001 highly significant at 1% level of Significance

**Table 3: Correlation between of gestational age and other biometric indices**

Gestational Age	Biometric Indices	FKL	BPD	HC	AC	FL
	Pearson Correlation	0.937**	0.926**	0.919**	0.887**	0.932**
	Sig. (2-tailed)	0	0	0	0	0
	N	100	100	100	100	100

Note:\*\*p-value<0.001 highly significant at 1% level of Significance

The correlation coefficient between Gestational Age and Fetal Kidney length is 0.937, which indicate 93.7 percentage positive relationships between Gestational Age and Fetal Kidney length and is significant at 1% level as predicted by BPD, HC, AC and FL (P-value<0.001) but among all these indices Fetal kidney length was highly and strongly correlated with Gestational Age.

Table No. 3 also illustrates an extremely strong correlation with other variables as well like with BPD (r=0.926), HC (r=0.919), AC (r=0.887) and FL (r=0.932). Scatter plots were drawn between gestational age (independent variable) and with all the dependent fetal biometric indices, to depict the best fit line, linear regression equation, its slope and intercept.

## DISCUSSION

In order to determine the estimated date of delivery in the first trimester and for evaluation of growth of fetus in second and third trimester gestational age is most important. Several studies have been done earlier to assess the variability in gestational age determination from FKL. They found that there is a linear relationship between the fetal kidney length in mm and the gestational age in weeks.

Our study was done to find out any difference in Indian population. There are various methods to calculate

Gestational Age; in the first trimester LMP and diameter or GS volume are adopted. As the pregnancy progresses parameter like, Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC) and Femoral length (FL) have been widely accepted fetal biometric parameters worldwide for estimation of gestation age. However, as the gestation progresses especially in third trimester the margin of error for these parameter are widened and these parameter might be inaccurate. Other parameter like fetal foot length, fetal kidney length etc have also been proposed to calculate gestational age.

Among all these parameters many studies found that fetal kidney length was the best parameter or well correlates with gestational age with high accuracy.<sup>[5-7]</sup> Ozat et al suggest that fetal sacral length can be used in dating labor due to the significant correlation between GA and sacral length they found.<sup>[8]</sup> And also other studies found parameter like BPD, HC, AC and FL are well correlates to GA but to assess these parameters requires advanced ultrasound skills.

In present study we found that FKL was best parameter to estimate gestational age (Table 2), these results are supporting by the study conducted by Kansaria et al who proved that by using parameter FKL improved the dating labor.<sup>[9]</sup> Study conducted by Das et al also emphasizes to use kidney length as accurate parameter to determine the gestational age.<sup>[10]</sup>

**Table 4: Comparison of intercept and regression coefficient values with previous studies<sup>11</sup>**

Studies	Intercept estimate	Slope Estimate	P-value	R <sup>2</sup> -value
Present Study	0.095	0.993	<0.001	0.878
Bardhan J. et al <sup>[11]</sup>	0.15	1	<0.001	0.99
Das et al <sup>[10]</sup>	4.305	1.07	<0.001	0.82
Ugur et al <sup>[12]</sup>	10.07	0.61	<0.001	0.896

We made comparison of intercept and regression coefficient (slope) between present study and some previous studies as shown in above table. The present result showed a positive Pearson's correlation and regression coefficient between kidney length and gestational age as compared to previous studies. This

positive and strong linear correlation between FKL and GA were because of better observation of researcher and better quality of ultrasound machine.

## CONCLUSION

Present study also showed that there was strong

correlation between fetal kidney length and gestational age. Thus we are concluding that for better prediction of gestational age, FKL can be measure readily and can also be added to other routine parameter in late trimester.

#### CONFLICT OF INTEREST:

The authors declared no conflict of interest.

**FUNDING:** None

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