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# Ultrasonographic Estimation of Fetal Weight – Residents Accuracy

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## A B S T R A C T

*The aim of this retrospective study was to evaluate the accuracy of gynecology and obstetrics residents when performing ultrasonographic estimation of fetal weight. The total of 400 ultrasonographic estimations of fetal weight and corresponding neonatal weight were collected and divided into 3 groups according to physicians' experience (junior and senior residents, staff physicians). The accuracy of fetal weight estimation correlated positively with the level of physicians' experience. The proportional difference between ultrasound estimation and actual birth weight varied from 8.45% to 6.88% (junior residents 8.45%, senior residents 6.95%, staff physicians 6.88%). The proportion of ultrasonograhic estimates that fell within 10% of birth weight varied from 59.09% to 79.21% (junior residents 59.09%, senior residents 78.44%, staff physicians 79.21%). Senior residents reach a highly acceptable accuracy in ultrasonographic estimation of fetal weight which is comparable to staff physicians.*

***Key words:*** *ultrasound, fetal weight estimation, residents*

## Introduction

Ultrasound is a basic diagnostic tool in obstetrics and its benefits extend from use in diagnosing localization of early pregnancy[1] to estimation of fetal weight at the time of delivery. An estimate of fetal weight (EFW) in a term pregnancy represents important variable which in many cases influences decision-making process in obstetrics. The correct estimation of fetal weight is extremely important in cases when fetal macrosomia or intrauterine growth retardation are suspected, also in cases of breech presentation or in a trial of vaginal birth after previous cesarean section. There are various techniques for fetal weight estimation. The simplest technique is a clinical estimation, using abdominal bimanual palpation (Leopol-Pavlik maneuvers). Accuracy of clinical estimation varies from inaccurate to highly accurate, and requires adequate clinical experience[2]. The introduction of real-time obstetric ultrasound enabled clinicians to observe and measure fetal structures. Sonographic measurements of various fetal dimensions are used in various developed regression formulas for fetal weight estimation. The validity of these formulas has been well documented, with a reported systematic error of 10% or less of actual birth weight[3,4]. However, there are several factors influencing accuracy of the method. Some of them, such as: fetal weight[5,6] the amount of amniotic fluid[7,8], presence of maternal diabetes mellitus[9] and maternal weight have been explored[10]. The effect of ultrasonographer's experience on the accuracy of ultrasonographic EFW remains an unanswered dilemma. It is presumed that resident's performance generally improves with practice. While some authors showed that the accuracy of EFW correlates positively with level of experience[11,12], others failed to show such correlation[13,14].

The aim of the present study was to describe our single-center ultrasonographic experience in predicting fetal weight, to determine whether the ultrasonographer's experience influences the accuracy of ultrasonographic EFW and if so, how long it takes to reach the acceptable level of accuracy.

## Materials and Methods

Data used in this study were obtained retrospectively, by analyzing birth records of parturients admitted to the delivery unit of our hospital during first trimester of the year 2004. Inclusion criteria for this study

were as follows: viable singleton pregnancy, vertex presentation, gestational age of 37–42 weeks, uEFW performed within 48 hours before the delivery and the live born infant without congenital malformations or hydrops. Following maternal anthropometric variables were obtained: maternal age, maternal height and maternal weight at delivery. Maternal height and weight were measured upon admission to the delivery unit. Maternal pregnancy body mass index (BMI) was calculated by the formula (BMI = weight in kilograms/ (height in meters)$^2$). Accepting above mentioned criteria, during the period, total of 400 ultrasonographic estimates of fetal weight (uEFW) were performed by residents or staff physician. Cases were assigned to physicians on the stochastic basis, without any effort to make a consistent or a random selection. Examiners were divided in 3 groups, according to the level of experience. 1st group (Group I) consisted of residents in their first 2 years of residency. 2nd group (Group II) consisted of residents in their 3rd or higher year of residency, and 3rd group (Group III) consisted of experienced staff physician. All the estimates of fetal weight were calculated by the equation of Shepard using measurements of biparietal diameter (BPD) and abdominal circumference (AC). These measurements were taken in an appropriate, well-described fashion[15,16]. All estimations were carried out using the ALOKA SSD-500 (Aloka Co, Ltd, Japan) and 3.5 MHz linear transabdominal transducer. Neonatal birth weight (BW) was measured within 15 minutes from delivery. The accuracy of EFW was compared with the actual birth weight, by calculating the mean percentage error (MPE=(EFW–BW)/BW*100). Grouped data on mean percentage error were statistically analyzed by analysis of variance (ANOVA) with Tuckey post-hoc. The accuracy of uEFW was further evaluated using the proportion of estimations that fell within 10% of actual birth weight. These data were analyzed by $\chi^2$-test. In all calculations p<0.05 was considered as significant. All statistical analysis was performed using STATISTICA (data analysis software system), version 6 (StatSoft, Inc, Tulsa, USA, 2001).

