Original Article

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A Comparative Study of Foetal Weight Estimation at Term Pregnancy by Johnson's Method and Dare's Method

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Abstract

Context: Estimation of birth weight is an important factor in antenatal and labour management. Estimation of birth weight determines the time, mode and place of delivery.

Aims: This study aims at comparing the accuracy of Johnson's method and Dare's method for estimating foetal birth weight at term.

Settings and Design: This was a prospective observational study done at a tertiary care teaching hospital over a period of one year.

Methods and Material: 300 women with singleton uncomplicated term pregnancy satisfying inclusion and exclusion criteria were included in the study. Foetal weight estimation was done by Johnson's method and Dare's method within 72 hours before delivery and was compared with actual birth weight.

Statistical analysis used: Statistical analysis for comparison was done using SPSS software (version 20). Mean absolute error, percentage error, overestimation and underestimation of both methods was compared.

Results: The mean actual birth weight (ABW) was 2861.8±460 grams. The mean estimated birth weight (EBW) by Johnson's method and Dare's method was 2979.1±382 grams and 2925.01±420 grams respectively. About 23.6% were low birth weight (LBW) and 1% was macrosomic babies. Dare's method had least maximum and minimum error than Johnson's method. The mean absolute error by Dare's method was lower than Johnson's method. The birth weight of 73% and 73.7% cases could be predicted within 10 % error of ABW by Dare's method and Johnson's method respectively. Both methods overestimated birth weight in LBW babies.

Conclusions: Dare's method is more accurate than Johnson's method in estimating foetal birth weight and predicting LBW and macrosomic babies.

Keywords: Dare's Method; Estimated Foetal Weight; Johnson's Method.

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Introduction

Knowledge of the birth weight of fetus before delivery is an important prerequisite to decide the time, mode and place of delivery [1-5]. Expected birth weight is an important parameter to evaluate for cephalopelvic disproportion when deciding the mode of delivery. It is especially important for the obstetrician to estimate the expected foetal birth weight while managing high risk pregnancies like breech presentation, IUGR, trial of labour after caesarean delivery, diabetic pregnancy, severe PIH etc [1,6,7]. Since perinatal morbidity and mortality is largely influenced by the birth weight of the baby, a knowledge of the estimated foetal weight prior to delivery can often avoid adverse outcomes [1]. Low birth weight (LBW) babies and macrosomic babies have higher perinatal morbidity and mortality. Macrosomia is associated with shoulder dystocia, birth asphyxia, birth trauma, metabolic complications and maternal, foetal trauma. Low birth weight babies are susceptible to birth asphyxia, hypothermia,

hypoglycaemia and other metabolic complications [6-11] . After birth, the prognosis of these babies depends upon good neonatal care facilities. The NICU and paediatrician can be alerted whenever the birth of a low birth weight baby or macrosomic baby is anticipated.

A reliable estimate of the foetal weight guides the obstetrician to counsel regarding perinatal prognosis while terminating pregnancy [9]. It is preferable to know the estimated foetal weight while deciding the time for elective LSCS or induction of labour to avoid low birth weight babies [1]. Estimation of birth weight prior to delivery is very important in the peripheral health centres where most of the deliveries are conducted by nurses, midwives and trained birth attendants and availability of obstetrician or paediatrician may be difficult [3,8]. In utero transfer to higher centres can be done timely if the birth of a low birth weight baby or macrosomic baby is likely.

Presently, many methods are in practice to estimate the foetal birth weight. All currently available techniques are associated with significant degree of inaccuracy [3,8,9]. Several studies have compared the accuracy of foetal weight estimation by USG and clinical methods. Some studies report that USG is superior to clinical methods in estimation of foetal weight [12-14]. Other studies have reported that clinical methods are equally accurate or even superior to USG estimation [1,5,6,8,9,15-19]. The advantages of clinical methods over USG in low resource settings cannot be overlooked. Availability of USG, radiologists and high cost may be constraints in low resource settings. However, clinical methods are simple, can be performed quickly and require no cost. It can be taught easily, does not require expertise and can be done by trained midwives, staff nurses, junior doctors and health care providers in a rural or poor resource set up [3,8]. Among the many studied clinical methods, Johnson's method and Dare's method are simple and widely used.

In this study, we aim at comparing the accuracy of these two clinical methods for estimation of foetal weight.

