

## ORIGINAL RESEARCH

# A comparative study of fetal weight estimation using Johnson's formula and ultrasound and their correlation with actual birth weight

<sup>1</sup>Dr. Bindeeya B. Dhrangiya, <sup>2</sup>Dr. Parul T. Shah, <sup>3</sup>Dr. Divyanshu D. Patel, <sup>4</sup>Dr. Payal P. Panchal, <sup>5</sup>Dr. Shlok V. Patel

<sup>1</sup>Senior Resident, SVP Hospital, Ahmedabad, Gujarat, India

<sup>2</sup>Head of Department, Professor, SVP Hospital, Ahmedabad, Gujarat, India

<sup>3</sup>1<sup>st</sup> year Resident, SVP Hospital, Ahmedabad, Gujarat, India

<sup>4</sup>Assistant Professor, SVP Hospital, Ahmedabad, Gujarat, India

<sup>5</sup>M.B.B.S., B.J. Medical College, Ahmedabad, Gujarat, India

### Corresponding Author

Dr. Payal P. Panchal

Assistant Professor, SVP Hospital, Ahmedabad, Gujarat, India

Received: 12 March, 2023

Accepted: 18 April, 2023

### ABSTRACT

**Background:** Accurate estimation of fetal weight is of importance in the management of labour and delivery. Both low birth weight and macrosomic fetus at delivery are associated with increased risk of newborn complications during labor and puerperium. Two important methods for predicting birth weight in current day obstetrics practice are clinical by Johnson's formula and ultrasonographic methods. **Aims and objective:** Aim of the present study is to compare and correlate the effective birth weight obtained by clinical method using Johnson's formula and ultrasonographically by Hadlock's formula with actual birth weight. Objective of this study was to assess the fetal weight by clinical and Sonographic and to compare the actual weight of baby after birth. **Material & Methods:** It was a prospective analytic study conducted in Department of Obstetrics and Gynecology at tertiary care hospital SVP hospital; NHL MMC, Ahmedabad from February 2022 to July 2022. The formulas used in study are Johnson's formula, Hadlock's formula and the statical method Bland Altman analysis used. **Result:** This study shows that birth weight calculated by using Symphysio fundal height and Birth weight with ultrasonographic method shows very negligible difference with actual birth weight. So both methods are equally important. **Conclusion:** Johnson's formula used for clinical weight estimation is inexpensive and readily available method done with help of non elastic tape and gives fairly precise results in term pregnancies and helps to recognize irregular fetal growth and diminish adverse perinatal outcome. Though ultrasonography is more accurate but it is costly and special skill also required. So clinical estimation of fetal weight has important role and as an alternative method where ultrasonography is not available.

**Keywords:** Symphysiofundal Height, Johnson Formula, Hadlock's formula, Birth weight

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

### INTRODUCTION

Accurate estimate of fetal weight is of paramount importance in management of labour and delivery and new born survival<sup>1</sup>. Antepartum evaluation of estimated fetal weight in high risk pregnancies like diabetic pregnancy, vaginal birth after caesarean section, breech presentations and preterm deliveries helps in perinatal counseling and managing optimal role of delivery and level of hospital where delivery should be conducted and hence to reduce the rate of neonatal morbidity and mortality. The potential complications of macrosomic fetus associated with

vaginal delivery include shoulder dystocia, brachial plexus injury, bone injuries, intrapartum asphyxia, while the maternal risks include birth canal and pelvic floor injuries, increased rate of operative vaginal and caesarean deliveries, and postpartum hemorrhage<sup>2</sup>. While low birth weight babies categories are prone to develop recurrent infection, malnutrition, diabetes, hypertension and neuro-developmental handicaps in their later life<sup>3</sup>. Various methods for fetal weight estimation include clinical, radiological method like ultrasonography (USG) and magnetic resonance imaging (MRI). Two important methods for

predicting birth weight in current day obstetric practice are clinical by Johnson's formula and ultrasonographic methods. Ultrasound is preferred because of its ease of use, objectivity and precision, but at the same time several technical limitations of the sonographic technique are well known like maternal obesity, oligohydramnios, and anterior placentation as well as expertise required. Therefore, clinical method is still a simple and effective methods to estimate fetal weight for birth attendant and paramedical staff in rural areas where facilities of ultrasound is not widely available, to decide timely referral of high-risk patients to tertiary centers for further management.

