A REPORT ON BIRTHWEIGHT, HEAD DIMENSIONS OF INDIAN BABIES WITH A PRELIMINARY COMMUNICATION ON "MOULDING"

BY

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Of the two mechanical factors involved in labour I have already dealt with the Indian Female Pelvis in another Paper and here I propose to deal with the size of the foetus, particularly its head.

MacLennan has pointed out that a slight increase of birthweight may tip the balance against normal confinement. Similarly, an increase in biparietal diameter may also result in disproportion and cause difficulty. For normal confinement, there must be an average pelvis, an average baby and an average amount of endurance of mother. The object of the present work is mainly to determine the average weight of Indian babies that are found here and also the average dimensions of the head, specially biparietal, at various stages of pregnancy, particularly at or near term. Along with this, I have tried to measure changes in the biparietal diameter that takes place during the process of labour. This cannot be exactly representative of the so-called moulding which, according to Moloy, is a change in shape affecting not only the vault but also the base of the foetal skull.

Previous works of Hastings Ince of London, published in 1939, pointed out that there is some statistical relationship between the biparietal diameter of the head and its birthweight. He produced a regression equation correlating these factors.

Clifford has constructed a table from observations of 479 babies which gives the average and minimum weights of babies which may be expected from a known occipito-frontal diameter of the skull. This table, however, is statistically incomplete.

Reece, Scammons and Calkin have calculated a table of foetal maturity from its biparietal diameter and have shown that the relative increases in the size of the diameters of the head bear a constant relation to the maturity. The latter authors state that the foetal head grows to the extent of 2.5 mm. per week. Chassar Moir thinks it to be 2 mm. and he states later that when the head is measured at birth and again 24 hours later it is usual to find that the biparietal diameter has increased by 1 or 2 mm. This may be more in those cases where the head is less ossified than normal. This he takes to be an evidence of moulding affecting the biparietal diameter. Both Moir and Hastings Ince have stated that on the 4th day after birth, the head of the baby returns in size to that just before birth.

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In the present work I have selected the biparietal diameter for observation on the following grounds:—(1) it equals (not invariably) the sub-occipito-bregmatic diameter except in soft skulls; (2) it engages the conjugate of the pelvic inlet in labour because of the fact that the sagittal suture of the head occupies the transverse diameter in majority of cases and lastly biparietal diameter can be fairly accurately determined by means of X-ray cephalometry. Thus if there is any relation of this factor to birthweight and maturity of the foetus, they can be evaluated before birth.

The Material

This report is based on a study of 225 new-born babies of different socio-economic groups representing a cross section of the local population and delivered consecutively at the Sanctoria Hospital, Disergarh. The subjects belong to the provinces of Bengal and Bihar and this restriction has been imposed to determine the relationship which the cephalic diameters of those foetuses bear with the maternal pelvis prevalent in this area. This is thus a corollary to my work on the female pelvis.

The babies were weighed carefully at birth and the biparietal diameter of the head was measured by means of an engineer's calipers, correct to thousandth of an inch, immediately or as early as possible after birth and on the 4th day. The latter day was chosen to allow for the moulding of the head to disappear completely and obtain measurements which would correspond more closely to the intra-uterine size at the time of birth. Both Hastings Ince and Chassar Moir have approved of this particular day. Changes that take place in the biparietal diameter may be taken as an indication of the amount of moulding affecting this particular diameter during the process of labour. This, however, cannot fully represent moulding changes but may be taken as a rough estimation of the process.

The results of my study are considered in 4 parts. Part 1 considers biparietal diameter of the foetal head; Part 2 the birthweight; Part 3 the relationship which the biparietal diameter bears with the birthweight and Part 4 deals with the changes in the biparietal diameter due to moulding of the head during labour. In the last part, I have also considered the amount of moulding that may be called safe and dangerous moulding resulting from difficult and/or instrumental labour.

