Clinical assessment of Fetal weight estimation using Johnson's formula & Ultrasonographic assessment using Hadlock's formula at or near term: A comparative observational study

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Abstract*—Fetal weight in conjuction with gestational age is an important indicator of pregnancy outcome. So this study was conducted to find out the better method among using Johnson's formula or using Hadlock's formula to estimate fetal weight antenatally at or near term. This prospective study conducted on 100 pregnant women selected by simple random sampling with single term pregnancy with no fetal anomalies, delivered within one week of ultrasonography as well as measuring the symphysiofundal height and accuracy of Johnson's and Hadlock's formula compared. Fetal Weight is overestimated in all groups by Johnson's formula whereas in Hadlock's formula there is underestimation of birth weight <2500 gms and >3500 gms babies and overestimation between 2500-3500 gms babies. The correct weight was estimated with an error of 100gms in 30% of cases by Johnson's formula and in 68% of cases by ultrasound Hadlock's method. Although Hadlock's formula was found relatively more accurate than Johnson's formula in predicting birth weight but Johnson's formula is a quick, easy, accurate, reliable and cost effective method for estimating the fetal weight in remote areas where ultrasound is not available if assessed by experienced obstetricians. Despite the superiority of ultrasonography the simple clinical method of predicting fetal weight is of great value especially in developing countries.*

Keywords: Fetal Weight, Johnson's Formula, Hadlock's Formula.

I. INTRODUCTION

The aim of modern obstetrics is to achieve the best quality of life for both mother and new born. Accurate estimation of fetal weight is of paramount importance in the prospective management of high risk pregnancies and considerable reduction in perinatal morbidity and mortality.[1]

Fetal growth has been divided into three consecutive cell growth phases. The initial phase of hyperplasia occurs during the first sixteen weeks and is characterized by a rapid increase in cell number. The second phase which extends upto 32 weeks, includes both cellular hyperplasia and hypertrophy. After 32 weeks, fetal growth occurs via cellular hypertrophy and it is during this phase that most fetal fat and glycogen deposition take place. The fetal growth rate is 5 gm/day upto 15 weeks, 15 – 20 gms next upto 24 weeks and 30 – 35.gms next upto 34 weeks.[2]

Growth is a basic fundamental of life. Fetal weight in conjuction with gestational age is an important indicator of pregnancy outcome.[5]It has become very important especially for prevention of prematurity, evaluation of fetopelvic disproportion, induction of labour before term and detection of IUGR.[3]

Obstetric sonographic assessment for the purpose of obtaining fetal biometric measurement to predict fetal weight has been integrated into the main stream of obstetric practice during the past quarter century.[2]

Accurate estimation of fetal weight helps knowing the salvagibility of the baby outside the uterus, as it is the principle variable affecting the survival of the neonate.[1]

Thus a quick, easy, accurate and reliable method for estimating the fetal weight in utero with optimum precision would be of obvious benefit to the modern obstetricians. Estimation of birth weight by Johnson's formula based on symphysiofundal height has advantages of speed, economy & general applicability.[3]

In developing countries like India estimation of fetal weight by clinical method is important in managing the high risk pregnancies and the care of neonate.[1] Obstetrics ultrasound has revolutionized the knowledge of fetal medicine in the present day and can also predict fetal weight in utero with a great degree of precision.[3]

In view of this the present study was conducted to find out the better method among using Johnson's formula or using Hadlock's formula to estimate fetal weight antenatally at or near term.

II. METHODOLOGY

This comparative study was conducted on 100 pregnant women selected by simple random sampling in women admitting to the labour room at Rajkiya Mahila Chikitsalaya, attached to JLN Medical College and Hospital Ajmer (Raj.) from June 2016 to June 2017.

All singleton pregnant women at or near term who were delivered within one week of ultrasonography as well as measuring the symphysiofundal height irrespective of parity and socioeconomic status were enrolled for the study. Women who had complication like placenta previa, Abruptio placentae etc and fetal presentation other than cephalic were excluded from this study. Women whose fetus having any anomaly was also excluded from study. Women having weight >29.5 BMI and any pelvic anomaly were also excluded from this study.

