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Poor effectiveness of antenatal detection of fetal growth restriction and consequences for obstetric management and neonatal outcomes: a French national study

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Objective To assess the proportion of small for gestational age (SGA) and normal birthweight infants suspected of fetal growth restriction (FGR) during pregnancy, and to investigate obstetric and neonatal outcomes by suspicion of FGR and SGA status at birth.

Design Population-based study.

Setting All French maternity units in 2010.

Population Representative sample of singleton births (n = 14 100).

Methods We compared SGA infants with a birthweight of less than the 10th percentile suspected of FGR, defined as mention of FGR in medical charts (true positives), non-SGA infants suspected of FGR (false positives), SGA infants without suspicion of FGR (false negatives) and non-SGA infants without suspicion of FGR (true negatives). Multivariable analyses were adjusted for maternal and neonatal characteristics hypothesised to affect closer surveillance for FGR and our outcomes.

Main outcome measures Obstetric management (caesarean, provider-initiated preterm and early term delivery) and neonatal outcomes (late fetal death, preterm birth, Apgar score, resuscitation at birth).

Results 21.7% of SGA infants (n = 265) and 2.1% of non-SGA infants (n = 271) were suspected of FGR during pregnancy. Compared with true negatives, provider-initiated preterm deliveries were higher for true and false positives (adjusted risk ratio [aRR], 6.1 [95% CI, 3.8–9.8] and 4.6 [95% CI, 3.2–6.7]), but not for false negatives (aRR, 1.1 [95% CI, 0.6–1.9]). Neonatal outcomes were not better for SGA infants if FGR was suspected.

Conclusion Antenatal suspicion of FGR among SGA infants was low and one-half of infants suspected of FGR were not SGA. The increased risk of provider-initiated delivery observed in non-SGA infants suspected of FGR raises concerns about the iatrogenic consequences of screening.

Keywords Antenatal detection, fetal growth restriction, obstetric management, small for gestational age.

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Introduction

Fetal growth restriction (FGR) is a failure of the fetus to reach its full growth potential and is associated with maternal, placental and fetal conditions, including hypertension, other placental deficiencies and congenital anomalies.[1] It increases the risks of stillbirth, birth hypoxia, neonatal death and neuro-developmental impairment.[2–7] Few interventions exist to prevent FGR,[1,8] but the surveillance of growth-restricted fetuses makes it possible to induce delivery in order to avoid severe fetal compromise or death. Antenatal monitoring includes umbilical artery Doppler velocimetry, allowing for a 30% reduction in perinatal mortality in high-risk pregnancies.[9,10]

Screening for FGR is thus a central component of prenatal care, as affirmed by recent professional guidelines from Canada, France, New Zealand, the UK and the USA.[1,8,11–13] Population screening relies on risk factor assessment, fundal height measurement and ultrasound to identify small for gestational age (SGA) fetuses, mostly defined as those with an estimated fetal weight less than the 10th percentile for gestational age.[8,11,12] Fetal growth is then monitored using ultrasound to differentiate between constitutionally small, but normal, fetuses and those with restricted growth. These recommendations justify the focus on the 10th percentile, because this threshold is associated with increased morbidity and mortality.[7,14] In France, Belgium and Germany, a third trimester ultrasound for monitoring fetal growth is integrated into standard prenatal care, whereas, in the USA, UK, New Zealand and Canada, a third trimester ultrasound is recommended only for women with risk factors for FGR.[15] Many recommendations and studies also acknowledge that FGR can be present in the absence of SGA,[12,16,17] but these cases are not a principal focus of population screening.[11,12]

Few studies have evaluated the effectiveness of screening for FGR in the general population. Existing studies have found that only between 10% and 36% of infants with a birthweight under the 10th percentile are detected during pregnancy.[18–22] However, many studies reflect practices in single centres only[18,22,23] and several are over 10 years old.[18,20] Of more concern, however, is the fact that these studies do not include normal birthweight infants. To assess screening practices, data are also needed on normal birthweight infants suspected of FGR during pregnancy, and their obstetric and neonatal outcomes.

