Symphysis–fundus measurements in screening for small-for-dates infants: a community based study in Gloucestershire

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SUMMARY. Symphysis–fundus charts were introduced into 50 general practitioner antenatal clinics and the hospital antenatal clinics of two obstetricians in Gloucestershire in February 1985 for a 12-month period. Of the 1139 charts analysed, the sensitivity of one or more low fundal height measurements in predicting birthweight below the tenth centile for gestational age was 51% with a specificity of 88%. In the 319 charts with four or more measurements after 26 weeks gestation a sensitivity of 65% was recorded in predicting birthweight below the tenth centile, rising to 91% in the prediction of birthweight below the fifth centile; the specificity was correspondingly 81% and 80%. The sensitivity of the test varied inversely with maternal body mass index. The mean absolute difference in pairs of observations between general practitioners, midwives and an observer was 1.5 cm.

Measurement of symphysis–fundus distance is not a precise diagnostic tool but it does provide an improvement on abdominal palpation in the prediction of small-for-dates infants. The findings of this study support the use of serial symphysis–fundus measurements in community antenatal clinics. Referral for ultrasound investigation is recommended when the measurement is low.

Introduction

RENEWED interest has recently been shown in the use of tape measurements of symphysis–fundus height as a screening test for intrauterine growth retardation.[1-8] With one exception when the sensitivity was found to be 27%,[5] the reported sensitivity of the test in these hospital based studies varied between 56% and 86%, and the specificity between 79% and 92%. The conclusions correspondingly varied from statements that fundal height measurement was of little value as a screening test for growth retardation[5,7] to recommendations that symphysis–fundus measurements should be routinely used in all antenatal clinics as a simple, inexpensive screening test.[1-4,6,8] Certainly, abdominal palpation and inspection have been shown to predict less than 50% of small-for-dates babies correctly[9,10] so that all but one of the reported sensitivities in the trials of symphysis–fundus measurement would be an improvement on clinical assessment.

It has been proposed that symphysis–fundus charts should be incorporated into the standard antenatal 'cooperation card'[2] and that their effectiveness in community based antenatal clinics should be examined.[11] This prospective study was undertaken to assess the value of symphysis–fundus measurements in general practitioner and hospital antenatal clinics.

Method

Standardization of measurements

A symphysis–fundus chart (18.0 × 10.5 cm) was constructed using the Cardiff model[2] (Figure 1) and designed to fit into the

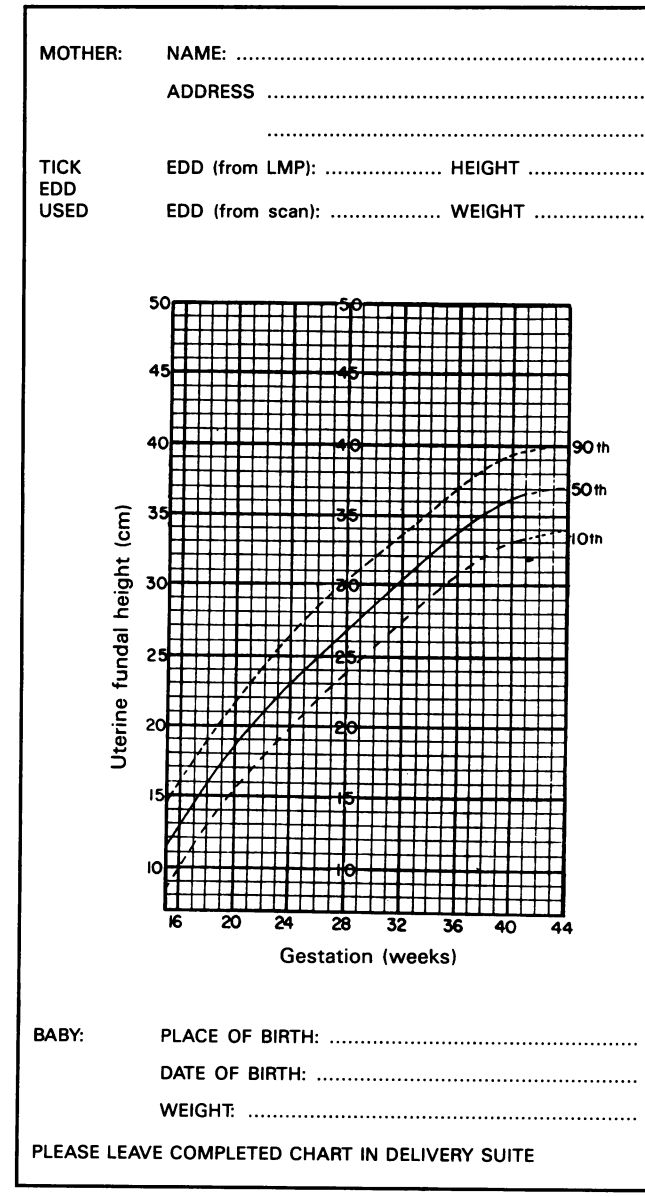

Figure 1. *Symphysis–fundus chart (EDD = estimated date of delivery; LMP = last menstrual period).*

