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Comparison of clinical estimations of foetal weight at the beginning and end of Labour

Samira Ebrahimzadeh Zagami[1], Nahid Golmakani[1], Seyyed Alireza Saadatjoo[2], Mehrdad Jalalian[3,4]

1. Department of Midwifery, Faculty of Nursing-Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran.

2. Department of Internal Medicine and Surgery, Faculty of Nursing-Midwifery, Birjand University of Medical Sciences, Birjand, Iran.

3. Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor D.E., Malaysia.

4. Khorasan-e Razavi Blood Center, Mashhad, Iran.

RESEARCH

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Corresponding Author:
Samira Ebrahimzadeh Zagami, Faculty of Nursing-Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran. Tel: +98.9155090407
ebrahimzadehzs@mums.ac.ir

Abstract

Background
Foetal weight is an important consideration when making decisions about intervention in labour. Although weight is estimated in the beginning of labour, the relevant decisions are made at the end of labour. It is not clear whether the estimation of weight at the beginning of labour is more accurate than the estimation at the end of labour.

Method
This prospective study included 214 pregnant women. Foetal weights were estimated at the time of admission, at full dilatation or before Cesarean section (CS) using Johnson's formula and multiplying symphysio-fundal height by the abdominal girth measurement.

Results
The accuracy of estimation of weight by the Johnson formula (insert measuring tape) at the beginning of labour was similar to weight at the end of labour, but the weight obtained by multiplying the symphysio-fundal height by the abdominal girth (insert the measuring tape and holding it straight) at the beginning of labour was more accurate than the same process at the end of labour ($p < 0.001$). However, using the Johnson formula (holding the meter straight) at the end of labour was more accurate than it was at the beginning of labour ($p = 0.02$).

Conclusion
The accurate of estimation weight varies depending on time, the method used, and the formula of measurement.

Key Words
Estimated weight, labour, fundal height, abdominal girth, birth weight

Background
Accurate estimation of weight is one of the most important factors in successful planning and management of labour and delivery, [1,2] and it is still a topic of great interest in obstetrics because abnormal labour and neonatal complications may be associated with higher or lower birth weights [3,4].

The two main methods for predicting birth weight are clinical and sonographic estimations. Multiple studies have shown similar accuracy for these methods for the estimation of foetal weight (EFW) [1, 3].

Clinical estimation based on abdominal palpation of foetal parts and fundal height [2,3] and various clinical formulas, such as Johnson's formula and multiplying abdominal girth by symphysio-fundal height (AG×SFH), have been used for estimating foetal weight [5]. Studies have shown that the average errors in various foetal weight groups using AG×SFH and Johnson's formula were 224 g and 310-338 g, respectively [5,6].

Although foetal weight is estimated in the beginning of labour, the clinical decision is made at the end of labour[7]. In

addition, changes in foetal position and station, as well as decreases in the volume of amniotic fluid following rupture of membranes, can result in an EFW that is different from the estimate obtained at the beginning of labour when foetal head position was not in the pelvis [7]. In one study, obstetricians obtained and compared clinical EFWs at the beginning (initial EFW) and end (repeat EFW) of labour in 138 women with term pregnancies. They found that a repeat EFW obtained at the end of labour was more accurate than the initial EFW obtained at the beginning of labour[7]. They stated that the factors that contributed to the changes in the weights were unknown [7]. It is possible that various clinical formulas and inconsistent application of the Measuring tape could influence the accuracy of EFW. Also labour pains, especially at the end of labour, result in maternal movement from side to side, and these movements may influence the accuracy of EFW.

Many obstetricians have used different methods to obtain accurate estimates of foetal weight, but the best time to make the estimation is unclear. Of the various studies, only one study compared the accuracy of the estimations of foetal weight at the beginning and end of labour[7].

The objective of this prospective study was to compare the accuracy of clinical estimation of foetal weight at the beginning and end of labour by Johnson's formula and by the AG×SFH technique.

