RESULTS AND ANALYSIS

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In this study a total number of 939 antenatal mothers were examined sonographically. They were grouped according to their calculated gestational age e.g. 24-28weeks, 29-32weeks, 33-36weeks and 37weeks to term.

The data derived from observations were arranged according to the different variables such as gravida, maternal age, gestational age, conventionally used biometric parameters like BPD, HC, AC and FL were compared with Fetal kidney length(FKL) at different gestational age.

These data were tabulated, analysed and the results were shown in tables and diagrams to arrive at a conclusion based on this study.

Table No.1

Frequency distribution of antenatal mothers according to their age groups (Years). n=939

Mothers / Mother's age groups(Years)	Absolute nos.	Percentage
19-24	415	44.2
25-29	260	27.7
30-34	264	28.1
Total	**939**	**100**

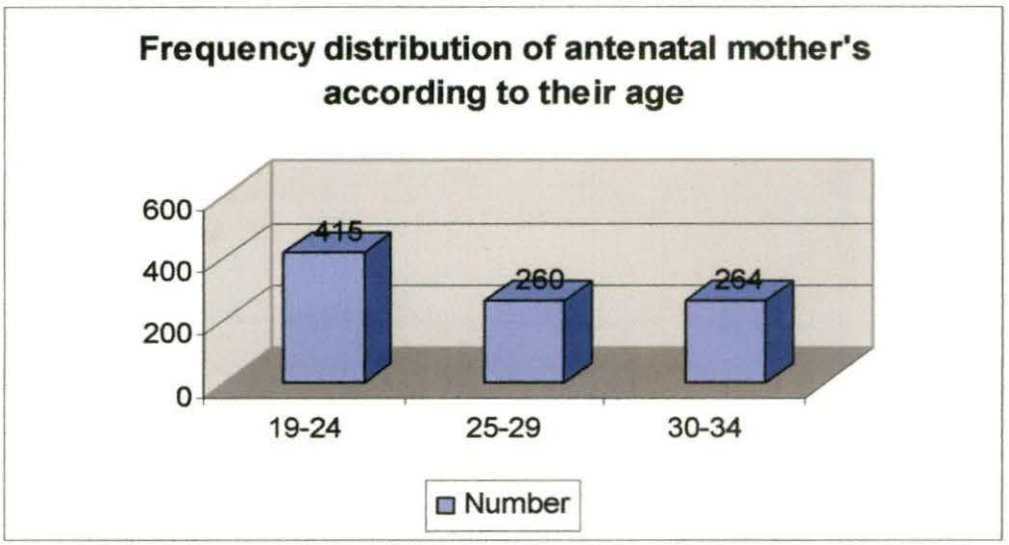


Fig: 1, Frequency distribution of antenatal mothers according to their age.

Table No.1 and Bar diagram of Fig:1, revealed the distribution of antenatal mothers according to age groups, where majority (44.2%) were below 25years; 27.7% in 25-29 years and rest 28.1% above 30years.

Table No.2

Frequency distribution of the fetuses according to the gestational age (weeks)

n=939

Cases / Gestational Age (wk)	Absolute nos.	Percentage
24-28	263	28
29-32	238	25.3
33-36	228	24.3
>36	210	22.4
Total	**939**	**100**

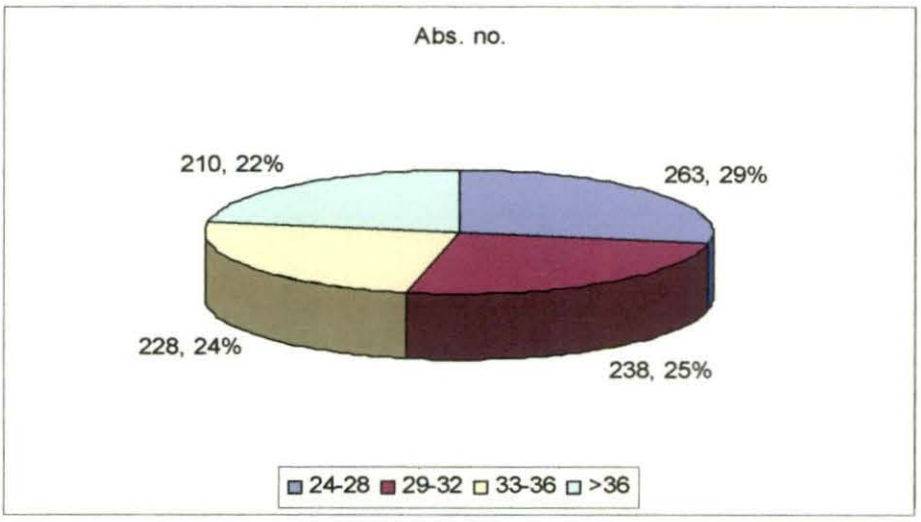


Fig: 2: Frequency distribution of fetuses according to gestational age in weeks and percentage.

Table No.2 and associated Pie diagram of Fig: 2, showed that, 28% of the cases were in 24-28 wks, 25.3% in 29-32 wks, 24.3% in 33-36 wks and rest (22.4%) of them having gestational age more than 36 weeks.