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cooperation card. The method of measurement of fundal height was defined with the assistance of diagrams (Figure 2). The instructions were that the mother should be lying absolutely flat (supine, horizontal, legs straight, arms by side) with an empty bladder and relaxed abdomen and uterus. With one finger vertically above the tip of the fundus (defined as the apex of the uterus, not necessarily in the midline), the skin was gently marked with a felt tip or ball point pen. One end of the tape measure (cloth or plastic) was pressed against the upper border of the symphysis-pubis and the distance to the fundal mark measured to the nearest half centimetre, keeping the tape smoothly in contact with the natural curve of the skin.

Implementation

Lectures explaining the method and purpose of the trial were given to general practitioner groups in four geographically separated areas in the two health districts of Gloucestershire and to the midwives in the two main maternity hospitals. General practitioners who agreed to participate in the study explained the method to the midwives attached to their practices. The symphysis–fundus charts were introduced in 50 general practitioner antenatal clinics and in the hospital antenatal clinics of two obstetricians for 12 months from 18 February 1985.

The charts were attached to the cooperation card at the first antenatal visit or to the hospital notes in those mothers whose general practitioners were not taking part in the study. An ultrasound scan between 16 and 20 weeks gestation was part of the usual antenatal care in both districts.

The fundal height was measured at each antenatal visit by the midwife, the doctor checked any difficult or doubtful palpations, and the symphysis–fundus chart was marked appropriately. The gestational age was calculated from the date of the last menstrual period and from ultrasound measurement of biparietal diameter. If there was a good menstrual history and if the two age estimates agreed within two weeks, the last menstrual period date was taken as correct; otherwise the age estimate obtained from ultrasound measurement was used. If symphysis–fundus measurements were below the tenth centile (the lower line on the chart, Figure 1[2]) after 26 weeks or were falling or static, referral to a consultant was suggested to the mothers by their general practitioner.

Analysis

After delivery the charts were completed and returned to the study coordinator. The data were entered into a microcomputer datafile and analysed using programmes written in BASIC. Babies with a birthweight below the fifth or tenth centile for gestational age were defined according to the data used in the construction of the paediatric growth charts of Gairdner and Pearson.[12-14]

Observer variation

During the study period a randomly selected group of 10 of the 50 participating general practitioners and their attached midwives were visited by an observer with two years experience of the symphysis–fundus method. Each general practitioner, midwife and observer measured in turn the symphysis–fundus distance in eight mothers attending antenatal clinics. The fundal marks were made with a felt tip pen and erased using a spirit swab between each observation. Each measurer recorded their symphysis–fundus distances on a separate card and results were not compared until the end of the clinic. Tape measures in use were compared against a 40.0 cm metal standard.

Results

The number of completed symphysis–fundus charts returned for analysis was 1445. Of these 306 (21%) were excluded from analysis for the following reasons: no measurements after 26 weeks (72), multiple pregnancy (12), card duplication (four), absent (or illegible) fundal height markings (126), no estimated date of delivery or birthweight (92).

Of the 1379 charts with a recorded birthweight, the percentage with a birthweight less than 2500 g (6.0%) was similar to the percentage of births below this weight recorded on the Office of Population Censuses and Surveys vital statistics forms for Gloucester and Cheltenham and District health authorities in 1986 (6.6%).

All charts

Of the 1139 charts analysed, the sensitivity of one or more low symphysis–fundus readings after 26 weeks in predicting a birthweight below the tenth centile was 51% with a specificity of 88%; that is 51% of the small-for-dates babies were correctly predicted as small and 12% of normal weight babies were incorrectly predicted as small (Table 1). Using the same criteria in the prediction of birthweight below the fifth centile, the sensitivity was 54% and the specificity 87%.

