Original Article

Comparison of birth weight prediction equation and tactile assessment for estimation of fetal weight in uncomplicated term singleton pregnancies

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ABSTRACT

Background

Estimation of fetal weight is of utmost importance in birth planning. Various methods such as ultrasonography and clinical methods such as tactile assessment by Leopold's manoeuvres or by equation-based methods are in vogue for the estimation of fetal weight. However, available literature is inconsistent on the best method. The aim of the present study was to compare the accuracy of estimating fetal weight by Leopold's manoeuvre and Johnson's formula, in singleton term pregnancies.

Methods

This was a prospective observational study conducted in the Department of Obstetrics and Gynaecology of a tertiary care hospital in Delhi over a period of 3 months following institutional ethical committee clearance. A total of consecutive 100 pregnant women admitted for delivery in the obstetric unit were included in the study following inclusion and exclusion criteria. The outcome was to compare absolute error in weight (in grams), absolute percentage error and percentage of estimates within 10% for fetal weight estimation using Leopold's manoeuvre and Johnson's formula versus actual birth weight taken as gold standard.

Results

The mean estimated fetal weight by Johnson's formula was 4.00 ± 0.59 kg (range 2.64-5.74 kg) and by Leopold's manoeuvre was 2.88 ± 0.30 kg (range of 2.30-3.80 kg). The mean actual baby weight was 2.84 ± 0.42 kg (range 2.00-3.89 kg). The difference from actual baby weight was found to be significantly more by Johnson's formula as compared to Leopold's method.

Conclusion

Tactile assessment by Leopalds manuover is better than equation-based methods for estimating fetal weight.

Keywords

Fetal weight estimation, Leopold's Manoeuvre, Johnson's formula, tactile assessment, equation-based method

INTRODUCTION

Fetal weight is a great surrogate indicator of fetal health as it directly reflects the growth of the baby. Its estimation is of utmost importance especially nearing term in decision making for optimal obstetric planning and management in terms of mode of delivery. There are various methods for estimating fetal weight which include clinical palpation, equation-based methods or even self-estimation by the mother and imaging.

The literature search revealed a conflicting result regarding accuracy of various methods of fetal weight estimation.[1,2] Ultrasonography has long been considered a gold standard for estimating fetal weight. However, ultrasound has various innate drawbacks of being expensive and requiring a trained professional to perform it. In resource limited settings, estimation of fetal weight using ultrasound may not be of much help especially in centres catering to unsupervised pregnant women. Clinical method like Leopold manoeuvre is a skill and experience-based method not requiring additional resources. Similarly, equation-based methods such as the Johnson's formula are also clinical bed

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side methods which simply require measurement of symphisio-fundal height to estimate the fetal weight.

Lacunae in present knowledge

Many prospective studies have shown advantage of clinical methods over ultrasound method especially in cases of fetal macrosomia while others have established the superiority of ultrasonography especially in overweight women.[3,4,5] There is also no paucity of studies comparing abdominal palpation method and birth weight prediction equations for estimation of fetal weight but the results are conflicting. Thus, there is still no consensus over the best method available for estimation of fetal weight in the general population. This study was conducted to compare the accuracy of estimating fetal weight by 2 clinical methods i.e., tactile assessment with Leopold's manoeuvre and derived from equation-based method using Johnson's formula in singleton term pregnancies. The actual baby weight post-delivery was taken as gold standard to calculate the accuracy of both methods.

MATERIAL AND METHODS

Our study was a prospective blinded observational study conducted in the Department of Obstetrics and Gynaecology of a tertiary care hospital in Delhi over a period of 3 months following institutional ethical committee clearance. Sample size was calculated using the formula; n = [Z1-α/2σ/d]2, where: α= 0.05; estimated standard deviation in previous study(σ)= 353.7 gm and estimated error in previous study i.e., estimated (d)= 84.3 gm.[6] Sample size was calculated as 68, so we decided to take 100 as sample size. A total of consecutive 100 pregnant women admitted for delivery (for induction of labour or in early labour, average duration between estimation of fetal weight and delivery for 26.5 hours) in the obstetric unit were included in the study following inclusion and exclusion criteria. This method avoided selection bias.

Inclusion criteria

1) Women with uncomplicated term (between 37 0/7 weeks of gestation and 41 6/7 weeks of gestation) singleton pregnancy.

2) Women willing to participate.

Exclusion criteria

1) Women with either congenital malformation in the baby or uterus.

2) Women with medical disorders of pregnancies i.e., hypertension, diabetes mellitus or heart disease.

3) Diagnosed cases of fetal growth restriction or disorders of liquor i.e., oligohydramnios and polyhydramnios.

4) Women in active labour.

5) Women with rupture of membranes.