Table No.3

Frequency distribution of antenatal mothers according to gravida.

n=939

Number of mothers / Gravida	Absolute nos.	Percentage
Primi	511	54.42
Multi	428	45.58
Total	**939**	100

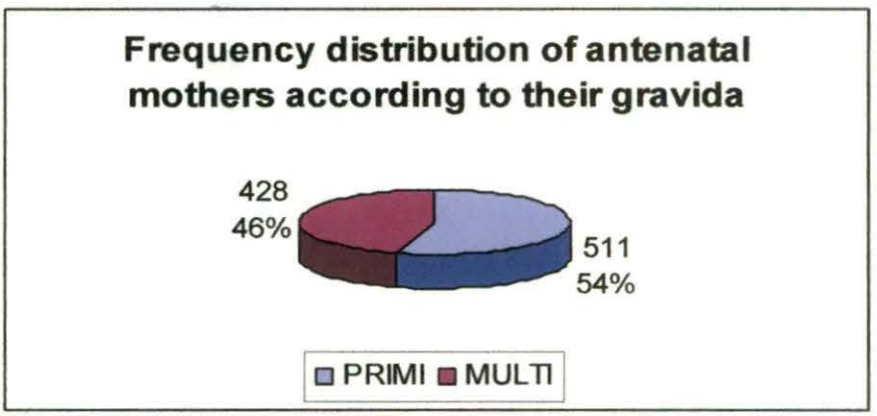


Fig: 3: Frequency distribution of antenatal mothers according to their gravida.

Table No.3 and Pie diagram of Fig:3, revealed the distribution of antenatal mothers according to gravida, 54 % (511) was primi and 46% (428) was multi gravida.

Table No.4

Frequency distribution of fetus according to Biparietal diameter (BPD) in millimeter (mm).

n=939

Fetus / BPD(mm)	Absolute nos.	Percentage
60-69	**221**	24
70-79	**280**	29
80-89	**281**	30
90-99	**157**	17
Total	**939**	**100**

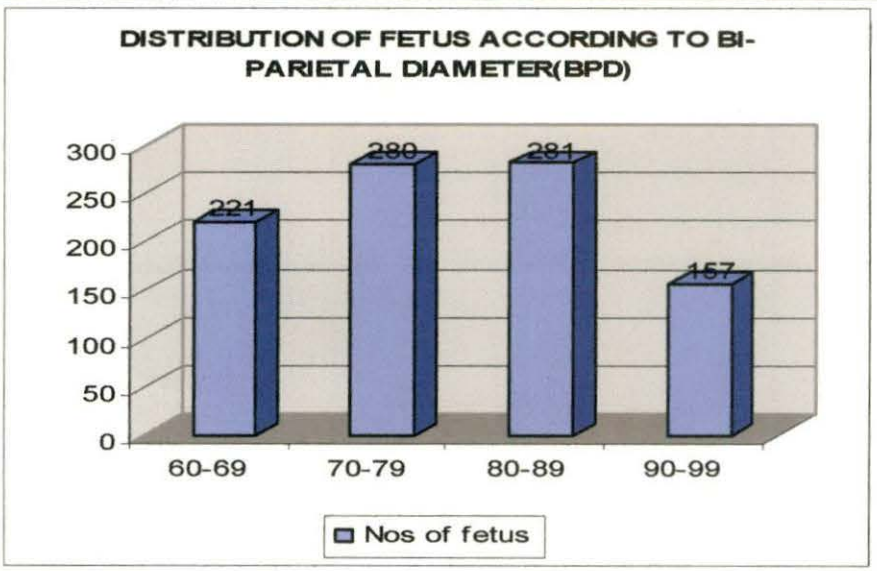


Fig: 4: Frequency distribution of fetus according to Biparietal diameter (BPD) in millimeter (mm).

Table No.4 and Bar diagram of Fig:4, showed the distribution of fetus according to Biparietal diameter (BPD) in millimeter, where 24% were in 60-69 mm, 29% in 70-79mm, 30% in 80-89mm and rest 17% in 90-99 mm.

Table No.5

Frequency distribution of fetus according to Head circumference (HC) in millimeter (mm).

n=939

Fetus / HC(mm)	Absolute nos.	Percentage
222-253	221	24
254-285	210	22
286-317	221	24
318-349	287	30
Total	**939**	**100**

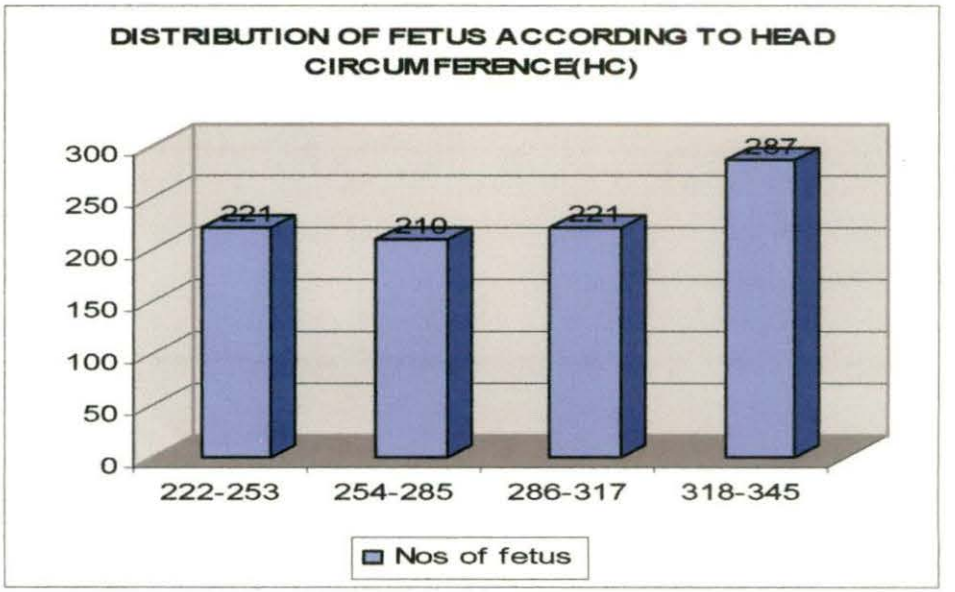


Fig: 5: Frequency distribution of fetus according to Head circumference (HC) in millimeter (mm).

