European Journal of Molecular & Clinical Medicine (EJMCM)
ISSN: 2515-8260 Volume 09, Issue 03, 2022

Original research article

Estimation of Foetal Gestational Age by Measuring the Head Circumference

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Abstract

Introduction: The estimates of age based on measurements of Head Circumference can be used as an alternative in pregnancy dating. These additional measurements taken provide a more 'universal view' of the foetal development than can be afforded by any single measurement. In the present study Bi-parietal diameter [BPD] & Head Circumference [HC] were measured to study the correlation and significance of this parameter with LNMP in estimating the foetal gestational age [FGA].

Material and Methods: In the Present study, a total of 100 antenatal women attending Out-Patient Department of Obstetrics and Gynaecology at Government Maternity Hospital, Sultan Bazaar, during the period of January 2016 to August 2016 i.e. for eight months were included in the study, undergone ultrasonography of multiple bone parameters including BPD & HC.

Result: BPD and LNMP and HC and LNMP value in Total estimating the FGA with correlation coefficient r value of 0.967 and 0.965 respectively, correlation was significant at < 0.01 level (p value 0.000) and < 0.01 level (p value 0.000) respectively. In second Trimester r value of 0.895 and 0.885 respectively, and correlation was significant at the 0.01 levels (p value 0.000) and < 0.01 level (p value 0.000). In 3rd Trimester r value of 0.771 and correlation is significant at < 0.01 level (p value 0.000) and 0.740 and correlation was significant at <0.01 level (p value 0.000). When the correlation coefficient r-values were compared, BPD (0.967), had highest r-value followed by HC (0.965), in the study population, as well as when compared trimester wise.

Conclusion: We concluded that ultrasonographically measured of BPD, and HC of the foetus is reliable predictors in estimating the foetal GA.

Key words: Bi-Parietal Diameter, Foetal Gestational Age, Head Circumference, and Ultrasonography

Introduction

Previously, estimation of gestational age was based on the history and physical examination like the menstrual history, maternal sensations of foetal movements, and assessment of uterine size by bimanual examination in 1st trimester, initial detection of foetal heart tones by doppler and uterine fundal height measurement. (1, 2) The estimation of FGA from menstrual history is done using Naegele's rule and it is the method that is universally used. By this rule, FGA is estimated by taking the first day of the LNMP and adds seven days to it, then subtracting three months and adds a year. This is assuming that the average length of the menstrual cycle is 28 days. In the fundal height method, depending upon the height of the fundus from the symphysis pubis, FGA will be determined. However, it has been reported that even in the best known cases, these techniques were filled with error (3). In most of the cases, the date of the last normal menstrual period is not known or there may be history of irregular menstrual cycles or may be on contraceptives and in such a case, estimation of FGA becomes difficult, hence the estimation of FGA by various parameters measured on ultrasonography will be very much useful. Ultrasonographic foetal biometry is the most wide spread method used to establish gestation age, estimate foetal size and monitor its growth.

FGA is proper assessment of the foetal well being requires an accurate knowledge of gestational age of the foetus. BPD is an accurate predictor of gestational age in the first trimester. After 20wks of gestation there is a progressive increase in variability about the mean for BPD, which makes estimation of gestational age littlie bite difficult. Hence sole dependence on BPD becomes relatively unreliable (4). Also sometimes the foetal position makes it difficult to measure the BPD. Therefore averaging the estimates of age based on measurements of HC can be used as an alternative in pregnancy dating.

These additional measurements taken provide a more 'universal view' of the foetal development than can be afforded by any single measurement. Furthermore the advantage of this method of measuring multiple parameters is that the same single ultrasound examination employed for BPD measurement is enough to measure all the multiple parameters without any potential hazard to both mother and the foetus.

It can also be used to confirm the gestational age estimated from BPD measurements. Hence, the present study was designed to assess the correlation between the various bony parameters measured on ultrasonograph and LNMP for estimation of FGA. In the present study BPD & HC were measured to study the correlation and significance of this parameter with LNMP in estimating the FGA.