Materials and Methods

This is a prospective observational study carried out in the Department of Obstetrics & Gynaecology of a tertiary care teaching hospital over a period of one year. Institutional ethical committee clearance was obtained. The participants were explained about the purpose and nature of the study and consent was obtained from them. 300 women with singleton uncomplicated term pregnancy (37-41 weeks) in vertex presentation, admitted to the labour ward or antenatal ward in whom delivery was anticipated within 72 hours were selected by simple random sampling method. In women who did not deliver within 72 hours, measurements were repeated and this was taken into consideration. Only women with good dates and dating scan were included in the study. Women with polyhydramnios, oligohydramnios, PROM, malpresentations, multifoetal gestation, fibroids or adnexal mass complicating pregnancy, maternal weight more than 90 kg, foetal demise, foetal anomalies, unreliable dates, medical disorders such as PIH, DM, renal disorders, severe anaemia or others which could influence foetal growth were excluded from the study.

A structured proforma was used to enter the information collected. A detailed history regarding age, parity, past pregnancy outcome and present pregnancy details were noted. Gestational age was confirmed by last menstrual period and dating scan. A thorough general and obstetric examination was carried out.

Clinical estimation of foetal weight was done by Johnson's method and Dare's method. Patient was asked to empty the bladder and lie in dorsal position. After correcting dextrorotation, symphysiofundal height (SFH) and abdominal girth (AG) was measured using a flexible, inelastic centimetre tape. Distance from the upper edge of pubic symphysis to the fundus was noted in centimetres and recorded as SFH. Station of the presenting part was assessed by abdominal examination and vaginal examination. AG in centimetres was recorded at the level of umbilicus.

Foetal weight in grams by Johnson's formula was calculated as follows:

Estimated foetal weight (EFW in grams) = (SFH-13) X 155, when presenting part was at minus station, (SFH-12) X 155, when presenting part was at 0 station, (SFH-11) X 155, when presenting part was at plus station.

Foetal weight in grams by Dare's formula was calculated as follows:

Estimated foetal weight (EFW in grams) = (SFH X AG).

Actual birth weight in grams was measured using a single weighing scale immediately after the birth of the baby.

Data was entered into Microsoft excel and statistical analysis was performed using SPSS software (version 20). Values obtained by Johnson's formula, Dare's formula and actual birth weight were compared. Percentage, mean, standard deviation,

mean absolute error, percentage error and chi-square test were used for statistical analysis. Accuracy of the two methods was compared using mean birth weight, mean absolute error, accuracy of estimation within 10% of error, and percentage of underestimation and overestimation of birth weight. The values were compared at 0.05 levels of significance.

Results

A total of 300 women participitated in the study. The mean age of the mothers included in the study was 24.51 ± 3.5 years. 38.7% women were primigravida and 61.3% were multigravida. 49% women had normal vaginal delivery, while 47% underwent LSCS and 4% had instrumental delivery.

The mean actual birth weight of the babies was found to be 2861.8 ± 460 g .The birth weight of the babies ranged from 1750 to 4300 g. 23.6 % of babies were low birth weight(<2500g). 1 % of babies was macrosomic (>4000g). 75.4% of babies had normal birth weight. Majority (36%) of the babies weighed between 2.5 – 2.9 kg. Table 1 shows the distribution of cases according to birth weight.

Table 2 shows that the mean birth weight by Dare's method was 2925.01 ±420 grams and by Johnson's method was 2979.10±382. The difference in estimation of birth weight by both the clinical methods in comparison to the actual birth weight (2861.80± 459.79) was statistically significant (p< 0.05). The difference in estimation of birth weight between the two clinical methods was also statistically significant (p< 0.05).

Table 3 shows that the overall mean absolute error by Dare's method (63.2g) was lesser than that by Johnson's method (117.3g). The minimum and maximum error was more with Johnson's method than by Dare's method.

Table 4 shows that the mean absolute error by Dare's method was least for babies with birth weight between 3000-3499 grams (10.2 grams) and maximum for more than 4000 grams group (127 grams). Johnson's method had least mean absolute error in 3000-3499 grams group (12 grams) and maximum for more than 4000 grams group (431 grams). Both Dare's and Johnson's method had minimum mean absolute error in the 3000-3499 grams group and maximum mean absolute error in the more than 4000 grams group followed by less than 2000 grams group. The mean absolute error by Dare's method was lower than Johnson's method for all the foetal weight groups.

Table 5 shows that both Dare's method (73%) and Johnson's method (73.7%) were able to predict the birth weight within 10 percentage error in more than 70% cases and there was no statistically significant difference between the two clinical methods within the 10 percentage error. However, by Dare's method up to 99% cases could be predicted within 20% error in comparison to 93% by Johnson's method, which was statistically significant (p<0.05).