Table No.5 and Bar diagram of Fig:5 , revealed the distribution of fetus according to Head circumference (HC) in millimeter, where 24% were in 222-253mm; 22% in 254-285; 24% in 286-317 and rest 30 % in 318-349 mm.

Table No.6

Frequency distribution of fetus according to Abdominal Circumference (AC) in millimeter (mm):

n=939

Fetus / AC(mm)	Absolute nos.	Percentage
207-244	263	29
245-282	238	25
283-320	228	24
321-358	210	22
Total	**939**	**100**

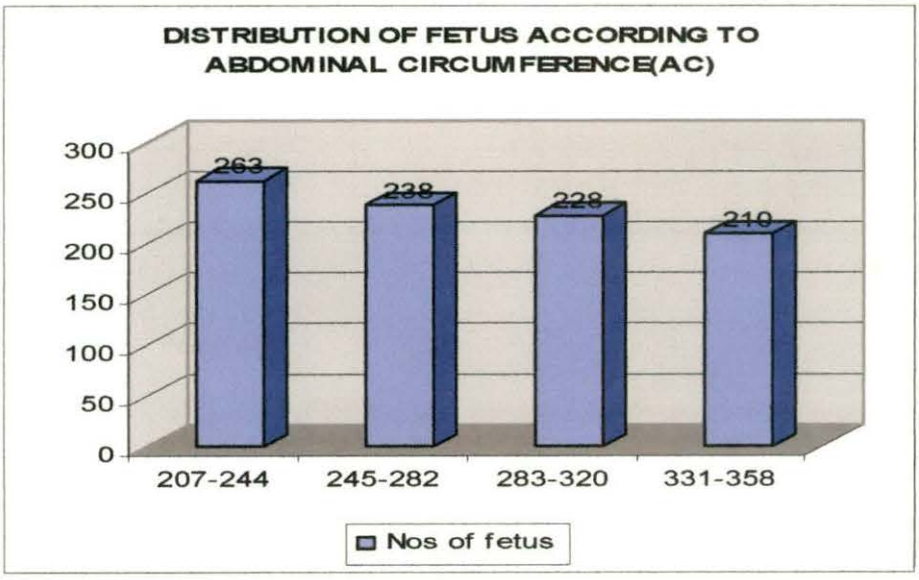


Fig: 6: Frequency distribution of fetus according to Abdominal circumference (AC) in millimeter (mm).

Table No.6 and Bar diagram of Fig:6, revealed the distribution of fetus according to Abdominal circumference (AC) in millimeter, where 29% were in 207-244 mm; 25% in 245-282; 24% in 283-320 and rest 22% in 321-358 mm.

Table No.7

Frequency distribution of fetus according to Femoral length (FL) in millimeter (mm):

n=939

Fetus / FL(mm)	Absolute nos.	Percentage
43-51	**221**	24
52-60	**210**	22
61-69	**298**	32
70-78	**210**	22
Total	**939**	**100**

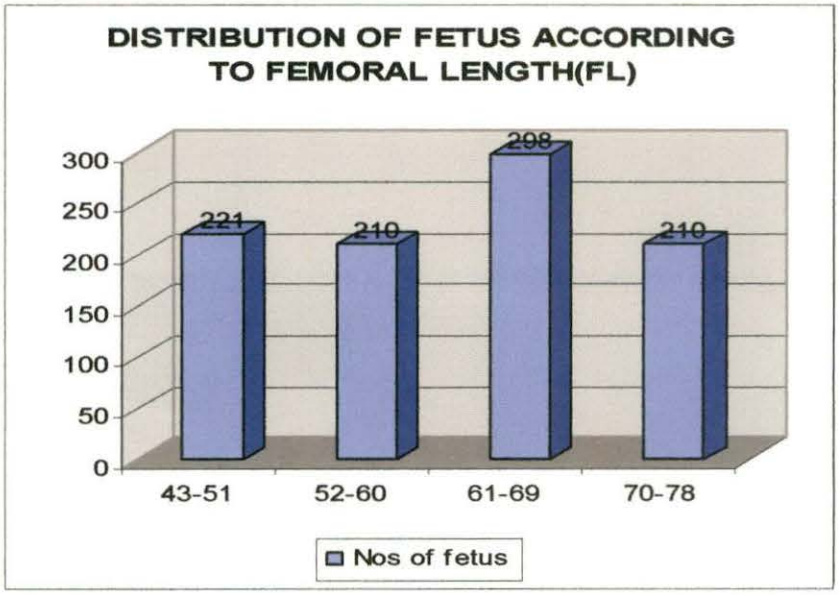


Fig: 7: Frequency distribution of fetus according to Femoral length (FL) in millimeter (mm):

Table No.7 and Bar diagram of Fig:7, showed the distribution of fetus according to Femoral length (FL) in millimeter where 24% were in 43-51 mm; 22% in 52-60; 32 % in 61-69 and rest 22 % in 70-78 mm.

