Symphysis-fundus measurement – the predictive value of a new reference curve

BACKGROUND Symphysis-fundus measurement is used in pregnancy care to detect poor fetal growth. Symphysis-fundus measurement curves (percentile curves) and prediction of fetuses with a birth weight below the 10th percentile have been published previously. The percentile curves show the distribution of symphysis-fundus measurements in the reference population and are recommended as the national standard. This article discusses the predictive value of this method for identification of neonates who are small for gestational age (SGA).

MATERIAL AND METHOD This is a population-based registry study of pregnant women who gave birth at Sahlgrenska University Hospital in Gothenburg in the period 2005–2010. Diagnostic accuracy was analysed using ROC curves and presented with the area under the curve (AUC) from gestational week 24 to 42. Sensitivity, specificity, and positive and negative predictive value were calculated.

RESULTS A total of 42 018 pregnant women carrying a single fetus were included. The AUC values showed that a symphysis-fundus measurement late in pregnancy was a stronger predictor for determining fetuses that are small for gestational age than a measurement early in pregnancy. The AUC value increased from 0.61 in week 24 to 0.74 in week 40. With a threshold value at the 10th percentile, symphysis-fundus measurement has a total sensitivity of 47 % and a specificity of 79 %. A positive total test was defined as at least one measurement below the 10th percentile curve in the course of the pregnancy.

INTERPRETATION Symphysis-fundus measurement may be important for the identification of high-risk pregnancies, but should preferably be used in conjunction with other clinical variables.

Fetal growth restriction / small for gestational age

Fetal growth restriction (FGR) means that a fetus is not growing satisfactorily in relation to its genetic potential, and therefore indicates pathological growth (4). Small for gestational age applies to all infants who have a birth weight below a defined percentile in relation to length of gestation. In Norway this is defined as a birth weight below the 10th percentile (5).

A proportion of the small for gestational age infants will not have fetal growth restriction because some are genetically small. Of those who are not classified as small for gestational age, some will also have fetal growth restriction. There is no general agreement on the required deviation from a reference curve and on the duration of this deviation in order for the fetus to be classified as growth-restricted.

Fetal growth restriction signals deviation in fetal health for a number of conditions, mainly malformations, chromosomal abnormalities and various forms of placental insufficiency. These fetuses have a significantly increased risk of injury, acute interventions and mortality during the pregnancy, birth, and as neonates (6–10). More than half of stillborn babies in Norway have restricted growth before birth (11). Identification of these fetuses is highly prioritized in order to reduce the risk of perinatal morbidity and mortality (12).

New national reference curves and their predictive value

We have previously published percentile curves for symphysis-fundus measurement.
We have developed relative risk curves (RR) as an alternative to traditional percentile curves. We have also published a prediction model for small-for-gestational-age, where small-for-gestational-age is defined as birthweight below the 10th percentile for a given threshold value for symphysis-fundus measurement.

### Results

We present the results primarily using symmetric-fundus threshold values at the 10th and 2.5th percentiles, since these are the values used in Norway. In Table 2 we show AUC values for selected gestational weeks with a 95% confidence interval. Figure 1 shows the total predictive value for all symmetric-fundus threshold values.

### Material and method

The percentile curves assessed in this article were developed by the Norwegian Institute of Public Health in collaboration with Oslo University Hospital and Sahlgrenska University Hospital in Gothenburg (13). The curves are recommended by the Norwegian Directorate of Health as the national standard (13). We have also published a prediction model for small-for-gestational-age, where small-for-gestational-age is defined as birthweight below the 10th percentile for a given threshold value. We present the results primarily using symmetric-fundus measurement can predict small-for-gestational-age in neonates, including information on sensitivity, specificity, and positive and negative predictive value.

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With a symphysis-fundus threshold value which an infant is small for gestational age.

Discussion

Symphysis-fundus measurement early in pregnancy has limited value for identifying infants who are small for gestational age at birth, but the closer the measurement is taken to the due date, the greater the diagnostic accuracy. Symphysis-fundus screening will be a balance between the highest-quality symphysis-fundus measurement late in pregnancy and the clinical benefit of early identification of infants who are small for gestational age.

