

Derivation of new fetal weight estimation models using fractional limb volume

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Objective: Develop new fetal weight estimation models that combine fractional limb volume with conventional 2D biometry. **Methods:** A cross-sectional study of 271 fetuses used 3DUS to acquire biparietal diameter (BPD), abdominal circumference (AC), femoral diaphysis length (FDL), fractional arm volume (AVol) and fractional thigh volume (TVol) within 4 days of delivery. Weighted multiple linear regression was used to develop 'modified Hadlock' models for comparison to new models using natural logarithmic (Ln) transformed parameters for birth weight (BW). Predicted and observed weights were compared using mean % difference between predicted and actual BW (systematic error) and SD of the % differences (random error). The proportion of newborns with EFW within 5 or 10% of BW, were compared using McNemar's test. **Results:** Most infants were delivered from uncomplicated pregnancies. BW ranged from 235 to 5,790 g. Six models were very accurate with mean systematic errors that were not significantly different from zero (t-test). Model 3 ($0.18 \pm 6.6\%$, $R^2 = 0.99$) and Model 6 ($0.12 \pm 6.6\%$, $R^2 = 0.99$) provided the best results when compared to modified Hadlock models (random error = 8.5%) (Pitman test). Model 6 classified an additional 7.3% and 4.1% of infants within 5% and 10% of BW, respectively ($p < 0.0001$).

Model 3

$$\text{Ln BW} = 0.5046 + 1.9665 (\text{Ln BPD}) - 0.3040 (\text{Ln BPD})^2 + 0.9675 (\text{Ln AC}) + 0.3557 (\text{Ln AVol})$$

Model 6

$$\text{Ln BW} = -0.8297 + 4.0344 (\text{Ln BPD}) - 0.7820 (\text{Ln BPD})^2 + 0.7853 (\text{Ln AC}) + 0.0528 (\text{Ln TVol})^2$$

Conclusions: More precise fetal weight estimations are possible by combining fractional limb volume with 2D biometry. Substitution of FDL by fractional limb volume, use of Ln transformations with weighted regression analysis, and selective application of squared transformed parameter terms reduced the random error to 6.6%. New fetal weight estimation models, that incorporate soft tissue parameters, may offer new insight regarding the body composition of malnourished fetuses.