Table No.8

Distribution of fetal kidney length according to gravida in different gestational age:

n=939

Gestational age group calculated as per CRL.	Average fetal kidney length in study population according to gravida				**Total (n)**		**Statistical Significance**
	Primigravida		Multigravida				
	Number	Mean (range)	Number	Mean (range)	Number	Mean (range)	
24-28 weeks	159	26.04 (22-29)	104	25.22 (22-28)	**263**	**25.72 (22-29)**	P>0.05
29-32 weeks	170	30.63 (28-33)	68	30.50 (28-33)	**238**	**30.59 (28-33)**	P>0.05
33 -36 weeks	33	33.70 (32-35)	195	35.15 (33-37)	**228**	**34.94 (32-37)**	P>0.05
> 36 weeks	149	38.58 (36-41)	61	38.30 (37-40)	**210**	**38.50 (36-41)**	P>0.05
Total	**511**		**428**		**939**		

Fig 8: Mean distribution of fetal kidney length according to gravida in pregnant women of different gestational age groups.

FKL = Fetal Kidney Length, **wks** = weeks

From the Table No.8 and composite Bar diagram of Fig:8, it was found that there was no significant difference in the fetal kidney length related to the gravida of the mother in different gestational age.

Table: 9.

Distribution of fetal kidney length expressed in millimeter (mm) compared with different maternal age group in different gestational periods.

n=939

Gestational age group calculated as per CRL.	Average fetal kidney length in study population of different maternal age group						Total (n)		Statistical Significance
	19-24 years		25-29 years		30 – 34 years				
	Number	Mean (range)	Number	Mean (range)	Number	Mean (range)	Number	Mean (range)	
24-28 weeks	176	25.64 (22-29)	39	25.79 (22-29)	48	25.96 (22-29)	263	25.72 (22-29)	p>0.05 (0.584)
29-32 weeks	59	30.29 (28-33)	136	30.70 (28-33)	43	30.67 (28-32)	238	30.59 (28-33)	P>0.05 (0.139)
33 -36 weeks	67	34.90 (32-36)	68	34.93 (33-37)	93	34.99 (33-37)	228	34.94 (32-37)	p>0.05 (0.896)
> 36 weeks	62	38.26 (37-41)	52	38.65 (36-40)	96	38.56 (36-41)	210	38.50 (36-41)	p>0.05 (0.170)
Total	**364**		**295**		**280**		**939**		

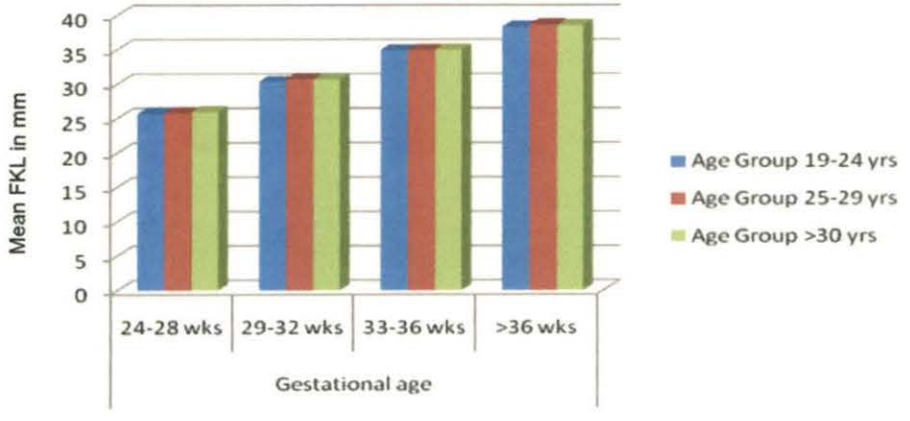


Fig.No.9: Showing the mean fetal kidney length in different maternal age groups as per gestational age.

FKL = Fetal kidney length. **wks** = weeks.

The Table No.9 and the composite Bar diagram of Fig:9, showed that the age group wise mean distribution of fetal kidney length was not significantly different in different gestational weeks of different aged antenatal mothers.

Table: 10

Ultrasonographic assessment of gestational age as determined from Biparietal diameter (BPD) estimation and its correlation with average fetal kidney length expressed in millimeter (mm).

Biparietal diameter in mm	Gestational age in weeks as determined from BPD estimation	Mean fetal kidney length(mm)	Correlation Coefficient
60 - 69	24 – 28	25 (22 – 29)	p<0.05 r=0.854
70 - 79	29 - 32	30 (28 – 33)	p<0.05 r=0.763
80 - 89	33 - 36	35 (32 – 37)	p<0.05 r=0.826
90 - 99	37 – 40	38 (36 – 41)	p<0.05 r=0.902

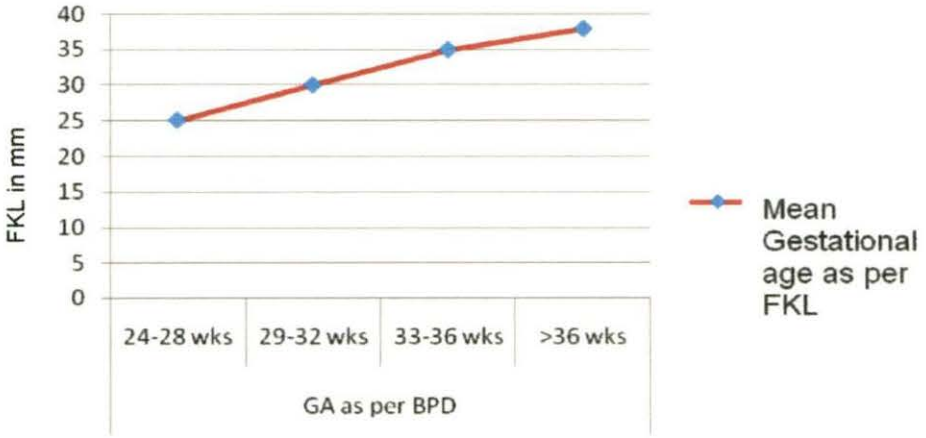


Fig: 10: Distribution of mean of Fetal Kidney Length according to the Gestational age (in weeks) calculated on the basis of BPD.