An informed written consent was taken from the participants prior to their enrolment in the study.

Participant's general demographic profile was noted in pre-formed performa (age, parity, gestational age in weeks, obstetric, trimester wise and past history). Weight in kilograms (pre-pregnancy) and height in centimetres of the pregnant woman was noted and body mass index (BMI) was calculated. Woman was then asked to empty her bladder and a per-abdominal examination was done by one experienced clinician under adequate light and exposure. Fundal height was marked first followed by measurement of symphysio fundal height (SFH) in centimetres. Estimated foetal weight was calculated using Johnson's formula.

Johnson's formula: Weight in grams of foetus= 155 X (SFH-x)

where x was taken as 12 in women with fetal head above 0 station and 11 with fetal head below 0 station.

In case the current weight of the woman was more than 91 kg, 1 cm was subtracted from the SFH. The result obtained was kept blinded from the second examiner.

The second examiner was an experienced clinician who estimated the fetal weight using tactile assessment by Leopold's manoeuvres and the value was noted.

After delivery of the baby by vaginal route / caesarean section, the baby's weight was measured on a weighing scale and noted. All the data collected was analysed statistically. The outcome was to compare absolute error in weight (in grams), absolute percentage error and percentage of estimates within 10% for fetal weight estimation using Leopold's manoeuvre and Johnson's formula versus actual birth weight taken as gold standard.

Statistical analysis

All the data was analysed using SPSS 21.0 and MedCalc 19.0.3 version. Data was presented as mean and standard deviation for continuous variables. Percentiles were calculated for different measures of fetal weight. Reliability of each measure was measured using

intraclass correlation coefficient. Pearson correlation coefficient was done to measure correlation between continuous variables. Bland Altman analysis was done to measure the difference between actual and estimated fetal weight using two methods. P value less than 0.5 was considered significant.

RESULT

A total of 100 pregnant women were included in the data analysis. Patient characteristics are depicted in table 1. The mean estimated fetal weight by Johnson's formula was 4.00 ± 0.59 kg (range 2.64-5.74 kg) and by Leopold's manoeuvre was 2.88 ± 0.30 kg (range of 2.30-3.80 kg). The mean actual baby weight was 2.84 ± 0.42 kg (range 2.00-3.89 kg). A statistically significant difference in the accuracy of fetal weight estimation was observed in favour of Leopold's Manoeuvre in all absolute error calculations as can be seen in Table 2. The actual birth weight was divided into two groups; less than 2.5 kg and between 2.5-3.9 kg and the two methods analysed. It was found that estimated fetal weight using Johnson's formula was much higher in both weight categories as compared to Leopold's manoeuvre, (figure 1). Pearson correlation estimation done in different weight bands depicted low positive correlation between Johnson's formula for both weight bands as compared to Leopold's method where it was negligible negative in <2.5kg and negligible positive in 2.5-3.9 kg band. The difference from actual baby weight was significantly more in estimating fetal weight using Johnson's formula as compared to Leopold's method using Blad Altman analysis (figure 2). Thus, Leopold's manoeuvre was found to predict fetal weight close to actual baby weight as compared to Johnson's formula which predicted the weight higher than the actual baby weight.

DISCUSSION

Fetal weight estimation at term holds great significance in deciding the mode of delivery.[7,8] It helps in anticipating problems so that necessary measures are taken to curtail maternal complications (prolonged labour, postpartum haemorrhage, trauma to genital tract) and fetal (shoulder dystocia, skeletal and nerve injuries, birth asphyxia). [9] The various methods used for estimating fetal weight are clinical palpation or Leopold's manoeuvre, equations for weight estimation or maternal self-estimation of fetal weight and imaging (ultrasonography and magnetic resonance imaging).[8,10] Obstetric ultrasonography is considered the gold standard but is not widely available especially in peripheral health setups.[11] Leopold's manoeuvre was first described by Christian Gerhard Leopold in the 19th century and has been used ever since for estimating fetal weight by palpation of mother's abdomen. Equation-based formulas are other clinical methods to estimate fetal weight using various maternal and fetal characteristics. Various formulas used are Johnson's, Dare's, Dawn's, Kongnyuy-Mbu's formulas.[8, 12] Johnson's formula is the one most widely used as it combines both maternal and fetal parameters. Both these methods; Clinical and formula based are simple to learn, cost-effective and easy to use. These can be used by doctors, nurses and even paramedics for estimating fetal weight and planning management of pregnant woman at term nearing delivery especially in centres with non-availability of ultrasound facility. Maternal self-estimation of fetal weight is another modality where mother herself is asked to estimate fetal weight based on her lifestyle and diet, but its clinical reliability has not yet been established. [13]

