

# A COMPARISON OF FETAL BIPARIETAL DIAMETER MEASUREMENTS BETWEEN LOCAL CHINESE AND CAUCASIAN POPULATIONS

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## ABSTRACT

*Since the advent of ultrasound, various workers have published nomograms of the fetal biparietal diameters (BPD). In the Singapore General Hospital, the nomogram established by Campbell and Newman was adopted initially for our multi-racial society. Data from the cross-sectional study of the 1442 BPD measurements of the Chinese fetuses between 17 to 40 weeks showed that the mean BPD values of the Chinese fetuses are lower than the Caucasians. The 2 standard errors of the BPD of the Chinese fetuses does not lie within the 2 standard errors of the BPD of the Caucasian fetuses. The reasons for the difference remain speculative. The presence of the statistical difference between the two means and the 2 standard errors establishes the need for constructing nomograms for our own local reference.*

**Keywords:** ultrasound, biparietal diameter, nomogram

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## INTRODUCTION

In 1752, Smellie pointed out that it is the biparietal diameter which passes through the narrowest part of the brim of the pelvis<sup>(1)</sup>. Ultrasound measurement of the biparietal diameter in utero was introduced by Donald in 1959 and first reported in 1961<sup>(2)</sup>. In contemporary obstetrics, the measurement of biparietal diameter (BPD) offers an index in assessing gestational age, monitoring fetal growth and in estimating fetal weight<sup>(3-6)</sup>. Incorrect decisions and management can be made if BPD measurements derived from one population are used as the basis for decision making in a different population. Therefore, it is important for each population to establish its own normal growth curve of biparietal diameter. Results of biparietal diameter measurements, mostly from European populations, have been published by various authors<sup>(7-11)</sup>. In our hospital, we initially adopt the nomogram established by Campbell and Newman<sup>(7)</sup>. The purpose of this presentation is to establish whether the biparietal diameter measurements in the Chinese population are similar to the BPD measurements of the Caucasian fetuses established by Campbell and Newman in United Kingdom in 1971.

If the difference between the means of the two populations is statistically significant, the validity of adopting the nomogram of the Caucasian population is questionable, hence the need to establish our own nomogram.

## METHODOLOGY

The majority of patients booked in the Singapore General Hospital are offered routine ultrasound examinations. Patients

are either self-referred or are referrals from the general practitioners, the Maternal and Child Health Care and private gynaecologists.

Repeat ultrasound scans are performed if there are indications such as assessment of fetal growth, placental localisation and liquor volume estimation. All data of the ultrasound examinations are entered into the computer at the time of the procedure.

Since Singapore is a multi-racial society, the patients consist of Chinese, Malay, Indians and others (Eurasians, Thais etc.).

Table I shows the racial distribution of the patients who delivered in the Singapore General Hospital between 1 December 1987 and 31 January 1989.

**Table I**  
Racial Distribution of Patients in SGH

Race	No. of patients	Percentage
Chinese	3124	58.7
Malay	1563	29.4
Indian	367	6.9
Others	267	5.0
Total	5321	100.0

The Chinese patients contribute the largest proportion of patients, followed by the Malays, and the Indians.

The study population is a subset of the total number of patients delivered in the Singapore General Hospital between 1 December 1987 and 31 January 1989. The Chinese patients are selected for comparison with Caucasian population purely because of sample size.

A total of 1442 Chinese patients between 17 weeks and 40 weeks with scans done were analysed retrospectively. The selected patients fulfilled the following criteria:

- Pregnancies were single and uncomplicated;
- Their menstrual cycles were monthly and regular. The exact date of onset the last normal menses was known;
- Delivery occurred within two weeks of the expected dates of delivery.

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The biparietal measurements were made as part of the routine ultrasound scans using the Aloka 280. Majority of the measurements were done by an experienced trained ultrasonographer. The biparietal diameter was measured from the outer edges of the skull echoes. It was measured perpendicularly to the midline. Higher gain settings which may erroneously increase the apparent thickness of the skull were avoided. Only one ultrasound measurement per patient was considered, hence allowing single reading of BPD for each patient to be included in this study data.

The BPD database were retrieved from the Antenatal Clinic computer and related to the perinatal database in the Labour Ward. The database were indexed to the patients' identity number and a true cross-sectional database was created, ensuring that none of the patients were represented more than once even if they may have received more than one scan in their pregnancies.