FKL = Fetal kidney length. **GA** = Gestational age. **BPD** = Biparietal diameter. **wks** = weeks.

From the Table No.10, in a comparative analysis it was found that the fetal kidney length (in mm) closely approximates with gestational age with the advancement of pregnancy, as derived from Biparietal diameter (BPD).This has been represented in the Line diagram of Fig:No.10.

Table: 11

Ultrasonographic assessment of gestational age as determined from Head circumference (HC) estimation and its correlation with average fetal kidney length expressed in millimeter (mm).

Head circumference (mm)	Gestational age in weeks as determined from HC estimation	Mean fetal kidney length(mm)	Correlation Coefficient
222 - 253	24 – 28	25 (22 – 29)	p<0.05 r=0.854
254 - 285	29 - 32	30 (28 – 33)	p<0.05 r=0.763
286 – 317	33 - 36	35 (32 – 37)	p<0.05 r=0.826
318 – 349	37 – 40	38 (36 – 41)	p<0.05 r=0.902

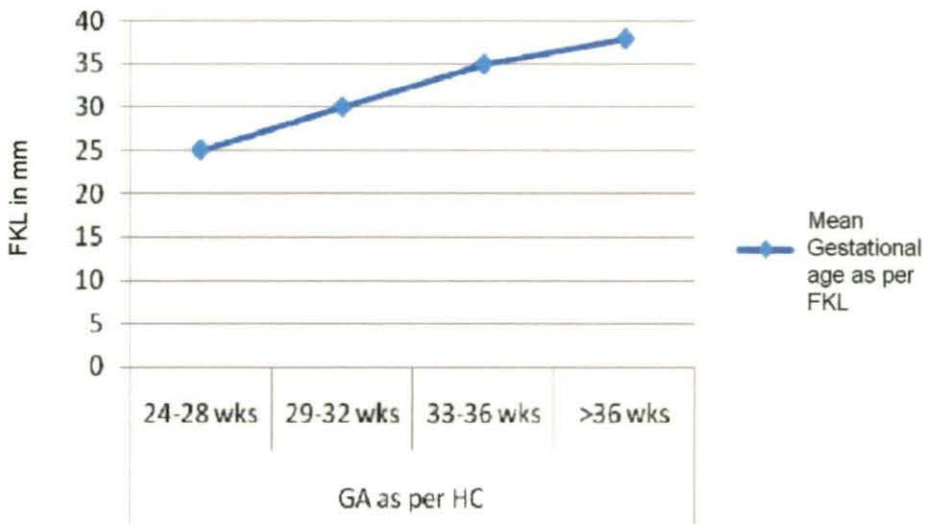


Fig:11. Distribution of mean of Fetal Kidney Length according to the Gestational age (weeks) calculated on the basis of HC.

FKL = Fetal kidney length. **GA** = Gestational age. **HC** = Head circumference. **wks** = weeks.

From the Table No.11, the comparative analysis of fetal kidney length (in mm) with head circumference (HC), it was found that the fetal kidney length in millimeter (mm) closely approximates with gestational age with advancement of pregnancy, as derived from Head circumference (HC). This has been represented in the Line diagram of Fig: No.11.

Table: 12

Ultrasonographic assessment of gestational age as determined from Abdominal circumference (AC) estimation and its correlation with average kidney length expressed in millimeter (mm).

Abdominal circumference in mm.	Gestational age in weeks as determined from AC estimation	Mean fetal kidney length expressed in mm	Correlation Coefficient
207 – 244	24 – 28	25 (22 – 29)	p<0.05 r=0.854
245 – 282	29 - 32	30 (28 – 33)	p<0.05 r=0.763
283 – 320	33 - 36	35 (32 – 37)	p<0.05 r=0.826
321 – 358	37 – 40	38 (36 – 41)	p<0.05 r=0.902

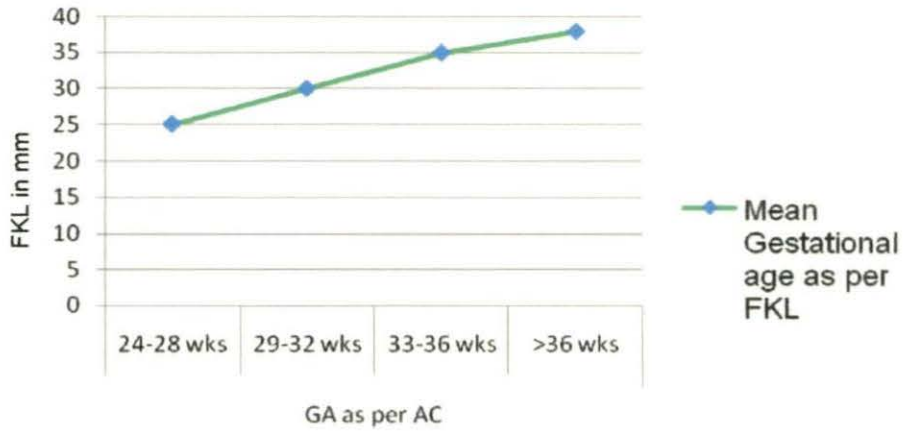


Fig:12: Distribution of mean of Fetal Kidney Length according to the Gestational age (weeks) calculated on the basis of AC.

