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CORRELATION OF VARIOUS PARAMETERS FOR GESTATIONAL AGE ESTIMATION

Forensic Medicine

Shailesh Kumar — Assistant Professor, Dept. of Forensic Medicine, Heritage Institute of Medical Sciences, Varanasi

Shankar M Bakkannavar* — Associate Professor, Dept. of Forensic Medicine, Kasturba Medical College, Manipal. *Corresponding Author

Vikram Palimar — Professor, Dept. of Forensic Medicine, Kasturba Medical College, Manipal.

ABSTRACT

Gestational age is the age of unborn baby. Proper assessment of foetal well-being requires an accurate knowledge of gestational age of the fetus. Developmental status can be assessed by noting out the progressive differentiation, growth and maturation of the organ system of the body. Almost any organ system in the body may be used to assess developmental status, providing that it manifests progressive differentiation, growth and maturation. 100 dead fetus preserved in 10% formalin solution were analysed in this study and various parameters such as Crown heel length, Biparietal diameter, Head circumference, Chest circumference, Abdominal circumference were measured and correlated with the gestational Age of fetus.

KEYWORDS

Gestational age, fetus

INTRODUCTION

In the process of development the sequential changes occur as embryogenesis and organogenesis. Although the embryogenesis has been extensively explored, the literature relating to the organogenesis appears relatively deprived of adequate scientific attention. Gestational age is the age of unborn baby. Proper assessment of foetal well-being requires an accurate knowledge of gestational age of the fetus. Developmental status can be assessed by noting out the progressive differentiation, growth and maturation of the organ system of the body. Almost any organ system in the body may be used to assess developmental status, providing that it manifests progressive differentiation, growth and maturation.

Unfortunately, in the forensic context there are cases involving fetuses. Accurate age estimation of these fetuses can be very important to medico legal authorities, particularly as it is sometimes necessary to determine if these fetuses are those of a full-term or a pre-term fetus.

Age estimation of foetus can be done with the help of various parameters such as Ossification centres, Biparietal Diameter (BPD), Abdominal Circumference, Head Circumference, Crown Rump Length (CRL) & Length of the Long Bones.

In the literature all the above mentioned parameters were used for gestational age estimation using Ultrasonography (USG) and radiography. In majority of the forensic analysis there may be large variability in the emergence and development of the various analytical characteristics. Multiple criteria are more accurate than a single criterion and a narrow age tolerance is required if fetuses are to be accurately aged.

AIM & OBJECTIVE

The present study is aimed to correlate the values of various parameters such as Crown heel length, Biparietal diameter, Head circumference, Chest circumference, Abdominal circumference with the Gestational Age of fetus.

MATERIAL & METHODS

100 dead fetus preserved in 10% formalin solution in the Department of Anatomy, Kasturba Medical College, Manipal were analysed in this study. Crown heel length was measured using Non Stretchable Measuring Tape. This length was the distance between vertex to the heel. Biparietal diameter was measured using vernier calipers. Head Circumference was measured using Non Stretchable Measuring Tape, from the Occipital Protuberance to a point one centimeter above the Glabella. Chest Circumference was measured using Non Stretchable Measuring Tape, at the level of nipples. With the help of a Non Stretchable Measuring Tape, Abdominal Circumference was measured at the level of umbilicus.

All the Parameters were tabulated and subjected for Statistical Analysis. The results were analysed using SPSS version 14. A p-value of <0.05 was considered to be statistically significant. Linear regression analysis was used to calculate the coefficients for each parameter.

RESULTS & DISCUSSION

In the present study a total of 100 dead fetuses in the gestational age group of 13 weeks to 42 weeks were examined as shown in **Table 1.**

Table 1: Number of cases studied

Gestational age in weeks	Total Number
13	2
14	1
15	2
16	4
17	2
18	14
19	5
20	2
21	3
22	4
24	1
25	1
26	7
27	8
28	4
29	7
30	4
31	1
34	4
35	1
36	1
37	4
38	5
39	1
40	9
42	5
TOTAL	**100**

The gestational age was considered with 2 weeks interval starting from 13th week of intra-uterine life upto 42 weeks as depicted in **Table 2.**

Table 2: Total number of cases divided on the basis of gestational age of 2 weeks interval

Gestational age in weeks	Total Number
13-14	3
15-16	6

17-18	16
19-20	7
21-22	7
23-24	1
25-26	8
27-28	12
29-30	11
31-32	1
33-34	2
35-36	2
37-38	9
39-40	10
41-42	5
TOTAL	**100**

Any fetus less than 13 weeks was not obtained during the study period.