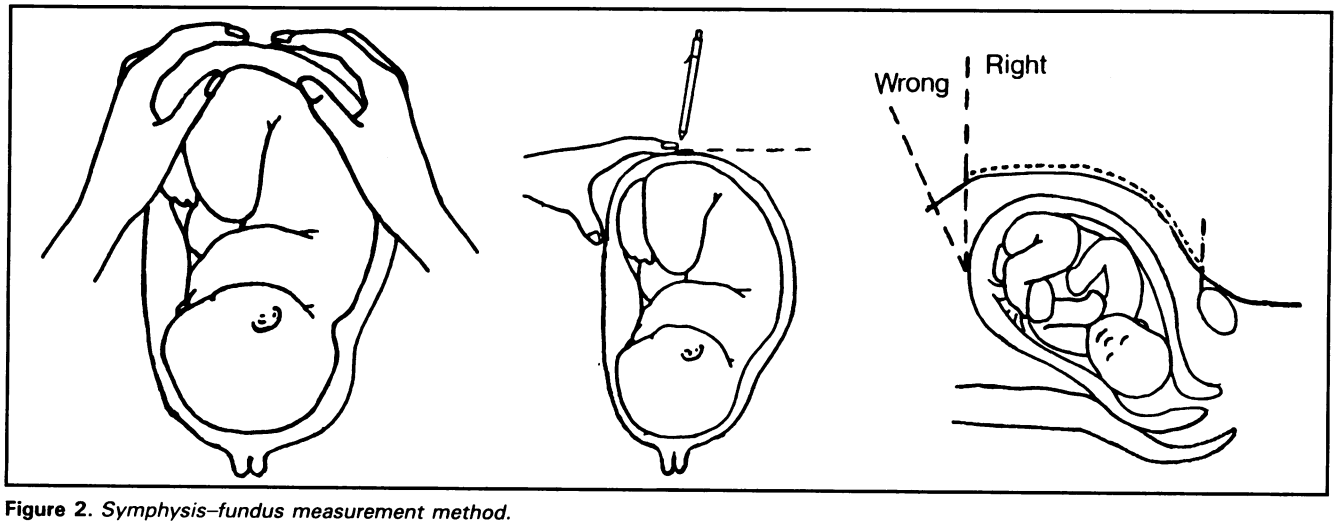

Figure 2. *Symphysis–fundus measurement method.*

Table 1. Evaluation of symphysis–fundus measurements in predicting small-for-dates infants for all symphysis–fundus charts and charts with four or more serial measurements after 26 weeks gestation.

	Number of charts		
	Birthweight <10th centile for gestational age	Birthweight ⩾10th centile for gestational age	Total
All charts			
Charts with one or more low symphysis–fundus measurement	44	127	171
Charts with no low symphysis–fundus measurements	43	925	968
Total	87	1052	1139
Charts with serial measurements			
Charts with one or more low symphysis–fundus measurement	15	57	72
Charts with no low symphysis–fundus measurements	8	239	247
Total	23	296	319

Charts with serial measurements

The analysis of the 319 symphysis–fundus charts with four or more serial measurements after 26 weeks gestation showed that the sensitivity of one or more low measurements in detecting babies with a birthweight below the tenth centile was 65% and the specificity was 81%; that is 65% of the small-for-dates infants were correctly predicted as small and 19% of the normal weight babies were false positives (Table 1). In these same charts one or more low measurements picked out 91% (10 out of 11) of the babies born with a birthweight below the fifth centile, with a specificity of 80%. The predictive value of a positive test varied between 14% and 21%, and the predictive value of a negative test between 97% and 100%.

Static measurements

Of the 200 charts which showed static or falling fundal height measurements after 26 weeks, the sensitivity was again highest in those charts with serial measurements at 61% but specificity was very low at 37%.

Body mass

Increasing maternal body mass index, grouped according to the Royal College of Physicians guidelines[15] and calculated from body weight and height at booking, showed a consistent tendency to lower sensitivity and higher specificity (Table 2).

Observer variation

Although the mean differences of measurements between general practitioners, midwives and the observer were small and the 95% confidence interval included zero in all three groups (Table 3), there was a large range of measurement differences between pairs of observations. An examination of the data by practice showed statistically significant differences of greater than 2 cm between measurement means in three of the 10 practices. In two practices these differences were between general practitioner and midwife ($P<0.01$) and in the third practice both doctor and midwife differed from the observer ($P<0.02$) but not from each other. The mean difference between measurements made by the observer and the general practitioner or midwife was 1.5 cm.

Table 2. Influence of bodyweight on one or more low symphysis–fundus measurements as a predictor of birthweight below the tenth centile, for the 1005 women for whom weight and height were recorded.

Maternal body mass index (kg/m^2)	Number of women	Sensitivity (%)	Specificity (%)
<18.7 (underweight)	62	*71*	*58*
18.7–23.8 (normal weight)	610	*47*	*85*
23.9–28.6 (overweight)	257	*44*	*94*
>28.6 (obese)	76	*25*	*97*

Table 3. Variation in symphysis–fundus measurements by general practitioners, midwives and the observer.