FKL=Fetal kidney length. **GA**=Gestational age. **AC**=Abdominal circumference. **wks** = weeks.

From the Table No.12, in a comparative analysis, it was found that the fetal kidney length in millimeter (mm) closely approximates with gestational age with advancement of pregnancy, as derived from Abdominal circumference (AC). This has been represented in the Line diagram of Fig: No.12.

Table: 13

Ultrasonographic assessment of gestational age as determined from femoral length (FL) estimation and its correlation with average kidney length size expressed in millimeter (mm).

Femoral length in mm.	Gestational age in weeks as determined from FL estimation	Mean fetal kidney length expressed in mm	Correlation Coefficient
43 – 51	24 – 28	25 (22 – 29)	p<0.05 r=0.854
52 – 60	29 - 32	30 (28 – 33)	p<0.05 r=0.763
61 – 69	33 - 36	35 (32 – 37)	p<0.05 r=0.826
70 – 78	37 – 40	38 (36 – 41)	p<0.05 r=0.902

Fig:13: Distribution of mean of Fetal Kidney Length according to the Gestational age (in Weeks) calculated on the basis of FL.

FKL = Fetal kidney length. **GA** = Gestational age. **FL** = Femoral length. **wks** = weeks

From the comparative analysis as shown in Table No.13, it was found that the fetal kidney length in millimeter (mm) closely approximates with gestational age with the advancement of pregnancy as derived from femoral length (FL). This has been represented in the Line diagram of Fig: No.13.

Table: 14.

Distribution of fetal kidney length (right & left) according to different gestational age group.

n=939

Gestational age group calculated as per CRL.	Average fetal kidney length in study population (Right & Left) in mm				Total (n)	Statistical significance
	Right Kidney		Left Kidney			
	Number	Mean (Range) in mm	Number	Mean (Range) in mm		
24-28 weeks	137	25.68 (22-26)	126	25.76 (22-27)	263	P>0.05
29-32 weeks	111	30.76 (29-32)	127	30.45 (28-33)	238	P>0.05
33 -36 weeks	115	34.91 (33-37)	113	34.97 (32-37)	228	P>0.05
> 36 weeks	102	38.39 (3640)	108	38.59 (36-41)	210	P>0.05
Total	465		474		939	

In this analysis as shown in Table No.14, it was found that there was no significant difference in the fetal kidney length whether right or left kidney was measured.

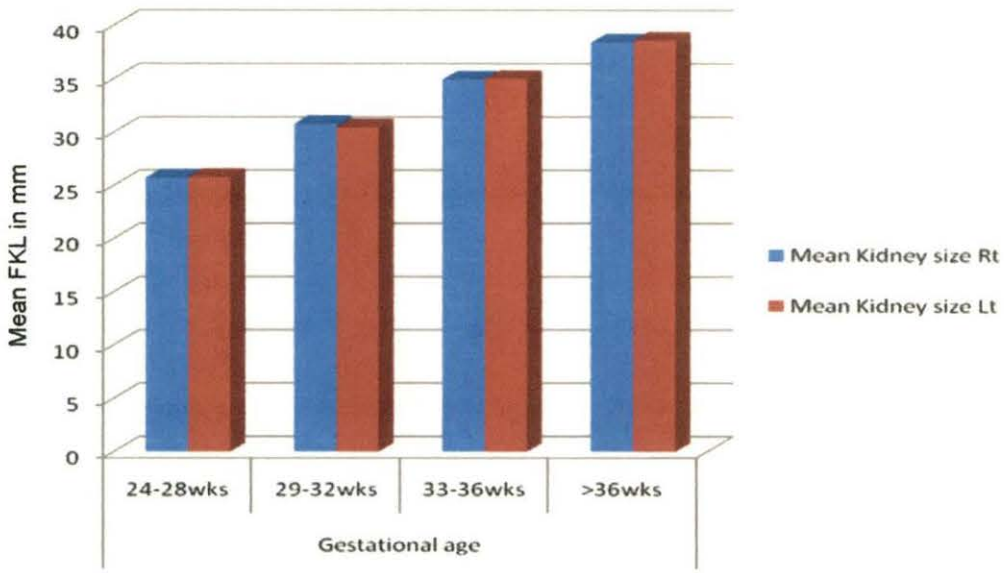


Fig: 14: Mean fetal kidney length (right & left) according to different gestational age groups.

FKL = Fetal kidney length. **wks** = weeks. **Rt**= Right. **Lt**= Left

Table: 15

Table showing distribution of the incidence of inclination to and / or deviation from the rule of thumb ("Renal length in millimeters approximates gestational age in weeks") according to gestational age.