Total sensitivity is moderate when a symphysis-fundus threshold value at the 10th percentile is used, since it only detects one in two fetuses that are small for gestational age. Specificity is better, since four out of five fetuses that are not small for gestational age are correctly identified. Positive predictive value shows that one out of five fetuses with a positive test on screening at birth is small for gestational age. Negative predictive value shows that as many as nine out of ten fetuses with a negative test are correctly identified. Theoretically, information about a falling or static symphysis-fundus curve may be clinically useful, and the possibility that it may provide a general indication of increased perinatal morbidity and mortality cannot be excluded. However, the correlation with the risk of the infant being small for gestational age is not sufficiently strong to be of practical value when symphysis-fundus measurement is used.

We have shown in a previous study (14) based upon the same population that longitudinal symphysis-fundus measurements with static or flat curve patterns did not improve the prediction of small-for-gestational-age cases compared with only using the last (most recent) symphysis-fundus measurement. Theoretically, information about a falling or static symphysis-fundus curve may be clinically useful, and the possibility that it may provide a general indication of increased perinatal morbidity and mortality cannot be excluded. However, the correlation with the risk of the infant being small for gestational age is not sufficiently strong to be of practical value when symphysis-fundus measurement is used.

Change in threshold value/criteria for symphysis-fundus measurement

The choice of threshold value determines the balance between sensitivity and specificity. The threshold value also dictates how many patients will be referred to specialist care, and is therefore of great practical significance. A lower cut-off for positive screening (2.5th percentile) entails considerably reduced sensitivity; in this case the test will only detect one in five pregnancies with growth retardation, in contrast to one in two with a threshold value at the 10th percentile. However, it results in a clear improvement in specificity.

The test therefore became less accurate for identifying actual births where the infant was small for gestational age, but there was a reduction in the number of false positive tests. A practical consequence of choosing the 10th percentile as a threshold for referral would be that 25% of pregnant women would be referred to a specialist, in contrast to 8% when choosing the 2.5th percentile.

Strengths and weaknesses

The present study is a population-based registry study that includes a large number of symphysis-fundus measurements. The study population from Västra Götaland county can be expected to be sufficiently representative of Norwegian conditions, and in a previous study we have shown that of the available variables, only the mother’s height and weight had an effect on the symphysis-fundus measurement. Smoking, parity and age had a minimal effect, which indicates that moderate differences in the variable distribution between Norway and Sweden will have little effect on the results (13).

The measurements are performed by a
number of different midwives and doctors, and different individuals will measure in different ways. The percentile curves nevertheless represent a population of healthcare personnel performing measurements (13). This will smooth out systematic biases and make them representative in a population context. Individual errors of measurement will reduce predictive value. Since the data are retrieved from a clinical population database, measurement errors will already be present. However, this also implies that our calculated predictive value will be realistic in relation to what may be anticipated in clinical practice.

The clinician’s knowledge of any general risk profile the women may have may have regard to intrauterine growth restriction or a small infant may have affected the symphysis-fundus measurement. We had no information on the times when possible diagnoses were made, nor on whether the clinician had knowledge of these when the symphysis-fundus measurement was performed.

Another element of uncertainty in the study is that pregnancy with a risk of intrauterine growth restriction or a small infant is excluded at some point in the pregnancy from symphysis-fundus screening and further growth is estimated exclusively with the use of ultrasound. This may produce an apparently weaker predictive value of the symphysis-fundus measurement. We found, however, that the number of measurements in low-risk pregnant women was on average only 0.2 more than in the rest of the population, which does not indicate a significant degree of selection (13).

Consequences for clinical practice

The study shows that symphysis-fundus measurement identifies only half the number of small fetuses, and it is essential that midwives and doctors are aware of the moderate sensitivity of the test. In pregnancy care, symphysis-fundus measurement is not used as the only screening tool to identify risk; it is combined with clinical findings, medical factors and previous obstetric history which together constitute the woman’s total risk profile for intrauterine growth restriction or a small infant.

Symphysis-fundus measurement has a relatively high specificity. This means that there are few cases in which the pregnant woman is further referred that the fetus is in fact not small for gestational age. However, false positive results with use of symphysis-fundus measurement are of less concern than failing to identify a pregnancy with intrauterine growth restriction or a small infant.

When screening is performed in primary health care, emphasis should therefore be placed on the importance of sensitivity at the expense of specificity in order to identify as many cases as possible where there is a risk of the fetus being small for gestational age.

Conclusion

Symphysis-fundus measurement may be an important method of identifying risk pregnancies. The predictive value is highest late in pregnancy, but this must be weighed against the clinical benefit of early identification. It is essential that healthcare personnel are aware of the test’s limitations.

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