The study comprised of 52 male and 48 female fetuses as shown in **Figure 1.**

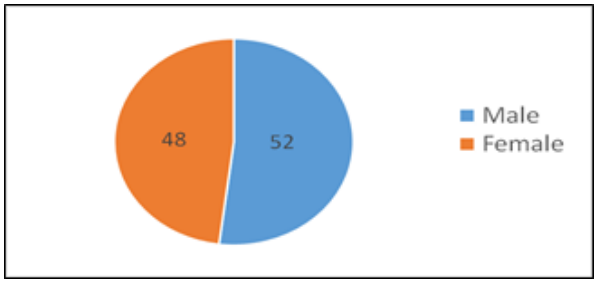


Figure No. 1: Gender wise distribution of cases

Crown Heel Length

The steady increase in crown heel length was observed as the gestational age of fetus increased as shown in Table 3.

Table 3: Distribution of Mean and standard deviations of crown heel length of fetus according to gestational age

Gestational age in weeks	Crown heel length [cm]	
	Mean	SD
13-14	11.27	0.64
15-16	15.38	1.20
17-18	19.50	1.02
19-20	23.79	1.35
21-22	27.14	1.07
23-24	30.00	-
25-26	32.75	0.71
27-28	34.42	0.73
29-30	36.68	0.96
31-32	39.00	-
33-34	42.50	0.71
35-36	44.75	1.06
37-38	47.00	1.00
39-40	49.90	0.32
41-42	52.40	0.55

With every unit increase in Crown heel length, the gestational age had an increment of 0.994 units (CI=0.701-0.733, p-value<0.001) as depicted in **Table 4.**

Table 4: Correlation between crown heel length and gestational age.

Parameter	Standardized Coefficients	p-value	95.0% Confidence Interval	
	Beta		Lower Bound	Upper Bound
Crown heel length	0.994	<0.001	0.701	0.733

Biparietal diameter

The steady increase in biparietal diameter was observed as the gestational age of fetus increased up till 25 – 26 week and again from 35 – 36 week onwards as shown in Table 5. There was no linear increase in biparietal diameter between 27 to 34 weeks of gestation.

Table 5: Distribution of Mean and standard deviations of biparietal diameter of fetus according to gestational age

Gestational age in weeks	Biparietal diameter [cm]	
	Mean	SD
13-14	2.50	0.00
15-16	2.78	0.26
17-18	3.61	0.49
19-20	4.17	0.63
21-22	4.37	0.66
23-24	6.30	-
25-26	6.56	0.62
27-28	5.59	0.63
29-30	6.96	1.54
31-32	5.50	-
33-34	6.35	1.20
35-36	7.40	0.14
37-38	8.29	0.25
39-40	8.66	0.98
41-42	9.08	0.71

With every unit increase in biparietal diameter, the gestational age had an increment of 0.916 units (CI= 3.332 – 3.974, p-value<0.001) as depicted in **Table 6.**

Table 6: Correlation between biparietal diameter and gestational age.

Parameter	Standardized Coefficients	p-value	95.0% Confidence Interval	
	Beta		Lower Bound	Upper Bound
Biparietal diameter	0.916	<0.001	3.332	3.974

Head circumference

The steady increase in head circumference was observed as the gestational age of fetus increased up till 23 – 24 week and again from 35 – 36 week onwards as shown in **Table 7**. There was no linear increase in head circumference between 25 to 34 weeks of gestation.

Table 7: Distribution of Mean and standard deviations of head circumference of fetus according to gestational age

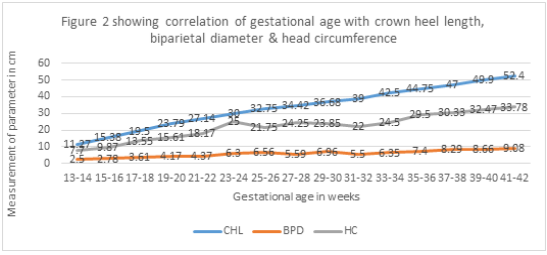
Gestational age in weeks	Head circumference [cm]	
	Mean	SD
13-14	7.70	1.21
15-16	9.87	1.09
17-18	13.55	1.62
19-20	15.61	2.15
21-22	18.17	1.04
23-24	25.00	-
25-26	21.75	1.77
27-28	24.25	2.48
29-30	23.85	2.88
31-32	22.00	-
33-34	24.50	3.54
35-36	29.50	4.24
37-38	30.33	1.94
39-40	32.47	2.81
41-42	33.78	0.22

With every unit increase in head circumference, the gestational age had an increment of 0.952 units (CI= 0.987 – 1.122, p-value<0.001) as depicted in Table 8.