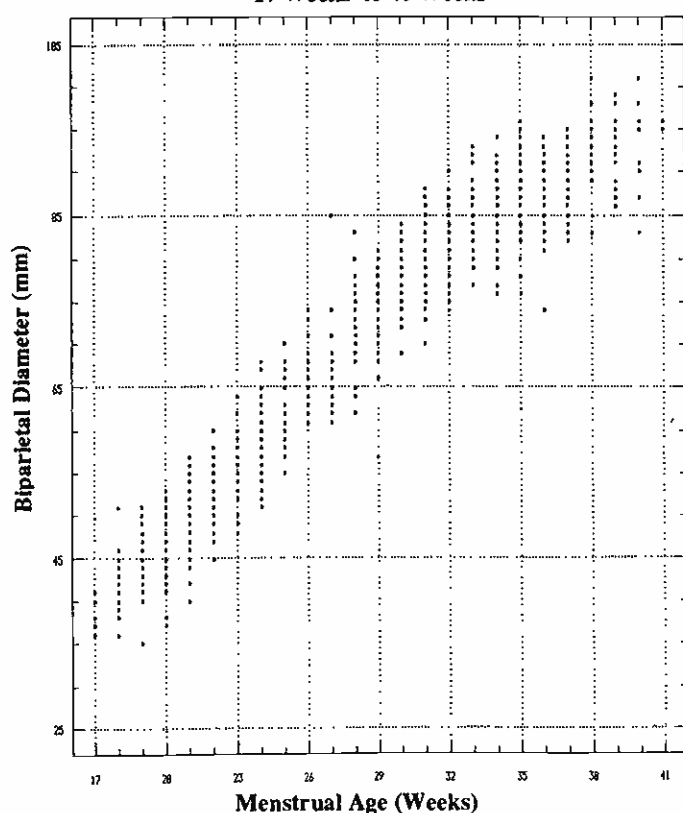
## RESULTS AND ANALYSIS

The 1442 measurements of the BPD obtained from the 1442 Chinese pregnant women from 17 weeks to 40 weeks were analysed. This represented 46.1% of the Chinese patients who delivered within the above stated time frame. The remaining 53.9% either did not fulfill the above criteria, did not have ultrasound scans done within 17 weeks and 40 weeks, or did not have any ultrasound scans done at the study location.

The menstrual age or the period of amenorrhea were classed as follows: patients with period of amenorrhea from 16.5 weeks to 17.4 weeks were classed as 17 weeks whilst patients from 17.5 weeks to 18.4 weeks were classed as 18 weeks and so forth.

Of the 1442 babies delivered, 722 (50.1%) and 720 (49.9%) were male and female respectively.

**Fig 1**  
Scattergram of BPD in Chinese Patients in SGH from 17 Weeks to 40 Weeks



## Biparietal Diameter and Menstrual Age

The values of the biparietal diameter measurements of the corresponding menstrual age are represented on the scattergram (Fig 1).

The means and the 2 standard deviations of the study population are illustrated in Table II. They are represented graphically in Fig 2. These values and the standard errors of the Chinese population are then compared to the data obtained by Campbell and Newmar as in Table III and depicted graphically in Fig 3.

**Table II**  
Mean Fetal Biparietal Diameter Values with 2 Standard Deviations for Each Week of Pregnancy from 17 Weeks to 40 Weeks in the Chinese and Caucasian Population

Gestation (weeks)	Chinese population		Caucasian population	
	No. of Measurements	Mean (2SD) (mm)	No. of Measurements	Mean (2SD) (mm)
17	6	38.00 (4.20)	30	40.1 (2.6)
18	38	41.70 (6.20)	44	43.9 (2.8)
19	77	44.39 (5.44)	36	47.2 (3.0)
20	97	47.02 (6.50)	45	50.2 (2.8)
21	78	49.77 (7.00)	35	53.5 (3.2)
22	41	52.80 (7.00)	35	56.7 (3.0)
23	54	55.67 (7.24)	33	61.0 (3.6)
24	45	59.22 (7.40)	33	64.3 (3.6)
25	29	62.48 (8.16)	36	67.2 (3.0)
26	36	66.55 (5.94)	29	69.5 (3.2)
27	31	68.03 (9.08)	31	72.9 (3.6)
28	55	72.58 (8.24)	42	75.8 (3.6)
29	47	74.57 (8.52)	35	78.5 (3.8)
30	69	77.56 (6.46)	30	81.3 (4.0)
31	82	79.32 (8.12)	53	83.3 (3.4)
32	100	81.47 (9.96)	47	85.8 (4.2)
33	93	85.01 (6.40)	35	88.6 (3.6)
34	119	85.96 (6.74)	39	90.0 (4.0)
35	104	87.40 (6.76)	44	92.2 (4.8)
36	85	88.40 (6.64)	41	93.2 (3.8)
37	86	89.52 (7.16)	48	95.0 (4.4)
38	44	92.18 (6.68)	52	96.3 (4.8)
39	20	92.50 (7.58)	41	97.4 (5.6)
40	9	92.89 (11.28)	29	98.1 (5.4)

