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Evaluating Accuracy of Foetal Weight Estimation by Clinicians in Christian Medical College Hospital, India and Its Correlation to Actual Birth Weight: A Clinical Audit

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***Abstract*—**A retrospective study conducted at Christian Medical College (CMC) Teaching Hospital, Vellore, India on 14th August 2014 to assess the accuracy of clinically estimated foetal weight upon labour admission. Estimating foetal weight is a crucial factor in assessing maternal and foetal complications during and after labour. Medical notes of ninety-eight postnatal women who fulfilled the inclusion criteria were studied to evaluate the correlation between their recorded Estimated Foetal Weight (EFW) on admission and actual birth weight (ABW) of the newborn after delivery. Data concerning maternal and foetal demographics was also noted. Accuracy was determined by absolute percentage error and proportion of estimates within 10% of ABW. Actual birth weights ranged from 950-4080g. A strong positive correlation between EFW and ABW (r=0.904) was noted. Term deliveries (≥40 weeks) in the normal weight range (2500-4000g) had a 59.5% estimation accuracy (n=74) compared to pre-term (<40 weeks) with an estimation accuracy of 0% (n=2). Out of the term deliveries, macrosomic babies (>4000g) were underestimated by 25% (n=3) and low birthweight (LBW) babies were overestimated by 12.7% (n=9). Registrars who estimated foetal weight were accurate in babies within normal weight ranges. However, there needs to be an improvement in predicting weight of macrosomic and LBW foetuses. We have suggested the use of an amended version of the Johnson's formula for the Indian population for improvement and a need to re-audit once implemented.

***Keywords*—**Clinical palpation, estimated foetal weight, pregnancy, India, Johnson's formula.

I. Introduction

FOETAL weight is an important predictor of foetal wellbeing and neonatal complications during both labour and the puerperium [1], [2]. Whilst low birth weight is commonly due to premature birth, it can result from intrauterine growth restriction, requiring special postpartum care [3]. Macrosomic foetuses are at risk of intrapartum complications such as shoulder dystocia, brachial plexus injuries and asphyxia. Maternal risks of delivering macrosomic babies via normal vaginal delivery include birth canal injuries, pelvic floor tears and postpartum haemorrhage [4], [5]. Therefore, estimating foetal weight prior to delivery can be a useful tool to predict the progression of labour and identify complications that may arise during the intra and postpartum period. This can allow staff to prepare adequately for delivery and preempt any complications.

Currently, there are two main methods which are used to estimate foetal weight. The first is using ultrasonography. This is the newest method, which uses modern algorithms and standard foetal parameters such as abdominal circumference, femur length, biparietal diameter and head circumference to generate an estimation of foetal weight. Although this is considered the more accurate, it is timely, requires trained staff and is relatively expensive compared to the alternative. The second method is via tactile assessment of the pregnant abdomen. This is also known as clinical palpation or Leopold's manoeuvre. Though this method is deemed to be less accurate, it is more practical in resource poor settings as it is faster and cost free. Overall, there is no statistically significant difference between the mean absolute percentage errors for the two methods [6].

Several investigators have compared the accuracy of clinical palpation for estimating foetal weight. In general, the technique is best for estimating foetal weight in the reference range of 2,500 - < 4,000g with a mean absolute percentage error of ±7.5–19.8 % depending on gestational age. Accuracy markedly deteriorates with newborns weighing <2500g with only 40-49% of estimates being within ± 10% of the actual birth weight [7]-[9].

The objective of this study was to determine how accurately clinicians at Christian Medical College (CMC), a tertiary centre hospital in Vellore, can estimate foetal weight using clinical palpation on admission of labour. Accuracy was determined as the estimated foetal weight (EFW) being within 10% of the actual birth weight (ABW).

II. Methodology

The audit was approved by the department of Obstetrics and Gynaecology at CMC. Implied consent was obtained as the data collected was from medical notes. All patients are informed that their data can be used for clinical audits without using patient identifiers.

Medical records from all female patients across three post-natal wards at CMC who had given birth to a single, live

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newborn were obtained. Inclusion criteria also stated that these women were required to have a recorded EFW on admission prior to delivery. Exclusion criteria included women who gave birth to multiple pregnancies, did not have an EFW on admission and who were delivered by Caesarean section.

***Statistical Analysis*:** Power calculations for sample size were calculated using Statmate version 2.0 (GraphPad Software Inc.) and the chi-squared test. Ninety-eight patients were required to obtain statistically significant results ($p<0.05$). Therefore, medical records from ninety-eight patients were obtained. EFW was compared to ABW to calculate correlation. Other than EFW and ABW demographic data such as maternal age, gravida, parity, BMI, blood pressure, maternal pulse, foetal heart rate and gender of the newborn were also collected (Table I).