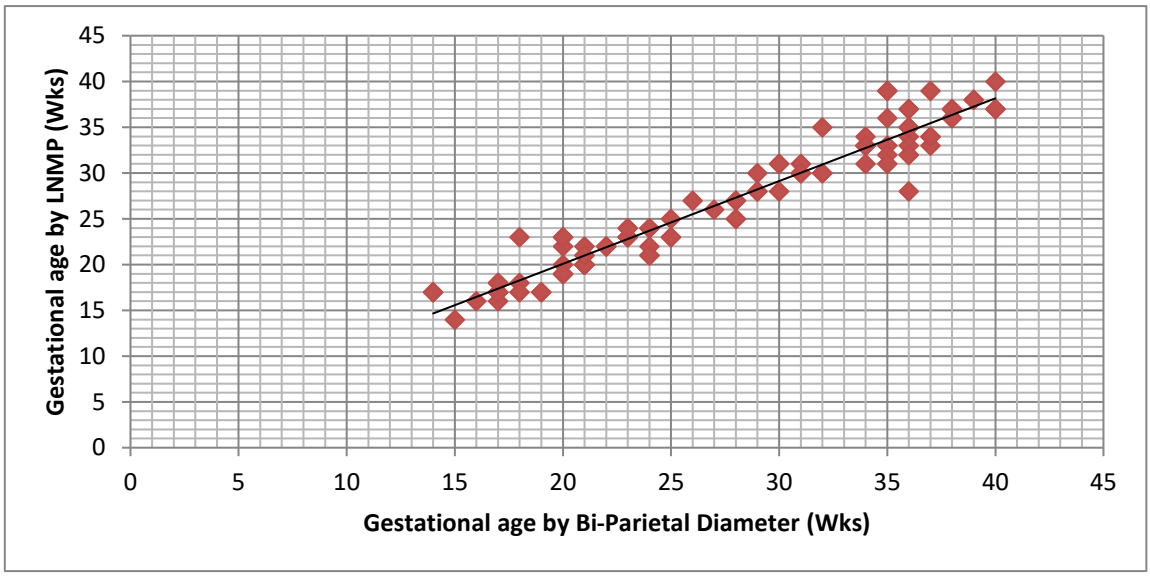
Material and Methods

In the Present study, a total of 100 antenatal women attending Out-Patient Department of Obstetrics and Gynaecology at Government Maternity Hospital, Sultan Bazaar, during the period of January 2016 to August 2016 i.e. for eight months were included in the study. The included patients were undergone the ultrasound scanning in the Hospital and the visibility on ultrasonography of multiple bone parameters including BPD & HC were obtained and tabulated. Multiple gestation, uncertain first day of last normal menstrual period, irregular menstrual cycle or <26 or >30 days, IUGR, major fetal abnormalities, and those who are having maternal complications were excluded from the study.

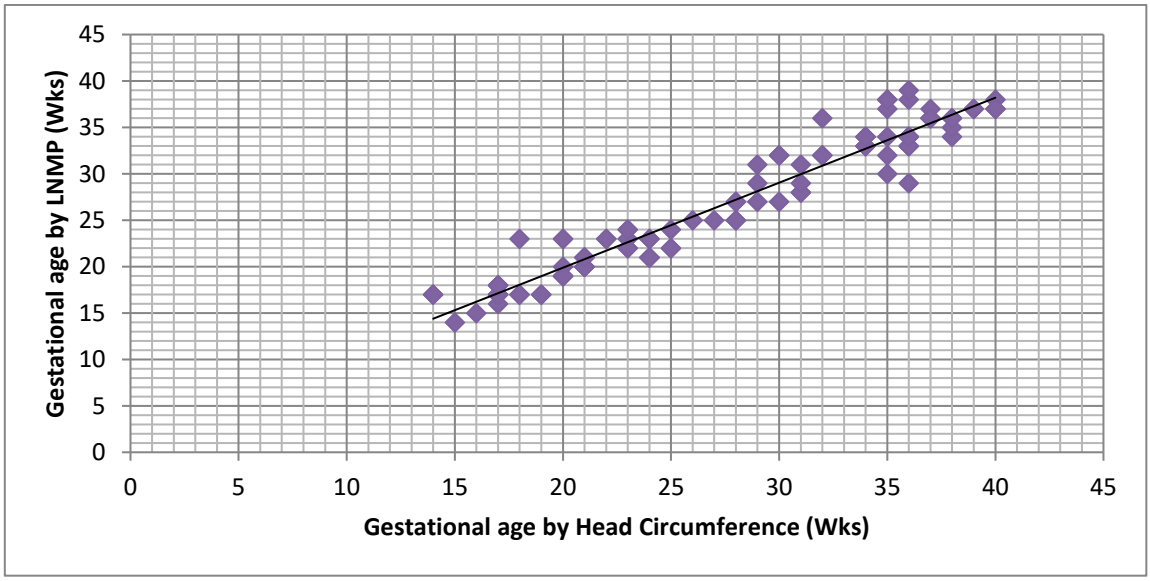
Results:

Table 1: Mean Gestational Age of the Foetus in Total participants, Foetus in second trimester, and Foetus in third trimester according to LNMP, BPD and HC

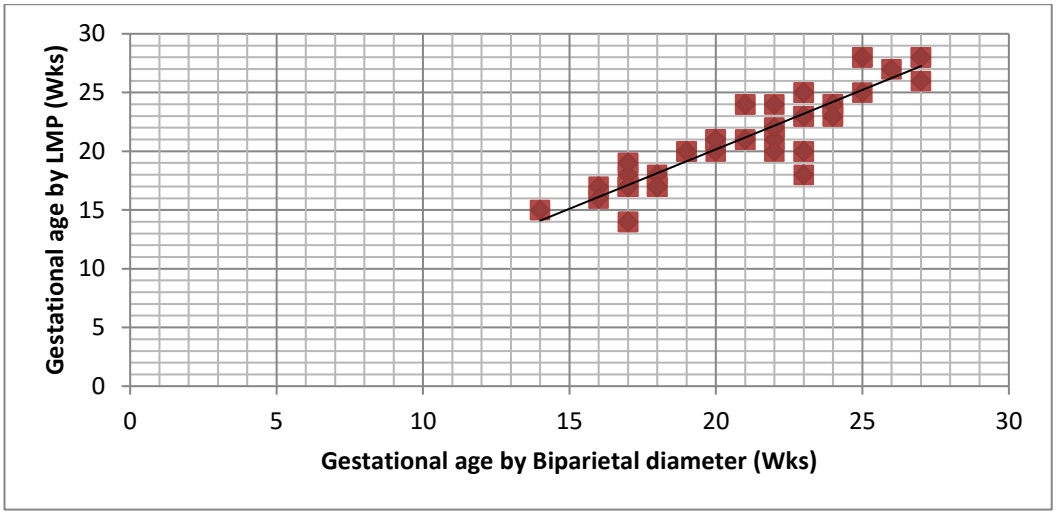
	Total			Second trimester			Third trimester		
	Bony parameter measurements in mm (Mean±SD)	GA in weeks Mean±SD	Range (weeks)	Bony parameter measurements in mm (Mean±SD)	GA in weeks Mean±SD	Range (weeks)	Bony parameter measurements in mm (Mean±SD)	GA in weeks Mean±SD	Range (weeks)
GA by LNMP	-----	27.62±7.70	14-40	------	21.02±3.71	14-28	------	34.77±3.08	29-40
GA by BPD	64.2±18.77	26.97±7.19	14-40	48.19±9.82	20.85±3.28	14-27	81.54±6.83	33.60±3.29	28-40
GA by HC	234.5±70.19	26.86±7.30	14-39	174.62±36.82	20.56±3.15	14-27	299.38±25.30	33.69±3.16	27-39