Our aim was to estimate the proportion of infants who were suspected of FGR among SGA (true positives) and non-SGA (false positives) infants, and to investigate the effects of suspicion on obstetric and neonatal outcomes in a representative national sample of births in France.

Materials and methods

Study design and population

Data were obtained from a nationally representative sample of births from the 2010 French National Perinatal Survey, which aims to monitor key indicators of perinatal health and care in France.[24] All live births and stillbirths at or after 22 weeks of gestation with a birthweight of at least 500 g were included over a 1-week period in all maternity units in France. Women were interviewed by midwives after delivery about their sociodemographic characteristics, prenatal care and health behaviours. Data on obstetric care and medical conditions were abstracted from medical records, which included antenatal and delivery notes available in the maternity unit in which the delivery took place.

The total sample comprised 15 418 infants. In our study, births outside of continental France (n = 515), medical terminations of pregnancy (n = 53) and multiple pregnancies (n = 443) were excluded. Cases with missing data on gestational age, birthweight and fetal sex (n = 304) were also excluded. The final study population consisted of 14 100 infants.

Variables

Suspicion of FGR was determined by whether there was mention of suspected growth restriction during pregnancy in the medical records. According to French recommendations, prenatal care should include a minimum of seven prenatal visits and three ultrasounds for a term birth.[25,26] An ultrasound is recommended for each trimester of pregnancy and the third trimester ultrasound is performed between 30 and 35 weeks of gestation. Its main objective is to detect abnormalities of fetal growth and congenital anomalies which cannot be diagnosed earlier. Quality standards have been developed by the French College of Fetal Ultrasound.[27] According to French guidelines,[12] suspicion of FGR should be based on an estimated fetal weight or other biometric measurement under the 10th percentile for gestational age, and additional ultrasounds should be performed every 3 weeks with Doppler measurements. In our study, information was noted on whether the medical team suspected FGR, but further details were not available on ultrasounds or Doppler velocimetry.

Small for gestational age was defined as a birthweight below the 10th percentile for gestational age and sex using French reference standards.[28] We defined severe SGA as a birthweight under the third percentile. Customised standards are not used in France.[12]

Obstetric management was assessed by investigating pre-labour caesareans, caesareans after onset of labour and provider-initiated deliveries. Provider-initiated delivery was defined as the induction of labour or a caesarean section before the onset of labour.[29] We distinguished between provider-initiated deliveries before 37 weeks and before 39 weeks of gestation. Information was also available on indications for the induction of labour and pre-labour caesarean. These were presented separately and grouped into seven classes: prolonged or postdate pregnancy, defined as a birth after 41 weeks of gestation; premature rupture of membranes, defined as a rupture 12 hours or more before the onset of labour; fetal indications (including suspicion of FGR, stillbirth, amniotic liquid abnormalities, abnormal fetal heart rate and suspicion of macrosomia); placental abnormalities; breech presentation; maternal causes; and no medical indication.

Neonatal outcomes included fetal death at or after 28 weeks of gestation, preterm birth (before 37 weeks of gestation), the Apgar score, resuscitation, defined as oxygen

administration or intubation in the delivery room, and admission to a neonatal special care or intensive care unit.

Covariates were maternal, pregnancy and neonatal factors hypothesised to affect closer surveillance for FGR and outcomes. Maternal characteristics included medical and obstetrical risk factors, maternal age, parity, body mass index, poor education, smoking in the third trimester of pregnancy and adequacy of prenatal care. Inadequate care was defined as late initiation of care and/or fewer than the number of recommended prenatal visits and/or ultrasounds for gestational age.

To take into consideration medical risk factors and complications of the current pregnancy, we grouped women on the basis of French National Health Board recommendations specifying conditions requiring care by an obstetrician as opposed to a midwife or primary care physician.[25,26] A first group was composed of women with medical and obstetric risk factors specified in these recommendations that are known to impact on fetal growth (previous hypertension, stillbirth or SGA infant, chronic hypertension and, for the current pregnancy, gestational hypertension, pre-eclampsia and congenital anomalies). A second group included women with all other medical and obstetric risk factors (previous pregnancy complications unrelated to FGR, diseases requiring regular visits to a doctor, other complications of the current pregnancy). A third group was defined as all other pregnancies and was considered to be low risk.