TABLE I
CHARACTERISTICS OF FEMALE PATIENTS (N=93)

Variable	Mean
Age (years)	25.4
Gravida	1.7
Parity	0.5
BMI (kg/m2)	25
Systolic Blood Pressure (mmHg)	161
Diastolic Blood Pressure (mmHg)	78
Pulse (bpm)	84
EFW on admission (kg)	2.86
ABW (kg)	2.90
Foetal Heart Rate (bpm)	140

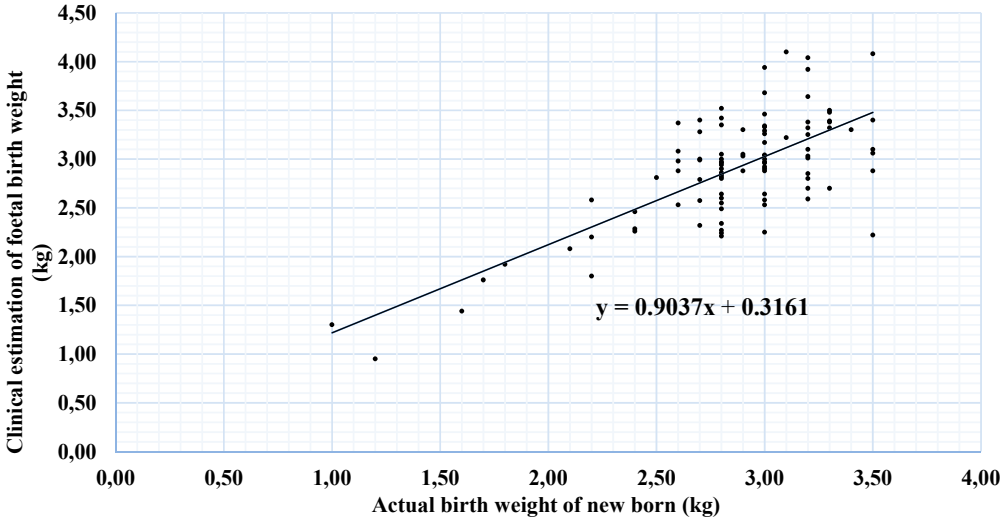

Fig. 1 Scatter Diagram of Clinically Estimated Foetal Weight and Actual Birth Weight, *n=98*

III. RESULTS

Ninety-eight women were included in the study. The average age was 25.4 years (range 18-36years). The mean ABW was 2.9kg (range 0.95-4.08kg). 78% of births were in the reference birth-weight range of 2500-4000g, while 3% were >4000g and 19% were <2500g.

The median gravida and parity were 1.5 (range 1-4) and 0 (range 0-3) respectively. The mean gestational age was 38.2 + 2.6 (range 28-48weeks).

Fig. 1 shows the scatter diagram of EFW against ABW. The correlation coefficient between EFW and ABW is strongly positive (r = +0.9037) and statistical analysis showed the relationship to be statistically significant. Table II shows the accuracy and differences in estimations in different groups such as term and pre-term deliveries according to actual birth weight. The best estimates for term deliveries were in the normal reference birth weight range of 2500-4000g, with 59.5% of estimates being accurate. This is higher than the percentage of accurate estimates in the same weight range for preterm deliveries, which was 42.9%.

Macrosomic term deliveries were underestimated by a mean percentage error of -25% whilst low birth weight (LBW) term foetuses were overestimated by a mean percentage error of 12.7%.

The least accuracy rates were seen in preterm LBW foetuses (<1500g) at 33.3% of total estimates.

Females were estimated more accurately with a lower mean percentage error of 2.44% and with a higher accuracy rate of 62.8% compared to males with a mean percentage error of -9.13% and accuracy rate of 45.5%.

IV. DISCUSSION

There was a strong positive correlation between the EFW and ABW of the new-borns indicating that overall registrars at CMC can accurately predict the birth weight using clinical palpation. Therefore the null hypothesis of no significant difference between clinical and actual foetal weight is assumed to be true. The difference between actual and clinical birth weight followed a normal distribution. However, clinicians are more accurate in estimating birthweights of term babies in the normal weight range of (2500-4000g) than pre-

term babies and tend to underestimate LBW babies and overestimate high birthweight babies. There may be several reasons for this trend. As foetal weight cannot be measured directly, it must be estimated from foetal and maternal anatomical characteristics. One suggestion is that at a registrar level, there would be at least 5 years of experience of estimating birthweight and at least 45-50 deliveries occur at CMC per day. This contributes to the high overall accuracy. However, according to a recent study, the level of experience and type of obstetric profession such as attending obstetricians, residents and midwives does not influence the accuracy of clinical EFW [10].

Majority of babies born at CMC are term and within normal weight ranges, hence the higher accuracy in this category of deliveries. However, there needs to be an improvement in accurately estimating weights of pre-term babies as well as those outside of the normal weight range. Being able to correctly identify macrosomic and microsomic babies is essential for optimal delivery. To improve estimation of those babies outside of the normal weight range, we have suggested the use of the Johnson's formula which takes into account fundal height and maternal weight.

Johnson's Formula:

$$\text{Foetal weight (g)} = \text{f H (cm) n} \times 155$$

where, fH=fundal height, n=12 if vertex is above ischial spine, n=11 if vertex is below ischial spine. If a patient weighs more than 91 kg, 1 cm is subtracted from the fundal height.

