Available online at **Available online at: www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2016, 5, 1:184-190

Comparison of the accuracy of clinical methods for estimation of fetal weight

Haji Esmaeilou M[1] and Mohamadi E[2]*

[1]MSc of Midwifery, Department of Midwifery, Urmia Branch of Islamic Azad University, Urmia, Iran
[2]Internist, Urmia University of Medical Sciences, Urmia, Iran

---

ABSTRACT

Estimation of fetal weight (EFW) is one of the essential measures for labor and delivery. While the use of ultrasonography for EFW is costly, may not work in some centers. So, to make a non- ultrasound method for EFW is important. This study aimed to compare the accuracy of various clinical methods for EFW with the actual birth weight at term pregnancy. A cross-sectional study conducted on 98 pregnant women who were admitted for delivery with gestational age of 37-42 weeks, singleton pregnancy and cephalic presentation in Imam Khomeini hospital, Ahvaz. The fetal weight was anticipated by a midwife through abdominal palpation (using Leopold's maneuvers), measurements of symphysis-fundal height and abdominal girth, and also three formulas. The results were analyzed using the software SPSS version 20 and SATA11. The actual average birth weight was3242.85±43.37 gr. A significant positive correlation was observed between actual birth weight and clinically estimated weight. Kappa coefficient was > 0.8 when all studied methods were compared with the actual weight. This agreement was greater on abdominal palpation and Risanto's formula, respectively. In the present study, abdominal palpation and Risanto's formula are more accurate for predicting fetal weight. Since these methods are quick, simple and cost-effective for EFW so, they can be a useful alternative instead of routine ultrasonography.

Keywords: Estimation of fetal weight, Actual birth weight, Clinical estimation, Ultrasonography, Abdominal girth, Symphysis-fundal height, Maternity care.

INTRODUCTION

The correct estimation of fetal weight [EFW] in relation to gestational age is one of the key issues in the management of the labor and delivery. Every year, about 20 percent of the 4 million new born babies in the U. S. are at the low and high ends of the weight spectrum. Neonates in the both groups; low birth weight[LBW] and large for gestational age [LGA][macrosomia] need to specific attention at birth and afterwards. Moreover, rates of cesarean delivery among LGA and LBW infants will be increased. In 2006, 8.3% of all newborns had low birth weight - less than 2500 grams. Infants weighing less are at risk of hypoxia, hypothermia, hypoglycemia, skull injuries, limb fractures, trauma to the abdominal organs such as the liver and spleen, and the risk of neurological problems. Thus, LBW infant remains at much higher risk of morbidity and mortality. On the other hand, the birth weight is greater than 4000 grams was reported in 7.8% of infants[macrosomia].The macrosomic infant is at risks of prolonged labor, shoulder dystocia, permanent paralysis of brachial plexus and even fetal death. In these cases, the mother's life is threatened usually followed by atonic uterus, postpartum hemorrhage and sometimes due to severe birth canal laceration[1-4].

Therefore, EFW is one of important consideration for maternity care. It can be done by clinical methods and ultrasonography. The ultrasound measure small and preterm fetal size with reasonable accuracy, but has limited accuracy for prediction of large fetal weight. Russ et al. reviewed 13 studies which were performed about accuracy

of ultrasonography. They reported that ultrasound has moderate sensitivity [60 %] to predict macrosomia, but has high specificity [90 %] to reject LGA infant[5]. Behnamfar et al. in their study showed that to assess baby's weight; clinical and ultrasound estimation was acceptable in 83% and 67% of cases, respectively. Also they found a statistically significant differences between these two estimates [P <0.009] [6].But, in Ugwn's study has been indicated that ultrasound is better than clinical methods for EFW [7].It is believed that definitely cannot be advised routine use of ultrasonography to detect fetal birth weight. Overall, ultrasound for EFW is an expensive method; also quick access to this method is not available in some labor centers especially in developing countries. Several studies have reported that EFW by abdominal palpation or even mother's opinion have accuracy like ultrasound accuracy in measurement of fetal size, except that; they are inexpensive methods and always available. Estimated fetal weight by abdominal palpation is a subjective method and may be difficult for midwifery students. In contrast, other clinical methods for estimation of fetal weight are objective methods and simple. They included using the fundal height and abdominal girth measurement also application of formulas like Johnson, Dare and Risanto. Torloni et al reported the accuracy of EFW in Brazilian population was 57 % and 61% by Johnson and Dare formula, respectively [8]. Bani Aqil in his study concluded that a direct correlation was between the actual birth weights and estimated fetal weight by Johnson formula, so that with increasing the actual weight, a greater number was also shown in the estimated weight. But there were no significant differences between the mean of these two varieties [9]. Asheber et al reported that estimated fetal weight by abdominal palpation was more accurate than Johnson formula in low birth weight[68 % vs. 40 %], while Johnson formula had more accuracy among higher weight group [10].

