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Morphometric Analysis of Foetal Biparietal Diameter and Head Circumference Using Ultrasonography in the Assamese Population

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ABSTRACT:

Introduction: The period of intrauterine development constitutes one of the most vulnerable phases in the life cycle, with a lasting profound influence on subsequent growth. It is universally acknowledged that size at birth is an important indicator of foetal and neonatal health. Size at birth is the product of duration of gestation and rate of foetal growth. to evaluate the growth pattern of biparietal diameter (BPD) and head circumference (HC) of foetuses Assamese population, which is our local sample of population belonging to state Assam situating in the north-east part of country India. **Materials and method:** This study was carried out in Five hundred and fifty pregnant women attending to the Obstetrics and Gynecology outpatient department as well as those who were admitted as indoor patient in this department of Gauhati Medical College and Hospital. **Results:** Regarding the study group our demographic data Most of the pregnant women were within age group of 21-25(50 %). No. of cases between age group of 26-30 yrs is 220 (40%) and between age group of 31-35 is 40 (8%). No. of cases with 20 years and below is 11(2%) and no. of cases above 35 is 0. **Discussion**: The comparison of our result in the present study with Hadlock`s scale which was compiled in 1984 with help of his co-workers based mainly on Caucasian population and which is commonly used as reference chart for our foetal growth and also with the scale compiled by S.Campbell.

Keywords: Morphometry, Biparietal, head circumference, ultrasonographic, foetal.

1. Introduction

The period of intrauterine development constitutes one of the most vulnerable phases in the life cycle, with a lasting profound influence on subsequent growth. It is universally acknowledged that size at birth is an important indicator of foetal and neonatal health. Size at birth is the product of duration of gestation and rate of foetal growth. The effects on foetal growth of differing sex, race, and exposure to common growth promoting and growth-inhibiting environmental influences do not appear to diverge until the late second or early third trimesters. Several studies in different countries have shown that differences exist in the growth pattern of different foetal measurements in different ethnic groups.
Women from the Indian subcontinent have babies that are, on average, 100-400g smaller at term than their Caucasian counterparts (1,2,3,4). Several authors have therefore suggested that it is inappropriate to assess the birth weight of Indian babies using Caucasian birth weight standards (5,6,7). As fetal size is also likely to be different in the two populations, the use of Caucasian derived standard for abdominal circumferences (AC) and estimated fetal weight (EFW), the two most widely used ultrasonic measures of foetal size, may be equally inappropriate.

Ultrasonic foetal morphometry is commonly used to assess fetal age and growth. This is also useful for medico legal purpose.
Although it has not been possible to distinguish nature from nurture in explaining the differences in mean birth weight for gestational age between different racial groups, it is difficult to imagine any environmental influence that would lead to faster growth early in the third trimester and slower growth later on.
Unless evidence is produced to the contrary, differences in the rate of growth at different periods of gestation seem likely to be genetically determined. These differences are, however, small.

Variation in stature and other dimensions associated with age, sex and race are clearly too some degree genetically conditioned, but nutritional levels also have profound effects especially in regard to race. (8,9,10)
Differences in method of assessing gestational age, socio-economic status, and altitude, as well as inclusion or exclusion of multiple births, stillbirths, or infants with congenital anomalies are probably far more responsible than race for the differences between the existing reference curves. In summary, fetal sex is a major influence on birth weight, but since current knowledge does not confirm large genetic differences in birth weight among various populations and therefore does not support the use of separate, race-specific reference curves where race is associated with other risk factors, such as poor nutrition or low socio-economic status. Thus, the use of a single, sex-specific international reference is recommended. But several studies shows that difference in fetal body proportion do exist between some races.

