Original Article

Estimated Fetal Weight; A Comparison between Clinical and Ultrasonographical Measurements

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Abstract

Objective: To determine which method (clinical or ultrasonogrpahic) is more accurate in the estimation of fetal weights by comparing these methods with actual birth weights.

Methodology: It was a prospective and comparative study of 100 women at term gestation admitted in KRL General Hospital,Islamabad from July 2018 to Dec 2018. Patients of different parities at term were included.Their ultrasound scans for fetal weight were performed within last 1 week.Johnson's formula and Dare's formula were used for clinical method of fetal weight estimation.Hadlock's formula was used for ultrasonographic estimation of fetal weight.A comparison between estimated and actual birth weights was made after delivery. All statistical data was analysed through Statistical Package for Social Sciences (SPSS) version 21 software.

Results: It was seen that <500g error was given by ultrasound in 77% of the participants,by Dare's method in 57% and by Johnson's method in 47 % participants. Ultrasound gave >1000g error in only 3% of patients, while Johnson's and Dare's formulae gave it in 15% of patients each. The average error given by ultrasound (361.36+277.78g) was significantly lower than by Johnson's method (585.74+343.62g) and Dare's method (521.52+370.86g). There was statistically significant difference between fetal weights estimated by clinical methods and actual birth weights (P value <0.001). There was no statistically significant difference between measurements by ultrasound scan and actual birth weights (P value= 0.289).

Conclusion: Fetal weight estimation by ultrasound scan is better than by clinical methods (Johnson's and Dare's methods). Among the clinical methods Dare's method is more reliable than Johnson's method in the estimation of fetal weight.

Keywords: Fetal weight, Fetal body weight, Birth weight.

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Introduction

Fetal weight estimation is a universal part of antenatal care and management of labour and delivery. It is also vital for management of high risk pregnancies and monitoring of fetal growth.[1]

A UNICEF report on child mortality revealed that Pakistan has 3rd highest infant mortality rate (IMR) in the world. A baby born in Pakistan has one in 22 chance of death, while a newborn in Japan has only a one in 1,111 risks of dying.[2]

Fetal growth restriction (FGR) refers to fetuses with birth weights below the 10th percentile. Large for gestational age (LGA) fetuses have birth weights greater than the 90th percentile [3]. Both low and excessive birth weights lead to complications in newborns during labor and

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puerperium.[4] Birth weight is the single most important factor that determines the survival of the newborn.[5] Low birth weight and prematurity are among leading causes of neonatal death in developing countries.[6] There is high incidence of cephalo-pelvic disproportion (CPD), shoulder dystocia, brachial plexus injuries and fractures in the macrosomic babies during vaginal deliveries. Maternal complications include cervical and vaginal tears, postpartum hemorrhage, increased rate of instrumental delivery and caesarean section.[7]

Thus Fetal weight estimation is of paramount importance.[8] It helps in decision making regarding mode of delivery and to anticipate problems that may occur during labour.[9] Methods of estimating intrauterine fetal size include clinical examination and ultrasound scan.[10] Clinical methods are simple, easy to perform.[11] These methods have less accuracy and some observer variation.[9] Clinical estimation of fetal weight is done by obstetrical examination.[4] Johnson's and Dare's formulae have been used in many studies for clinical estimation of fetal weight.[1] In ultrasound scan, Hadlock formula is used in estimation of fetal weight.[3] In developing countries ultrasound scan may not be extensively available. It requires expensive machine and trained personnel.[7]

There are conflicting results in comparisons of clinically and ultrasonographically estimated fetal weights among different studies. According to Bajaj P, et al**.** Dare's formula is best one, followed by Hadlock's formula (ultrasonogrpahic method).[1] According to Joshi A, et al. Ultrasound is superior to clinical methods.[12] According to Roy AG, et al. both Hadlock's formula and Dare's formula have good correlation with actual birth weight.[4] To the best of our knowledge, data on the weight of Pakistani fetuses required to establish the effectiveness of estimation models are lacking. The aim of this study is to determine which method (clinical or ultrasonogrpahic) is more accurate in estimation of fetal weights by comparing these methods with actual birth weights.

