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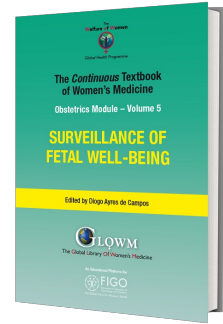
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SURVEILLANCE OF FETAL WELL-BEING

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Chapter

Clinical Assessment of Fetal Growth

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AUTHORS

Maria Carvalho Afonso

Departamento de Obstetrícia, Ginecologia e Medicina da Reprodução, Hospital de Santa Maria, Lisboa, Portugal

Nuno Clode

Faculdade de Medicina da Universidade de Lisboa, Hospital de Santa Maria, Lisboa, Portugal

Diogo Ayres-de-Campos, MD, PhD

Departamento de Obstetrícia, Ginecologia e Medicina da Reprodução, Hospital de Santa Maria: Faculdade de Medicina da Universidade de Lisboa, Hospital de Santa Maria, Lisboa, Portugal

INTRODUCTION

Fetal growth reflects a complex interaction between the genetically predetermined growth potential and pregnancy-related maternal, placental and fetal factors.¹ Assessment of fetal growth is one of the main aims of antenatal care, as fetal size and growth trajectories are important indicators of underlying fetal health. Both extremes of fetal growth are associated with an increased incidence of adverse perinatal outcomes. Fetal growth restriction is associated with stillbirth, low 5-minute Apgar score, neonatal seizures, acidosis and neonatal death.² Fetal macrosomia is associated with an increased risk of complications such as arrested labor, instrumental vaginal delivery, cesarean delivery, postpartum hemorrhage, genital tract lacerations, shoulder dystocia, birth trauma, fetal hypoxia, and admission to the neonatal intensive care unit.³

Assessment of risk factors present at booking or occurring during pregnancy remains an important determinant of how further screening should be performed. These risk factors include previous history of fetal growth restriction or stillbirth, maternal diseases such as hypertension and diabetes, as well as complications arising during pregnancy, such as reduced fetal movements and antepartum hemorrhage (Table 1). With the widespread use of ultrasound, particularly in high-resource countries, scanning performed 2–3 times in pregnancy has become common practice in many settings, and is currently recommended by the World Health Organization (WHO).⁴

Table 1 Risk factors associated with small for gestational age (SGA) fetuses. Adapted from Reeves and Galan, 2017.⁵

Maternal	Hypertensive disease: chronic hypertension, gestational hypertension, pre-eclampsia
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	Pre-gestational diabetes Autoimmune disease Antiphospholipid syndrome Systemic lupus erythematosus Cardiac disease: congenital heart disease, heart failure Pulmonary disease: cystic fibrosis, poorly controlled asthma Renal diseases: chronic renal insufficiency, nephrotic syndrome Gastrointestinal disease: ulcerative colitis, Crohn's disease, malabsorptive disorders, gastric bypass Toxic exposure: smoking, alcohol, cocaine Malnutrition Living in high altitudes Low socioeconomic status Extremes of maternal age
Fetal	Aneuploidy Fetal malformations Multiple gestation Fetal infection: cytomegalovirus, toxoplasmosis, rubella, malaria
Placenta	Abruption Placenta previa and accreta Chorioangioma

Ultrasound estimation of fetal growth is the current “gold standard” for diagnosis of small for gestational age (SGA) and macrosomia, but it is time-consuming and requires expertise. For these reasons, only a limited number of scans can be routinely performed during pregnancy, even in high-resource countries. In medium- and low-resource countries ultrasound is frequently unavailable, or the expertise required to perform it is lacking. Therefore, clinical assessment of fetal growth remains an important part of obstetric care, both as a screening method in between ultrasound scans, and as a diagnostic tool in settings where ultrasound is unavailable. In high-resource countries, it is reasonable to establish that pregnancies at high-risk for SGA and macrosomia, are primarily screened by increasing the number of ultrasound scans. A similar approach can be used whenever symphysis–fundal height (SFH) measurement is difficult, as may occur with maternal obesity and uterine leiomyomas.

CLINICAL ASSESSMENT

Clinical estimation of fetal growth can be performed by subjective evaluation of fetal size on abdominal palpation or by SFH measurement. The first requires experience and continued practice. The second aims to make the evaluation more objective and less user dependent.

One of the challenges of assessing fetal growth is the correct estimation of gestational age. Adequate dating of pregnancy is necessary to evaluate whether growth is appropriate for that particular gestational age. Traditionally, gestational age is calculated from the first day of the last menstrual period, and assumes that ovulation occurred on day 14 of the menstrual cycle. Irregular menses, unknown or uncertain dates, oral contraceptive use in the previous month, recent pregnancy or breastfeeding may all influence the method's accuracy, and occur in an important proportion of women.^{6,7,8}

In high-resource countries, this is largely overcome by the routine use of early pregnancy or first-trimester ultrasound. It is well established that crown–rump length measurement between 8 and 14 weeks is the most reliable method for

estimating gestational age.⁹ Even when women present for antenatal care between 14 and 26 weeks, head circumference and femur length are reasonably accurate at estimating gestational age.¹⁰ Ultrasound dating of pregnancy after 26 weeks has a substantial inaccuracy and should only be considered when there is no alternative.¹¹ When a reliable gestational age is unavailable, a single estimated fetal weight cannot be reliably interpreted, but growth trajectories can still be calculated, by plotting measurements at regular time intervals and evaluating whether percentiles are being maintained.