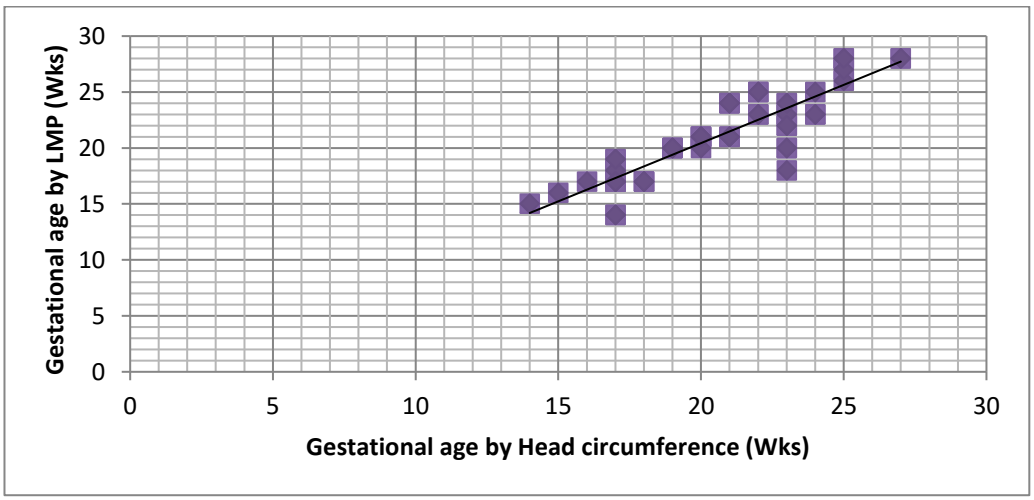
Graph 1: Correlation between BPD and LNMP in estimation of foetal GA



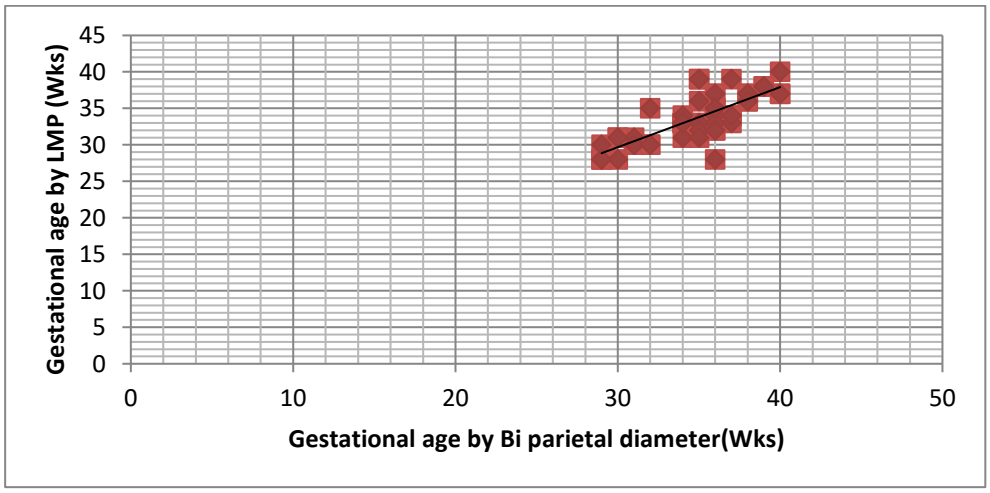
Graph 2: Correlation between Head Circumference and LNMP in estimation of foetal GA