Method

After approval of this research project by the Ethics Committee of Mashhad University of Medical Sciences, we received a formal letter of introduction from officials in the School of Nursing and Midwifery at Omolbanin Hospital. We explained the research objectives and how the research would be conducted to them, and we received their consent to proceed. The study included 214 women who were admitted to the Mashhad University Hospital delivery room between June 20 and November 4, 2009. The inclusion criteria were: 1) single pregnancy with vertex presentation; 2) gestational duration of 37-42 weeks based on last menstrual period or sonographic dating; 3) weight less than 90 kg; 4) admission for planned delivery or in early labour; and 5) membranes ruptured less than 12 hours before admission to the hospital. The exclusion criteria were: 1) known anomaly by ultrasound; 2) recent ultrasound EFW; and 3) contraindication to labour. After the patients were enrolled, their characteristic data were recorded. The patients were in a supine position with bent knees for relaxation of the abdominal wall. The researcher clinically estimated foetal weight at the beginning of labour (latent phase or early active phase) based on Johnson's formula and the AG×SFH technique (Figure 1).

Johnson's formula for estimation of foetal weight is as follows: Foetal weight (g) = [FH (cm)] x [n] x [155], where FH is fundal height and n = 12 or n = 11, depending on whether the vertex was above or below the ischial spine, respectively.

The product of symphysio-fundal height and abdominal girth at the umbilical level measured in centimeters was calculated, and the results were expressed in grams.
The same researcher repeated clinical estimation of foetal weight at the end of labour when the patients were fully dilated or, if the labour stopped, just before Caesarean delivery.

Birth weight was estimated with the Seca scale by the midwifery that did not know estimation of foetal weight, immediately after delivery and was recorded. Scale device was similar for all infants. The accuracy of measures that were used in our statistical analysis, i.e. the number of estimates within ±10% of actual birth weight, mean percentage error, and mean absolute percentage error. For practical clinical purposes, the variation between estimated foetal weight and actual birth weight was expressed by the mean absolute percentage error.

Percentage of absolute error was defined as the absolute value of the difference between the birth weight and estimated weight divided by the birth weight. Paired t-test and Pearson correlation were used to compare accuracy of the 2 estimation foetal weights.

Results

Of the 214 women studied, 55.6% were primigravidas and 44.4% multigravidas. None of them had an instrumental delivery; 89.7% had normal deliveries and 10.3% had Caesarean delivery. The demographic and obstetric data for the study population are shown in Table 1.

The mean absolute percentage error in the estimation of foetal weight by Johnson's formula (apply the measuring tape from symphysis to uterus fundal) at the end of labour (repeat EFW) was smaller than at the beginning of labour (initial EFW), although the difference was not statistically significant.

The repeat EFW by Johnson's (by measuring in a straight line from the symphysis to the top of the fundus) was statistically more accurate than the initial EFW ($p = 0.02$).
The initial EFW taken at the beginning of labour by the AG×SFH technique (with holding straight and insert meter from symphysis to uterus fundal) was statistically more accurate than the repeat EFW taken at the end of labour (Table 2). The Pearson correlations for the estimation of foetal weight by Johnson's formula (insert meter from symphysis to uterus fundal) at the beginning and end of labour, compared to actual birth weight, were 0.68 and 0.67, respectively.

The Pearson correlations for the estimation of foetal weight by Johnson's formula (with holding straight of meter from symphysis to uterus fundal) at the beginning and end of labour, compared to actual birth weight, were 0.62 and 0.61, respectively.

The Pearson correlations for the estimation foetal weight by the AG×SFH technique (Apply the measuring tape from

symphysis to uterus fundal) at the beginning and end of labour, compared to actual birth weight, were 0.71 and 0.68, respectively. The Pearson correlations for the estimation of foetal weight by the AG×SFH technique (with holding straight of meter from symphysis to uterus fundal) at the beginning and end of labour, compared to actual birth weight, were 0.68 and 0.63, respectively, and the results of statistical analysis showed the relationships to be statistically significant ($p < 0.001$).
The difference of foetal station at the end of labour was statistically significant in both the normal delivery group and the Caesarean section group ($p < 0.001$).