Neonatal characteristics were infant gender, gestational age and birthweight. Birthweight was analysed in birthweight percentile classes (less than third, third to ninth, 10–25, >25th) and also as a continuous variable using the birthweight ratio (birthweight/mean birthweight by gestational age and sex).[30,31]

Analysis strategy

The study population was divided into four groups on the basis of SGA status at birth and antenatal suspicion of FGR: (i) SGA infants suspected of having FGR (true positives); (ii) SGA infants without a suspicion of FGR (false negatives); (iii) non-SGA infants suspected of FGR (false positives); and (iv) non-SGA infants without a suspicion of FGR (true negatives). The latter group was our reference group.

We described the maternal and neonatal characteristics of these four groups using chi-squared test or Fisher's exact test, as appropriate. We then derived adjusted risk ratios (aRRs) for obstetric management and neonatal outcomes for the four groups using Poisson regression.[32] All maternal and pregnancy characteristics, as well as infant sex and the birthweight ratio, were included in the model. We included the birthweight ratio in our adjusted models in order to assess whether obstetric and neonatal outcomes differed as a result of the suspicion of FGR, independent of the size of the fetus. Gestational age was included in descriptive tables, but not in analytical models, because gestational age at birth can be a consequence of the antenatal suspicion of FGR. Given the small number of late fetal deaths, we did not perform multivariable analyses for stillbirths. To take into account the delay between fetal death and delivery, we subtracted 2 days from the duration of pregnancy to calculate birthweight percentiles for fetal deaths, as performed in other studies.[33]

Analyses were performed for the entire sample of women and for women with low-risk pregnancies only. The analysis of low-risk women was performed because systematic screening in the third trimester is intended to detect FGR in pregnancies without medical and clinical risk factors, and also in order to study obstetric management and neonatal outcomes in pregnant women who do not normally require provider-initiated delivery. Analyses were also carried out for infants with birthweights under the third percentile by whether FGR was suspected during pregnancy in order to confirm our results in infants with severe SGA. The analyses were performed using STATA 11.0 software (StataCorp LP, College Station, TX, USA).

Results

Among the 14 100 singleton liveborn and stillborn infants included in the study, 8.6% (n = 1219) were SGA and, of these, 21.7% (n = 265) were suspected of FGR during pregnancy (true positives), as shown in Figure 1. Two per cent of infants with a normal birthweight (n = 271) were also suspected of having FGR (false positives). Of all babies, 3.2% (n = 451) were severe SGA and 33.0% (n = 149) were suspected of FGR during pregnancy (data not shown).

The maternal and neonatal characteristics for each group are displayed in Table 1. Pregnant women with antenatal suspicion of FGR (true and false positives) were more likely to have risk factors for FGR, including a previous history of stillbirth/SGA infant and pre-eclampsia or other medical risk factors, be younger, have more ultrasounds, give birth to a girl and have a lower average length of gestation than the false and true negative groups. Women with SGA infants (true positives and false negatives) were more likely to be nulliparous, to smoke and to have inadequate prenatal care. In comparison with true negatives, all other groups had lower educational attainment. True positives had the lowest birthweight (2195 g) of all groups; false negatives and false positives had similar absolute birthweights, but different birthweight ratios, reflecting the earlier gestational age of the false positive group. These findings were similar for low-risk pregnancies (Table S1).

Table 2 presents the rates of obstetric and neonatal outcomes and rate ratios adjusted for medical risk factors,

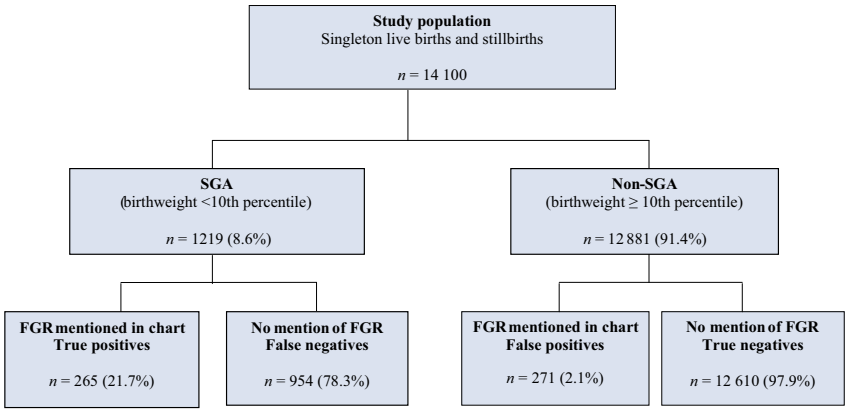

Figure 1. Description of the study population by small for gestational age (SGA) status at birth and antenatal suspicion of fetal growth restriction (FGR) during pregnancy.