The aim of present study is to compare and correlate the effective birth weight obtained by clinical method using Johnson's formula and ultrasonographically by Hadlock's formula with actual birth weight.

## METHODS

It was a prospective analytical study conducted in the department of obstetrics and gynecology at tertiary care centre, at western part of India from February 2022 to July 2022. For this study Institutional ethical committee approval had been taken.

A total of 150 antenatal pregnant women with singleton vertex presentation, gestational age between 37 to 40 weeks and in early labour, from all socioeconomic classes, with medical disorders complicating pregnancy were included. Women who have history of irregular menses, multifetal gestation, obesity, oligohydroaminos, polyhydroaminos, malpresentation, Congenital anomalies of babies, intrauterine fetus death, pregnancy with uterine fibroid or any abdominal or adnexal or urinary bladder mass, placental anomalies for placenta previa, abruption placenta were excluded. All the detailed history like obstetrics and menstrual were taken and examination of patients were done using proforma after obtaining verbal and informed consent. Period of gestation was calculated according to Naegele's rules.<sup>4</sup> After general physical examination, careful obstetric examination was done in supine position after emptying of bladder and with hips semi flexed to determine the presentation and

position of the foetus. Position of the fetal heart sound was noted. Vaginal examination was done to determine the dilatation and effacement of the cervix, presentation and position of the fetus and station. Symphysis-fundal height measurement was taken in supine position with knee and hip semi flexed along the longitudinal axis of uterus with a measuring tape from upper border of pubic symphysis along the curvature of gravid uterus up to the fundus where the height of the fundus is defined by the gentle pressure exerted by the ulnar border of the left hand in a plane right angle to the abdominal wall, dextrorotation if present was corrected beforehand. Measurements were taken during uterine relaxation, if patient was in labour. Clinical estimation of EFW was done by Johnson's formula.

Johnson's formula: Foetal weight (in grams) = (SFH - n) X 155 SFH = Symphysis-fundal height in centimetres n= 12 if vertex is above or at the level of ischial spines, n= 11 if vertex is below the level of ischial spines.<sup>5</sup>

All women were subjected to ultrasonography using real time ultrasound scanner linear probe 4MHz. The fetal dimensions studied were BPD, HC, AC and FL which were obtained in centimetres. Estimation of EFW based on USG was done by using Hadlock's formula which yields foetal weight in grams.

Hadlock's formula:  $\text{Log}_{10} \text{ EFW (grams)} = 1.3596 - 0.00386(\text{AC} \times \text{FL}) + 0.0064(\text{HC}) + 0.00061(\text{BPD} \times \text{AC}) + 0.0425(\text{AC}) + 0.174(\text{FL})$ .<sup>5</sup>

After birth, the actual birth weight was measured using a standardized digital neonatal weighing machine approved by ISI. The estimated fetal weights by Johnson's formula, USG were compared with the actual birth weight.

Statistical method:

The data obtained was entered into Microsoft Excel worksheet. Data like mean, standard deviation (SD), standard error (SE) were calculated. Comparison between Actual birth weight measured by clinical method using Johnson's formula and Actual birth weight measured by Ultrasonography by using Hadlock's formula were compared using BLAND ALTMAN METHOD analysis.

## RESULTS

**Table 1: Maternal Age distribution(N=150)**

Maternal age in years	Distribution	Percentage	Bajaj P <i>et al.</i> study <sup>6</sup>
<20	10	7%	2.5%
21 to 25	78	48%	60.5%
26 to 30	44	27%	24.5%
31 to 35	13	8.66%	8.5%
>35	5	3.33%	

In present study majority of patients (48%) were in age group 21 to 25 years of age, followed by 27% were between age of 26 to 30 years.