Pakistan is one of the countries with the highest newborn and infant mortality rates. Birth weight is the single most important factor to determine survival of the newborn. Thus, Fetal weight estimation is of great interest in obstetrics as both low birth weight and macrsomic fetuses are associated with high perinatal morbidity and mortality.

Methodology

This Cross sectional comparative study was conducted in the Inpatient Department of Obstetrics and Gynecology Department of KRL General Hospital, Islamabad, over a duration of 6 months (from July 2018 to Dec 2018). The study was approved by the local Ethics Committee of KRL General Hospital. The sample size was calculated on the basis of WHO sample size calculator and it came out to be 61.[15] To get better results we enrolled a total of 100 consecutive patients on the basis of specific inclusion criteria.

Patients who were included in the study were pregnant patients above 18 years of age, term Gestation (37 to 42 weeks of gestation), singleton pregnancies, cephalic presentation, delivery within 7 days of estimation of fetal weight, vaginal delivery and birth by Cesarean section

Patients excluded from the study were women with oligohydramnios, polyhydramnios, congenital malformations of fetus, ruptured membranes, pregnancy with uterine fibroid or any abdominal mass, intrauterine death of fetus,placenta previa, antepartum hemorrhage and eclampsia.

Patients were included irrespective of parity, maternal weight, height, head descent, routes of delivery and presence of pregnancy complications other than those in exclusion criteria.

Permission was taken from the Ethical Committee of the hospital. Patients admitted in Gynaecology department of KRL General hospital were taken in study after fulfilling inclusion and exclusion criteria. History, thorough general physical and obstetrical examinations were performed. The obstetric examination included Symphysio-fundal height,

fetal lie, presentation,5th palpable and station of fetal head (on per vaginal examination).

Clinical and ultrasonographical methods are used to estimate fetal weight in utero.

Methods of measurements: *Symphysio-fundal height (SFH):* Patients were asked to empty bladder and then lie flat on their back, with thighs slightly flexed. Symphysio-fundal height was taken from upper edge of symphysis pubis and following the curvature of abdomen till top of fundus with non-elastic measuring tape (in centimeters).

The measuring tape was positioned to encircle the woman's waist, at the level of the umbilicus. Station of fetal head was assessed by pelvic (per vaginal) examination (-3 ,-2,-1,0,+1, +2,+3)

Johnson's formula: Fetal weight (gram) =155 × (Symphysio-fundal height in cm – K)

K= 11 (fetal head at plus station), K=12 (fetal head at zero station), K=13 (fetal head at minus station).

Dare's formula: Fetal weight in (gram) = Fundal height (cm) × Abdominal girth (cm)

Fetal weight estimation was done by inbuilt Hadlock's formula, based on biparietal diameter (BPD), abdominal circumference (AC), and femural length (FL).

Follow up of patients was done till delivery and actual birth weight of babies were measured. All the data was recorded as per performa. All statistical data was analysed through Statistical Package for Social Sciences (SPSS) version 21 software. Descriptive statistics were measured for Qualitative and Quantitative variables. A qualitative variable like education was measured by frequency and percentage. The average errors of each method were calculated. A quantitative variable like birth weight was measured in terms of mean and standard deviation. A paired t-test was applied to assess P-values for comparison between fetal weights estimated by clinical methods and actual birth weights. P-value <0.05 was considered statistically significant.

Results

The study was conducted during 6 months period. the sample size was 100 during that period. The study participants aged between 18 – 40 years and mean maternal age was 28.98±4.709 years. Maximum patients were observed in the age group of 26-30 years (38%). (Table-I)

Table I: Distribution of age among participants

Age (years)	Participants (n) (%)
18-20	4(4%)
21-25	31(31%)
26-30	38 (38%)
31-35	14 (14%)
>35	13(13%)
Total	100 (100%)
Mean maternal age	= 28.98 ± 4.709 years

The majority of the women were educated, with 54% of women having higher education as shown in Figure 1.