Belete [11] concluded that accuracy by clinical palpation is better than the Johnson's method for the lower and average birth weight range, while in the higher weight category the Johnson's method appears to be more accurate. Other methods of estimating foetal weight such as ultrasonography have shown to not significantly improve accuracy compared to clinical palpation [9]. They would also be more time consuming and expensive to conduct. The data also shows that the weight of female babies were more accurately estimated compared to male babies and the clinical weight of females were overestimated whereas the weight for males were underestimated. Again, the trend for this may be explained by the fact that Tamil Nadu, where CMC is located, has a greater female population than male population and the accuracy could be due to more experience in assessing female babies.

One of the main limitations of this audit was that despite there being an appropriate sample size for the overall conclusion, the sample size for each category birthweight was insufficient. To improve this, it is necessary that this factor is taken into account when a re-audit is conducted so that there is a sufficient sample size to power each group. Another limitation is that the majority of patients in this audit were within normal ranges for various parameters such as BMI. Further studies into different populations outside the normal values need to be done to see whether the same conclusions can be applied to all populations. A similar audit structure can be applied to investigate accuracy of EFW to these individuals outside of the normal ranges for various parameters.

The strengths of this audit included a sufficient sample size to power the overall conclusion of this study that registrars are accurate at estimating foetal weight. However, improvements in accurately estimating babies outside the normal ranges is required. There is a need to re-audit once the Johnson formula has been implemented into clinical practice after 6 months to establish an improvement in accuracy. Further studies comparing accuracy of different suitable methods to estimate foetal weight in CMC are also required.

TABLE II
ACCURACY (±10% OF ABW) OF EFW AND DIFFERENCES BETWEEN GENDERS, TERM AND PRETERM DELIVERIES

	Number of newborns	Number of EFW within ±10% of ABW	Mean (%) error	Percentage (%) of accurate EFW
Term deliveries (>37 weeks), n=86				
Weight (g)				
>4000	3	0	-25	0
2500 - 4000	74	44	-3.7	59.5
<2500	9	4	12.7	44.4
Preterm deliveries (<37weeks), n=12				
Weight (g)				
2500-4000	2	0	0.5	0.0
1500-2499	7	3	0	42.9
<1500	3	1	0.3	33.3
Gender, n=98				
Female	43	27	2.44	62.8
Male	55	25	-9.13	45.5

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REFERENCES

[1] Jolly MC, Sebire NJ, Harris JP, Regan L, Robinson S. 2003. "Risk factors for macrosomia and its clinical consequences: a study of 350,311 pregnancies", *European Journal of Obstetrics & Gynecology and Reproductive Biology*, Vol. 111, no.1, pp. 9-14

[2] Patterson RM, Prihoda TJ, Gibbs CE, Wood RC. 1986. "Analysis of birth weight percentile as a predictor of perinatal outcome", *Obstetrics and Gynecology*, Vol. 68, no. 4, pp. 459-63.

[3] Wilcox AJ, Skjaerven R. 1992, “Birth weight and perinatal mortality: the effect of gestational age”, *American Journal of Public Health*, Vol. 82, no. 3, pp. 378-82
[4] Baskett TF, Allen AC. 1995, “Perinatal implications of shoulder dystocia”, *Obstetrics and Gynecology*. Vol. 86, no. 1, pp. 14-7.
[5] Boyd ME, Usher RH, McLean FH. 1983, “Fetal macrosomia: prediction, risks, proposed management”, *Obstetrics and Gynecology*, Vol. 61, no. 6, pp. 715-22.
[6] Ugwa EA, Gaya S, Ashimi A. 2015, “Estimation of fetal weight before delivery in low-resource setting of North-west Nigeria: can we rely on our clinical skills?”, *Journal of Maternal and Fetal Neonatal Medicine*, Vol. 28, no. 8, pp. 949-53
[7] Nahum G, 2014. “Estimation of Fetal Weight”, Article last updated Sept 2014. Last accessed 10/7/15. Available at: http://emedicine.medscape.com/article/262865-overview#showall
[8] Sherman DJ, Arieli S, Tovbin J, Siegel G, Caspi E, Bukovsky IA. 1998, “A comparison of clinical and ultrasound estimation of fetal weight”, *Obstetrics and Gynaecology*, Vol. 91, no. 2, pp. 212-7
[9] Shittu, A.S., Kuti, O., Orji, E.O., Makinde, N.O., Ogunniy, S.O., Ayoola, O.O. & Sule, S.S. 2007, "Clinical versus sonographic estimation of foetal weight in southwest Nigeria", *Journal of health, population, and nutrition,* vol. 25, no. 1, pp. 14-23.
[10] Levin I, Gamzu R, Buchman V, Skornick Rapaport A, Pauzner D, Lessing JB, Almog B. 2011, “Clinical estimation of fetal weight: Is accuracy acquired with professional experience? *Fetal Diagnosis and Therapy*, Vol no. 4, pp. 321–324.
[11] Belete, W. & Gaym, A. 2008, "Clinical estimation of fetal weight in low resource settings: comparison of Johnson's formula and the palpation method", *Ethiopian Medical Journal,* Vol. 46, no. 1, pp. 37-46.