Accuracy of ultrasound biometry in the prediction of macrosomia: a systematic quantitative review

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CRD summary
This review assessed the accuracy of ultrasonographic techniques for predicting macrosomia. The authors’ conclusions, that ultrasonographic techniques have similar but poor accuracy, were supported by the data presented. The review appears to have been concluded in 2003 and may, therefore, be somewhat out of date.

Authors’ objectives
To determine the accuracy of estimated foetal weight (EFW) and abdominal circumference (AC), on ultrasound, for the prediction of macrosomia.

Searching
MEDLINE (1996 to 2003), EMBASE (1980 to 2003), the Cochrane Library (2003 to 2004), SciSearch (1974 to 2003) and ISI Proceedings (1974 to 2003) were searched for relevant studies; the search terms were reported. In addition, the reference lists of all primary and review articles known to the authors were checked for additional studies, frequently cited articles were used in the Science Citation Index to identify additional citations, and researchers in the field were contacted for unpublished studies. No language restrictions were applied.

Study selection
Study designs of evaluations included in the review
Diagnostic case-control studies were excluded.

Specific interventions included in the review
Studies evaluating EFW or AC for the prediction of macrosomia were eligible for inclusion. The included studies used several different formulae to calculate EFW; these were reported. The majority of the studies used an EFW threshold of 4,000 g for macrosomia; other thresholds used were 3,800 g, 4,500 g, >90th centile, or >1.5 standard deviations. In the studies using measured AC, the threshold for macrosomia was 36 cm, 37 cm, >90th centile, or >2 standard deviations.

Reference standard test against which the new test was compared
The included studies were required to report birth weight as the reference standard. The birth weight threshold for macrosomia was as for EFW.

Participants included in the review
No inclusion criteria were specified for the study participants. The included studies were of women in the final weeks of pregnancy; no further details were reported.

Outcomes assessed in the review
No inclusion criteria were specified for the test outcome, but the authors stated that they extracted 2x2 data from all included studies.

How were decisions on the relevance of primary studies made?
Electronic searches were screened and full manuscripts of citations deemed likely to meet the inclusion criteria were retrieved; final decisions on inclusion were based on examination of the full manuscripts. The authors did not state how many reviewers were involved in this process.

Assessment of study quality
The included studies were assessed against the following methodological criteria: use of a prospective design, consecutive enrolment of the participants, full verification of the test result with the reference standard, and adequate test description. The authors did not state how the validity criteria were applied, or how many reviewers performed the validity assessment.

**Data extraction**
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction. Data on study characteristics, quality and accuracy (2x2 data) were extracted from each article.

**Methods of synthesis**
How were the studies combined?
Summary likelihood ratios (LRs) were estimated using a random-effects model. The data were synthesised separately for EFW and AC, and the analyses were stratified by technique or formulae used for the index test, index test threshold, and reference standard threshold. Summary receiver operating characteristic (sROC) curves were constructed to compare the overall accuracy of EFW and AC.

Publication bias was assessed using a funnel plot and Begg's and Egger's tests for asymmetry.

How were differences between studies investigated?
Between-study heterogeneity was assessed graphically using forest plots of the diagnostic odds ratio and statistically using the chi-squared test.

Possible sources of heterogeneity were explored using regression analyses, with all variables defined a priori. The variables were inclusion criteria (diabetes, post-dates or other), gestation (>36 weeks or other), scan-to-delivery interval (<1 week or other), type of recruitment (consecutive or other), study design (prospective or retrospective) and test description (adequate or inadequate).

**Results of the review**
Thirty-six studies (19,117 participants) were included in the review. The 36 studies reported 63 data sets, 51 evaluating the accuracy of EFW and 12 evaluating the accuracy of AC.

Full results (pooled LR estimates) for all combinations of index test formula and index test and reference standard threshold were tabulated.

The most commonly used methods for EFW were Hadlock's formula (using femur length and AC) and Shepard's formula (using biparietal diameter and AC), (6 studies each). The pooled positive LR for ultrasound EFW over 4,000 g to predict birth weight over 4000 g, using Hadlock’s formula, was 5.7 (95% confidence interval, CI: 4.3, 7.6); the corresponding negative LR was 0.48 (95% CI: 0.38, 0.60). The regression analysis showed that accuracy was unaffected by any of the variables investigated.

The pooled positive LR for an AC over 36 cm to predict a birth weight over 4,000 g (4 studies) was 6.9 (95% CI: 5.2, 9.0), and the corresponding negative LR was 0.37 (95% CI: 0.30, 0.45). The pooled positive LR for an AC over the 90th centile to predict a birth weight over the 90th centile (5 studies) was 4.2 (95% CI: 2.3, 7.7), and the corresponding negative LR was 0.33 (95% CI: 0.21, 0.54). The regression analysis showed that accuracy was unaffected by any of the variables investigated.

The areas under the sROC curves, generated from EFW and AC data sets where the reference standard threshold was 4,000 g or the 90th centile, were not significantly different (P=0.91).

**Authors' conclusions**
There was no difference in the accuracy of ultrasonographically EFW and AC for the prediction of macrosomia. Ultrasonic techniques for predicting macrosomia have generally poor accuracy, but a positive test result is more
accurate for ruling in macrosomia than is a negative one for ruling it out.

**CRD commentary**
This review addressed a clearly stated research question and its inclusion criteria, though broad, were appropriate to that question. A comprehensive search strategy was reported, which included attempts to identify unpublished studies and a subsequent assessment of publication bias, and no language restrictions were applied. However, the literature searches appear to have been concluded in 2003 and, as the article was published in November 2005, its summary of the available evidence may be somewhat out of date. Relevant criteria for assessing the methodological quality of the included studies were reported and aspects of methodological quality were considered as potential sources of between-study heterogeneity. However, the reporting of the methods used to conduct the review was limited, so it is not possible to judge the potential for the introduction of error and bias during the review process.

The methods of data analysis used in the review were broadly appropriate for meta-analyses of diagnostic accuracy studies. However, the authors acknowledged the presence of heterogeneity within groups of studies for which pooled LRs were presented; since neither the extent of heterogeneity, results of individual studies, or detailed characteristics of the individual studies were presented, it is not possible to judge whether pooling these studies was appropriate. In addition, regression analyses were described as a method of investigating possible sources of heterogeneity; the data presented (the maximum number of data sets used to generate a pooled estimate was 6) were unlikely to be sufficient to support the regression analyses described. The authors' conclusions about the approximate equivalence in accuracy of EFW and AC, and the poor accuracy of ultrasonic techniques for predicting macrosomia, are supported by the data presented.

**Implications of the review for practice and research**
Practice: The authors stated that both normal and abnormal ultrasounds for predicting macrosomia are likely to be inaccurate in many cases. Over-reliance on them to guide practice should, therefore, be avoided.

Research: The authors made no specific recommendations for research.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.