Part (1) Biparietal Diameter

Table I and Figure 1 represent my observations on biparietal diameter. Statistical mean of the observations is 3.554 inches with standard error of 0.012. It will be seen from the table that 81.3% of the observations lie between 3.3 and 3.79 inches and 60.2% between 3.4 and 3.69 inches.

In Table II, I have detailed the measurement of the biparietal diameter in different socio-economic groups. It will be evident from this table that the dimensions of this diameter is significantly higher in the upper income group than in the lower. Thus the biparietal diameter tends to increase in length with rise of socio-economic status of the mother. It will be shown also that the birthweight has also the same tendency.

In Table III, I have described the biparietal diameter as found in different weeks of pregnancy. We can conclude from this that at 28th week of pregnancy in my series, the biparietal diameter is the smallest. It also shows that the diameter of over-mature babies is the longest. There does not appear to be any appreciable difference during the weeks from 34th to 38th though it is significantly lower than at term. We can deduce from this table that the biparietal diameter increases by 1.96 mm. every week.

Corresponding figures for growth of the foetal head of Scammons and Calkin and of Chassar Moir are 2.5 and 2 mm. respectively per week.

TABLE I

Incidence of Biparietal Diameter

Biparietal Diameter. Inches.	Number of Observaions. Total—224		Incidence of Operative Interference	
			Caesarean %	Others. %
From......3.0	2		..	..
3.01......3.09	..		..	..
3.10......3.19	5		..	20
3.20......3.29	12		..	16.7
3.30......3.39	23	81.3%	4.4	4.4
3.40......3.49	38		2.6	13.2
3.50......3.59	48		..	22.9
3.60......3.69	49		4.1	8.1
3.70......3.79	24		4.1	20.9
3.80......3.89	18		11.1	22.2
3.90......3.99	5		..	40.

Note: Range of Observations 2.7 to 3.973 inches.

TABLE II

Biparietal Diameter in different Socio-Ecōnomic Group

Socio-Economic Group.		Approximate Income Per Mensem	Biparietal Diameter. Inches	Standard Error.
Labour	..	Rs. 50/-	3.543	0.028
Lower Middle	..	150/-	3.558	0.018
Middle	upto	250/-	3.584	0.027
Upper Middle	upto	500/-	3.654	0.084
Upper	above	500/-	3.710	0.048
General	..	—	3.554	0.012

From Table I it will be evident that the need for operative interference increases as the biparietal diameter increases in length. Greater incidence of forceps application in the group with smaller biparietal diameter is due to attempt on my part to help the premature babies with signs of distress. The incidence of caeserean section in the group of biparietal diameter between 3.3 and 3.9 was due to presence of placenta praevia and smaller pelvis.

The relation of the biparietal diameter to the birthweight will be dealt with later on in the Paper.

TABLE III

Biparietal Diameter in Different Weeks of Pregnancy.

Weeks of Pregnancy.	Average Biparietal Diameter Inches.	Standard Error.
28	2.700	0.187
34	3.378	0.132
35	3.518	0.187
36	3.503	0.059
37	3.430	0.048
38	3.485	0.040
39	3.561	0.041
40	3.583	0.015
41	3.560	0.108
42	3.799	0.108

Note: Average gain per week equals to 1.96 mm.

Part 2: Birthweight.

Figure 2 and Table IV represent my observations on birthweight. Average birthweight in general has been found to be 93 ozs. with standard error of 1.16. 82.7% of the birthweight lie between 70 and 119 ozs. and 68% between 80 and 109 ozs.

Table V records average birthweight in different socio-economic groups. From this it will be evident that the birthweight is significantly higher in the higher income group than in the lower. Hence, it appears that the birthweight improves with improvement of socio-economic status of the mother.

The average birthweight in those cases which received antenatal supervision is 108.7 ozs. with standard error of 2.86. When compared to the general average of 93 ozs. this is statistically significant. Hence, it may be said that antenatal supervision is attended with improvement in birthweight. Table V also records percentage of mothers in each socio-economic group who received this supervision. It is highest in the upper income group and may be contributory factor towards higher birthweight as met with in them.

