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ESTIMATION OF FETAL WEIGHT WITH THE USE OF HEAD, BODY AND FEMUR MEASUREMENTS – A PROSPECTIVE STUDY

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Abstract:
In utero estimates of fetal weight were evaluated prospectively in 109 fetuses with the use of ultrasonography models developed in a previous study. This report confirms that the best in utero weight estimates result from the use of models based on measurements of head size, abdominal size, and femur length. Since the accuracy of these models (1 SD = 7.5%) is significantly better than those based on measurements of head and body (e.g., biparietal diameter, abdominal circumference), we recommend routine use of such models in obstetric ultrasonography.

Key words: *Birth weight; Fetal weight; Infant, newborn; Pregnancy; Ultrasonography*

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1.0 INTRODUCTION:

The birth weight is the key factor for the outcome of in utero growth of the foetuses. It has been well recognised that foetuses at the extremes of the normal birth weight range are associated with increases in perinatal morbidity, mortality, and adverse developmental outcomes (Aksoy et al., 2015).

In addition, macrosomic infants have a Six-fold increase of marked birth trauma. The antenatal foetal weight measurement is of tremendous importance because it can give us useful information for the foetal growth assessment. This information could help us decide the time of delivery, the need for specific obstetrical intervention, and whether it is necessary for the delivery to be at a centre equipped with intensive neonatal care support (Barel et al., 2013).

The purpose of the current study was to evaluate the method of estimating fetal weight prospectively in a new fetal population.

2.0 MATERIAL AND METHOD:

The study population consisted of 109 predominately middle class Caucasian patients examined by physicians by means of commercially available linear array real-time systems. The majority of patients were examined within 3 days of delivery, and all patients were examined within at least 1 week of delivery (Barel et al., 2013).

The study population was unselected and included preterm, term, and postterm fetuses as well as fetuses that were growth retarded or macrosomic. The imaging and measurement techniques used have been previously described in detail. The fetal weight was estimated in this population by means of models from our previous study. These estimates were compared with weight estimates with the use of the model of Shepherd et al. which is based on measurements of biparietal diameter and abdominal circumference. The errors in predicting fetal weight were expressed as a percentage of actual birth weight by means of the following method:
Error (%) =predicted weight - actual weight/actual weight X 100

The t test was used to determine if the mean errors were different from zero, and the F test was used to determine if there were significant differences in the standard deviations of the mean errors (Fawzy and Kamal, 2010).

3.0 RESULTS

The accuracy of our original models,' as well as the model of Shephard et al., 2 are summarized in Table I. As noted in our previous study, the combination of abdominal circumference and femur length and all combinations of three or more parameters resulted in significantly ($p = 0.05$) better weight estimates than those using measurements of head and abdomen (e.g., biparietal diameter and abdominal circumference, head circumference and abdominal circumference). The largest random errors (the standard deviation is an index of random errors) resulted from use of the model of Shephard et aU; the size of the error (1 SD = 10.1%) is identical to the standard deviation of the regression originally reported by Warsof and associates3• 4 with use of the biparietal diameter and abdominal circumference (Barel et al., 2013).

The standard deviation for our head circumference and abdominal circumference model is slightly higher (9.8% versus 9.1%) than previously reported. 1 The standard deviation for our abdominal circumference and femur length model is slightly lower (7.7% versus 8.2%) than previously reported. These differences, and the minor differences in standard deviations for biparietal diameter, abdominal circumference and femur length (7.3% versus 7.7%), head circumference, abdominal circumference, and femur length (7.4% versus 7.6%), and biparietal diameter, head circumference, abdominal circumference, and femur length (7.3% versus 7.5%), are not statistically significant ($p = 0.05$ (Fawzy and Kamal, 2010)).

Of some concern is the finding of small systematic errors (in this context the mean deviation is an index of systematic error) for several of the models (Table 1). The largest systematic error was 2.3% for the head circumference, abdominal circumference, and femur length model. The reason for this systematic error is not readily apparent; it may be related to the fact that many of the examinations in this study were performed by physicians with less experience than those in the previous study.