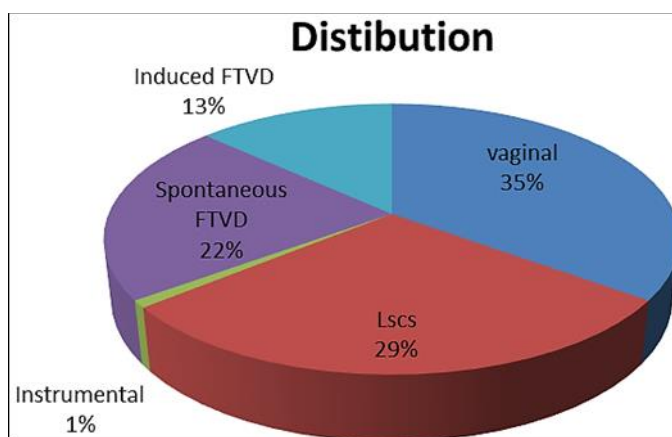
**Table 2: Maternal parity distribution (N=150)**

Study	Primi gravid	Multigravida
Present study	31.33%(47)	68.66%(103)
Bajaj P <i>et al.</i> <sup>6</sup>	34.5%	65.5%
Bhandery A <i>et al.</i> <sup>7</sup>	45%	55%

In this study, out of 150 women 31.33% were comparable with Bajaj P *et al.*<sup>6</sup> and Bhandery *et al.*<sup>7</sup> primigravida and 68.66% were multigravida which is

**Table 3: Mode of Delivery (N=150)**

Mode of delivery	Distribution	Percentage
vaginal	82	54.66%
LSCS	68	45.33%
Instrumental	2	1.33%
Spontaneous FTVD	51	62%
Induced FTVD	31	37%



Out of 150 patient 82(55%) female were normal delivered and 68(45%) were delivered by cesarean section. Among 68 women who underwent for vaginal delivery 51 pt had spontaneous delivery and 31 had induced vaginal delivery.

**Table 4: Birth weight of baby**

Birth Weight	Distribution	Percentage of present study	Meena k <i>et al.</i> <sup>8</sup>	Sowjanya <i>et al.</i> <sup>9</sup>
1.5kg-2.0kg	2	1.33%		
2.1kg-2.5kg	36	24.00%	17%	16%
2.6kg-3.0kg	74	49.33%	46%	48%
3.1kg-3.5kg	30	20.00%	32%	34%
>3.5kg	8	5.33%	5%	2%

In our study 49.33% baby belongs to birth weight of 2.5-3.0kg group while 24% were belongs to birth weight of 2.1-2.5kg, as in Indian population it's average birth weight. Which is comparable with Meena k *et al.*<sup>8</sup> and Sowjanya *et al.*<sup>9</sup>.

**Table 5: NICU admission of Baby**

Nicu admission	Ditribution	Percentage
Neonatal Jaundice	29	19%
RDS	6	4%
LBW	2	1%
Sepsis	4	2.66%
MSL	14	9%
Not required	95	64.00%

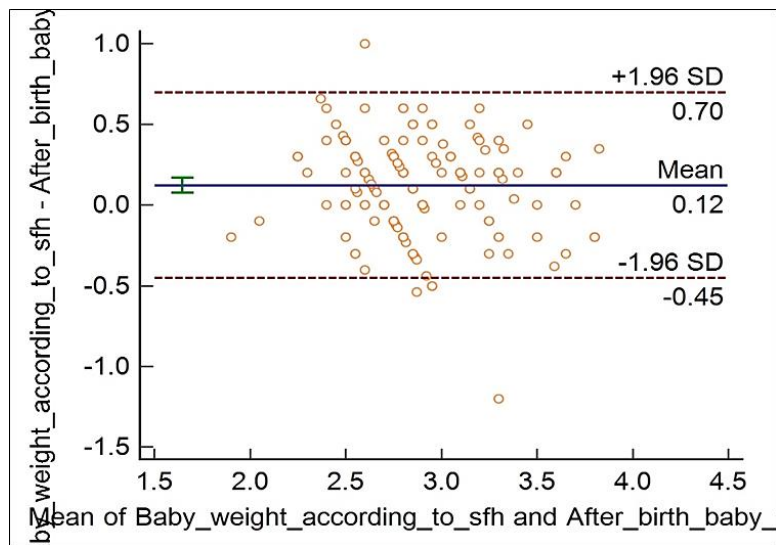
In view of neonatal outcome out of 150, 29 babies admitted in NICU for neonatal jaundice and 14 were admitted for MSL, while 95 babies did not require NICU admission.