Table 6 shows the percentage of over estimation and under estimation of birth weight by both the clinical methods in different weight groups. Both Dare's method and Johnson's method had tendency to overestimate birth weight in the low birth weight group (<2500g). Dare's method was significantly better in predicting low birth weight babies than Johnson's formula (p= 0.002). The accuracy of predicting birth weight within the range was maximum in 2500-4000 grams group for both methods. Dare's method had a significantly higher sensitivity and specificity of predicting normal weight babies compared to Johnson's method (p=0.029). Dare's method had 100% accuracy in predicting macrosomia while Johnson's method was predictive in 66.7% of cases.

Table 1: Distribution of cases according to birth weight of babies

Birth weight(grams)	No. of cases (n=300)	%
Less than 2000	7	2.3
2000-2499	64	21.3
2500- 2999	108	36.0
3000- 3499	99	33.0
3500-3999	19	6.4
More than 4000	3	1.0

Table 2: Mean actual birth weight in relation to Mean estimated birth weight by Dare's method and Johnson's method

S. No.	Method of estimation	Birth weight in grams (Mean ± S.D.)
1	Dare's method	2925.01 ±420.29
2	Johnson's method	2979.10 ± 382.14
3	Actual Birth Weight	2861.80 ± 459.79

Table 3: Details of error between Dare's method and Johnson's method:

Error (grams)	Dare's Method	Johnson's Method
Minimum error	-518.00	-755.00
Maximum error	566.00	695.00
Mean error	63.2067	117.3000

Table 4: Mean absolute error of Dare's method and Johnson's method for different birth weight groups:

Methods	Less than 2000 g	2000-2499 g	2500- 2999 g	3000- 3499 g	3500 -3999 g	More than 4000 g	All Cases
Dare's method	-78.7	-54.7	-59.8	-10.2	39.6	136.2	-63.2
Johnson's method	-137.5	-128.4	-58.4	-12	60.3	307.2	-117.3

Table 5: Percentage error in Dare's method and Johnson's method

Percentage Error	Dare's Method	Johnson's Method
Up to 5%	59.0	50.7
Up to 10%	73.0	73.7
Up to 15%	92.0	84.7
Up to 20%	98.7	93.0
Up to 25%	99.3	95.3
Above 25.1 %	100	100

Table 6: Comparison of over estimation and under estimation of birth weight by both the clinical methods in different weight groups:

Methods	Birth weight < 2500 grams (n=71)				Birth weight 2500–3999 grams (n=226)				Birth weight ≥4000 grams (n=3)			
	UE		OE		UE		OE		UE		OE	
	n	%	n	%	n	%	n	%	n	%	N	%
Dare's Method	1	1.5	16	22.5	5	2.2	1	0.5	0	0	0	0
Johnson's Method	0	0	35	49.3	16	7.1	0	0	1	33.3	0	0

UE- Under estimation, OE- Over estimation

Table 7: Comparison of the accuracy of birth weight up to 10% error of actual birth weight by both methods between the present study and other studies [2,6,7,9,15,16,20]

S. No.	Studies	Dare's Method	Johnson's Method
1	Present study	73%	73.7%
2	Thombarapu et al	83%	77%
3	Raghuvanshi et al	65%	73%
4	Malik et al	92%	94%
5	Yadav et al	81%	47%
6	Kathiriya et al	67%	22%
7	Bhandary et al	67%	41%
8	Torloni et al	57%	61%

Discussion

Estimation of foetal weight is an important prerequisite for decision making in obstetrics and labour management [3,5,8]. Currently, ultrasound and several clinical methods are available to estimate foetal weight. Ultrasound is costly, requires a skilled radiologist and may not be available in all settings [1,3,8]. Clinical methods for estimation of foetal weight are simple, easily available, involves no cost, are non invasive, reproducible and easily acceptable to patients. They are especially useful in situations where ultrasound is not possible [13]. However, clinical methods have variable degrees of error and are influenced by intra observer and inter observer variations [1,3]. Maternal obesity and liquor amount can also influence the measurements [1,4,12]. However, currently, methods which can estimate birth weights within 10% accuracy of actual birth weight are considered acceptable [8]. Several studies have shown that clinical methods are as accurate or superior to ultrasound in estimating foetal weight [1,5,8,9,16-18]. In this study, we aim at analysing the accuracy of Dare's method and Johnson's method in estimating foetal weight.

In the present study, the mean birth weight

calculated by Dare's method and Johnson's method was 2925.01 ±420.29grams and 2979.10±382.14grams respectively in comparison with mean actual birth weight of 2861.80± 459.79grams. This shows that foetal weight estimation by Dare's method is closer to actual birth weight when compared to Johnson's method and this difference was statistically significant. Yadav et al [9] and Raghuvanshi et al [15] have reported that the EBW by Dare's formula is closer to ABW. However, Esmaeilou et al [10] and Malik et al [6] found that the mean difference in birth weight was least with Johnson's method than Dare's method.