There is a progressive increase in the biparietal diameter with increasing weeks of pregnancy. The mean values of the Chinese population are lower than the Caucasian population for the corresponding menstrual age but describe a similar asymptotic curve as in the Caucasian population. The 2 standard deviations of the Chinese population are almost twice the Caucasian population which implies that the dispersion of values about the mean is more.

The confidence limits (5th and 95th percentile) of the means for both populations were determined. (The confidence limits are the limit values whereby the true mean of the universe from which the sample was taken would lie). This implies that the confidence limits of the means of the Chinese population is the limit where the true mean of the Chinese women in the Singapore General Hospital would lie and likewise for the Caucasian population. Fig 3 clearly indicates that the confidence limits of the 2 populations do not overlap suggesting that the 2 populations are entirely different.

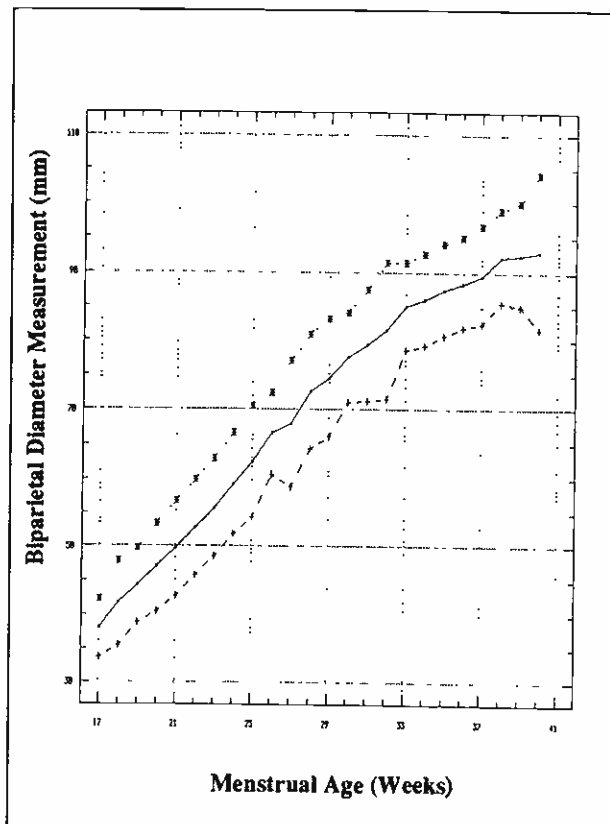
## DISCUSSION

Okupe and Coker found that the growth of the BPD in their Nigerian

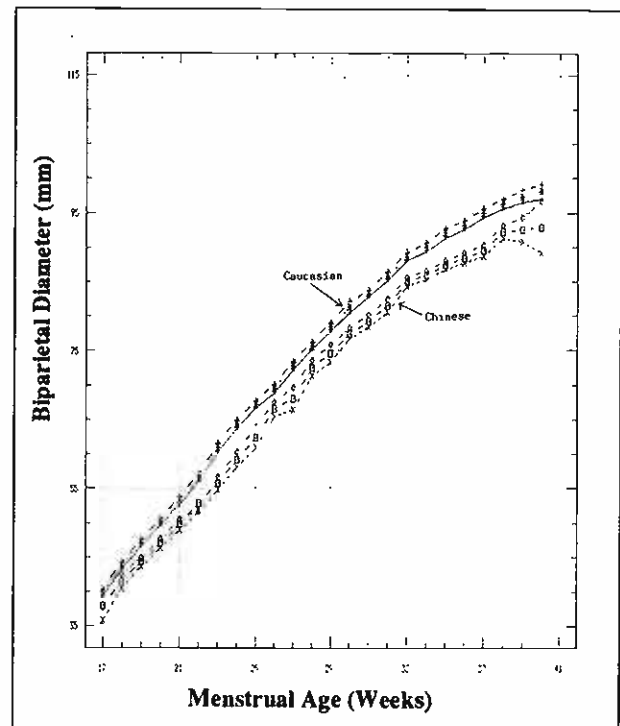
**Table III**  
The Value of 2SE of Chinese and Caucasian Patients