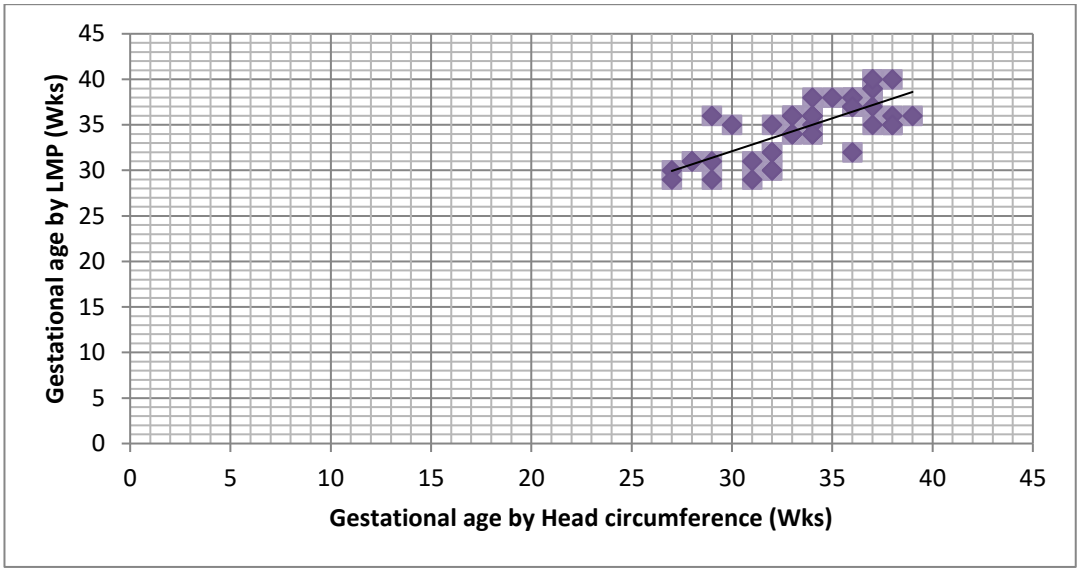
Graph 3: Correlation between BPD and LNMP in estimation of foetal GA in second trimester



Graph 4: Correlation between HC and LNMP in estimation of foetal GA in Second Trimester



Graph 5: Correlation between BPD and LNMP in estimation of foetal GA in third trimester



Graph 6: Correlation between HC and LNMP in estimation of foetal GA in third trimester

Table 2: Correlation coefficient values of various bony parameters in estimating the fetal GA

Bony Parameter	2nd trimester r-value (n=46)	3rd Trimester r-value (n=54)	Total study population r-value (N=100)
BPD	0.895	0.771	0.967
HC	0.885	0.740	0.965

Discussion

The most important aspect of pregnancy management is the assessment of gestational age. Gestational age is the estimation of age of an unborn baby. It is generally accepted that safe obstetric practice depends on the valid prediction of gestational age as it is the key for successful ante partum care and critical interpretation of antenatal diagnostic tests and successful planning of intervention. Uncertain gestational age is associated with adverse pregnancy outcomes including low birth weight, spontaneous preterm delivery and post dated pregnancy. Thus by knowing the appropriate gestational age, the follow up in obstetric practice becomes easy and improves the foetal and maternal outcome.

In this study, the antenatal women were grouped according to the age into two groups. It was observed that most of them (97%) belonged to the age group of 18- 27 years and only 3% of them were between the age group of 28 – 37 years. The Mean±SD of age of the patients was 22.1±2.58 years. The antenatal women when categorized according to the parity, it was observed nearly half of them (43%) belong to first gravida (Primi), 36% were in second gravida, 20% in third gravida and only 1% in fourth gravida. It was observed that 48% of the antenatal women included in the study population were in 2nd Trimester and 52% in third trimester. In the present study, when the distribution of the antenatal women according to the type of presentation was assessed, it was observed that majority were in cephalic presentation (72%). The other types of presentations observed were breech (10%), transverse lie (7%) and unstable lie (11%).

In the present study, the mean gestational age of the foetus, was calculated using various parameters likes last normal menstrual period (LNMP) and other bony parameters visualized on ultrasonography i.e., BPD and HC was given in the Table-1. And we observed that on analysis using Pearson correlation coefficient indicated a significant positive linear relationship between BPD and LNMP in estimating the foetal Gestational Age with correlation coefficient r value of 0.967 and correlation was significant at < 0.01 level (p value 0.000) was given in Graph 1, HC and LNMP value for gestational age with r value of 0.965 and correlation was significant at < 0.01 level (p value 0.000) was given in Graph 2.
In the present study, correlation of the various bone parameters and LNMP was also done according to the pregnancy trimester.

In second Trimester: when analysis using Pearson correlation coefficient was done, it indicated a significant positive linear relationship between BPD and LNMP value and between HC and LNMP value in estimating the foetal gestational age, with r value of 0.895 and 0.885 respectively, and correlation was significant at the 0.01 level (p value 0.000) and < 0.01 levels (p value 0.000) was given in Graph 3 and 4.