In concordance to the present study, Bhandary et al [2], Raghuvanshi et al [15] and Kathiriya et al [16] found higher mean absolute error with Johnson's formula than Dare's method. The mean absolute error by both the methods was least in the normal birth weight babies and maximum in the macrosomic group followed by LBW group. Similar to our study, Thombarapu et al [7] found that the average error by both methods was maximum in the large for gestational age group. Bhandary et al [2], Kathiriya et al [16] and Malik et al [6] reported maximum error in the LBW group.

In the present study, we found that both Dare's method and Johnson's method were able to predict the birth weight up to 10% error in 73% of cases. Similarly, studies by Malik et al [6] , Thombarapu et al [7] and Raghuvanshi et al [15] have reported that Dare's method and Johnson's method were comparable in predicting birth weight up to 10% error, though Malik et al [6] reported higher accuracy of up to 92-94% than the other studies. Bhandary et al [2], Yadav et al [9], and Kathiriya et al [16] found that Dare's method had much better accuracy than Johnson's method in predicting birth weight up to 10%. Torlani et al [20] found that the rate of estimation of birth weight within 10 % error of actual birth weight was better with Johnson's method than Dare's method. A comparison of the accuracy of prediction of birth weight up to 10% error of actual birth weight between the present study and other studies is shown in Table 7.

In the present study, both Dare's method and Johnson's method had tendency to overestimate birth weight in the LBW group. Between the two methods, Dare's method was more accurate in predicting LBW babies. Similar to our study Thombarapu et al [7] and Raghuvanshi et al [15] found that Dare's method and Johnson's method overestimated birth weight in the LBW group but Dare's method was better than Johnson's method in predicting LBW babies. In contrast, Malik et al [6] found Johnson's method more sensitive than Dare's method to predict IUGR babies.

In our study, Dare's method was able to predict all the macrosomic babies whereas Johnson's method underestimated the weight of one case (33.3%).Since, there were only 3 macrosomic babies in our study which is insufficient for comparison , we could not derive a conclusion for this group. Malik et al [6] found that Dare's method was more sensitive but Johnson's method was more specific in predicting macrosomia. Rajmohan et al [21] found Johnson's method to be more accurate than Dare's method for predicting babies more than 4000g.

In this study, among the normal weight babies Dare's method and Johnson's method were able to predict weight within the normal birth weight range (2500 -4000grams) in 98% and 93% cases respectively. Dare's method had better accuracy in predicting normal weight babies.

Shittu et al [1] and Emechebe et al [8] found that clinical methods over estimated birth weight in all birth weight groups. Accuracy of clinical estimation was highest in the normal birth weight range and lowest for the LBW group. Johnson's method overestimated all birth weight groups according to the studies by Numprasert [11], Annapurna et al [13] and Sowjanya et al [14].

To sum up , when the accuracy of the two methods were compared, Dare's method of estimation of birth weight was closer to actual birth weight and had lesser mean absolute error in all birth weight groups than Johnson's method. However, both Dare's method and Johnson's method had similar accuracy of estimation of birth weight (73% and 73.7% respectively) up to 10% error of actual birth weight. Dare's method and Johnson's method had tendency to overestimate birth weight in LBW group. Dare's method was better in predicting birth weight in all birth weight groups. The accuracy of predicting birth weight was maximum in birth weight of 2500-4000 grams group for both methods.

In accordance with our studies, Bhandary et al [2], Raghuvanshi et al [15] and Yadav et al [9] found Dare's method more accurate than Johnson's method in estimating foetal birth weight. In contrast, Torlani et al [20], Esmaeilou et al [10] and Malik et al [6] found Johnson's method better than Dare's method. Thombarapu et al [7] found that both methods correlated well with actual birth weight.

Conclusions

Both Dare's method and Johnson's method can

estimate birth weight within 10% error of actual birth weight in more than 70% cases. Dare's method was more accurate in predicting the birth weight of babies in all groups compared to Johnson's method. The accuracy of both methods was maximum for normal weight babies and least for LBW babies. Our study could not provide conclusive results for macrosomic babies. Therefore, whenever there are identifiable risk factors for birth of LBW or macrosomic babies, clinical methods may be combined with ultrasound to improve the accuracy of predicting birth of high risk babies. Since the main aim of estimating birth weight is to identify the low birth weight and macrosomic babies, large scale studies comparing the accuracy of Dare's method and Johnson's method should be done to arrive at a consensus. Further researches may be carried out to devise new clinical methods or modify the existing methods to improve the accuracy and reliability for estimating foetal birth weight.

Declarations

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Conflict of Interest

None Declared

Ethical Approval

The study was approved by the Institutional Ethics Committee.

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