Gestational age in weeks	No. of cases studied in different gestational age group.	Study of cases showing inclination to the "Rule of thumb"			Study of cases showing deviation from the "Rule of thumb".		
		Range of Kidney Length in mm.	No. of cases	Percentage of accuracy (%)	Range of Kidney Length in mm.	No. of cases	Percentage of accuracy (%)
24 – 28	263	25 – 28	23	**8.74**	22 – 29	240	**91.25**
29 – 32	238	28 – 31	53	**22.26**	30 – 33	185	**77.73**
33 – 36	228	35 – 37	105	**46.05**	32 – 34	123	**53.94**
37– 40	210	37 - 40	152	**72.38**	40 – 42	58	**27.61**

Analysis of Table No. 15, it was found that the fetal kidney length(mm) showed an inclination with standardised gestational age by 8.74% during 24 to 28 weeks of gestational age, 22.26% during 29 to 32 weeks of gestational age, 46.05% during 33 to 36 weeks of gestational age and 72.38% during 37 to 40 weeks respectively.

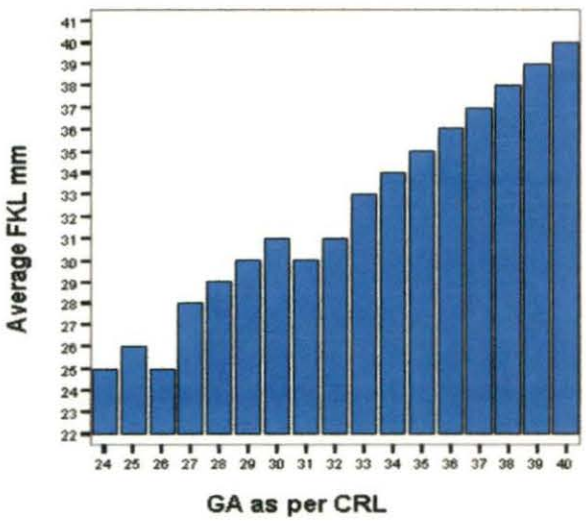


Fig:15: Histogram of different modes of Fetal Kidney Length in millimeter(mm) with Gestational age as per Crown Rump Lengths(CRL).

FKL = Fetal kidney length. **GA** = Gestational age. **CRL** = Crown rump length

The histogram showed in Figure: 15, the fetal kidney length in millimeter (mm) was not so much linear in early pregnancy till 32 weeks but very much linear in late pregnancy i.e. 33 weeks to term.

Table: 16

Table showing fetal kidney length (mm) in different gestational age groups which showed the percentage of accuracy and deviation in relation to gestational age of the fetus derive from other biometric parameters.

Total No. of cases studied in different gestational age groups.	Gestational age as derive from CRL,BPD, HC, AC, FL (weeks)	No. of cases where the fetal kidney length (mm) accurately matched with the gestational age, erived from other parameters	Total No. of cases in different gestational age groups (week) where fetal kidney(mm) matched with estimated gestational age	Percentage of accuracy in different gestational age groups	Gestational age as derive from CRL,BPD, HC, AC, FL (weeks)	No. of cases where the fetal kidney length (mm) deviated from Gestational age derived from other parameters	Total No. of cases in different gestational age groups (mm) where fetal kidney length(mm) deviated from the estimated gestational age	Percentage of deviation in different gestational age groups.
263 in 24-28 weeks	24 weeks	3	23	**8.74%**	24 weeks	67	240	**91.25%**
	25 weeks	3			25 weeks	56		
	26 weeks	4			26 weeks	48		
	27 weeks	5			27 weeks	35		
	28 weeks	8			28 weeks	34		
238 in 29-32 weeks	29 weeks	10	53	**22.26%**	29 weeks	39	185	**77.73%**
	30 weeks	11			30 weeks	43		
	31 weeks	13			31 weeks	52		
	32 weeks	19			32 weeks	51		
228 in 33- 36 weeks	33 weeks	20	105	**46.05%**	33 weeks	13	123	**53.94%**
	34 weeks	24			34 weeks	29		
	35 weeks	29			35 weeks	36		
	36 weeks	32			36 weeks	45		
210 in 37- 40 weeks	37 weeks	35	152	**72.38%**	37 weeks	18	58	**27.61%**
	38 weeks	40			38 weeks	15		
	39 weeks	38			39 weeks	17		
	40 weeks	39			40 weeks	8		

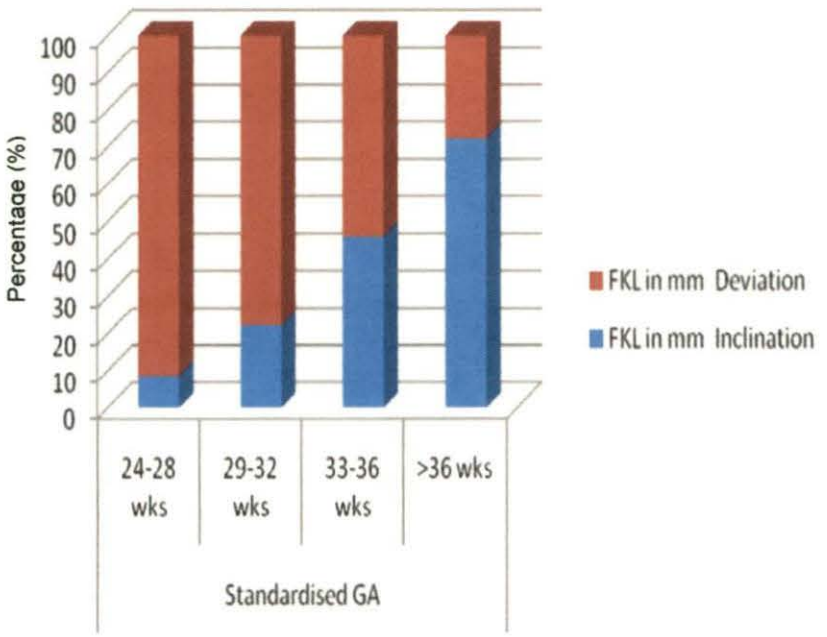


Fig: 16: Proportion of the incidence of inclination and/or deviation of the FKL in millimeter (mm) with standardised GA in different weeks of gestation.