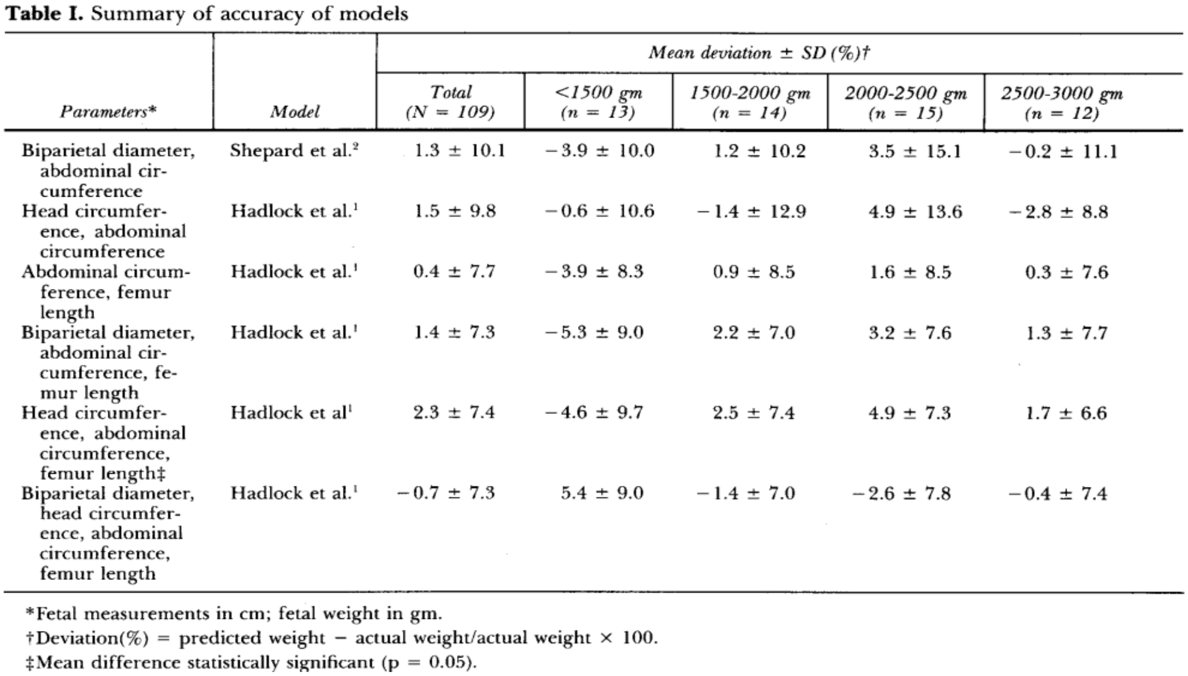

Table I. Summary of accuracy of models

Parameters*	Model	Mean deviation ± SD (%)† Total (N = 109)	<1500 gm (n = 13)	1500-2000 gm (n = 14)	2000-2500 gm (n = 15)	2500-3000 gm (n = 12)
Biparietal diameter, abdominal circumference	Shepard et al.[2]	1.3 ± 10.1	−3.9 ± 10.0	1.2 ± 10.2	3.5 ± 15.1	−0.2 ± 11.1
Head circumference, abdominal circumference	Hadlock et al.[1]	1.5 ± 9.8	−0.6 ± 10.6	−1.4 ± 12.9	4.9 ± 13.6	−2.8 ± 8.8
Abdominal circumference, femur length	Hadlock et al.[1]	0.4 ± 7.7	−3.9 ± 8.3	0.9 ± 8.5	1.6 ± 8.5	0.3 ± 7.6
Biparietal diameter, abdominal circumference, femur length	Hadlock et al.[1]	1.4 ± 7.3	−5.3 ± 9.0	2.2 ± 7.0	3.2 ± 7.6	1.3 ± 7.7
Head circumference, abdominal circumference, femur length‡	Hadlock et al[1]	2.3 ± 7.4	−4.6 ± 9.7	2.5 ± 7.4	4.9 ± 7.3	1.7 ± 6.6
Biparietal diameter, head circumference, abdominal circumference, femur length	Hadlock et al.[1]	−0.7 ± 7.3	5.4 ± 9.0	−1.4 ± 7.0	−2.6 ± 7.8	−0.4 ± 7.4

*Fetal measurements in cm; fetal weight in gm.
†Deviation(%) = predicted weight − actual weight/actual weight × 100.
‡Mean difference statistically significant (p = 0.05).