After bio-socio-demographic and clinical evaluation the following measurements were taken:

Symphysiofundal height was measured (in cm) using a non elastic measuring tape with the patient in supine position with legs semiflexed and bladder empty. The highest point of the fundus was marked by left index and middle finger at the fundus. The distance from the upper border of symphysis pubis to the fundus was taken with a tape lying in contact with the skin of the abdominal wall. By careful examination the status of the vertex was determind.[3] The fetal weight was estimated by using:-

JOHNSON'S FORMULA[1,4,5]-:

- Weight in grams = (Mcdonald's measurement of Symphysiofundal height in centimeters –x) × 155
- x = 13, when presenting part was floating
- x = 12, when presenting part was at brim
- x = 11, when presenting part was fixed

HADLOCK'S FORMULA[4,5,6]

Log 10 EFW = 1.3596 - 0.00386 (AC x FL) + 0.0064 (HC) + 0.00061 (BPD X AC) + 0.0425 (AC) + 0.174 (FL)

1. BPD measurement-

BPD was measured at right angles to the longitudinal axis of the elliptical\skull at a level at which a clear mid line echo & easily discernable lateral ventricles could be visualized. BPD was measured from the outer table of anterior skull to the inner table of the posterior skull.[1]

2. AC measurement –

The major landmark in transvers axial image of fetal abdomen to measure AC is the umbilical portion of the left portal vein deep in the liver with the fetal stomach representing secondary landmark.[5]

3. FL measurement –

Obtained from the greater trochanter to the lateral condyle. The measured ends of the bones were blunt and not pointed excluding the epiphysis if any present.[1]

Predicted estimated fetal weight by each method was compared with respective neonatal actual birth weight using weighing scale.

Data was analyzed with the help of SPSS trial version 16 statistical software using student 't' test and chi square test for inferring significance of difference in means and proportions respectively. For significance p value <0.05 was considered as significant.

III. RESULTS

Study was conducted on 100 pregnant women. Age of the sample ranged from 19 – 34yrs with mean age 23.77 yrs. All of them were delivered within one week of examination.

In this study majority 46% of cases the birth weight ranges from 2501 – 3000 gms. There were 17% low birth weight babies (2001 - 2500 gms). Mean birth weight of babies under study was 2952gms. (Table 1)

Table 1
Distribution of cases according to birth weight of babies (N=100)

S. No.	Groups	Weight of babies in gms	No. of cases	Percentage
1	I	2001 – 2500	17	17
2	II	2501 – 3000	46	46
3	III	3001 – 3500	32	32
4	IV	>3500	05	05

Average error was calculated by adding the error of estimation of fetal weight from actual birth weight in all cases and dividing it by total number of cases. These calculations were done for each method separately. Average error was least with Hadlock's Formula than Johnson's Formula. (Table 2)

Maximum error was least in group III in Johnson's formula and group IV in Hadlock's formula but average maximum error in both groups was comparable. (Table 2)

In this study, the average maximum error was least by Hadlock's ultrasound method when compared to Johnson's clinical method. (Table 2)

Table 2
Average and Maximum error in the fetal weight by both the methods

Method		I	II	III	IV	Average
Johnson	**Average error (in gms)**	177.94	170	161.72	217	171.05
	Maximum error (in gms)	335	565	320	330	387.5
Hadlock's	**Average error (in gms)**	73.41	114.71	111.88	85.4	105.32
	Maximum error (in gms)	260	414	637	114	356.25

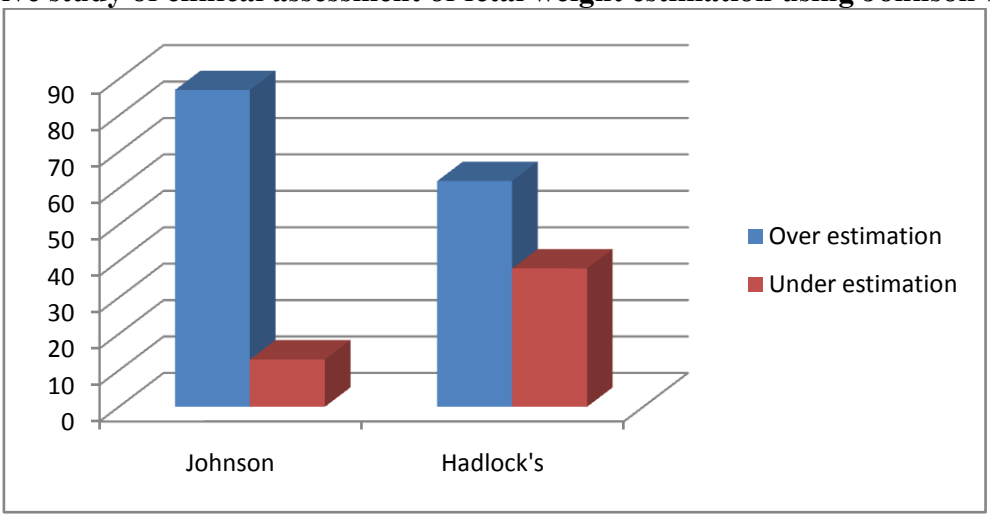
Johnson's method overestimated the birth weight in all age groups. Hadlock's method also overestimated the birth weight in group II and III but under estimated in group I and IV. (Table 3)