Easy access to accurate and low cost methods for EFW -as a primary screening technique- can help to prevent several maternal and fetal complications in labor and delivery. Considering the global importance in the development of simple, effective and affordable reproductive health, and due to the high cost of ultrasound and lack of easy access to it at some medical centers, clinical methods for EFW are considerable. It is noteworthy that, we did not find any studies in which the various clinical methods of EFW were simultaneously compared with together and with to actual birth weight.

Objective:
The present study aimed to compare the accuracy of various clinical methods for EFW with the actual birth weight at term pregnancy.

MATERIALS AND METHODS

Study design, setting and sampling- In this cross-sectional study, diagnostic tests were used. The study population was 98 full - term pregnant women who have been admitted for delivery. The study setting was the Imam Khomeini hospital in Ahvaz, a city in the south of Iran. Inclusion criteria were; singleton pregnant women with gestational age 37 -42 weeks who had a viable fetus with cephalic presentation. Exclusion criteria included; multiple pregnancies, presentations other than cephalic, poly - or oligohydramnios, uterine fibroids, fetal abnormalities, placenta previa reported by ultrasound and the reluctance of women to participate in the study.

Data collection-Data-gathering tools included a scale to measure the mother's weight and the other scale to measure baby's weight. The accuracy of scales was measured with a standard scale, daily. Also we used a flexible, non-elastic, standard sewing tape that was divided with inches and cm. Moreover one check list that was made by the researcher was used in this study. It includes demographic, obstetric data and recorded information on conducted measurements and estimated fetal weight.

Study process-Eligible pregnant women in obstetric clinic were counseled and explained about the objective of the study by the researcher. After written consent, during an interview, woman's demographic and obstetric information were recorded and the patient was then asked to empty her bladder and afterward her weight was measured. Then mother stayed in the supine position while the legs are slightly bent at the knees. At that time, between the uterine contractions intervals, the EFW were done and recorded by researcher through abdominal palpation [using Leopold's maneuvers].At this stage; symphysis-fundal height [SFH],the upper border of the pubic symphysis to the highest point of the uterus, was measured with standard sewing tape in inches. This measurement is accomplished in the midline, or in the parallel of the longitudinal axis of the uterus. In case of uterus deviation from the midline, uterus was kept by the other person toward the midline, to measure the height of the uterus. Mother's abdominal girth was measured at the umbilicus level by standard sewing tape without excess pressure to tighten the tape and to

her abdomen. It should be noted that to avoid bias tape, the division posted in inches was placed on the mother's abdomen. Then values of SFH and abdominal girth were rounded to the nearest unit based on cm.

After these measurements, the researcher performed a vaginal examination to determine fetal station. Fetal station refers to where the presenting part is in mother's pelvis [in our study vertex was the presenting part]. If the presenting part lies above the ischial spines, the station is reported as minus station and if it places in the lower level, fetal station is stated as plus station. And if the presenting part is at the level of the spines, it is considered as zero station. To avoid bias, all examinations on all samples were performed by a single person. It should be noted that all measurements were recorded in the check list. Then, EFW were done by someone else via using the check list information that was put in the studied formulas. The studied formulas for EFW consisted of following formulas:

1-Johnson's formula(11):
Fetal Weight in gr. = 155 x (SFH in cm* – K)
K = 11 (fetal vertex at plus stations)
K = 12 (fetal vertex at zero station)
K = 13 (fetal vertex at minus stations)
[* For patients over 90 kg, subtract 1 from the SFH]
2- Dare's formula (12):
Fetal weight in gr. = SFH in cm x abdominal girth in cm
3- Risanto's formula (13-14):
Fetal weight in gr. = (126.7 x SFH in cm) - 931.5**
[**931.5 wasthe constanta]

After delivery the exact weight of the newborn was carefully measured by another person and recorded in the check list. If the time of EFW and delivery time was longer than 3 days, the study subject was excluded from the study. The calculated weights - by all methods- were considered acceptable if they were in the range of ± 10% of real weights.