## Results

During the observed period 400 ultrasonographic estimates of fetal weight (uEFW) were performed by residents or staff physician. Residents in their first 2 years of residency (Group I) performed 132, residents in their 3rd or higher year of residency (Group II) performed 167, whereas staff physicians (Group III) performed 101 ultrasonographic estimations of fetal weight. Although cases were assigned to the mentioned groups unequally, all the groups were similar considering gestational age, maternal age and maternal body mass index (BMI). The median of maternal age was 28 years (range 17–45) without significant difference among groups. The median of gestational age was 39 weeks (range 37–42), without difference among groups. The mean maternal BMI for all cases was 28.09±3.84, and did not differ sig-

nificantly among groups (27.52, 28.52 and 28.33, respectively). 205 fetuses were female and 195 were male.

The average fetal birth weight for all cases in the study was 3497±438 g, and did not differ significantly among groups (3508, 3496 and 3515, respectively).

Determination of the mean percentage error (MPE) for each group showed significant improvement with advancing experience between inexperienced and experienced group of residents (8.45±2.5% and 6.95±2.5%, respectively). Comparing the experienced residents and staff physicians one can notice a slight improvement in performance with advanced experience, but this improvement is not statistically significant (6.95±2.5% and 6.88±2.5%, respectively).

The accuracy of uEFW was further evaluated using the proportion of estimations that fell within 10% of actual birth weight (Figure 1). In total, 72.25% of all estimations fell within 10% of actual birth weight. There is statistically significant improvement ($\chi^2$=17.03, df=2, p<0.05) in performance with advancing experience between inexperienced and experienced residents (59.09% and 78.44%, respectively), but without significant improvement of performance when comparing experienced residents and staff physicians (78.44% and 79.21% respectively).
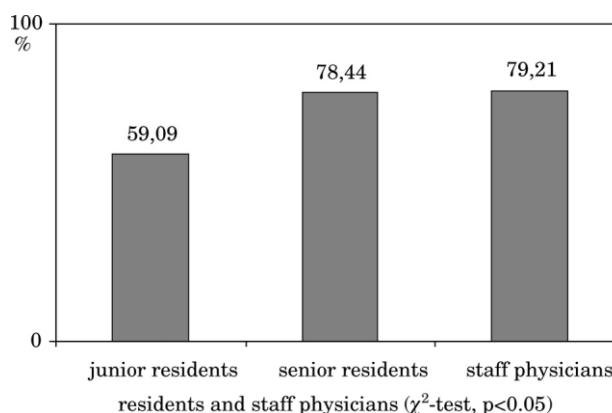


Fig. 1. The proportion of estimations that fell within 10% of actual birth weight.