maternal characteristics, prenatal care, fetal sex and the birthweight ratio (unadjusted rate ratios are provided in Tables S2 and S3). Rates of caesarean section, pre-labour caesarean and provider-initiated delivery were highest for true and false positives. Provider-initiated preterm delivery rates were 21.1% and 22.2% for true and false positives, respectively, compared with <3% in the other two groups. After adjustment, suspicion of FGR was associated with a higher risk of provider-initiated preterm delivery for true positives and false positives, but not for false negatives, in comparison with true negatives. In contrast, caesarean section after onset of labour was more frequent for SGA infants regardless of antenatal suspicion of growth restriction. True and false positives had a higher risk of preterm birth and resuscitation than true negatives. In comparison with true negatives, all other groups had a higher risk of admission to a neonatal unit; low Apgar scores were also higher in these groups, but confidence intervals for aRR included unity. Rates of stillbirth were similar in true positive and false negative groups (0.8%) and highest for false positives (1.5%).

For low-risk pregnancies, the risks of provider-initiated preterm and early term deliveries were also significantly higher for true and false positives, but not for false negatives, as shown in Table 3. Only SGA infants (true positives and false negatives) were at significantly higher risk of admission to a neonatal unit. Infants suspected of FGR had higher overall preterm delivery rates. The four late stillbirths among low-risk women with an SGA infant occurred to women in the false negative group; however, these differences were not significant.

We found similar results when analyses were performed in the subsample of infants with severe SGA. Suspicion of FGR was associated with the presence of more medical risk factors and ultrasounds during pregnancy. Provider-initiated preterm deliveries were increased (20.1% versus 6.0%), as was the need for resuscitation and admission to a neonatal unit (5.7% versus 1.8% and 45.8% versus 16.9%, respectively). Rates of late fetal death (1.4 versus 1.0 per 1000) and low Apgar scores (4.2% versus 4.4%) were similar. Full data are presented in Tables S4 and S5.

Table 4 presents indications for induction of labour and pre-labour caesarean section. Inductions and pre-labour caesareans for fetal indications were higher for true and false positives. For instance, 12.4% of true positives and 9.6% of false positives had prelabour caesareans for fetal indications versus 1.4% of false negatives and 0.7% of true negatives.

Discussion

Main findings

Our study found that the suspicion of FGR during pregnancy among infants with a birthweight less than the 10th percentile was low in France, despite a policy of routine third trimester ultrasound to monitor fetal growth. Furthermore, one-half of infants with an antenatal suspicion of FGR had birthweights above the 10th percentile, comprising 2.1% infants with a normal birthweight. There were more provider-initiated deliveries before 37 and 39 weeks of gestation associated with an antenatal suspicion of FGR, regardless of whether birthweight was actually below the 10th percentile. Neonatal outcomes were not better for SGA infants with suspected growth restriction. Results were similar in the subpopulation of women with low-risk pregnancies and for severely SGA infants.