In this study in Johnson's formula 87% cases were overestimated and 13% cases were underestimated. ByHadlock's formula 62% cases were overestimated and 38% cases were underestimated. (Table 3)

Table 3
Number of over and under estimation by both the methods in various weight groups.

Method	I		II		III		IV		Total	
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under
Johnson	16	01	40	06	26	06	05	0	87	13
Hadlock's	07	10	32	14	22	10	01	4	62	38

Figure 1
Comparative study of clinical assessment of fetal weight estimation using Johnson's Formula



In this study correct birth weight could be estimated by Johnson's formula with an error of 100 gms in 30% of cases and by Hadlock's formula correct birth weight could be estimated with an error of 100 gms in 68% of cases. In 79% of the cases the accuracy by ultrasonic method of estimation of percentage error was upto 5% compared to only 46% in the case of clinical method. (Table 4 and Figure 2&3)

Table 4
Percentage error per method

S. No.	Percentage error	Johnson's Method	Hadlock's Method
1	**Upto 5%**	46%	79%
2	**Upto 10%**	93%	91%
3	**Upto 15%**	98%	98%
4	**Upto 20%**	100%	100%

Figure 2
Cases with degree of Errorin both method

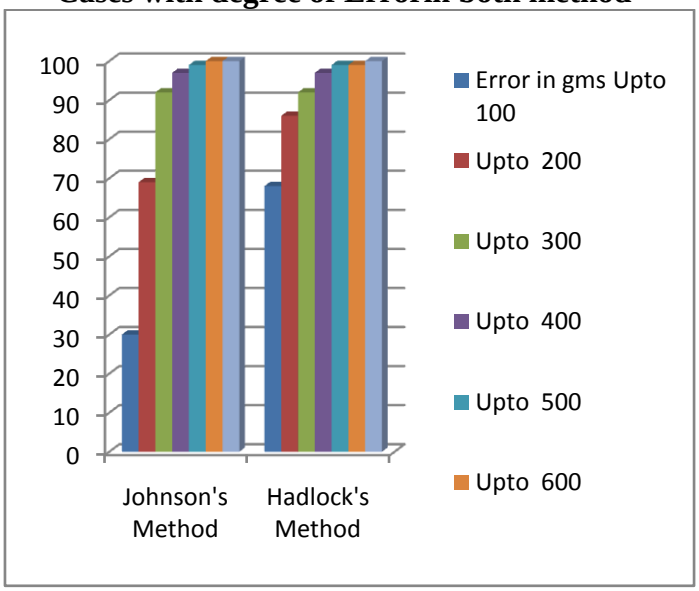
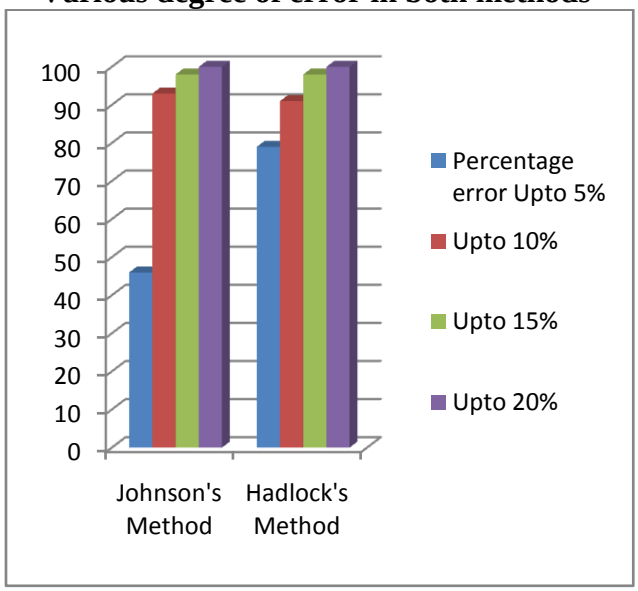


