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● *Original Contribution*

ULTRASOUND FETAL WEIGHT ESTIMATION: HOW ACCURATE ARE WE NOW UNDER EMERGENCY CONDITIONS?

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Abstract—The primary aim of this study was to evaluate the accuracy of sonographic estimation of fetal weight when performed at due date by first-line sonographers. This was a prospective study including 500 singleton pregnancies. Ultrasound examinations were performed by residents on delivery day. Estimated fetal weights (EFWs) were calculated and compared with the corresponding birth weights. The median absolute difference between EFW and birth weight was 200 g (100–330). This difference was within ±10% in 75.2% of the cases. The median absolute percentage error was 5.53% (2.70%–10.03%). Linear regression analysis revealed a good correlation between EFW and birth weight ($r = 0.79$, $p < 0.0001$). According to Bland–Altman analysis, bias was −85.06 g (95% limits of agreement: −663.33 to 494.21). In conclusion, EFWs calculated by residents were as accurate as those calculated by experienced sonographers. Nevertheless, predictive performance remains limited, with a low sensitivity in the diagnosis of macrosomia. (E-mail: kaouther.dimassi@gmail.com) © **2015 World Federation for Ultrasound in Medicine & Biology.**

Key Words: **Fetal weight, Birth weight, Ultrasound estimation, Neonatal.**

INTRODUCTION

Ultrasound estimation of fetal weight is routinely performed in labor rooms at due date. It is thought to be helpful in predicting fetal survival and making management decisions in very low birth weight infants and in managing delivery of large babies, in whom complications may occur (Dudley 2005). This is not trivial and has its consequences. As an example, one study suggested that after adjustment for confounding factors, overestimation of fetal weight remained associated with a high rate of cesarean delivery (CD) (Blackwell et al. 2009). Moreover, ultrasound examination during labor could potentially be problematic owing to the low position of the head and an increased risk of abdominal circumference distortion or posterior position of the femurs (Peregrine et al. 2007). Finally, in labor rooms, and when gestational age is >37 wk, ultrasound examinations are routinely performed by residents, and *senior* sonographers are sought only in the case of anomalies.

The aims of this study were to estimate the accuracy of sonographic estimation of fetal weight when performed during labor by trainees and to evaluate the effects of different maternal and fetal factors on this prediction.

METHODS

This prospective single-center study was conducted among pregnant women attending the Obstetrics and Gynecology Unit of Mongi Slim Hospital, La Marsa, Tunisia, between April 1 and November 30, 2014. The research protocol was approved by the hospital's ethics committee. All participants gave informed consent, and data were analyzed anonymously.

Inclusion criteria were: a singleton pregnancy in labor, and gestational age greater 37 wk of amenorrhea. Exclusion criteria were: detection of an intrauterine fetal demise and fetal pathology.

The ultrasound examination was performed in the labor ward by one of the five residents involved in the study, who had at least 1 y of practical experience in measuring fetal biometry. A Toshiba SSA-510 A (famio5, Osaka, Yokohama, Japan) was employed with a 5- to 2-MHz probe. Fetal measurements of biparietal diameter,

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abdominal circumference and femur length were obtained, and the estimated fetal weight (EFW) was calculated using the formula of Hadlock et al. (1985): log EPF = 1.335 + 0.0316 BIP + 0.0457 PA + 0.1623 LF − 0.0034 PA LF), where EPF = EFW, BIP = biparietal diameter, PA = abdominal circumference and LF = femur length. EFW was compared with actual birth weight (BW).

Data were collected on a standard spreadsheet (Microsoft Excel). Descriptive parameters are expressed as median (first–third quartiles) values. Frequencies are expressed as percentages.

The analysis was performed in several ways: percentage error was calculated by subtracting the actual BW from the EFW and then dividing the difference by the actual BW and multiplying by 100. Mean percentage error (MPE), expressing the systematic error, was calculated from the percentage error. Absolute percentage error and mean absolute percentage error (MAPE) were calculated the same way using the absolute value of the difference between the EFW and actual BW. The proportion of estimates within 10% of the actual BW was also calculated.