**Table 6: Statistical comparison of actual fetal birth weight with Johnson’s formula and Hadlock’s formula**

	Mean fetal birth weight	Standard Deviation	Standard Error	(95%) Confidential Interval
Johnson's Formula	2862	349.62	28.5	2805 to 2919
Hadlock's Formula	2800	369.83	30.1	2740 to 2860
Actual Birth weight	2820	396.31	32.3	2756 to 2884

In our study Mean actual birth weight was 2820±396 gm while the mean estimated fetal weights by clinical and ultrasound methods were 2862±349 gm and 2800 ± 369 gm respectively. The mean bias for clinical method and actual birth weight is 0.12 gm which is considered to be negligible. While mean bias by

ultrasound is 0.03 which is not significant. Hence both methods are similar. Confidence interval for the clinical and ultrasound method compared to actual birth weight was 2805 to 2919 and 2740 to 2860 respectively.



The scatter diagram showing relation between the clinical fetal weight estimation and actual birth weight in figure 1. Clinical method by SFH (Johnson’s

formula) of fetal weight estimation showed positive correlation with actual baby weight and showing mean bias 0.12 which is negligible.

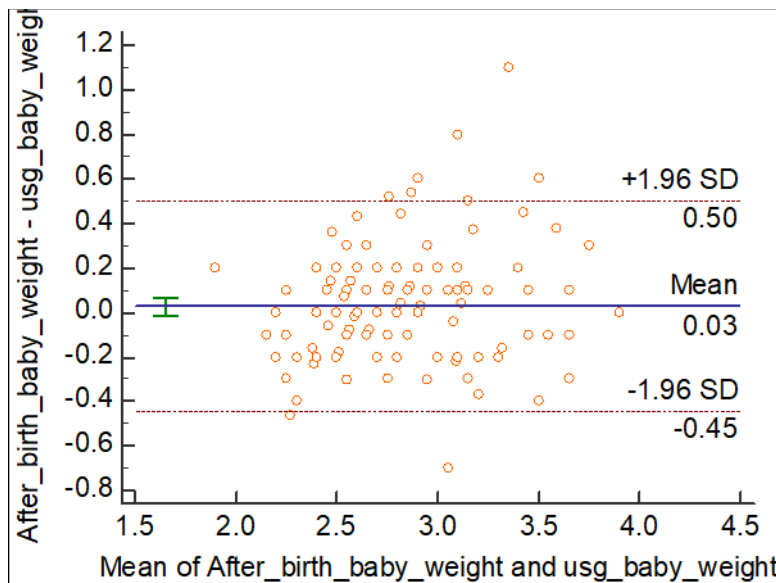


Figure 2 is the scatter diagram showing relationship between ultrasound fetal weight and actual birth weight. Ultrasound method shows positive correlation

with actual birth weight. Here mean bias is 0.03 which is very less. So, this method is also useful.

## DISCUSSION

Fetal weight is the most important tool in obstetrics as Macrosomia and intrauterine growth restriction increased risk of perinatal morbidity and mortality and long term neurological & developmental disorder<sup>3</sup> So, identification of this condition will reduce the chances of fetal morbidity and mortality.

So, accurate Prediction of fetal weight has been great interest. As fetal weight measurement requires maternal and fetal anatomical characteristics.

In our study, most of the patient belongs to age group of 21 to 25(48%) and 26 to 30(27%) year of age as it was most common age of reproductive age which is comparable to Bajaj P *et al.* study<sup>6</sup>.

In Present study, 54.66% women underwent for normal vaginal deliveries among them spontaneous deliveries 62% were and induced deliveries were 37% and 45.33% were delivered by caesarean section. In our setup higher caesarean rate is due to our set up is tertiary care center with an emergency obstetrics units where maximum pregnant women are referred with high risk pregnancies and severe co morbid conditions like associated obstetrics and medical complications.

In India, average birth weight of babies is 2.5 to 3.0 kg. In the present study neonates were distributed as per the birth weight into five groups, Birth weight range of 2.5 to 3.0 kg had maximum distribution (49.33%) of babies. Which was comparable to other studies by Meena k *et al.*<sup>8</sup> and Sowjanya *et al.* study<sup>9</sup>.