Of the current available methods, diagnostic ultrasound has been postulated to be the best mode of estimation for obtaining certain foetal dimensions that correlate with foetal weight. The measurements of foetal anatomic part by sonography has provided a direct way of assessing foetal size and weight and thus can predict foetal weight more accurately.
Since the introduction of modern ultrasound to obstetrics in the mid 1960 it has become possible to visualize the foetus and to make direct measurements of foetal anatomy (11,12,13,14,15)

to evaluate the growth pattern of biparietal diameter (BPD) and head circumference (HC) of foetuses Assamese population, which is our local sample of population belonging to state Assam situating in the north-east part of country India

2. Materials and Method

This study was carried out in Five hundred and fifty pregnant women attending to the Obstetrics and Gynecology outpatient department as well as those who were admitted as indoor patient in this department of Gauhati Medical College and Hospital. The study was approved by the ethics committee, and before the inclusion of the patient, informed consent was obtained.

Sonographic machine is a real time gray scale scanner Make-WIPRO-GE,model RT-3200,Advantage 11.
The BPD is the maximum linear distance between foetal parietal bones at the accurately determined landmark, originally proposed by Hadlock (16). The anatomical landmarks used to ensure the accuracy and reproducibility of the measurement include: 1) a midline falx, 2) the thalami symmetrically positioned on either side of the falx, 3) visualization of the Septum Pellucidum at one third the frontooccipital distance.4) The Basal cisterns .A wrong measurement plane can produce errors up to 20mm.
The HC is used similar to the BPD for dating. The head circumference is measured on the same section as biparietal diameter. The computer is used to sum the distance between a series of dots put around the perimeter of the foetal skull by electronic digitizer.

Inclusion criteria
The patients consisted of Local Assamese population from both rural and urban areas in and around the city of Guwahati and belonging to different socioeconomic classes. And also belonging to different races that is tribes and non-tribes of Assamese population

Exclusion criteria
Patients were excluded if they: were not from Assam; had a twin gestation; had a stillbirth; previously delivered a foetus with a congenital foetal anomaly or known chromosomal abnormality; had a diagnosis of either gestational diabetes mellitus, preeclampsia and/or HELLP syndrome or chronic hypertension; had inadequate glucose testing to rule out gestational diabetes; had inadequate gestational dating; smoked cigarettes during pregnancy; or had history of inter racial marriage.

Statistical analysis
The findings were presented as Mean Standard Deviation (SD). Shapiro-Wilks normality test and Kruskal-Wallis H test were applied to analyze the data set. The closeness of the percentile values of the studies was determined by hierarchical cluster analysis. Results were shown dendrogram graphics using the Ward Linkage method. A "P" value of 0.05 or less was deemed significant for all parameters.

3. Results

Regarding the study group our demographic data Most of the pregnant women were within age group of 21-25(50 %). No. of cases between age group of 26-30 yrs is 220 (40%) and between age group of 31-35 is 40 (8%). No. of cases with 20 years and below is 11(2%) and no. of cases above 35 is 0.

Table: 1 Gestational weeks specifics BPD and HC

Gestation(weeks)	Mean BPD(mm)	Mean HC(mm)
12	18±3	74± 5
13	21± 4.8	83± 7.8
14	25± 4	98± 1.8
15	30± 3.5	110± 10.4
16	32± 3	125± 7.5
17	38± 2.7	138± 9.2
18	40± 5.6	150± 16.4
19	43± 3.5	155± 7.9
20	47± 3.6	175± 9
21	49± 5.6	179± 15.1
22	53± 3.8	195± 11.6
23	56± 4.7	206± 20.9
24	60± 6	218± 15.9
25	62± 4.7	231± 14.2
26	64± 5.8	235± 21.3
27	67± 4.9	243± 22
28	70± 8.6	255± 19.5
29	71± 2.3	261± 9.7
30	73± 4.9	274±28.1
31	75± 4.2	279± 15.3
32	77± 6.2	289± 12.7
33	79± 5.8	291± 11.6
34	81± 6.4	294± 25.4
35	83± 8	298± 12.9
36	84± 5.8	301± 21
37	85± 4.3	306± 23.4
38	86± 6	310±21.9
39	87± 6.5	313± 18.8
40	88± 7.7	316± 18.4
41	89± 3.6	317± 10.3
42	89.5± 4.2	317± 20.1

(Values are expressed as mean standard deviation, significance levels of $p< 0.05$)