Figure 3
Various degree of error in both methods



In this study, standard deviation of prediction error and standard error of mean of Johnson's Method was 405.94 and 40.59 respectively where as it was 404.25 and 40.43 in Hadlock's formula method. (Table 5)

Table 5
Standard deviation of prediction error and standard error of mean of both methods

Type of Method	Standard deviation	Standard error of mean
Johnson's Method	405.94	40.59
Hadlock's Method	404.25	40.43

There was statistically significant correlation coefficient r =0.9466, p=<.001 between actual birth weight and estimated by Johnson`s method. However the estimated weight was on an average 0.1820 kg higher than actual weight the over estimation of weight by Johnson`s formula was statistically significant. By Paired t test if t value is > 3.46 then p value is < 0.001 and differences are highly significant as in this study showing by Johnson's method.

There was no statistically significant correlation coefficient r=0.9281, p=>0.05 between actual birth weight and estimated by Hadlock`s method. However the estimated weight was on an average 0.0945 kg higher than actual weight the over estimation of weight by Hadlock`s formula was statistically not significant (p> 0.05).

IV. DISCUSSION

The present study majority 46% of cases the birth weight ranges from 2501 – 3000 gms in group II almost similar results have been reported by Daya Sirohival et.al[7] and Bhandary Amritha et.al[8] in 2004.

There were 17% low birth weight babies in this study. Comparable observations were made by R. Sowjanya and S.Lavanya et. al[3] in April 2015.

In this study, average error was least with Hadlock's formula than Johnson's formula. Similar Observations of R.Sowjanya[3] were well in resonance with present study in this regards.

In this study average maximum error was least by Hadlock's ultrasound method when compared to Johnson's clinical method and similar results were reported by Bhandary Amritha et.al.[8]

In this study in Johnson's formula 87% cases were overestimated and 13% cases were underestimated similar results have been reported by Tiwari and Sood (1989)[9], Rajya Shri Sharma et.al. (2000)[10] and Daya Sirohival et.al.[7]

By Hadlock's formula 62% cases were overestimated and 38% cases were underestimated. in this study. Tiwari and Sood et.al.[9] in 1989 reported almost equal incidence of underestimation and overestimation using Warsof et.al.[11] formula by ultrasonography. Ultrasonographic estimation by Shephard's method had a tendency to underestimate in 58% of the cases. Similar results reported in R. Sowjanya, S.Lavanya[3] who reported 61% overestimated and 39% underestimated with Hadlock's method.

In this study correct birth weight could be estimated by Johnson's formula with an error of 100 gms in 30% of cases which was 32% in Daya Sirohiwal et.al.[7] study in 2004.By Hadlock's formula correct birth weight could be estimated with an error of 100 gms in 68% of cases which was 74% in Daya Sirohival[7] study in 2004.

In 79% of the cases the accuracy by ultrasonic method of estimation of percentage error was upto 5% compared to only 46% in the case of clinical method.

V. CONCLUSION

Fetal weight estimation has become increasingly important especially for the prevention of prematurity, evaluation of fetopelvic disproportion, decision for mode of delivery, induction of labour before term, in complications of pregnancy and in detection of intrauterine growth retardation.

Fetal weight estimation by clinical methods was criticized on the basis of being less accurate and subject to considerable observer variation. Ultrasonography has gained popularity for determination of fetal parameters and wellbeing and also found to be useful for estimation of fetal weight.

This study observed that fetal weight is overestimated in all age groups of babies by Johnson's Formula and Hadlock's Formula but error in difference of weight less with Hadlock's Formula is more.

There was statistically significant correlation coefficient r =0.9466, p=<.001 between actual birth weight and estimated by Johnson`s method whereas there was no statistically significant correlation coefficient r=0.9281, p=>0.05 between actual birth weight and estimated by Hadlock`s method.

The correct weight was estimated with an error of 100gms in 30% of cases by Johnson's formula and in 68% of cases by ultrasound Hadlock's method.

Hadlock's formula is more accurate than Johnson's Formula in predicting birth weight however the results of Johnson's Formula were comparable to Hadlock's Formula. And Johnson's Formula is a quick, easy, accurate, reliable and cost effective method for estimating the fetal weight in remote areas where ultrasound is not available and can be included in MCH training programme of medical and Paramedical staff and birth attendenants. So despite the superiority of ultrasonography the simple clinical method of predicting fetal weight is of great value especially in our country.

CONFLICT OF INTEREST

None declared till now.

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