Gestation Weeks	Chinese 2SE	Caucasian 2SE
17	2.14	0.48
18	1.02	0.43
19	0.62	0.51
20	0.66	0.42
21	0.79	0.55
22	1.09	0.51
23	0.98	0.64
24	1.10	0.64
25	1.51	0.51
26	0.99	0.61
27	1.63	0.66
28	1.11	0.56
29	1.24	0.65
30	0.78	0.75
31	0.90	0.47
32	0.99	0.62
33	0.66	0.62
34	0.63	0.65
35	0.66	0.73
36	0.72	0.60
37	0.77	0.64
38	1.01	0.67
39	1.77	0.88
40	3.76	1.02

**Fig 2**  
Mean BPD and the 2 SD of Chinese Fetuses from 17 to 40 Weeks



**Fig 3**  
Comparison of the Means and 2 Standard Errors of Chinese and Caucasian Fetuses



population followed an asymptotic curve like the Caucasians<sup>(12)</sup>. Although their values were slightly higher, there was no significant difference between the measurements except towards term when their BPD showed reduced variability with narrowing of the standard deviation. Study of another African population by Ayangade and Okonofua revealed that the BPD values for the corresponding week were less compared to the Caucasian population<sup>(13)</sup>. In our study, the Chinese fetuses showed lower BPD values in comparison to the Caucasian fetuses.

Our data represents a retrospective cross-sectional study. The menstrual age of the subjects ranged from 17 weeks to 40 weeks. The small number in the 40 weeks category accounts for the wide variation with a 2 SD of 11.28. The methodology and patient selection are almost similar to the study conducted by Campbell and Newman<sup>(9)</sup>. In the paper presented by the two authors, a total of 1029 measurements were obtained from 574 patients with menstrual age from 13 weeks to 40 weeks. Of these patients, 383 had one reading and in the remaining 191 patients, 646 measurements were made. Hence, it is both a cross-sectional and longitudinal study.

The machine used by Campbell was the Dasonograph with a tissue speed calibrated at 1600 m/s which is 4% higher than the 1540 m/s tissue speed used in newer machines. In their study, the BPD was measured from the outer table of the proximal skull interface to the inner table of the distal skull interface (O-I). A four percent difference in tissue speed was compensated for by changing the O-I measurement to O-O measurement (also estimated to be 4% difference) to allow the nomogram constructed with O-I measurements to be used with the newer machines. This is a common practice in London hospitals. The methodological difference in measuring the BPD could not totally account for the marked difference of the measurements between our Chinese and their Caucasian patients.

The fetal growth is governed by two main factors: the genetically determined intrinsic growth potential of the fetus

and the growth constraints from the mother<sup>(14)</sup>. Grundy and Hood in a prospective study of the birthweight standards in a mixed racial community found that babies of Indian mothers were approximately 300 gm lighter<sup>(15)</sup>. Applying the Aberdeen study data of the Caucasian population by Thomson et al 1968, 80% of Indian babies and 70% of West Indian babies were below the 50th centile. The most obvious observation accounting for the difference between the races were the height and weight of the mothers. Jordaan suggested that birthweights of babies are significantly correlated with the maternal stature and weight<sup>(16)</sup>.

In one of our prospective studies of 661 Chinese mothers who delivered at  $40 \pm 2$  weeks in the SGH between April 1990 and August 1990, the average height was 156.4 cm (SD = 5.4) and the average weight at delivery was 64.5 kg (SD = 8.2). The smaller statured Chinese are likely to deliver smaller size babies compared to the Caucasian. BPD variation within a population are related to the birthweight<sup>(16)</sup>. The average birthweight of the 661 infants was 3214 g (SD = 369).

Other postulations that could account for the differences between the two nomograms are the socio-economic, demographic and geographical factors and inter-observer error. The reasons for the observed difference remain speculative. More importantly, the purpose of the study has been achieved. Since the nomogram of the Chinese population does not lie within the 2 standard errors of the Caucasian population, we conclude that we need to establish our own nomogram. Data of head circumference, abdominal circumference and femur length will be analysed simultaneously with biparietal diameter in establishing the nomogram for our population. Inter-ethnic group data will also be compared to investigate any differences amongst the ethnic groups.

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