In our study, majority of babies admitted in NICU were due to Jaundice (19%) and MsL (9%). While 95 babies among were healthy and back to mother.

This study revealed that there was no significant difference found between the mean birth weight obtained through clinically by Johnson's formula and ultrasound method by Hadlock's formula with actual birth weight. The mean actual birth weight in this study was 2820±396 gm which is similar to mean actual birth weight of 2770±470 gm reported by Shirish *et al.*<sup>10</sup>.

In our study, clinical and ultrasonographic method of birth weight compare to actual birth weight which showed mean bias of ±0.12 and ±0.03 respectively so both method co-relate positively with actual birth weight. It is clear that clinical estimation of fetal weight is as equally important as ultrasound in prediction of actual birth weight which is similar to finding obtained in study Bajaj P *et al.*<sup>6</sup>.

## CONCLUSION

This study indicates that clinical estimation of birth weight has important a role in management of labour and delivery in a term pregnancy. So, it indicates that fetal weight estimation using Johnson's formula is comparable to ultrasound estimating actual birth weight. Johnson's formula is a quick, easy, simple, accurate, reliable and cost-effective method for estimating the fetal weight and it should be included in routine training of medical personnel and it will help in earlier referral of mothers with macrosomic

fetuses, reduction of obstructed labour and its subsequent complication.

Fetal weight estimation by ultrasonographic requires expensive sonographic equipment and specially trained personnel; expertise. Its availability is difficult in developing nations like India. It is recommended that the ultrasound method should be used in estimating the birth weight whenever accessible. However, the clinical method should remain a valuable alternative where ultrasound is unavailable and also for screening as it also has strong correlation with the actual birth weight.

## REFERENCES

1. Suresh S. Sonographic evaluation of fetal growth patterns and perinatal outcome. *Ultrasound J Obstet Gynecol.*2010;(1):300-9
2. B. Ekele and J.A.M.Otubu, "Maternal and perinatal mortality," in textbook of obstetrics and gynecology for medical student, A. Agboola, Ed, vol.1, pp.526-531, Heinemann Educational Books, Ibadan, Nigeria, 2<sup>nd</sup> edition, 2006.
3. Njoku C, Emechebe C, Odusolu P, Abeshi S, Chukwu C, Ekabua J. Determination of Accuracy of Fetal Weight Using Ultrasound and Clinical Fetal Weight Estimations in Calabar South, South Nigeria. *Int Sch Res Notices.*2014;2014:970973.
4. D.C. Dutta's textbook of Obstetrics, 9<sup>th</sup> edition, page no.83.
5. D.C. Dutta's textbook of Obstetrics, 9<sup>th</sup> edition, page no.84.
6. Bajaj P, Kadikar GK, Kannani M, Bhatt M, Shah S. Estimation of birth weight clinically and sonographically and its correlation with its actual birth weight: a prospective and comparative study. *IntJ Reprod Contracept Obstet Gynecol.*2017;6:3103-8.
7. A.B. Amritha, J.P. Palric, and P.S. Ashwin, "Comparative study of various methods of fetal weight estimation at term pregnancy" *Indian Journal of Obstetrics and Gynecology*, Vol. 54, pp. 2004 pg 336-339, 2004.
8. Meena K, Jain D. Clinical assessment of fetal weight estimation using Johnson's formula & Ultrasonographic assessment using Hadlock's formula at or near term: A comparative observational study. *International Multi-speciality J Health(IMJH).*2018 4(4):11-3.
9. Sowjanya R, Lavinia S. Comparative Study of Clinical Assessment of Fetal Weight Estimation Using Johnson's Formula and ultrasonography assessment using Hadlock's Formula at or Near Term. *IOSR-JDMS.*2015;14(4):20-3.
10. Dr. Shirish Toshniwal, Dr. Swarnima Saxena and Dr. Hetal Sarvaiya. 2017. "Comparative study of fetal weight estimation using hadlock's, johnson's & dare's formula and its correlation with actual birth weight", *International journal of Current Research*, 9(07), 54728-54730.