Correlation between BW and ultrasound EFW was evaluated using the Pearson coefficient, and agreement between these two measurements was assessed using Bland–Altman plots (Bland and Altman 1986).

Percentage errors were compared using Student's *t*-test with respect to maternal body mass index (BMI)—BW ≥ 4500 g, BW < 2500 g—and amount of amniotic fluid.

We calculated the sensitivity, specificity, negative predictive value and positive predictive value of each EFW to detect fetal macrosomia.

Statistical analysis was performed using MS excel software XLSTAT (2014.4.09; Addinsoft, New York, NY, USA). $p < 0.05$ was considered to indicate statistical significance.

RESULTS

During the study period, we analyzed 500 singleton pregnancies. The mean maternal age was 29.6 ± 4.6 y (range: 17–42), and the mean gestational age at delivery was 39.6 ± 1.3 wk (range: 37–42). Thirty-six patients (7.2%) had gestational diabetes mellitus, and 51 (10.2%) had a hypertensive disorder. Fifty-three patients (10.6%) had a BMI ≥ 35 kg/m^2. Patient clinical and demographic data are summarized in Table 1.

The median BW was 3500 ± 476.8 g (3200–3850). Ten (2%) BWs were <2500 g and 73 (14.6%) were >4000 g. The median EFW was 3480 ± 431 g (3150–3700). The median absolute difference between EFW and BW was 200 ± 259.4 g (100–330), and the MAPE was 5.53% (2.70%–10.03%); 75.2% of the measurements had an error <10%.

Table 1. Patient demographic data

	Median	First quartile	Third quartile
Maternal age (y)	29	26	33
Body mass index (kg/m^2)	29.73	27.53	31.88
Gestational age (wk of amenorrhea)	40	39	40

There was a significant positive correlation between EFW and BW (r = 0.79, 95% confidence interval: −111.029, −59.091 ($p < 0.0001$) (Fig. 1).

Figure 2 is the Bland–Altman analysis of these variables. Bias was −85.06 g (95% limits of agreement: −663.33 to 494.21).

Fetal macrosomia was associated with the worst accuracy of EFW (MPE = 11.3%, $p < 0.0001$). However, neither low BW, nor maternal BMI, nor oligohydramnios nor polyhydramnios had an impact on the accuracy of the EFW ($p = 0.19$, $p = 0.46$, $p = 0.62$ and $p = 0.82$, respectively) (Table 2).

The sensitivity, specificity, and positive and negative predictive values of predicting a BW ≥4000 g and BW ≥4500 g are given in Table 3.

DISCUSSION

The use of prenatal ultrasound scanning has increased in developed countries, but also in Tunisia. Today, ultrasound has become a common examination used daily in labor wards. Moreover, sonographic estimation of fetal weight is generally entrusted to residents. As the EFW is of major interest when the route of delivery

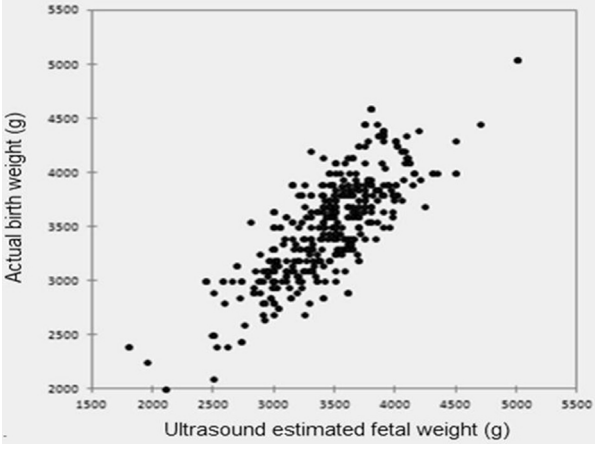

Fig. 1. Correlation between sonographically estimated fetal weight and birth weight. The linear correlation coefficient R is close to +1 (R = 0.79), indicating the strength of the positive correlation between estimated fetal weight and birth weight.