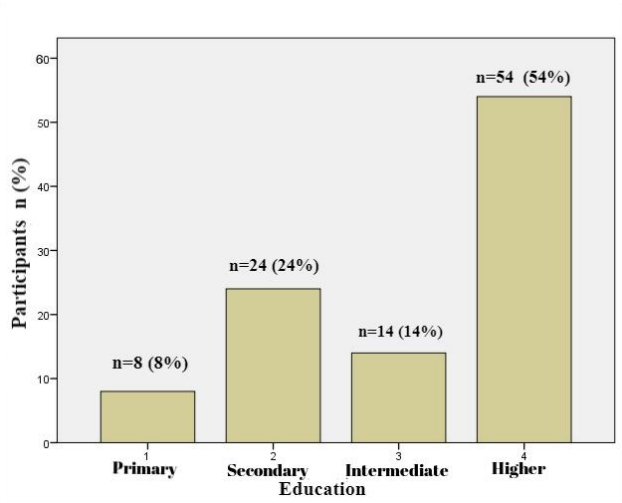

Figure 1. Distribution of Participants according to educational level.

Out of 100 participants,58 women (58%) were at 37-38+6 weeks of gestation and 42 women (42%) were at ≥39 weeks. Most of the participants (n=41, 41%) were primigravida, while the rest (n=26, 26%) were second or multigravida (n=33, 33%). Majority of the women (n=70) 70% delivered by caesarean section. This could be due to the hospital being a tertiary care hospital where high

risk cases are referred from other hospitals. BMI of most of the women (n=54)54% fell in the category of 25-30 kg/m^2, (n=17) 17% below that and (n=29) 29% had BMI above 30 kg/m^2.Maternal BMI influenced the birth weight positively i.e. birth weight increased with an increase in BMI of the mother**.** The majority of babies (n=82) (82%) belonged to the normal

weight group (2500 g-3500g). There were only (n=4) 4% low birth weight (< 2500g) babies and (n=18) 18% macrosomic babies (> 3500 g). (Table II)

The birth weight was divided into five ranges. In this study,3000-3500 gm group had the maximum distribution of cases (45%, n= 45). The mean birth weight was 3147.46±381.66g.

When errors were compared between the clinical and ultrasonographic methods it was found that less than 500gm error was given by ultrasound in 77% (n=77) of the participants followed by Dare's method 57% (n= 57) and Johnson's method 47 % (n=47). Ultrasound gave a huge error of more than 1000gm in only 3% (n= 3) of patients while Johnsons and Dares formulae gave it in 15% (n=15) of patients each. (Table-III)

Average error in estimated fetal weight given by ultrasound (361.36±277.78g) was significantly lower than by Johnsons method (585.74±343.62g) and Dares method (521.52±370.86g).When errors were compared according to the birth weight categories it was found that clinical methods had greatest errors in birth weight category of 2000-2500g.Johnson's and Dare's method gave errors of 1,178.75g and 1,135.50g respectively, in babies below 2500g birth weight. While ultrasound showed an error of 663.75g in that group. The average errors decreased along with increase in the birth weights in all categories. The accuracy of clinical methods was found acceptable in birth weights of more than 3500g. (Table-IV)

Table II: Distribution of Birthweight According To BMI, Gestational Age and Mode of Delivery

		Birthweight (g)				Total	Percentage
		2000-2500 g	2501-3000 g	3001-3500 g	>3500 g	**(n)**	**(%)**
BMI (Kg/m2)	20-24.9	0	7	6	4	17	17%
	25-30	2	21	24	7	54	54%
	>30	2	9	15	3	29	29%
Gestational Age (weeks)	37-38+6	3	24	27	4	58	58%
	39-40+6	1	8	14	5	28	28%
	>40+6	0	5	4	5	14	14%
Mode of Delivery	SVD	3	7	12	5	27	27%
	Instrumental	0	2	1	0	3	3%
	LSCS	1	28	32	9	70	70%
Total		**4**	**37**	**45**	**14**	**100**	**100 %**

Table III: Error Between Clinical Methods and Ultrasound

Error (g)	USG (n)%	Johnson's method (n)%	Dare's method (n)%
<100	17 (17%)	5 (5%)	12 (12%)
100-250	23 (23%)	12 (12%)	15 (15%)
251-500	33 (37%)	30 (30%)	30 (30%)
501-750	14 (14%)	23 (23%)	18 (18%)
751-1000	6 (6%)	15 (15%)	12 (12%)
>1000	3 (3%)	15 (15%)	13 (13%)
Total	100 (100%)	100 (100%)	100 (100%)

Table IV: Average Error in Fetal Weight Groups by Clinical Methods and Ultrasound Scan

Birthweight (g)	Number of patients (n)	Error by USG(g)	Error by Johnson(g)	Error by Dare(g)
2000-2500	4	663.75±757.23	1178.75±52.65	1135.50±505.07
2501-3000	37	357.89±265.68	889.59±227.06	674.89±333.27
3001-3500	45	371.78±231.90	406.67±157.88	440.07±312.27
>3500	14	250.64±189.91	188.86±140.71	202.57±188.18
Total	100	361.36±277.78	585.74±343.62	521.52±370.85

Table V: Comparison of different methods with actual birth weights by paired t-test.

