

# Accuracy of fetal measurements in estimation of gestational age

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## Abstract

**Back ground:** Gestational age (GA) is a fundamental requisite at autopsy as well as for clinical assessment of growth of the fetus within the womb. Fetal parameters like anthropometric measurements and visceral developments can be used for calculation of GA. The present study was conducted with an aim of assessing the accuracy of fetal measurements like Foot length, Head Circumference, Crown-Rump length, Crown-Heel length and Abdominal Circumference for calculation of GA and to derive regression formulas for the same.

**Methods:** The study was conducted on 60 fetuses with known gestational age (calculated by obstetrical methods). The fetal measurements were measured as per the standard protocol.

**Results:** The study showed that there is a good correlation between gestational age and FL, HC, CRL, CHL and AC. FL was more accurate in assessing GA followed by HC, CRL, CHL and AC. The correlation coefficients of the equation & standard error of the estimate were 0.922 & 2.41088, 0.901 & 2.70397, 0.878 & 2.97715, 0.900 & 2.77665 and 0.886 & 2.89121 respectively for FL, HC, CRL, CHL and AC.

**Conclusion:** We conclude that fetal measurements like FL, HC, CRL, CHL and AC are reliable for estimation of fetal age. FL is more accurate than other fetal parameters for estimation of GA followed by HC, CRL, CHL and AC.

**Key words:** Gestational age, Foot length, Head Circumference, Crown-Rump length, Crown-Heel length, Abdominal Circumference.

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## Introduction

Gestational age (GA) estimation is an essential tool in Obstetrics to counsel the parents and to plan for appropriate perinatal care in cases of malformed fetuses and in conditions of recurrent abortion. GA estimation is also a prime requisite at fetal autopsy specially, in situations of criminal abortion, alleged infanticide, and in medical termination of pregnancy. Various fetal parameters are tested and found to be useful in assessing the GA (1,2). The commonly used parameters for estimation of GA are head circumference (HC), abdominal circumference (AC), crown-rump length (CRL), crown-heel length (CHL), femur length, foot length (FL) and head length (HC)(1,2,3,4). In this study we have assessed the accuracy of fetal measurements like HC, AC, CRL, CHL and FL for gestational age estimation.

## Materials and Methods

This is a retrospective study, conducted at a tertiary care teaching hospital and medical college, on 60 fetal autopsies performed between January to December 2012. The demographic details, measurements like HC, AC, CRL, CHL and FL were retrieved from the autopsy protocol. It is our routine practice to record measurements as per the standard protocol. HC is measured from glabella to the most prominent point posteriorly; AC was recorded at the level of umbilicus. By placing the foetus in supine position distance between the crown of the head to highest point on the trunk corresponds to CRL. The CHL, which corresponds to distance between crown of the head to the heel was recorded with the foetus in supine position with the leg extended. Foot length was recorded with the help of a scale along the medial border of the foot. All the parameters were recorded in centimetres to the nearest 0.1 decimal.

Statistical analysis was done using SPSS version 16. Linear regression equations were deduced to estimate GA from FL, HC, AC, CHL and CRL. P-value less than 0.05 were considered significant.

## Aims and Objective

To assess the accuracy of fetal measurements like FL, HC, CHL, CRL and AC for estimation of GA and to derive regression formulas for the same.

**Results**

The present study comprised of 60 fetuses ranging in GA from 15-41 weeks. Maximum number of cases were in GA of 32 weeks (6 cases), minimum number of cases were in GA of 15, 27, 29, 39 and 41 weeks (1 case each). There was no representation in the GA of 16, 17,23,35,38 and 40 weeks. The FL, HC, CRL, CHL and

AC and their means increased as the GA increases (Table 1) The GA in weeks calculated from FL, HC, CRL, CHL and AC showed good correlation with the GA obtained by obstetric method. FL was more accurate, followed by HC, CRL, CHL and AC (p Value <0.005). The regression equations along with correlation coefficients of the equation and Standard error of estimate for FL, HC, CRL, CHL and AC were shown in Table 2.