In my series, I have found a relation between the birthweight and age and parity of the mother. It has been observed by many previous authors that the birthweight increases with the increase of age of the mother. Table VI represents the birthweight in relation to age of the mother. From my observations, I have arrived at a regression equation correlating birthweight, age and parity, namely $Z = 93.88772 + 0.27393X - 2.01206Y$ where Z is birthweight and X, Y represent age and parity of the mother. From this, we can conclude that the effect of maternal age on birthweight is small, but birthweight decreases with increase in parity at any given age. S.E. of the equation is 17.1.

Percentage of premature termination of pregnancy is lowest in the upper income group but difference is not very significant in the three lower income groups. In Table V, I have detailed its incidence in different socio-economic groups.

This observation on prematurity rate is in accord with that of Dougal Baird, and Douglas.

TABLE IV

Incidence of Birthweight

Birthweight in Ozs.		Number of Observations.	Per centage.
40 — 49		2	
50 — 59		6	
60 — 69	Mean 93.0	15	
70 — 79		16	
80 — 89	S.E. 1.16	48	
90 — 99		61	82.7 (70 — 119)
100 —109		44	
110 —119		17	
120 —129		10	
130 —139		5	
140 —149		0	
150 —159		1	

Note: Range of observation—41 to 150 ozs.

TABLE VI

Effect of Age on Birthweight.

Age Groups Years	Number of Observations. Total — 174	Average Weight in Ozs.
15 — 19	41	85.8
20 — 24	52	93.36
25 — 29	52	95.04
30 — 34	16	99.03
35 —	13	108.86

Comments on Birthweight

The observations detailed above lead to the conclusion that the birthweight is greatly influenced by the nutritional status of the mother, particularly during the last 3 months of pregnancy. Sufficient nutrition also prevents premature termination of pregnancy. This has been recently corroborated by the study of population investigation committee formed under the auspices of the Royal College of Obstetricians and Gynaecologists and Douglas states that "A significantly low incidence is found among the most prosperous of the social classes. In the rest, it is not so significant." Similarly, investigation by Dougal Baird among his cases has proved that neonatal mortality in pri-

TABLE V

Birthweight in relation to Socio-Economic Group

Socio-Economic Group	Birthweight in Ozs.	Standard Error.	Percentage of Prematurity.	Percentage of Antenatal Supervision.
Labour	84.9	2.54	32	4.2
Lower Middle	92.3	1.65	33	4.5
Middle	94.4	2.51	31	31.2
Upper Middle	113.3	4.50	27	73.3
Upper	108.6	7.81	20	80.0

miparae is nearly 3 times higher in lower income group than in the higher, the main reasons being greater incidence of prematurity, birth injury, toxaemia and infection. Since the standard of obstetric care is the same in both groups, the difference must be due to great difference between these 2 groups in mother's physique, health and diet, all of which partly or wholly depend on the standard of living. The importance of dietary and economic influences on prematurity has also been stressed by Mengart and Neal Edwards. During antenatal supervision, a pregnant mother gets conscious of the importance of nutrition and this explains the beneficial effect of this care on birthweight.

Part 3: Relation between Biparietal Diameter and Birthweight.

The general trend of my observation on birthweight and biparietal diameter can be represented by the regression equation

$W = 57.382 + 63.921B$, where W is birthweight in ounces and B is the biparietal diameter in inches. Standard error of estimate is 12.64. For any value of B, the value of W determined from this equation $\pm$ 25 will cover more than 95% of all possible values. In other words, only in rather less than 5% of cases will the birthweight fall outside the limits determined above. Hence, it can be stated that the greater the birthweight the wider is the biparietal diameter, and there is a definite positive statistical relationship between these two factors.