In 3rd Trimester: On analysis using Pearson correlation coefficient indicated a significant positive linear relationship between BPD and LNMP value and between HC and LMP value in estimating the foetal Gestational Age with r value of 0.771 and correlation is significant at < 0.01 level (p value 0.000) and 0.740 and correlation was significant at <0.01 level (p value 0.000) was given in Graph 5 and 6.

The obtained correlation coefficient values for different bony parameters, when compared it was observed that irrespective of the trimester, individually all the bony parameters were having a significant positive linear relationship with LNMP in estimation of foetal gestational age and BPD with more linear relationship compared to others. When the study population was analysed according to the trimester and the correlation was assessed, it was observed that the r- value of all the bony parameters during the second trimester was slightly higher than 3rd trimester, indicating that all these parameters were more linearly associated with LNMP in estimating GA. In this study, it was also observed that from the correlation value of composite GA and Average GA with LNMP for estimating foetal GA, showed significant positive linear relationship.

For estimating the fetal gestational age, various bony parameters were measured under ultrasonography guidance. Both the BPD and HC are measured in the plane which includes cavum septum pellucidam, thalamus and choroid plexus in the atrium of the lateral ventricles. The BPD has greatest accuracy between 12-28 weeks and is measured from the outer table of the skull to the inner table of the skull at the parietal bones and it is the widest transverse diameter of the foetal head. HC is measured around the outer table of the skull. The Disadvantage of BPD is that it disregards the shape of the cranium. i.e., two heads of equal widths but different lengths will have the same BPD's, but the longer head will have a greater corrected BPD or HC than the shorter head.
Corrected BPD is calculated using the below formula:

Shape Corrected BPD = BPD X FOD*/1.265
*FOD- Fronto-occipital Diameter.
When this shape correction is performed the BPD is equivalent to the head circumference, as a predictor of menstrual age as is it becomes shape independent (5).

When the correlation coefficient r-values were compared, Bi-Parietal Diameter (0.967), had highest r-value followed by Head Circumference (0.965), in the study population, as well as when compared trimester wise. It indicates that BPD is having more linear relationship with LNMP value in estimating the gestational age when compared to the others.

Our study findings are comparable to that of the study done by DP Gupta et al, 2013, in which they assessed the correlation of BPD and HC and observed that these parameters shown significant linear relationship with LNMP values in estimating the foetal gestational age. (6)
When the study population was analysed according to the trimester and the correlation was assessed, it was observed that the r- value of all the bony parameters during the second trimester was slightly higher than 3rd trimester, indicating that all these parameters worsened progressively as pregnancy proceeded. The similar finding were seen in the previous studies and suggested that the accuracy of estimating fetal age in 2nd and 3rd trimester decreases as pregnancy progresses due to increasing biological variation. The gestational age estimates done early in the 2nd trimester were more accurate than measurement done later in the second trimester or in the third trimester (7, 8). In general, the accuracy of gestational age prediction in the 2nd trimester is approximately +7 days before 20 weeks and +10 days after 20 week; the accuracy of fetal age prediction in the 3rd trimester is about +21 day (9, 10).

Normally, the ultrasonographic parameters assessed during the first trimester were the best predictors in estimating the foetal gestational age. But unfortunately, in developing countries, most of the antenatal women come for their first check up after their first trimester (11). In many studies it was reported that in second trimester, corrected bi-parietal diameter and head circumference were more accurate predictors in estimating gestational age than femur length and abdominal circumference. In the third trimester, corrected bi-parietal diameter, head circumference were the best indicators compared to the abdominal circumference (12).

Conclusion

From the present study, it was concluded that ultrasonographically measured bony parameters like Bi-Parietal Diameter, and Head Circumference of the foetus are reliable predictors in estimating the foetal gestational age. By estimating the foetal gestational age, appropriate measures can be taken to prevent the pre-term deliveries / maternal complications / post dated pregnancies, thereby decreasing peri-natal morbidity and mortality.

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