In our study, rates of estimates within 10% of actual birth weight was higher i.e., 47% for Leopold's method and 6% for Johnson's formula. Also, estimated fetal weight using Johnson's formula was much higher in weight bands; less than 2.5 kg and 2.5-3.9 kg as compared to Leopold's method. In comparison to a study done in Ethiopia by Belete W et al, rates of estimates within 10% of actual birth weight were 68% for palpation method and 38% for Johnson's formula. For birth weight less than 2.5 kg, both methods were found to overestimate the birth weight. In 2.5-3.9 kg birth weight range, Leopold's method was found to have no systematic error whereas Johnson's formula overestimated the birth weight. They concluded that Leopold's method was better in estimating fetal weight in lower and average weight category and Johnson's formula was found to be better in higher weight category i.e., more than 4 kg with less systematic error.[14] In another study by Peregrine E et al, rate of estimates within 10% of actual birth weight was 71% for Leopold's method and 42% by ultrasound estimation using Hadlock's formula. They concluded that although clinical and ultrasound estimation of fetal weight were comparable, but ultrasound was more accurate at predicting low and high birth weight fetus.[15] Shittu AS et al in their study from Nigeria concluded that Leopold's method was as accurate as ultrasound in estimating fetal weight except in birth weight less than 2.5 kg.[16] Yomibo-Sofolahan AN et al in their study

found accuracy of Johnson's formula in estimating fetal weight to be 59.5%. They also used Johnson's formula to predict the mode of delivery and found sensitivity of Johnson's formula to be 75.1%. They concluded that fetal weight estimation using Johnson's formula was reliably predictive of estimating actual baby weight and also spontaneous vaginal delivery.[17]

In a study done on Celik F.C, Aygun C, Tumer G et al, anthropometric measurements of babies in the first 48 hours were done to assess its correlation with the need for NICU admission. They concluded that among various parameters taken, triceps skin fold thickness, head circumference and mid-upper arm circumference/ head circumference ratio correlated well with the need for NICU admission. [18]

Strengths of the present study

The strength of our study is an unbiased comparison of two clinical modalities of fetal weight estimation. Both the methods were done by 2 separate clinicians who were blinded about the result given by each method. The statistical analysis was done by an independent neutral person not involved in the study. The results of the study will be helpful for health care professionals working in primary health care centres to estimate fetal weight using clinical methods and anticipate need for timely referral to higher centres. This holds true especially in cases with fetal weight estimated to be large i.e., more than 4 kg to prevent catastrophic events related to obstructed labour. Clinical estimation of fetal weight is an important tool for residents in tertiary level hospitals as well to optimize management of labouring women by decreasing possibilities of prolonged labour and its associated complications.

Limitations

The major limitation of our study is small sample size and shorter time duration. Also, maternal BMI was not taken into consideration as the factor which can hamper estimation of fetal weight using clinical methods appropriately.

CONCLUSION

Clinical acumen is taking a back seat with the advent of increased availability of ultrasonography but still has an important role in limited resource settings. Clinical methods are non- invasive and easy to perform for estimating fetal weight which can be used even by health care workers working in peripheral health facilities. The present study establishes the superiority of tactile assessment of fetal weight as compared to equation-based formula. It also emphasizes the importance of training the medical as well as paramedical staff providing care around birth, in this method

Table 1: Demographic characteristics

Characteristics	Mean	N= 100 (%)
Age (years)	26.9 ± 3.9	
Body mass index {BMI} (Kg/m^2)	22 ± 4.4	
Primiparous		41 (41%)
Multiparous		59 (59%)
Mean gestational age at estimation (weeks)	38.43 ± 1.43	
Mode of delivery Vaginal delivery Cesarean section		 79 (79%) (21%)

Table 2: Accuracy of both weight estimation methods regarding effective birth weight.

Variables	Johnsons	Leopold	P value
	Mean+/-SD	Mean+/-SD	
Difference from actual weight	1.15+/-0.5	0.04+/-0.4	**<0.001***
Absolute difference	1.15+/-0.5	0.33+/-0.27	**<0.001***
Actual error %	41.97+/-20.3	2.97+/-15.6	**<0.001***
Absolute error %	41.97+/-20.3	11.8+/-10.6	**<0.001***
Absolute error >10%	94%	53%	**<0.001#**
Absolute error >20%	85%	11%	**<0.001#**
Absolute error >0.5kg	91%	20%	**<0.001#**

1. *Paired sample t test was done to compare means between two methods
2. #McNemer test was done to compare the percentages of error between the groups for same sample

Conflict of interest: None

Research involving Human participants/ animals: Not applicable

Informed consents: Yes

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Ethical approval from Institution