Method	Mean weight(g)	Std. Deviation (g)	Actual birth weight Mean (g)	Mean difference(g)	Paired t-test	p-value
John's method	3,729.40	153.725	3,147.46±381.66	581.94± 227.93	16.633	<0.001
Dare's method	3,660.32	359.453		512.86± 22.207	13.381	<0.001
USG method	3,193.92	476.421		46.46±94.76	1.066	0.289

A paired t-test was applied, with P value <0.05 considered statistically significant. There was a statistically significant difference between fetal weights estimated by clinical methods and actual birth weights but no statistically significant difference was found between measurements by ultrasound scan and actual birth weights (P value= 0.289). (Table V)

Discussion

In this study sample size was taken as 100, which was comparable to the study by Sowjanya R, et al.[13] Mean maternal age was 28.98±4.709 years that was close to the study by Njoku C, et al. in which mean maternal age was 28.86±6.355 years.[7] In present study, 59% (n=59) women were multigravida and 82% (n=82) babies belonged to normal weight groups (2500 g to 3500 g).These findings were same as studied by Mallikarjuna M, et al.[11] In this research, 4% (n=4) babies were low birth weight (<2500g) and 18% (n=18) were macrosomic (> 3500 g).That was in contrast to Kathirya D, et al where 24.4 %were low birth weight and only 3.6% were macrosomic babies.[8] The results in this study were similar to Yadav R, et al. where 19.5% babies were macrosomic. The mean actual birth weight was 3147.46 ± 381.663 g in our study, which was comparable to 3100 ± 455.8 g by Yadav R, et al.[14]

We had ultrasonographical method giving least average error of the three methods (361.36±277.78g), followed by Dare's (521.52±370.86g) and Johnson's method (585.74 ± 343.62g). These findings were consistent with Yadav R, et al. in that the average error was minimum with an ultrasound scan (190 ± 251.3g) followed by that with Dare's formula (208 ± 240.9g) ,and maximum with Johnson's formula (290.29 ± 324.7 grams).[14] The mean error by ultrasound was least probably because Hadlock formula uses four parameters i.e., abdominal circumference (AC), femur length (FL) and head circumference (HC).Similar findings were observed by Aruna S, et al.[15] This shows that Ultrasound is better than clinical methods for estimation of fetal weight.

In this study, less than 500g error was given by ultrasound in 77% (n=77) of cases, while by Dare's and Johnson's method it was 57% (n=57) and 47% (n=47) of participants respectively. The findings by Kathiriya D, et al. were in contrast, where Dare's method had an error of <500 g in 91.6% of participants, showing that Dare's method was better than ultrasound in that article.[8] It was found in our study that with increasing birth weight, errors by all the three methods decreased, which was consistent with Prajapati DG, et al.[16] In the low birth weight babies (<2500g), maximum errors were given by Johnson's and Dare's method, being 1178.75±52.65g and 1135.50±505.07g respectively, while ultrasound gave minimum error (663.75±757.23g). This shows that Ultrasound is better than clinical methods, out of which Dare's method is more

reliable. In the researches conducted by Zahran M, et al. and Lanowski JS ultrasound was proven to be better than clinical methods for fetal weight estimation methods which was similar to our study and ultrasound training was described as being essential.[17,18]

Strengths and limitations: Limitations of this study include small sample size which should be increased for generalization of results. This study was conducted in a single center, so results cannot be generalized. Strengths of this study include its prospective study design and the clinical measurements performed by a single researcher, omitting inter-observer variation.

Conclusion

Fetal weight estimation by ultrasound scan is better than by clinical methods (Johnson's and Dare's methods). Among the clinical methods, Dare's method is more reliable than Johnson's method in the estimation of fetal weight.

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