Data analysis - All data analysis was done on software SPSS version 20 and SATA11. Descriptive statistics included calculations of means ± standard deviations, medians with ranges, and frequencies expressed as percentages with 95% confidence intervals.

Kappa coefficient was calculated to evaluate the agreement among estimated weight by each of the discussed methods and actual birth weight. The Kappa coefficient calculated up to 4.0 to 6.0 were considered to be medium, greater than 7.0 good and more than 8.0 was considered to be excellent. Repeated Measurement ANOVA was used to compare the mean birth weight based on discussed methods.

RESULTS

In this study, 100 women were enrolled among who were referred for delivery to our study place. Two women were excluded, because they didn't have delivery during 3 days after the day of EFW. Finally, obtained information was analyzed from 98 women.

The mean age of the sample population were 23.59 ± 4.77 years. The educational level in 71.4% of the study population was less than 8^{th} standard and 98 % were housewives. The most of participants were nulliparous (65.3 %) and the mean gestational age in this study was 39.5 weeks (Table 1).Among newborn babies 44.9% were daughter and 77.6% of women had vaginal delivery.

In our study, the EFW were performed by Leopold maneuvers, measuring SFH and abdominal girth by a midwife as well as using Johnson, Dare and Risanto formulas. The actual weight of the baby was immediately measured after birth. The estimated weight was acceptable, if were in the range of ±10 % of real weight. The outside from this range was considered unacceptable. Our results showed that the ability of palpation method for EFW were better than the other studied methods while Dare formula had the lowest ability to estimate weight (79.6% vs. 69.4%)(Table 2).

The mean of real weight among newborn babies was 3242.85 ± 43.37gr (maximum = 4.4Kg and minimum = 2.45Kg).The weight of 89.8 % of the newborn babies was 2500-4000 gr. While the weight of 8.2 % of babies was higher than 4000 gr., only 2% of those weighing less than 2500 gr. at birth.

Table 3 compares the actual weight of the fetus with estimated fetal weight by four studied methods. In general, the significant differences were observed among the mean weight measured by four methods in this study (P value< 0.001) (Table 3).

In comparison pairwise; a significant difference was seen between the mean weight estimated by midwives and the mean weight estimated by Dare formula(P value = 0.002). Also significant differences were observed among the mean weight estimated by midwives and the mean weight estimated by Risanto formula (P value < 0.001),Johnson and Dare formulas (P value = 0.001), and Johnson and Risanto formulas (P value < 0.001).

Moreover significant differences were detected among the actual weight and the estimated weight on the Dare formula (P value = 0.001) and between the actual weight and the estimated weight by the Risanto formula (P value < 0.001).A strong positive correlation was seen among the actual weight and weights estimated by four clinical methods. This correlation was more observed in Leopold's maneuver and Risanto formula(r =0.85, p< 0.001and r =0.81,p<0.001, respectively)(Table 4).

Table 1-The mean age, gestational age, SFH, abdominal girth, parity, gravity and abortion in pregnant women

Statistics Variables	Mean ± SD	Minimum	Maximum
Age	23.59±4.77	17	34
Gestational age	39.50±1.15	37	41
SFH	33.59±2.95	28	41
Abdominal girth	99.00±9.40	84	121
		No.	**(%)**
Gravity	1	57	58.8
	2	18	18.6
	3	12	12.4
	≥4	10	10.3
Parity	0	64	65.3
	1	18	18.4
	2	6	6.1
	3	2	2
	≥4	8	8.2
Educational level	<8th std.	70	71.4
	8-12thstd.	26	26.5
	College education	2	2