SYMPHYSIS-FUNDAL HEIGHT MEASUREMENT

SFH is the distance between the upper border of the pubic symphysis and the top of the uterine fundus. Serial measurement of SFH at routine prenatal visits is a simple and inexpensive method of screening for abnormal fetal growth between 16 and 41 weeks of gestation. In order to reduce error, use of a non-elastic tape that is unmarked on one side is recommended. The following standardized technique should also be followed: pregnant women should have an empty bladder and adopt a semi-recumbent position. Measurement starts from the uterine fundus, and the tape is placed along the longitudinal axis of the uterus, with the unmarked side facing upwards. The side of one hand is placed on the upper border of the pubic symphysis and the tape is turned around it to reveal the SFH measurement. Whenever possible, measurements should be performed by the same healthcare provider, to decrease interobserver variation in the technique.

Traditionally, simple rules for determining the adequate evolution of SFH measurements were developed. One of them established that, after 20 weeks of pregnancy, weekly increments of 1 cm were expected.¹² A fundal height in centimeters that is more than three centimeters below gestational age in weeks (e.g. a fundal height of 32 cm at 36 weeks of gestation) should be considered suspicious of abnormal fetal growth.¹³

In an attempt to provide a more precise approach, reference charts for SFH values were developed, similar to those for ultrasound fetal weight estimation. Individual measurements are plotted in a chart that is regularly updated during pregnancy, and growth trajectories are evaluated, determining whether similar centile curves are being followed. Gardosi *et al.* subsequently developed customized growth charts for SFH measurements, adjusting centiles to maternal height, weight, parity and ethnic group.¹⁴ The INTERGROWTH-21st project developed population-based standards for SFH measurements (Table 2), derived from eight multinational urban populations of healthy, well-nourished women, at low risk of adverse outcomes.¹⁵ A detailed description of the advantages and disadvantages of the customized versus the population-based approach to fetal growth evaluation can be found in the chapter on “Sonographic assessment of fetal growth”. In summary, both options can be used, but when using population-based curves the normal distribution of local population characteristics needs to be identified, and the cut-off values requiring referral for ultrasound may not necessarily coincide with the 10th and 90th centiles.

Table 2 Population-based standards for symphysis–fundal height (SFH) measurement, rounded to the nearest 0.5 cm. Adapted from INTERGROWTH-21st Project¹⁵

Gestational age (weeks)	Centiles of SFH (cm)						
	3rd	5th	10th	50th	90th	95th	97th
16 ⁺⁰	13.0	13.5	14.0	16.0	17.5	18.0	18.5
17 ⁺⁰	14.0	14.5	15.0	17.0	18.5	19.0	19.5
18 ⁺⁰	15.0	15.5	16.0	18.0	19.5	20.0	20.5
19 ⁺⁰	16.0	16.5	17.0	19.0	20.5	21.0	21.5
20 ⁺⁰	17.0	17.5	18.0	20.0	21.5	22.0	22.5
21 ⁺⁰	18.0	18.0	19.0	21.0	22.5	23.5	23.5

22 ⁺⁰	19.0	19.0	20.0	22.0	24.0	24.5	24.5
	Centiles of SFH (cm)						
23 ⁺⁰ Gestational age (weeks)	20.0 3rd	20.0 5th	20.5 10th	23.0 50th	25.0 90th	25.5 95th	25.5 97th
24 ⁺⁰	20.5	21.0	21.5	24.0	26.0	26.5	27.0
25 ⁺⁰	21.5	22.0	22.5	24.5	27.0	27.5	28.0
26 ⁺⁰	22.5	23.0	23.5	25.5	28.0	28.5	29.0
27 ⁺⁰	23.5	24.0	24.5	26.5	29.0	29.5	30.0
28 ⁺⁰	24.5	25.0	25.5	27.5	30.0	30.5	31.0
29 ⁺⁰	25.5	26.0	26.5	28.5	31.0	31.5	32.0
30 ⁺⁰	26.5	26.5	27.5	29.5	32.0	32.5	33.0
31 ⁺⁰	27.0	27.5	28.0	30.5	33.0	33.5	34.0
32 ⁺⁰	28.0	28.5	29.0	31.5	34.0	34.5	35.0
33 ⁺⁰	29.0	29.5	30.0	32.5	34.5	35.5	36.0
34 ⁺⁰	29.5	30.0	31.0	33.0	35.5	36.5	36.5
35 ⁺⁰	30.5	31.0	31.5	34.0	36.5	37.0	37.5
36 ⁺⁰	31.5	31.5	32.5	35.0	37.5	38.0	38.5
37 ⁺⁰	32.0	32.5	33.0	35.5	38.0	39.0	39.5
38 ⁺⁰	33.0	33.0	34.0	36.5	39.0	39.5	40.0
39 ⁺⁰	33.5	34.0	34.5	37.0	40.0	40.5	41.0
40 ⁺⁰	34.0	34.5	35.5	38.0	40.5	41.5	42.0

The criteria for referral must be developed and disseminated in each center, including those for a single SFH measurement that falls outside predetermined cut-off values, and for consecutive measurements that suggest static or slow fetal growth (crossing centiles).