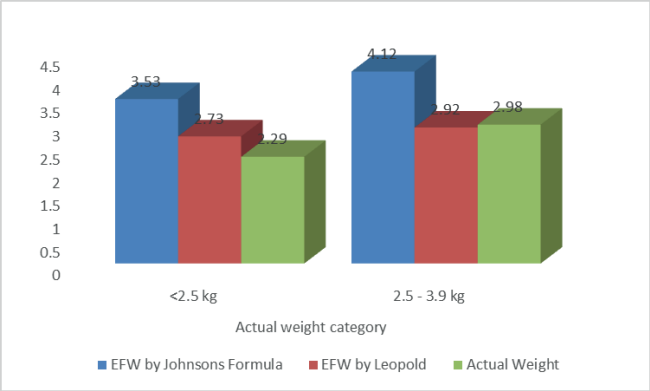

Figure 1: Mean estimated fetal weight using Leopold's maneuver, Johnson's formula and actual birth weight in different weight categories (< 2.5kg and 2.5 kg-3.9 kg)

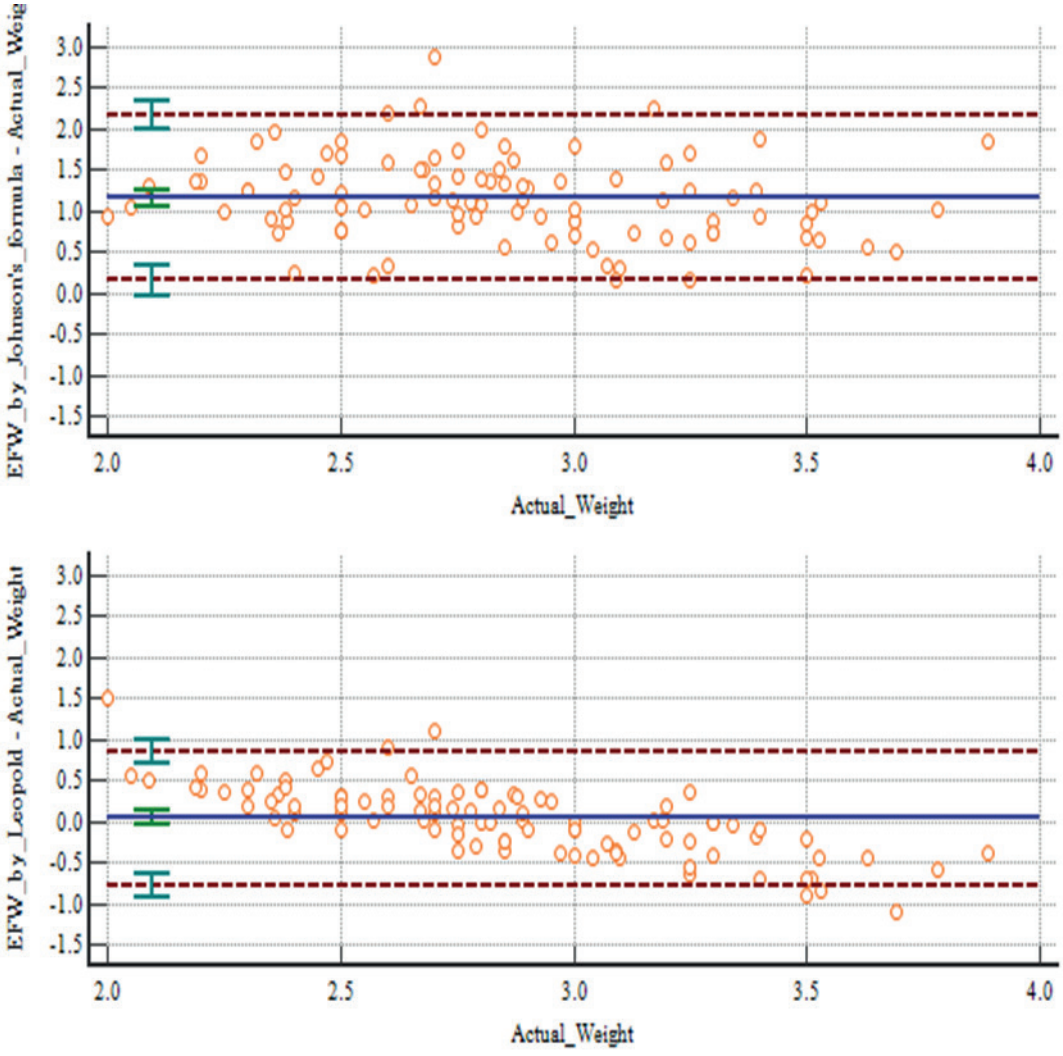

Figure 2: Blad Altman analysis to estimate error in estimation by each method

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