Table 2- The frequency distribution of the acceptable cases (±10%) based on four methods used to estimate fetal weight

Statistics weight	**No. (%)**
Estimated weight by midwife	78 (79.6)
Estimated weight with Johnson formula	74 (75.5)
Estimated weight with Dare formula	68 (69.4)
Estimated weight with Risanto formula	70 (71.4)

Table3- Comparative of the mean weight by 5 methods studied

Statistics weight	**The mean weight ± standard error**	**95% Confidence interval**	**P value**
Estimated weight by midwife	3242.85±43.37	(3156.78-3328.93)	<0.001
Estimated weight with Johnson formula	3252.14±45.56	(3161.71-3342.57)	
Estimated weight with Dare formula	3347.26±55.46	(3237.18-3457.34)	
Estimated weight with Risanto formula	3334.69±38.32	(3258.63-3410.75)	
The actual weight at birth	3217.95±51.09	(3161.55-3319.36)	

Table 4-Pearson correlation coefficient between the variables studied (the estimation of fetal weight by different methods)

Variables	Estimated weight by midwife		Estimated weight with Johnson formula		Estimated weight with Dare formula		Estimated weight withRisanto formula	
	r	P value	r	P value	r	P value	r	P value
Estimated weight with palpation method								
Estimated weight with Johnson formula	0.82	< 0.001						
Estimated weight with Dare formula	0.81	< 0.001	0.85	< 0.001				
Estimated weight with Risanto formula	0.87	< 0.001	0.89	< 0.001	0.89	< 0.001		
The actual weight at birth	0.85	< 0.001	0.76	< 0.001	0.74	< 0.001	0.81	< 0.001

Table 5 compares EFW-by each of the discussed methods-with baby's actual birth weight. In this study the kappa values (percentage of non-random agreement) was more than 0.8 in all the methods used. Therefore, the value of the agreement is at excellence level for each of the EFW methods with the actual birth weight. Limits of agreement were also statistically significant in EFW with actual birth weight (in all cases; P<0.001,on Dare formula;P value=0.004).Although, limits of agreement were more than other methods among EFW by midwives via Leopold's maneuvers and Risanto formula as compared with actual birth weight.

Table 5-Comparison of EFW by each method with the actual birth weight

EFW method / Actual birth	Estimated weight by midwife			Estimated weight with Johnson formula			Estimated weight with Dare formula			Estimated weight with Risanto formula		
	<2500	2500-4000	>4000	<2500	2500-4000	>4000	<2500	2500-4000	>4000	<2500	2500-4000	>4000
<2500g	0	2	0	0	2	0	0	2	0	0	2	0
2500-4000g	0	88	0	8	78	2	2	76	10	0	88	0
>4000g	0	4	4	0	4	4	0	4	4	0	4	4
Studied Statistics	kappa statistic		P value	kappa statistic		P value	kappa statistic		P value	kappa statistic		P value
% of non-random arrangement in each method with the actual weight	93.88		<0.001	83.76		<0.001	81.63		0.004	93.88		<0.001

DISCUSSION

An accurate EFW helps to make the best decision on the maternity care. Several studies have conducted about comparison of ultrasound with clinical methods for EFW. Some researches have indicated ultrasound is the best method of EFW (7, 15). On the other hand, some have shown the clinical methods have same accuracy or even better than ultrasound method(16-19).So far, we did not find studies about EFW in which clinical methods were simultaneously evaluated with together and with actual birth weight or were determined their level of agreement with the actual birth weight. Accordingly, this study aimed to compare the results of EFW by four clinical methods and actual birth weight. Our studied clinical methods included mother's abdominal palpation (Leopold's maneuvers), measurements of SFH and also abdominal girth by a midwife, and using three formulas of Johnson, Dare and Risanto.

The results of current study showed that all mentioned methods had high and statistically significant agreement level with actual birth weight. In two methods agreement level was more than others; abdominal palpation with Leopold's maneuver, also using Risanto formula (kappa=93.88,P<0.001).Moreover a positive correlation was observed among actual birth weight and clinical estimated weight. This correlation was also detected more than others among palpation method and Risanto formula(r =0.85,r=0.81 P <0.001, respectively).