Fig: 1 ultrasound image of BPD

Fig: 2 ultrasound image of HC

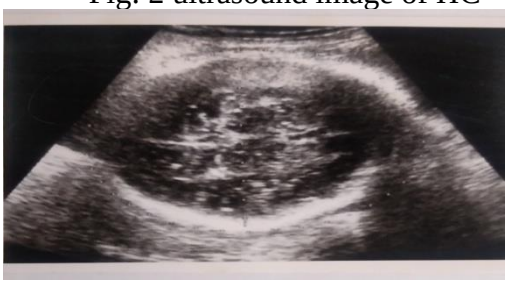
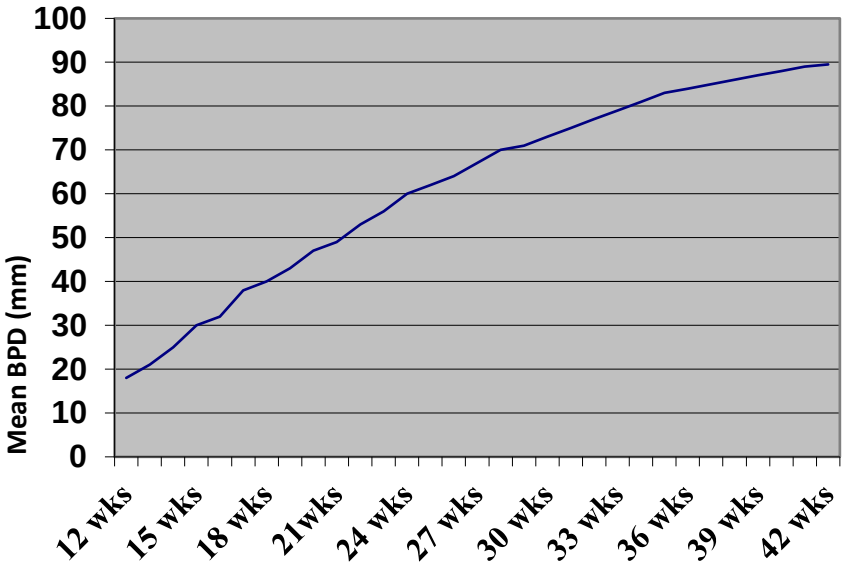
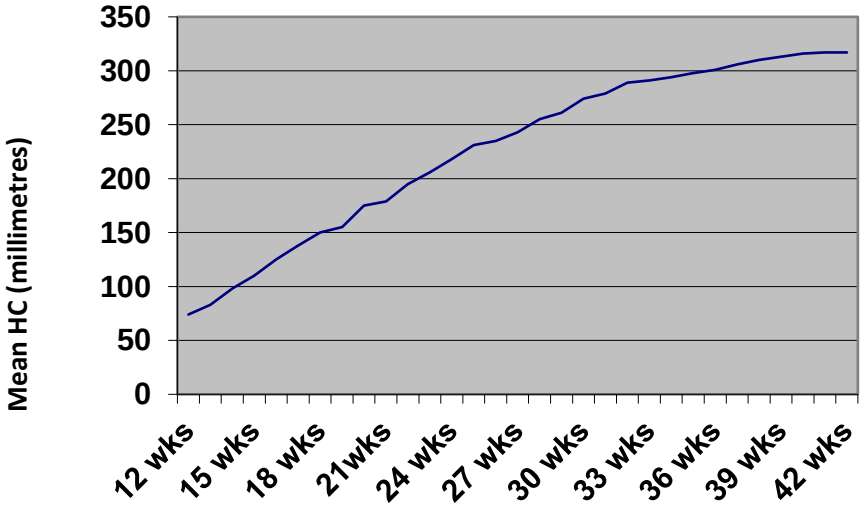


Fig: 3 measurement of BPD



From fig 3, it is seen that there is a rapid increase in BPD up to 28 weeks. After 28 weeks of gestation the centiles showed a slower growth rate toward 42 weeks.
The rate of growth of BPD in the study was observed to be about 3 to 5 mm per week between 12 –28 weeks and about 2 mm per week between 28 to 34 weeks.
There after the growth of BPD was markedly slowed down and it was only about 1 mm per week between 34 to 41 weeks and only 0.5 mm per week after 41 weeks.