The mean actual neonatal weights were 3248 ± 397.2 g and 3232.7 ± 444.3 g for normal deliveries and Caesarean sections, respectively, and the difference was not statistically significant ($p = 0.77$). The mean abdominal girth, fundal height at the beginning and end of delivery were not statistically significant in either normal deliveries or Cesarean section deliveries. The subsequent management of these labours includes the regular evaluation of the labour progression and the foetal heart rate. If the labour is in successfully progressive we let the normal vaginal delivery otherwise the caesarean section surgery should be the final decision.

Discussion

Estimation of foetal weight is important for the management of labour and decision on the type of delivery is influenced by these measurements. Clinical estimation is used in many centres in the world. Foetal weight is not measured directly, it is estimated by external palpation of foetal parts[3]. It seems that time of estimation of foetal weight is also important but it is not much attended to it.
In this prospective study, we found that:

1- The initial EFW obtained at the beginning of labour by AG×SFH (with holding straight from symphysis to uterus fundal) was more accurate than the repeat EFW obtained at the end of labour (Mean absolute error: 466 versus 535 grams) or 10% of the actual birth weight. EFW by measurement from symphysis pubs to the height of the fundus was much more accurate at teh beginning of labour than at the end of labour (Mean absolute error at the beginning and end of labour were 129 and 248 grams) (table 2). Studies have shown that the AG×SFH technique provides better and more predictable foetal weight estimation results compared to other formulas [4, 5].

2- For the clinical EFW obtained by Johnson's formula, the initial EFW obtained at the beginning of labour was just as accurate as the repeat EFW obtained at the end of labour (Mean absolute error: 113 versus 122 grams) (table 2).

3- For the clinical EFW obtained by Johnson's formula (with holding straight of meter from symphysis to uterus fundal), the repeat EFW obtained at the end of labour was more accurate than the initial EFW obtained at the beginning of labour (Mean absolute error: 656 versus 598 grams) (table 2).

In this study, were used from two formulas at the beginning and end of labour. In both of formulas are used from fundal height. Fundal height may are independently affected amniotic fluid index (AFI), maternal body mass index (BMI), presenting part, status of membranes, site of placental implantation, maternal position and even the experience of the physicians[8]. The patients that have high BMI, clinical estimation was difficult because foetal parts are not easily palpated [3]. In this study, we selected the pregnant women who had BMI values less than 26 and whose membranes had ruptured. Status of membranes, maternal position and the examiner was similar at the beginning and end of labour. Mean fundal heights were 32.11cm at the beginning of labour and 31.1cm at the end of labour that it may be in the result of descending of presenting part. It is assumed that descent in foetal station at the end of labour may make the clinical estimation more accurate than the beginning of the labour [7] but in this study any relationship was not found between the fatal station and fundal height with EFW at the beginning and end of labour.
According to a recent study of 138 single-baby pregnancies, the results showed that a repeat EFW was more accurate than the initial EFW [7]. The fact that the results of our study differ from the findings in the aforementioned study may be attributed to the method and conditions that was used for clinical estimation in our study.

The possible factors that may affect accuracy of EFW, e.g., maternal age, number of pregnancies, maternal body mass index (BMI), presenting part, stage of labour, status of membranes, site of placental implantation, amniotic fluid index (AFI), gender of the foetus, and even the experience of the physicians, were found to have insignificant effects on the errors associated with the estimations. However, various studies have reached contradictory conclusions about the effects of these factors [2, 3, 7, 9, 10, and 12]. We also investigated the correlation between the gender of the foetus, the mother's height, and the time of the EFW, but we did not find any relationship. It is seemed that there are some factors that influence the accuracy of the EFW at the beginning and end of the labour but they are not measured.
Many researchers have concluded that an estimate of birth weight is associated with a wide range of actual birth weights, which could result in unnecessary intervention when obstetric decisions are based on such predictions [1]. Even so, in a developing country, clinical estimation is still useful and should be done first, with sonographic studies used only in cases with other indications such as the assessment of amniotic fluid, foetal age, evaluation of foetal health and the possible foetal abnormalities[2]. Therefore, we must also consider factors, such as mode and time of estimation, to reduce measurement errors.