Part 4: Changes in Biparietal Diameter.—"Moulding"

It is a well known fact that during labour the size of the area enclosed by the circumference of the foetal head slowly decreases through flexion and moulding. Besides the changes in the vault of the skull, Moloy's work has proved that changes also occur in the base of the skull, a region hitherto considered too rigid to be modified by the forces of labour. According to Moloy, essential changes are locking of the frontal and parietal bones at the coronal suture, and to a lesser extent, of the occipital and parietal bones at the lambdoidal suture. This mechanism of locking allows bending and displacement in the vault because there are compensatory changes in the base. Basal changes consist of elevation of the occipital region with bending at the spheno-petrous angle. Moulding is brought about by compression and results in change in shape of the head only. Certain cephalic diameters are affected directly by these changes but Moloy has shown that even in extreme moulding the mid-petro-vertical diameter remains constant. This observation is important since it would infer that it acts in a protective manner to avoid tension on the tentorium cerebelli. Important work of Holland has proved beyond doubt that the dangers of extreme moulding lie in intra-cranial haemorrhage resulting from tear of venous sinuses contained in falx cerebri and cerebelli.

In this study I have only considered the changes that affect the biparietal diameter of the foetal head during labour as evidence of moulding and base my observations on this. The average moulding calculated on this basis in a series of 72 neonatal heads is 1.83 mm. with standard error of 0.17. The amount of moulding bear a significant relationship to the level of 1% with the biparietal diameter. The correlation coefficient between these 2 factors is —0.572 Table VII represents average amount of moulding when the baby is born normal or asphyxiated.

TABLE VII

Moulding in relation to the condition of the Baby.

Condition of the Baby	Moulding in mm.	Standard Error.
Satisfactory	1.78	0.18
"Blue Asphyxia"	2.27	0.57
"White Asphyxia"	3.30	0.98

Hence the dangerous limit of moulding starts from 2.27 mm. Table VIII details the amount of moulding met with in different types of obstetric operations.

TABLE VIII

Moulding in relation to Operation.

Type of Operation.	Average Moulding in mm.	Standard Error.
Low Forceps	1.80	0.62
Mid Forceps	2.01	0.57
Episiotomy	2.24	0.62
Caesarean Section	1.43	1.37

TABLE IX

Moulding in relation to Prematurity

	Average Moulding in mm.	Standard Error.
Premature	1.90	0.34
General	1.83	0.17

Hence, I conclude that the average moulding in Indian babies is 1.83 mm. Dangerous limit starts from 2.27 mm. It is more than average in premature babies and diminishes as the biparietal diameter increases. In operations like mid-forceps application and episiotomy the mouldings verge near the danger zone. In caesarean section, it is less than the average of the babies born via naturalis.

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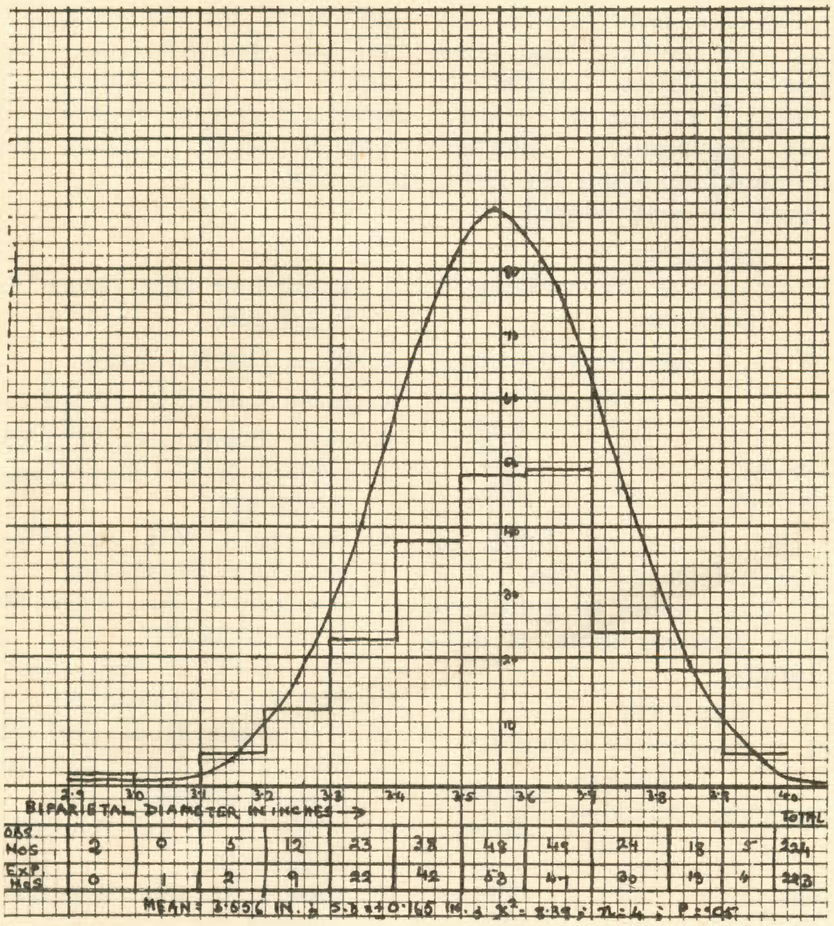