FKL= Fetal kidney length. **GA**= Gestational age. **wks** = weeks.

From the Table No.16 and Bar diagram of Fig:16, it was found that the accuracy in determining gestational age from fetal kidney length (mm) increased from 8.74% during 24 to 28 weeks of gestational age, 22.26% during 29 to 32 weeks of gestational age, 46.05% during 33 to 36 weeks of gestational age and 72.38% during 37 to 40 weeks of gestation. The percentage of deviation was more in early weeks of gestation and reduced with the advancement of pregnancy.

With the advancement of pregnancy the percentage of accuracy of fetal kidney length (mm) increased to the extent of 72.38% from 37 weeks to term pregnancy, when fetal kidney length (mm) was used as a parameter for determination of gestational age.

Table: 17.

Regression analysis between Average Fetal Kidney length (mm) and Gestational age (weeks).

Variable	Coefficient	Std Error	F-test	P-Value
Independent: Average Fetal kidney length(mm) **Dependent** : Gestational age (wks)	0.98	0.005	33170.7861	0.000
CONSTANT	**1.162**	**0.172**	**45.9137**	**0.000**

In this study the regression coefficient of the fetal kidney length was + 0.98 with a standard error of 0.005 and p value of 0.000.

As the correlation coefficient (r) value was very close to +1, the fetal kidney length in millimeter (mm) was strongly related with the calculated standardised gestational age in weeks.

Table: 18.

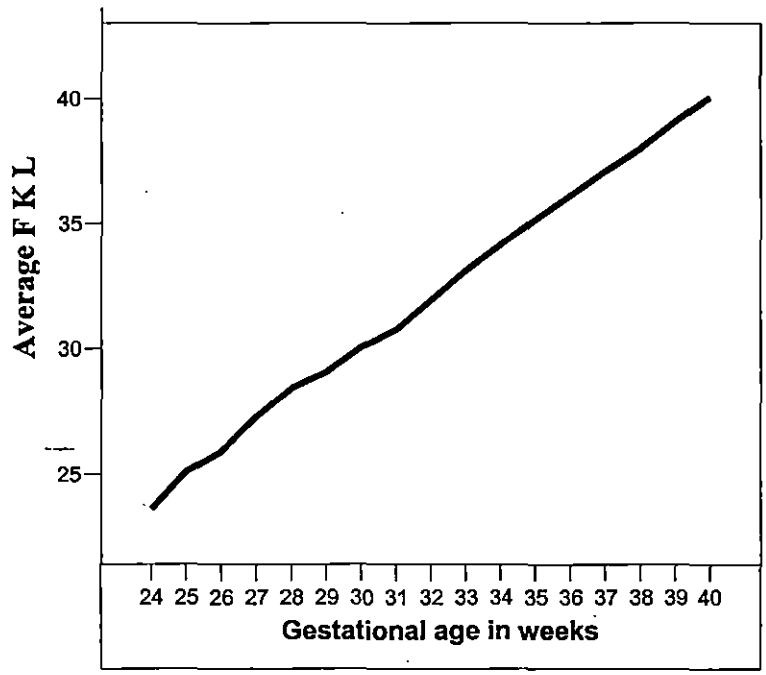
The value of standard deviation of fetal kidney length in millimeter (mm) calculating from weeks as per documented CRL:

Weeks as per documented CRL.	Standard deviation of fetal kidney length in mm.
24	1.244
25	0.9772
26	0.9631
27	0.9055
28	0.8007
29	0.8993
30	0.8990
31	0.8666
32	0.8567
33	0.6307
34	0.7348
35	0.7338
36	0.7604
37	0.5834
38	0.5267
39	0.5584
40	0.4148

If fetal kidney length in millimeter (mm) was considered as equivalent to gestational age in weeks then it was found from the Table No:18, that the maximum variation found in 24 weeks of gestation i.e. 1.244×2= 2.488 weeks = 2.488× 7= 17.416 days and minimum of 0.4148 ×2=0.8296 × 7= 5.8072 days in late pregnancy. So, from the above calculation it was found that the variation in determination of gestational age in relation to fetal kidney length at term was ±6 days (95% CI).

Table No.19

Correlation between Fetal Kidney length (mm) and Gestational Age (wk):

Variables	Independent	Fetal Kidney length (mm)
	Dependent	Gestational Age (wk)
Regression	Coefficient	Unstandardized.(B)= 0.963 (p=0.000; significant) Standardized (ß)= 0.986 (p=0.000; significant)
	Curve plot	
	Equation	**Gestational Age in weeks(Y) =** **0.963 x X [FKL(mm)] + 1.165(y intercept)**
Conclusion	1. The **Gestational age (wk)** has a significant positive correlation with **FKL (mm).** 2. Derivation of **Gestational age (wk)** can be done from **FKL (mm)** by the above mentioned equation.	

FKL= fetal kidney length. **wk**= week