EVIDENCE ON THE VALUE OF SYMPHYSIS–FUNDAL HEIGHT MEASUREMENT

Mongelli *et al.* investigated the association between specific maternal and pregnancy characteristics and SFH measurements at term, in an obstetric population dated by ultrasound. Maternal weight and parity had a small but statistically significant effect on measured SFH.¹⁶

In a large prospective observational study, serial plotting of SFH on customized charts was compared with routine assessment by palpation.¹⁴ The first method resulted in a significantly higher antenatal detection of SGA (48% vs. 29%) and large-for-gestational-age fetuses (46% vs. 24%). It did not change the overall number of scans per pregnancy, but resulted in fewer referrals (OR 0.7, 95% CI 0.5–0.9) and fewer hospital admissions (OR 0.6, 95% CI 0.4–0.7). The study was not powered to evaluate an effect on perinatal mortality.

Observational studies have reported that the sensitivity of SFH measurements in detection of SGA fetuses (birth weight <10th centile) ranges from 0.27 to 0.76, and the specificity from 0.79 to 0.92.^{4,16,17,18,19,20} These wide variations are likely to be due to different measuring methodologies, and to different criteria for defining abnormality. The method has also been shown to have a low sensitivity and a high specificity in the diagnosis of macrosomia, particularly when the latter is

defined as birth weight above 4500 g.¹⁷ To our knowledge, there are no studies comparing customized versus population-based standards in the accuracy of abnormal growth identification.

A single randomized controlled trial evaluating SFH measurements was conducted in Denmark in the late 1980s. It involved 1639 women enrolled at about 14 weeks of gestation. SFH measurements starting at 28 weeks of pregnancy were compared with abdominal palpation.²¹ Most women had at least three assessments, with measurements plotted on a chart. No difference between the two groups was found in antenatal detection of SGA neonates, additional diagnostic procedures, interventions, or perinatal mortality. The most recent Cochrane review on the subject includes only this single study, and concludes that there is insufficient evidence to determine whether SFH measurements are effective in detection of fetal growth restriction, and therefore does not recommend changes to existing practices.²²

Recommendations by international scientific societies

The National Institute of Clinical Excellence (NICE) recommends routine SFH measurements at each antenatal appointment from 24 weeks onwards, and suggests that further research is needed on the use of customized charts.²¹ The Royal College of Obstetricians and Gynaecologists recommends serial SFH measurements on customized charts from 24 weeks onwards, with referral for ultrasound if values fall below the 10th centile, or if there is slow or static growth.²³ The American College of Obstetricians and Gynecologists recommends serial SFH measurements at every antenatal visit, and referral for ultrasound if there is a discrepancy with gestational age that is greater than 3 cm.²⁴ The 2016 WHO guidelines on antenatal care state that replacing abdominal palpation with SFH measurement is not recommended to improve perinatal outcomes.²⁵ The authors point out that this is mainly due to the absence of evidence, rather than to evidence that SFH it is not beneficial. Following on from the conclusions of the Cochrane review, changing the usual practice (abdominal palpation or SFH measurement) is not recommended by WHO.

CONCLUSION

There is no consensus on the routine use of SFH measurements in high- and low-risk pregnancies, but the majority of medical scientific societies recommend it.²⁴ There is a need for further research and for a worldwide consensus on the definition of what constitutes an abnormal result and what should be the recommended management, including settings where obstetric ultrasound is unavailable.

PRACTICE RECOMMENDATIONS

Based on the existing evidence, the following practice recommendations should be considered:

- **Risk factors for abnormal fetal growth (Table 1) should be evaluated during the first and subsequent antenatal visits.**
- **Accurate gestational age estimation is essential for adequate interpretation of fetal growth.**
- **Pregnancies with risk factors for SGA or macrosomia, and those where symphysis-fundal height (SFH) measurement is difficult, probably benefit from an increased number of ultrasound scans.**
- **SFH measurements should be carried at each antenatal visit from 16 weeks onwards, according to a standardized methodology, if possible, by the same healthcare provider.**
- **Serial measurements should be plotted on reference charts, which may be customized or population-based. When the latter are used, the normal distribution of local population characteristics needs to be identified and healthcare providers must be aware that cut-off values requiring referral for ultrasound may not necessarily coincide with the 10th and 90th centiles.**
- **Criteria for ultrasound referral need to be developed and disseminated in each center, including those for a single SFH measurement that falls outside predetermined cut-off values, and for consecutive measurements that suggest static or slow fetal growth.**

CONFLICTS OF INTEREST

The authors of this chapter declare that they have no interests that conflict with the contents of the chapter.

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