Table 8: Correlation between head circumference and gestational age.

Parameter	Standardized Coefficients	p-value	95.0% Confidence Interval	
	Beta		Lower Bound	Upper Bound
Head circumference	0.952	<0.001	0.987	1.122

The correlation between gestational age with crown heel length, biparietal diameter and head circumference has been depicted in **Figure 2**, which shows linear increase in the parameter according to the increase in gestational age.



Chest circumference

The steady increase in chest circumference was observed as the gestational age of fetus increased up till 23 – 24 week and again from 33 – 34 week onwards as shown in Table 9. There was no linear increase in chest circumference between 25 to 32 weeks of gestation.

Table 9: Distribution of Mean and standard deviations of chest circumference of fetus according to gestational age

Gestational age in weeks	Chest circumference [cm]	
	Mean	SD
13-14	6.50	0.69
15-16	8.83	1.34
17-18	11.84	1.42
19-20	13.17	1.29
21-22	14.93	0.67
23-24	20.00	-
25-26	19.45	1.17
27-28	21.13	1.57
29-30	19.77	1.51
31-32	18.20	-
33-34	20.85	3.75
35-36	26.50	1.41
37-38	28.50	3.38
39-40	28.75	3.11
41-42	32.50	1.50

With every unit increase in chest circumference, the gestational age had an increment of 0.956 units (CI= 1.049 – 1.187, p-value<0.001) as depicted in Table 10.

Table 10: Correlation between chest circumference and gestational age.

Parameter	Standardized Coefficients	p-value	95.0% Confidence Interval	
	Beta		Lower Bound	Upper Bound
Chest circumference	0.956	<0.001	1.049	1.187

Abdominal circumference

The steady increase in abdominal circumference was observed as the gestational age of fetus increased up till 23 – 24 week and again from 33 – 34 week onwards as shown in **Table 11**. There was no linear increase in abdominal circumference between 25 to 32 weeks of gestation.

Table 11: Distribution of Mean and standard deviations of abdominalcircumference of fetus according to gestational age

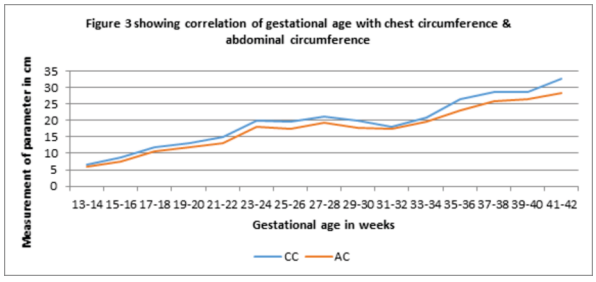
Gestational age in weeks	Abdominal circumference [cm]	
	Mean	SD
13-14	5.93	0.12
15-16	7.60	1.48
17-18	10.49	1.20
19-20	11.74	1.20
21-22	13.21	0.81
23-24	18.00	-
25-26	17.44	1.02
27-28	19.26	1.64
29-30	17.68	1.68
31-32	17.30	-
33-34	19.65	3.32
35-36	23.00	1.41
37-38	25.67	2.35
39-40	26.30	2.32
41-42	28.40	1.47

With every unit increase in abdominal circumference, the gestational age had an increment of 0.963 units (CI= 1.176 – 1.316, p-value<0.001) as depicted in **Table 12.**

Table 12: Correlation between abdominal circumference and gestational age.

Parameter	Standardized Coefficients	p-value	95.0% Confidence Interval	
	Beta		Lower Bound	Upper Bound
Abdominal circumference	0.963	<0.001	1.176	1.316

The correlation between gestational age with chest circumference and abdominal circumference has been depicted in **Figure 3**, which shows linear increase in the parameter according to the increase in gestational age.



CONCLUSION

As the gestational age of foetus increased there was linear increase in crown heel length (p value <0.001). With the increase in the gestational age there was a steady increase in biparietal diameter as the gestational age of foetus increased up till 25 – 26 week and again from 35 – 36 week onwards with (p value <0.001). There was steady increase in head circumference as the gestational age of foetus increased up till 23 – 24 week and again from 35 – 36 week onwards (p value <0.001).

As the gestational age of the foetus increased there was steady increase in chest circumference up till 23 – 24 week and again from 33 – 34 week onwards with (p value <0.001). The steady increase in abdominal circumference was observed as the gestational age of foetus increased up till 23 – 24 week and again from 33 – 34 week onwards. (p value <0.001).