Fig: 4 Measurement of HC



From fig 4, it is seen that there is a rapid increase in HC up to 32 weeks. After 32 weeks of gestation the centiles showed a slower growth rate toward 42 weeks.
The rate of growth of HC in the study was observed to be about 10-14 mm per week in most of the weeks between 12 –32 weeks and about 3-5mm per week between 32 and 40 week.

There after the growth of BPD was markedly slowed down and it was only about 1 mm per week after 40 weeks.

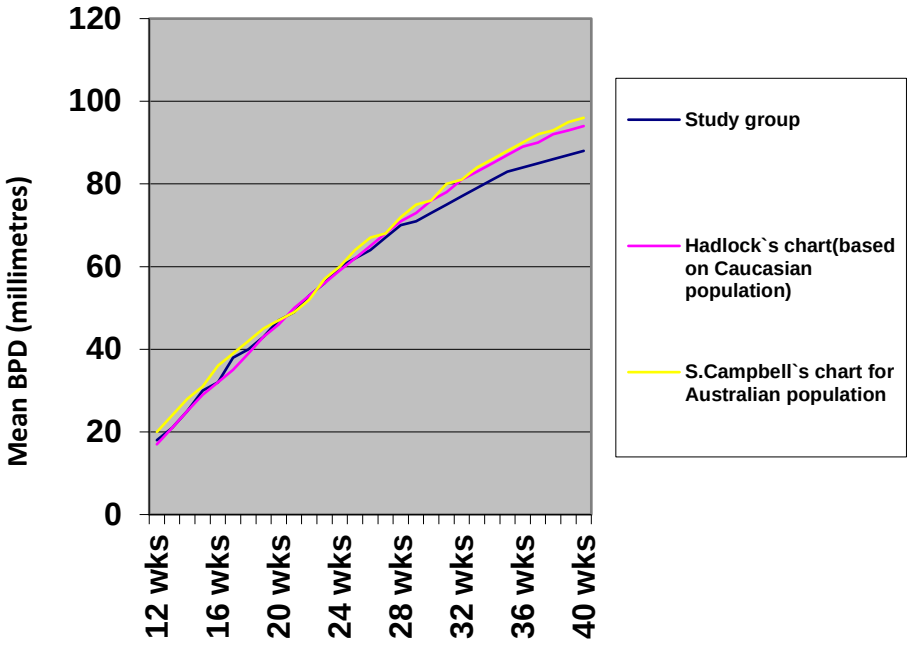
4. Discussion

The present study "ultrasonic foetal morphometry of Assamese population" was carried out on five hundred and fifty normal pregnant women who were sure of their last menstrual period between 12 to 42 weeks of gestation. Patients were excluded if they were not from Assam; had a twin gestation; had a stillbirth; previously delivered a foetus with a congenital foetal anomaly or known chromosomal abnormality; had a diagnosis of either gestational diabetes mellitus, preeclampsia and/or HELLP syndrome or chronic hypertension; had inadequate glucose testing to rule out gestational diabetes; had inadequate gestational dating; smoked cigarettes during pregnancy; or had history of inter racial marriage.
Relevant history was taken and the morphometry of the foetuses was done by ultrasound. Most commonly used parameters BPD, HC, were measured. The ultrasonic examinations were performed by a real time gray scale scanner machine with a convex curvilinear probe of 3.5 MHz frequencies.

The principal aim was to evaluate the growth pattern of foetuses of Assamese population, which is our local sample of population belonging to state Assam situating in the northeast part of country India. Secondly to compare the growth pattern of different foetal parameters of our local population with established growth charts of other races.
In the study most of the patient came from the urban area (70%) in and around the city of Guwahati .The percentage of patient from rural area was 30%. Of the total number of cases in the study 68% were from middle class socioeconomic condition. About 10% of the cases were from upper class. There were 60% primigravida and 40% multigravida.
Most of the patients in study were in the age group of 21-25 years (50%). There were 40 % of women in age group of 26-30 years and 8% in the age group of 31 –35 years. There were only 2% of cases at age group of 20 and below and no patient above 35 years.
The pregnant women in the study belonged to Assamese population (local population of Assam in the northeast part of India). The study did include both the tribes and non-tribes of Assamese population but maximum numbers of cases were non-tribes (96%) and only 4% of the cases were tribe.