Source: (Hadlock et al., 2002)

DISCUSSION:

Although the mean deviation and standard deviation of a regression model from a given population are useful indices of the magnitude of the systematic error and random error which one could expect using the model, it is important to keep in mind that there is an inherent bias in favour of the model, since it is in effect being tested on the population from which it was developed. It is appropriate therefore to initiate further testing of the model(s) in a new population of patients. The results from the 109 fetuses in this population indicate that the systematic and random errors for the models generated in our previous study are accurate estimates of these errors in our general population (Mladenovic-Segedi and Segedi, 2005).

A second question that someone should attempt to answer is whether the original sample population was large enough to be truly representative of a general population of fetuses. In order to answer this question, we combined the original study population (n = 167) with the current study population (n = 1 09) to form a composite population of276 fetuses. We then evaluated the various combinations of fetal parameters previously reported, 1 using regression analysis to determine whether improvements in the accuracy of the weight-estimating procedure (as indicated by the standard deviation of the regression) could be achieved by the increased sample size. The differences in the accuracy of the old and new models, which are summarized in Tables II and III, are not statistically significant (p = 0.05).

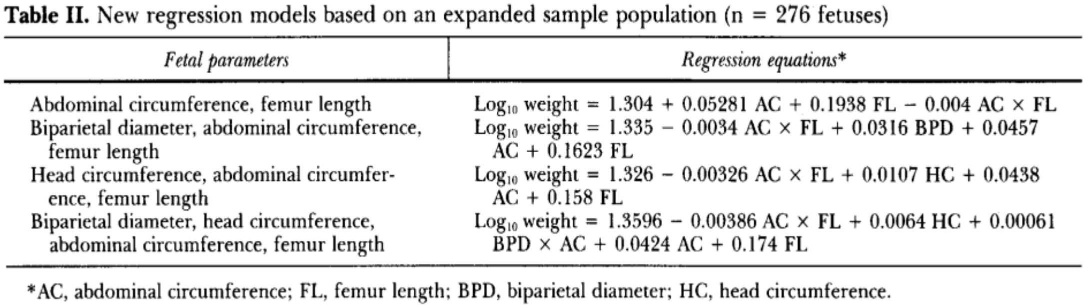

Table II. New regression models based on an expanded sample population (n = 276 fetuses)

Fetal parameters	Regression equations*
Abdominal circumference, femur length	$\text{Log}_{10}\ \text{weight} = 1.304 + 0.05281\ AC + 0.1938\ FL - 0.004\ AC \times FL$
Biparietal diameter, abdominal circumference, femur length	$\text{Log}_{10}\ \text{weight} = 1.335 - 0.0034\ AC \times FL + 0.0316\ BPD + 0.0457\ AC + 0.1623\ FL$
Head circumference, abdominal circumference, femur length	$\text{Log}_{10}\ \text{weight} = 1.326 - 0.00326\ AC \times FL + 0.0107\ HC + 0.0438\ AC + 0.158\ FL$
Biparietal diameter, head circumference, abdominal circumference, femur length	$\text{Log}_{10}\ \text{weight} = 1.3596 - 0.00386\ AC \times FL + 0.0064\ HC + 0.00061\ BPD \times AC + 0.0424\ AC + 0.174\ FL$

*AC, abdominal circumference; FL, femur length; BPD, biparietal diameter; HC, head circumference.

Source: (Mladenovic-Segedi and Segedi, 2005)

There was a slight increase in the coefficient of determination (r) for the models based on the population of 276 fetuses, which indicates that these models explain a slightly higher percentage of the observed variability than the previous models. We do not feel that these differences are clinically significant. One fetus that we have evaluated subsequent to this study provides a useful example of why it is important to analyze head size, trunk size, and length when attempting to estimate fetal weight in utero (Nasiri and Nasiri, 2013).