The results of some previous studies have confirmed our findings. One study of 300 pregnant women showed that EFW by abdominal palpation (Leopold's maneuvers)had more accuracy than Johnson's formula(20). Also Yazdani reported a significant positive correlation between estimated weight by Leopold's maneuvers and actual birth weight among 160 singleton pregnant women with gestational age of 37-41 weeks(r =0.73, p=0.00) (18).In the other study

was indicated that, EFW by Risanto formula had more precision than Johnson formula (14).Although in Goetzinger's study the relationship between EFW using Leopold's maneuvers and actual birth weight was weak(r=0.4) (21), which is contradicted with our findings.

In this study, the most acceptable methods in the range of ± 10% of real weights was related to abdominal palpation (78%) and the lowest to Dare formula (68%).In the Ugwu's study, there was a significantly positive correlation between the estimated weight by Dare formula and actual birth weight ($r = 0.71$ $p < 0.001$), however only 35% of the estimated weight was in the range of 10 ±% (7). Torloni et al also stated that only 57% of the estimated weight by Dare formula was in the acceptable range, while this rate was 61% for Johnson formula (8).Our results were somewhat consistent with Torloni study. Since in our study, estimated weight by Johnson formula was more acceptable than Dare formula (74% vs. 68%).One reason that shows why Johnson's formula is closer to reality than Dare formula, it is only SFH used in Johnson formula. While in Dare formula SFH and abdominal girth are used. In the case of obese mother and high subcutaneous fat thickness, abdominal girth shows more than SFH. This can reduce the accuracy of EFW in the Dare formula. Furthermore in comparison of Johnson and Risanto formulas; since in Johnson formula is needed to more practical skills for detecting fetal station, it seems Risanto method is more comfortable and easier than Johnson method.

Estimated fetal weight by abdominal palpation and Leopold maneuvers are conventional methods which dependent to the physician as well as some features such as the mother's abdominal wall thickness and also her weight and height (2). Although in one study significant differences was not observed between the estimated weights through abdominal palpation by three persons (two experts and a senior assistant).But in fact measurements via abdominal palpation are influenced by the doctors' and midwives' experiences and this is one of the reasons for differences in studies. Ben-Aroya et al have reported that physicians' assessment accuracy is affected by fatigue but does not effect on ultrasound estimate (22).Therefore, it seems that, the clinical measurement technique using a tape measure is less affected by fatigue compare as abdominal palpation method (8).

CONCLUSION

In the current study was concluded that abdominal palpation and Risanto's formula are more accurate for predicting fetal weight. Since Risanto method emphasizes only on measuring, so it is more appropriate and easier method for training of EFW to midwifery and medical students. Researchers believe that obstetricians and midwives in developing countries can use their clinical experiences for EFW, instead of spending precious resources on the equipment(23).The present study indicates that clinical methods have sufficient accuracy to predict the fetal weight in women with a singleton term pregnancy in cephalic presentation. It should be noted that the clinical methods of EFW can be simple, quick, inexpensive, and effective techniques for the less experienced persons.

REFERENCES

[1] Cunningham F Gary. William's Obstetrics.23st edition. 2010;pp1081
[2] Martin JA, Hamilton BE, Sutton PD ,et al. Final data for 2005. National vital statistics reports. 2009;57(7). Hyattsville ,Md, National center for Health Statistics.
[3] Adimora GN, Odetunde IO. Perinatal mortality in University of Nigeria Teaching Hospital (UNTH) Enugu at the end of the last millennium. Niger J Clin Pract 2007;10:19‑23.
[4] Olamijulo JA, Olaleye O. Perinatal mortality in Lagos University Teaching Hospital: A five year review. Nig Q J Hosp Med 2011;21:255‑61.
[5] Rous DJ,Owen, Goldenberg RL, et al . The effectiveness and costs of elective cesarean delivery for fetal macrosomia diagnosed by ultrasound. JAMA. 1996; 276:1480
[6] Behnamfar F , Sadat Z , Mousavi SG, Moosavi F. [Results of clinical and sonographic estimation of fetal weight] [Article in Persian]. Feyz Kashan Univ Med Sci 2006;9(36):23-6.-
[7] EO Ugwu, PC Udealor, CC Dim, SN Obi, BC Ozumba, DO Okeke, PU Agu. Accuracy of clinical and ultrasound estimation of fetal weight in predicting actual birth weight in Enugu, Southeastern Nigeria. Niger J Clin Pract 2014 ;17 :270-275
[8] Maria Regina Torloni, Nelson Sass, Jussara Leico Sato,et al.clinical formulas, mother's opinion and ultrasound in predicting birth weight. Sao Paulo Med J.may 2008;126(3).
[9] Bani Aqil, Asiya Sadat etal.Estimated fetal weight by using Johnson method.Journal of Gorgan University of Medical Sciences 1382;5(12)