Strengths and limitations

The strengths of our study are that it was population based and representative of all French births. Previous studies of antenatal detection of FGR came from selected hospitals or covered a limited geographical zone.[18,21,34,35] Further, these

Table 1. Maternal and neonatal characteristics by suspicion and small for gestational age (SGA) status

	SGA		Non-SGA		*P*
	True positives % or mean (SD)	False negatives % or mean (SD)	False positives % or mean (SD)	True negatives % or mean (SD)	
Total (*n*)	265	954	271	12 610	
Maternal characteristics					
Maternal age (years)	28.8 (5.6)	29.3 (5.6)	28.3 (5.3)	29.7 (5.3)	<0.001
Nulliparous	54.4	56.5	44.4	42.1	<0.001
Medical/obstetric factors*					
Risk factors for FGR	35.7	13.8	27.5	10.7	<0.001
Other risk factors	12.1	8.8	27.9	13.0	
No risk factor (low risk)	52.2	77.4	44.6	76.3	
History of stillbirth	5.1	1.3	2.7	1.9	0.001
History of an SGA infant	12.9	4.6	11.6	2.6	<0.001
Pre-eclampsia	8.0	2.6	10.0	1.8	<0.001
Body mass index (kg/m²)	22.2 (4.5)	22.4 (4.3)	22.4 (4.7)	23.5 (4.8)	<0.001
Less than high school education	58.9	53.1	56.5	47.3	<0.001
Smoke in third trimester	33.6	32.6	23.6	15.4	<0.001
Number of ultrasounds	6.4 (3.4)	4.9 (2.4)	6.8 (3.4)	4.9 (2.4)	<0.001
Inadequate prenatal care	16.5	16.1	15.3	12.8	0.008
Neonatal characteristics					
Male sex	42.3	52.1	41.0	53.0	<0.001
Gestational age at birth (weeks)	37.4 (3.3)	39.3 (2.3)	37.1 (3.2)	39.1 (1.7)	<0.001
Birthweight (g)	2195 (560.4)	2639 (376.7)	2635.0 (665.6)	3375.3 (462.9)	<0.001
Birthweight percentile					
<3rd	56.2	31.7	–	–	
3rd–9th	43.8	68.3	–	–	
10–25th	–	–	47.6	13.8	
>25th	–	–	52.4	86.2	
Birthweight ratio	0.7 (0.08)	0.8 (0.05)	0.9 (0.09)	1.0 (0.1)	<0.001

SD, standard deviation.

*Pregnancies with risk factors for fetal growth restriction (FGR) were those with medical and obstetric risk factors known to impact on fetal growth (previous hypertension, stillbirth or SGA infant and, for the current pregnancy, gestational hypertension, pre-eclampsia and congenital anomalies). Pregnancies with other risk factors were those with all other medical and obstetric risk factors (diseases requiring regular visits to a doctor, complications of the current pregnancy). Low-risk pregnancies were all other pregnancies.

studies only included SGA infants.[19,20,22,23,34] Our study made it possible to quantify the proportions of non-SGA infants suspected of FGR during pregnancy and to investigate their obstetric management and neonatal outcomes. Additional strengths are the high-quality data on pregnancy complications, allowing us to carry out analyses on low-risk pregnancies, and the low proportions of missing data.

Our study has some limitations. Although medical charts were reviewed for the mention of suspected FGR, data were not collected on the ultrasounds, Doppler velocimetry or fundal height measurements which led the clinical team to note this information in the charts, or used to follow-up the fetuses suspected of FGR. However, this indicator, which has been used in other studies,[6,18,34] provides a synthetic measurement of the antenatal assessment of fetal growth and its translation into clinical practice. Unsuspected SGA infants had the same average number of ultrasounds as unsuspected non-SGA infants, indicating that this group did not receive additional monitoring. We cannot, however, exclude some misclassification of our exposure variable. For instance, some cases of FGR suspected by the clinical team at the time of delivery may not have been clearly recorded in obstetric records. However, even if 10% of all cases of suspected FGR were unrecorded in medical records, the rate would only increase from 21.7% to 23.9%, a result that is still highly consistent with our conclusion of low detection. Also, as the survey took place after delivery, investigators may not have noted information on suspicion of FGR for non-SGA infants, if they considered this information incongruent with actual outcome. This would have contributed to an underestimation of the proportion of false positives.