This fetus, which had profound microcephaly secondary to an early viral infection in utero, had the following measurements: biparietal diameter, 5.7 cm; head circumference, 21.3 cm; abdominal circumference, 28.5 cm; femur length, 7.5 cm. The weight estimation based on the model of Shepherd et al. 2 using biparietal diameters and abdominal circumference resulted in an error of 1197 gm (46.8%), whereas the model using head circumference, abdominal circumference, and femur length resulted in an error of 165 gm (7.3%) when compared to the actual birth weight of 2250 gm (Vintzileos et al., 2005).

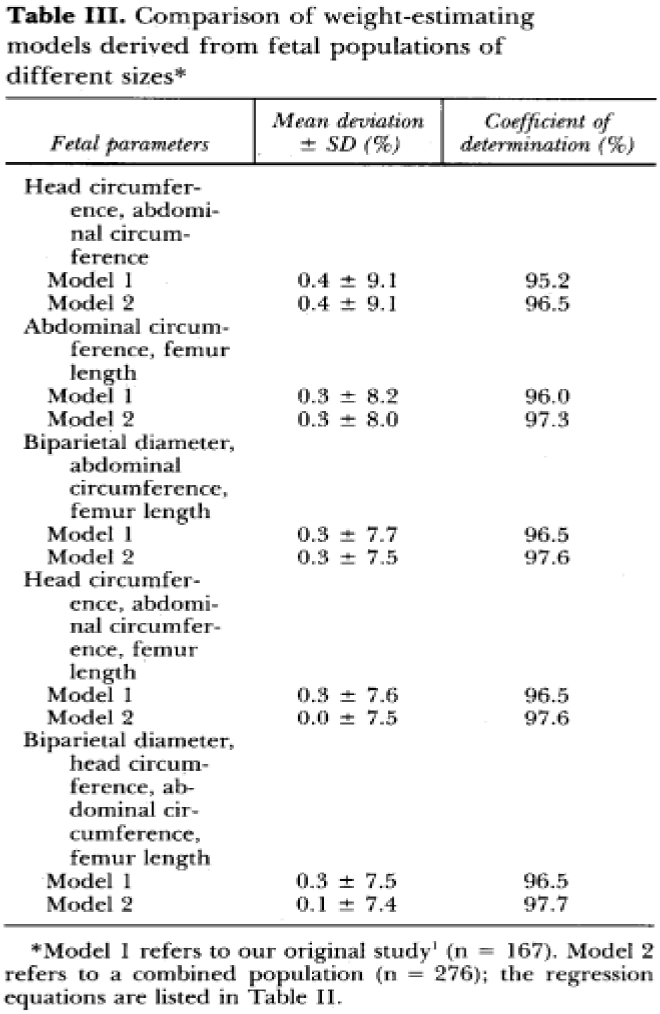

Table III. Comparison of weight-estimating models derived from fetal populations of different sizes*

Fetal parameters	*Mean deviation ± SD (%)*	*Coefficient of determination (%)*
Head circumference, abdominal circumference		
Model 1	0.4 ± 9.1	95.2
Model 2	0.4 ± 9.1	96.5
Abdominal circumference, femur length		
Model 1	0.3 ± 8.2	96.0
Model 2	0.3 ± 8.0	97.3
Biparietal diameter, abdominal circumference, femur length		
Model 1	0.3 ± 7.7	96.5
Model 2	0.3 ± 7.5	97.6
Head circumference, abdominal circumference, femur length		
Model 1	0.3 ± 7.6	96.5
Model 2	0.0 ± 7.5	97.6
Biparietal diameter, head circumference, abdominal circumference, femur length		
Model 1	0.3 ± 7.5	96.5
Model 2	0.1 ± 7.4	97.7

*Model 1 refers to our original study[1] (n = 167). Model 2 refers to a combined population (n = 276); the regression equations are listed in Table II.

Source: (Vintzileos et al., 2005)

A recent report has questioned the validity of currently available in utero weight standards such as the study by Williams et al. of over two million newborn infants. The argument against such standards is based on the premise that preterm deliveries (which are used in part to create these standards) are not normal physiologic events and that it may be erroneous to assume that these are normal fetuses (Vintzileos et al., 2005).