	Variation between GPs and observer ($n=80$)	Variation between midwives and observer ($n=80$)	Variation between GPs and midwives ($n=80$)
Mean overall difference (cm)	−0.07	−0.27	+0.21
95% confidence interval of mean overall difference (cm)	−0.48 to +0.35	−0.73 to +0.12	−0.30 to +0.72
95% confidence interval of range of differences between pairs of observations (cm)	±3.68	±4.10	±4.58
Mean absolute difference between pairs of observations (cm)	1.48	1.55	1.90

n = number of pairs of observations.

Tape measure variation

The lengths of 24 tape measures examined against the metal standard of 40.0 cm varied between 39.9 and 40.3 cm, the mean difference from 40 cm being +0.07 cm.

Discussion

Although 21% of returned charts were excluded from the analysis, the similarity between the observed percentage of birthweights below 2500 g in this study and in the official statistical returns from the two health districts supports the suggestion that the study population was a representative sample of pregnancies in Gloucestershire. As a consequence of this study it is possible that further investigation led to interventions (for example bed rest, elective early delivery) which affected birthweights; we have no evidence to support or refute such a hypothesis.

The sensitivity of one or more low symphysis–fundus readings in predicting small-for-dates babies at birth in this study varied between 51% and 91% depending on the criteria used in the analysis. When all the symphysis–fundus charts were considered, the majority of which had only one or two readings from the general hospital antenatal clinics, lower sensitivities were found than when charts with serial measurements, which originated mainly from the general practitioner clinics, were considered. The cumulative value of serial measurements has been demonstrated previously[4] and repeat measurements by the same observer may also improve sensitivity.[3,16]

Using static or falling symphysis–fundus measurements did not improve sensitivity, and the specificity was low. These measurements appear to be of less value as predictive criteria, a conclusion which has been reached in other studies.[2-4]

It has been stated that excess body weight is a contraindication to symphysis–fundus measurements.[3] In this study, while one or more low measurements in obese mothers correctly predicted only 25% of small-for-dates babies, the percentage of false positives identified was correspondingly low, that is the predictive value of a low measurement was similar in obese and non-obese mothers. The numbers are too small to draw confident conclusions about the value of the test in obese mothers, but the trend of increasing sensitivity and decreasing specificity with increasing body mass index was statistically consistent and fits with expectation.

There was no evidence of any overall bias in measurement between doctors, midwives and the observer. However, the range of observed differences between pairs of observations demonstrates a lack of consistency between measurers, and the significant differences recorded between four of the 30 pairs of measurers examined demonstrated the potential for bias. These two sources of error suggest that training in the technique of measurement is important. Midwifery training schools and medical schools should incorporate symphysis–fundus measurement into standard teaching practice if this method is to be introduced more widely. There was no evidence that the tape measures in use were a significant source of observer variation though it has been suggested that special non-elastic tape measures should be used (Westin B, personal communication).

Symphysis–fundus measurement cannot provide a diagnosis of intrauterine growth retardation but it can pick out a group of mothers with more small-for-dates babies than other methods of clinical assessment can. The problem of the numbers of false positives (up to 20% of normal weight babies in this and other studies) has been emphasized previously[7] so that symphysis–fundus measurements should only be considered as part of a multi-stage screening process. One recommended second procedure in countries where such facilities exist is ultrasound scanning of fetal abdominal circumference.[4] In the UK ultrasound services have recently been expanding rapidly; some hospitals already provide two scans routinely.[17] Limiting second scans to mothers who have low symphysis–fundus measurements is a means of restricting service costs with little reduction in the sensitivity of screening for small-for-dates infants.[4]

The obstetric sub-population of small-for-dates babies does have a relatively high perinatal mortality and morbidity[18,19] but identification of the fetus 'at risk' is imprecise and the effectiveness of intervention is uncertain.[20] It is, therefore, important to continue to develop methods of screening for growth retardation and of identifying the 'at risk' fetus so that effectiveness of intervention can be properly evaluated.

General practitioners and midwives should consider the use of standard symphysis–fundus charts as an alternative to clinical assessment in screening for small-for-dates babies. Symphysis–fundus measurements should be made by a doctor or midwife at every antenatal visit, attention should be paid to the technique of measurement, and fundal height should be recorded in centimetres instead of weeks. If one or more low measurements are recorded after 26 weeks gestation, referral for ultrasound investigation is recommended.

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Supplies of the symphysis–fundus chart (A4) size may be obtained from Titan Press Ltd, Wroughton Place, Fairwater, Cardiff (Tel: 0222-569321). Sample copies of the method of measurement and of the chart used in this study are available from Dr Stuart.