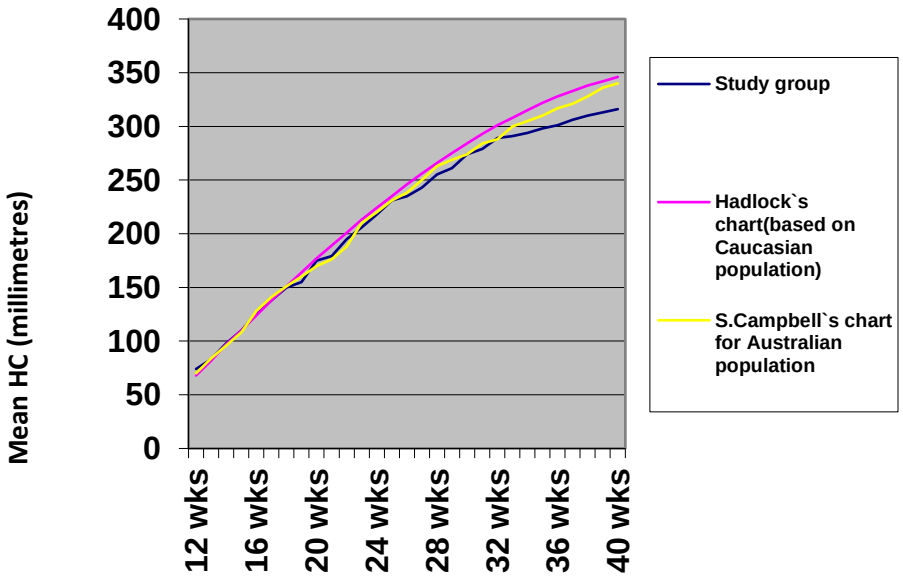
The mean BPD, HC obtained in the study are plotted in the graph against the corresponding gestational weeks calculated from LMP.
It is observed that the growth of BPD from 12 weeks onwards is fairly rapid and relatively constant until 28 weeks. After that it gradually slows down and after 34 weeks BPD growth is observed to be slightly less and from 41weeks onwards there is marked flattening of curve.
In case of HC, it is seen that after 32 weeks there is a marked flattening in the growth curve.
The comparison of our result in the present study with Hadlock`s scale which was compiled in 1984 with help of his co-workers based mainly on Caucasian population and which is commonly used as reference chart for our foetal growth and also with the scale compiled by S.Campbell revised in 2001 for Australian population is shown in figure 1 and 2 (17,18).

Fig: 5 Mean BPD



From the fig 3, it is observed that the growth of BPD in our study is parallel to that of Hadlock`s chart and S.Campbell`s chart for Australian population upto 28 weeks of gestation and the rate of growth of BPD was observed to be about 3 to 5 mm per week between 12 –28 weeks. After which there is a slight flattening of growth of BPD and about 2 mm per week between 28 to 34 weeks. There after the growth of BPD was markedly slowed down and it was only about 1 mm per week between 34 to 41 weeks and only 0.5 mm per week after 41 weeks. The results obtained in the study after 28 weeks are at lower level to that observed in Hadlock`chart which is commonly used as reference chart and S.Campbell`s chart for Australian population.

Fig: 5 Mean HC



From the fig 4, it is observed that growth of HC in our study is parallel to that of Hadlock`s chart and S.Campbell`s chart upto 20 weeks of gestational age, after which there is a slight flattening of growth of HC in our study as well as S.Campbell`s study in comparision with that of Hadlock`s study. After 25 weeks, growth of HC in our study is at lower level to that observed in Hadlock`s as well as S.Campbell`s study (19,20). After 32 weeks there is a marked flattening in the growth curve of our study.

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