Researchers have suggested the use of a new fetal weight standard based on in ultrasound weight estimates of 186 fetuses by means of the model of Shephard et al. (biparietal diameter and abdominal circumference). Given the inherent error in this weight-estimating procedure we feel that the weight standard suggested by the model of Ott and Doyle should not be substituted for standards such as those of Williams et al. In fact, when we evaluated our optimal model' (head circumference, abdominal circumference, and femur length) on 361 normal fetuses in utero, the shape of the weight curve was identical to that reported by Williams et al. and almost all data points fell within the normal range (Yu, Wang and Chen, 2008).

Moreover, when we compared the mean weight estimate at weekly intervals in this population with the predicted weight based on the longitudinal study of Deter et al. the growth curves were virtually identical. We conclude that weight standards such as those of Williams et al. are appropriate standards of normal growth for the populations from which they were derived. When choosing such a standard for one's own population, it is of obvious importance to consider race, sex, socioeconomic factors, geographic locale, or any other factor that may influence the normal weight range in a given population of fetuses (Viveki and Shirol, 2018).

In summary, our study establishes two points:

(1) It confirms that the addition of femur length to head and abdomen measurements increases the accuracy of in utero weight estimates based on ultrasound studies, and
(2) It demonstrates that the regression models from our original study' based on 167 fetuses are accurate estimators of weight in our general population. In our previous report we suggested that the head circumference is a better index of head size than the biparietal diameter (primarily because of its relative shape independence) and that the head circumference, abdominal circumference, and femur length model could be considered the best overall model.
Because of the small systematic error observed in use of the original head circumference, abdominal circumference, and femur length model in our prospective population, we suggest that the new head circumference, abdominal circumference, and femur length equation in Table II be considered the optimal weight-estimating model for general use. Clearly, when a given measurement is technically inadequate or impossible to obtain (e.g., the head measurement when the head is deeply engaged), a model should be chosen based on the measurements available.

CONCLUSION:

Finally, it must be emphasized that population differences or subtle differences in imaging and measurement techniques may change the form of the optimal equation or the values of its coefficients.

REFERENCES:

1. Aksoy, H., Aksoy, Ü., Karadağ, Ö., Yücel, B., Aydın, T. and Babayiğit, M. (2015). Influence of maternal body mass index on sonographic fetal weight estimation prior to scheduled delivery. Journal of Obstetrics and Gynaecology Research, 41(10), pp.1556-1561.
2. Barel, O., Maymon, R., Vaknin, Z., Tovbin, J. and Smorgick, N. (2013). Sonographic fetal weight estimation - is there more to it than just fetal measurements?. Prenatal Diagnosis, 34(1), pp.50-55.
3. Fawzy, I. and Kamal, N. (2010). Stature and Body Weight Estimation from Various Footprint Measurements Among Egyptian Population. Journal of Forensic Sciences, 55(4), pp.884-888.
4. Hadlock, F., Harrist, R., Carpenter, R., Deter, R. and Park, S. (2002). Sonographic estimation of fetal weight. The value of femur length in addition to head and abdomen measurements. Radiology, 150(2), pp.535-540.
5. Mladenovic-Segedi, L. and Segedi, D. (2005). Accuracy of ultrasonic fetal weight estimation using head and abdominal circumference and femur length. Medicinski pregled, 58(11-12), pp.548-552.
6. Nasiri, E. and Nasiri, R. (2013). Accuracy of estimation of total body weight by legs and head weight measuring and comparison method in the anesthetized patients. Anesthesia: Essays and Researches, 7(3), p.341.

7. Vintzileos, A., Campbell, W., Rodis, J., Bors-Koefoed, R. and Nochimson, D. (2005). Fetal weight estimation formulas with head, abdominal, femur, and thigh circumference measurements. American Journal of Obstetrics and Gynecology, 157(2), pp.410-414.
8. Viveki, P. and Shirol, V. (2018). Gestational Age Estimation by Ultrasonographic Measurements of Fetal Head Circumference in Local Population, Karnataka, India. Annals of International medical and Dental Research, 4(3).
9. Yu, J., Wang, Y. and Chen, P. (2008). Fetal ultrasound image segmentation system and its use in fetal weight estimation. Medical & Biological Engineering & Computing, 46(12), pp.1227-1237.