**Table 1: Showing the fetal anthropometric measurements and their mean**

GA	No of cases	Range of HC	Mean HC	Range AC	Mean AC	Range FL	Mean FL	Range CRL	Mean CRL	Range CHL	Mean CHL
15	1	16.4	16.4	10	10	2.3	2.3	15.5	15.5	24	24
18	3	18-19	18.5	14-15	14.5	3-4	3.5	17-18	17.33	27-28	27
19	2	18-19	18.5	14-15	14.5	3-4	3.5	21-21.5	17.5	28	28
20	5	16-21	18.6	15-19	16.8	3-4.5	3.6	16-19.5	18	24-31.5	28
21	3	18-21	20	16-18	17	3-4	3.6	15-19	18	26-31.5	28
22	3	17-26	20	15-18	17	3.5-4.5	3.9	16.5-24	20	25.5-34.5	30
24	5	20-25	22	15-18	17	4-6	4.5	17-22	20	27-36	32.5
25	2	20-26	23	19-20	19.5	4-6	5	20-23	21.5	34-35	34.5
26	4	21.5-28	24	17-24	20.5	4.5-5	5	20-26	23	31-40	36
27	1	24	24	20.5	20.5	5	5	23	23	36	36
28	5	24-28	25.5	17-24	20.5	4.4- 5.7	5	24-27	26	35-37.5	36.5
29	1	24	24	21	21	5.5	5.5	24	24	37	37
30	2	22-27	24.5	19-23	21	4.5-6	5.5	22-28	25	34-44	39
31	4	26.5-31	28.8	21-24	23	6-6.5	6	24-27	25.75	40-44	42.5
32	6	25.5-31	29	19.5-28	24	5.5-7	6	23-31.5	26.75	42-55.5	44
33	2	29	29	22	24.5	6.5-7	6.75	27.5-30	28.75	46.5-51	48
34	5	28.5-30	30	22.5-26.5	25	6.5-7	6.8	21-32	28.2	41.5-51	48
36	2	30	30	23-27	25	6.5-8	7.2	28-30.5	29	48-50	49
37	2	29-31	30	24.5-26	25.25	7-8	7.5	27.5-36	31	49-50	49.5
39	1	31	31	27	27	7.5	7.5	35	35	50	50
41	1	32	32	27	27	8.5	8.5	35	35	50	50

GA, Gestation estimation (cm); FL, Foot length (cm); HC: Head circumference; CRL: Crown-Rump length; CHL: Crown-Heel length; AC: Abdominal circumference; HL; (cm)

**Table 2: Regression equation for GA estimation.**

Equation	R	R <sup>2</sup>	SEE
GA=7.679+(3.795xFL)	0.922	0.848	2.41088
GA=1.007+(1.148xHC)	0.901	0.808	2.70397
GA=3.245+(1.017xCRL)	0.878	0.772	2.97715
GA=3.973+(0.623xCHL)	0.900	0.809	2.77665
GA=0.272+(1.326xAC)	0.886	0.786	2.89121

GA, Gestation estimation (cm); FL, Foot length (cm); HC: Head circumference; CRL: Crown-Rump length; CHL: Crown-Heel length; AC: Abdominal circumference; HL; (cm); R, Correlation coefficient; SE, Standard error of estimate (cm).

**Discussion**

GA estimation is an essential step for management of pregnancy. In autopsy practice it plays a pivotal role in medico legal and criminal abortion cases. Fetal anthropometric measurements are commonly used in both circumstances for calculation of GA. An obstetric GA estimation is facilitated by calculating the period of gestation from the date of last menstrual period, by measuring the fundal height and by anthropometric measurements with the help of ultrasound (5).

At autopsy GA estimation can be done by many methods, but the most commonly employed methods are measurements of fetal parameters like fetal weight, FL, HC, CRL, CHL, AC, fetal length, biparietal diameter, outer canthal distance, inner canthal distance, philtrum length, chest circumference, inter-nipple distance, small intestine length, and large intestine length (6). It is evident from the literature review and observation from our study that foot length gives the best GA assessment than other parameters (2, 7, 8, 9, 10, 11). Munro (12), in his study concluded that appearance of ossification

centres and fetal length are better parameters for GA. Hadlock (13). concluded that CRL is the better marker for GA. Panduranga et al.(2) and Kumar et al.(7) concluded both foot and hand length are reliable parameters for GA estimation. Various authors have derived regression formulae for various anthropometric measurements for calculation of GA (1, 4, 14, 15).

Visceral development has also been used by various authors for calculation of GA. Chikkannaiah et al. (1) and Kumar et al. (16) studied the sequential development of glomerulus and concluded that it is useful in deriving the GA. A significant correlation has been established between the period of gestation and immunohistochemical estimation of surfactant producing alveolar type II cells(17). Development of layers of skin is also useful for estimation of GA (18). Number of gyri crossed by a line drawn from the frontal to the occipital pole above the insula and adding 21 to the gyral count also helps in estimating the GA (19).

Even though our sample size is less, we had representation from all the fetal ages except 16, 17,23,35,38 and 40 weeks. In the present study we have assessed the accuracy of five commonly used fetal parameters for calculation of GA. Regression formulas for all the five were also given and our findings are in conclusion with the literature.

## Conclusion

To conclude GA estimation is an essential step at fetal autopsy. Among the anthropometric measurement FL is more reliable followed by HC, CRL, CHL and AC. Better results are possible if more than one parameters is employed for estimation of GA.

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