[10] Wondwossen B elete , Asheber Gaym . Clinicalestimation 0f fetal weight in low resource setting : comparision of Johnson's formula and the palpation method. Ethiopian medical journal.Jan 2008;46 (1).
[11] Johenson RW, Toshach CE. Estimation of fetal weight using longitudinal mensuration.Am J Obstet Gynecol. 1954;68(3);891-6
[12] Dare Fo, Ademowore As, Ifaturoti Oo,et al. The value of symphysio-fundal height/ abdominal girth mesurments in predicting fetal weight . Int J Gynaecol obestet. 1990;31(3): 243-8
[13] Siswosudarmo HR. Deteksi Bayi Berat Lahir Rendah pada Kehamilan Aterm dengan Pengukuran Tinggi Fundus. Berkala Epidemiologi Klinik & Biostatika Indonesia, 1995; 1 (20): 78-84.
[14] Hanifah I Titisari, Risanto Siswosudarmo. Risanto's Formulas is more Accurate in Determining Estimated Fetal Weight Based on Maternal Fundal Height. Indones J Obstet Gynecol. 2013;1(3):149-151.
[15] Chauhan SP, Hendrix NW, Magann EF, Morrison JC, Kenney SP, Devoe LD. Limitations of clinical and sonographic estimates of birth weight: Experience with 1034 parturients. Obstet Gynecol 1998;91:72‑7.
[16] Khani S, Ahmad-Shirvani M, Mohseni-Bandpei MA, Mohammadpour-Tahmtan RA. Comparison of abdominal palpation,Johnson's technique and ultrasound in the estimation of fetal weight in Northern Iran. Midwifery 2011; 27(1): 99-103.
[17] Abdulrazak H. Alnakash, Deniz Rashad Mandan. Fetal Body Weight: How Far the Clinical and Sonographic Estimations Can Coincide and their Correlation with the Actual Birth Weight. Iraqi J. Comm. Med., Apr. 2013 (2).180-183.
[18] Yazdani Sh, Bouzari Z ,Allah Nazari M ,et al. Comparision of fetal weight estimation with clinical, Ultrasonographic methods, and combined formula of Ultrasonography and maternal weight. Iranian Journal of Obstetrics Gynecology and Infertility. 2014;17(106): 1-7.
[19] Ashrafganjooei T, Naderi T, Eshrati B, Babapoor N. Accuracy of ultrasound clinical and maternal estimates of birth weight in term women. Estern Mediterranean Health J .2010;16:313-317.
[20] Balete W, Gaym A. Clinical estimation of fetal weight in low resource setting: comparison of Johnson's formula and the palpation method. Ethio Med J, 2008; 46(1): 37-46.
[21] Goetzinger KR1, Odibo AO, Shanks AL, Roehl KA, Cahill AG. Clinical accuracy of estimated fetal weight in term pregnancies in a teaching hospital. J Matern Fetal Neonatal Med. 2014;27(1):89-93
[22] Ben-Aroya Z, Segal D, Hadar A, et al. Effect of OB/GYN residents' fatigue and training level on the accuracy of fetal weight estimation. Fetal Diagn Ther. 2002;17(3):177-81
[23] Mehdizadeh A, Chaichian S, Hoursan H. [Comparison of ultrasonographic & clinical methods in fetal weight estimation] [Article in Persian]. Med Sci J Islam Azad Univ Tehran Med Unite 2004;14(1):51-5.