## Discussion

The birth fetal weight is extremely crucial variable which influences fetal and maternal morbidity and mortality. Thus, it presents an important variable in decision-making process in obstetrics. An accurate estimation of fetal weight is important in management of suspected fetal macrosomia, breech presentation or in a trial of vaginal birth after previous cesarean section. For centuries, the only possible technique for fetal weight estimation was clinical estimation using Leopold-Pavlik maneuvers. The introduction of real-time ultrasound enabled the clinician to measure accurately and reproducibly different fetal structures. These mea-

surements are used in various regression formulas in order to estimate fetal weight. Some of these formulas are adjusted for specific populations, in which are more often used. The most frequently used formulas in USA are those brought by Hadlock and colleagues[17], in Great Britain formulas by Campbell and Wilkin and by Shepard[18], and in Germany the formula by Merz. Some formulas are more appropriate for small fetuses, whereas some show the highest accuracy when predicting macrosomic fetuses[19]. For evaluation of »normal clinical population«, when patients are drawn from the full range of birth weight encountered in routine practice, Hadlock formula using 3 fetal biometry parameters (HC, AC and FL) provides more precise estimations. For the macrosomic fetuses (more than 4000 g) the Merz formula provides slightly better results than others. Several authors compared the accuracy of clinical and ultrasonographic fetal weight estimation, with opposing results. Clinical estimation of birth weight using abdominal palpation in early labor seems to be as accurate as ultrasonic estimation[20,21]. In the lower range of birth weight (less than 2500 g), ultrasonic estimation is more accurate where as in the 2500–4000 g range, clinical estimation is more accurate. In the higher range of birth weight (greater than 4000 g), both methods have similar accuracy[22]. In cases with ruptured membranes and low amniotic fluid index, ultrasonographic method is superior to clinical in fetal weight estimation[23]. The influences of various maternal and fetal characteristics on accuracy of fetal weight estimation are well studied and documented. Fetal weight influences the accuracy of uEFW, in fashion that small-for-gestation fetuses tent to be overestimated while macrosomic fetuses are likely to be underestimated[24,25]. Several studies showed that neither maternal obesity, nor variation in amniotic fluid volume influenced the accuracy of uEFW. The influence of examiners experience and formal ultrasonographic education on the accuracy of EFW is still an answered dilemma. Considering a role of Ob/Gyn residents in obstetric patient management in the majority of the university hospitals, it should be crucial to evaluate their performance in every aspect of clinical work, as well as in accuracy of fetal weight estimation. It has been presumed that resident's performance generally improves with practice[26]. Some authors showed that the accuracy of EFW positively correlates with level of experience while others failed to show such a correlation. In this paper we showed significant improvement in performance with advancing experience between inexperienced and experienced residents. However, comparing the group of experienced residents and staff physicians, we couldn't found any improvement. Thus, we conclude that residents after 2 years of their training reach a highly acceptable accuracy in ultrasonographic estimation of fetal weight (78.44% of estimates within 10% of actual birth weight) which is comparable to staff physicians (79.21% of estimates within 10% of actual birth weight). Residents with certain experience and adequately supervised training can present an important subject in obstetric patient management.

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## ULTRAZVUČNA PROCJENA MASE FETUSA – TOČNOST SPECIJALIZANATA

### S A Ž E T A K

Cilj retrospektivnog istraživanja je ispitati točnost specijalizanata ginekologije i porodništva u procjenjivanju mase fetusa ultrazvučnom metodom. Prikupljeno je ukupno 400 ultrazvučnih procjena mase fetusa zajedno sa odgovarajućim rodnim masama novorođenčadi. Ti su podaci podijeljeni u tri skupine u ovisnosti o iskustvu liječnika koji je procjenjivao masu fetusa (mlađi i stariji specijalizanti te specijalisti). Točnost ultrazvučne procjene mase fetusa pozitivno je korelirala s stupnjem iskustva liječnika. Prosječna razlika između ultrazvučne procjene mase fetusa i stvarne rodne mase varirala je od 8.45% do 6.88% (mlađi specijalizanti 8.45%, stariji specijalizanti 6.95%, specijalisti 6.88%). Udio ultrazvučnih procjena koje su se razlikovale za manje od 10% u odnosu na stvarnu rodnu masu kretale su se od 59.09% do 79.21% (mlađi specijalizanti 59.09%, stariji specijalizanti 78.44%, specijalisti 79.21%). Iskusni specijalizanti postižu visok stupanj točnost ultrazvučne procjene mase fetusa koja se ne razlikuje od one koju postižu specijalisti.