Conclusion

In summary, we concluded that estimated foetal weights at the beginning of labour by AG×SFH was more accurate than the repeat EFW at the end of labour but by Johnson's formula (with holding straight of meter, the EFW at the end of labour was more accurate than the EFW at the beginning

of labour. We recommend that primary health care providers for pregnant women become familiar with the various modes and times of measurement. However, further studies are necessary to investigate, using larger numbers of pregnant women, the effect of EFW time on the type of delivery.

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PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors have no conflict of interest.

Figures and Tables.

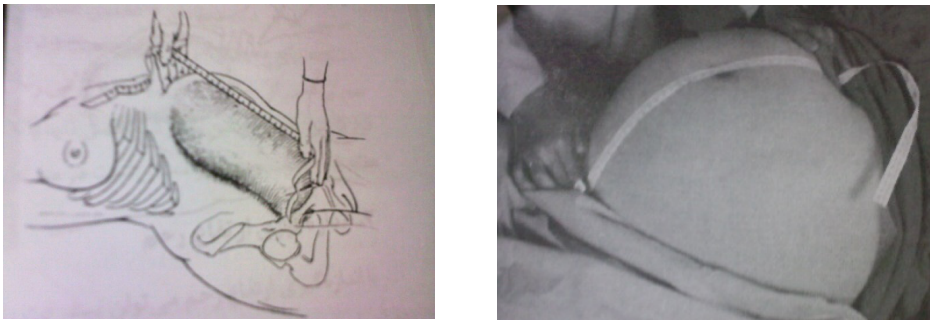

Figure 1. Holding straight of meter from symphysis to uterus fundal (left side); insert meter from symphysis to uterus fundal (right side).

Table1. The demographic and obstetric data of the study population (214 cases)

	Mean ± SD	Range
Age (years)	24.6± 4.9	14-41
Height (cm)	161.6 ± 5.9	150-183
Gravida	1.75 ± 1.07	1-6
Para	0.61 ± 0.95	0-5
Dilation	3.8 ± 0.7	2-5
Station		
At the beginning of labour	-1.6 ± 0.6	-3 to 0
At the end of labour	0.54 ± 0.6	-3 to +2
Abdominal girth (cm)		
At the beginning of labour	96.8 ± 7.4	77-114
At the end of labour	96.14 ± 7.4	77-119
Fundal height (cm)		
At the beginning of labour		
with holding straight of meter from symphysis to uterus fundal	28.6 ± 2.4	23-35
insert meter from symphysis to uterus fundal	32.1 ± 2.8	25-40
At the end of labour		
with holding straight of meter from symphysis to uterus fundal	28.1 ± 2.7	22-35
insert meter from symphysis to uterus fundal	31.1 ± 3.1	22.5-40
Gender	Female male	102 112
Birth weight (g)	3248.2 ± 403.5	2150-4500

Table 2. Accuracy of repeat estimation of foetal weight (EFW) compared with initial clinical EFW

	Initial clinical EFW	repeat clinical EFW	*P* value
Johnson's formula [1]			
Mean absolute error, g[a]	656 ± 459	598 ± 481	0.02
Mean absolute percentage error [b]	19.4 ± 13	17.6 ± 13	0.02
Johnson's formula[2]			
Mean absolute error, g[a]	113 ± 472	122 ± 500	0.29
Mean absolute percentage error [b]	2.7 ± 14.7	3.6 ± 15.4	0.28
AG✕SFH [1]			
Mean absolute error, g[a]	466 ± 429	535 ± 457	P<0.001
Mean absolute percentage error [b]	13.5 ± 12.6	6.8 ± 14.3	P<0.001
AG✕SFH [2]			
Mean absolute error, g[a]	129 ± 451	248 ± 469	P<0.001
Mean absolute percentage error [b]	3.1 ± 14.2	6.8 ± 14.3	P<0.001

[1] with holding straight of meter from symphysis to uterus fundal

[2] insert meter from symphysis to uterus fundal

[a]Absolute error: Absolute value of birth weight minus EFW

[b]Absolute percentage error: Absolute value of birth weight minus EFW divided by birth weight