Figure 1.

Histogram showing frequency incidence of the Biparietal Diameter of the Neonatal Head with superimposed normal curve round its mean.

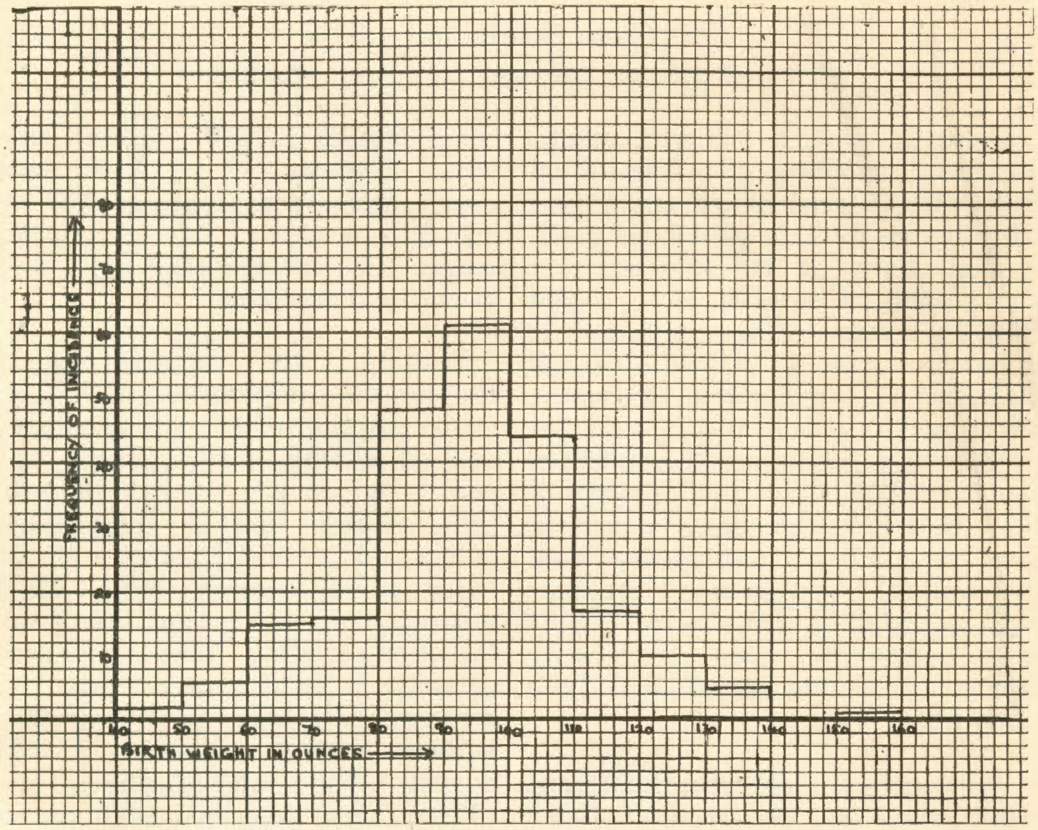

Figure 2.

Histogram showing frequency incidence of Birthweight.