Table 2. Obstetric management and neonatal outcomes by suspicion and small for gestational age (SGA) status: entire sample

	SGA		Non-SGA		*P*
	True positives % aRR** [95% CI]	False negatives % aRR [95% CI]	False positives % aRR [95% CI]	True negatives % aRR [95% CI]	
Total (*n*)	265	954	271	12 610	
Obstetric management					
Caesarean section	36.3	22.2	35.3	19.1	<0.001
	2.5 [2.0–3.2]	1.6 [1.3–1.9]	2.0 [1.6–2.5]	Ref	
Pre-labour caesarean	23.8	9.4	28.4	10.0	<0.001
	3.1 [2.2–4.3]	1.4 [1.1–1.9]	2.9 [2.2–3.9]	Ref	
Caesarean after onset of labour	16.1	13.9	9.4	10.0	<0.001
	2.4 [1.6–3.6]	1.9 [1.5–2.4]	1.2 [0.7–1.9]	Ref	
Provider-initiated delivery <37 weeks	21.1	2.8	22.1	2.1	<0.001
	6.1 [3.8–9.8]	1.1 [0.6–1.9]	4.6 [3.2–6.7]	Ref	
Provider-initiated delivery <39 weeks	44.1	7.9	40.6	10.7	<0.001
	4.1 [3.2–5.4]	0.8 [0.6–1.2]	3.0 [2.4–3.8]	Ref	
Neonatal outcomes					
Late fetal death, *n* (%)***	2 (0.8)	7 (0.7)	4 (1.5)	20 (0.2)	<0.001*
Preterm birth (<37 weeks)	23.4	3.9	28.9	5.0	<0.001
	4.7 [3.2–6.8]	0.9 [0.6–1.5]	3.2 [2.4–4.3]	Ref	
Apgar score <7 at 5 minutes	3.1	2.0	2.3	0.8	<0.001*
	2.1 [0.6–7.9]	1.8 [0.7–4.3]	2.2 [0.8–6.3]	Ref	
Resuscitation	6.4	1.6	7.9	1.2	<0.001
	3.0 [1.4–6.3]	1.0 [0.5–2.1]	3.8 [2.1–6.8]	Ref	
Admission to a neonatal unit	40.5	10.1	26.7	6.7	<0.001
	5.6 [4.2–7.6]	1.7 [1.3–2.2]	2.8 [2.1–3.8]	Ref	

CI, confidence interval.
*Fisher's exact test.
**Risk ratios were adjusted (aRR) for risk level, fetal sex, the birthweight ratio, maternal age, parity, body mass index, education, smoking in the third trimester and inadequate prenatal care.
***Late fetal death was defined as stillbirth at or after 28 weeks of gestation, expressed as *n* (%).

A more general limit is our inability to identify non-SGA infants who experienced growth faltering. SGA and FGR are not synonymous,[16,17] and our false positive group undoubtedly included some infants with restricted growth, but with a birthweight above the 10th percentile. However, we do not believe that these infants constitute a large proportion of our false positive group, because population screening in France does not focus on the identification of growth faltering in the absence of small fetal size.[12]

Interpretation

Our study adds to the existing literature because of the specificity of the French context in which ultrasound is recommended for all pregnant women in the third trimester and the prescription of additional ultrasounds is common.[24] The average number of ultrasounds per woman in 2010 was five.[24,25] Despite this high number, our study found that FGR was suspected in only 21.7% and 33.0% of cases in which the birthweight was below the 10th and third percentiles, respectively. This finding supports other research showing limited benefits of ultrasound in the third trimester in unselected populations.[36,37]

These results from the French context are concordant with previous studies which also documented low detection rates for SGA.[18–22,34] One reason may be that the effectiveness of ultrasound and symphysis–fundal height measurement for the detection of FGR is poor.[19,38] How the information from screening is used may also have an impact; one study showed that detection improved when screening results were plotted on an individualised curve over time.[39] This practice has been recommended in recent guidelines on SGA management in the UK and New Zealand.[1,8] We do not know how information from routine screening is used in French maternity units; a recent survey of policies of assessment and management of FGR in Australia and New Zealand has shown that they vary substantially between units.[40] These low detection rates appear to contrast with physician beliefs about the effectiveness of screening for intrauterine growth restriction (IUGR): a recent survey showed that 73% of members of the Central Association of Obstetricians and

Table 3. Obstetric management and neonatal outcomes by suspicion and small for gestational age (SGA) status: low-risk pregnancies

	SGA		Non-SGA		*P*
	True positives % aRR** [95% CI]	False negatives % aRR [95% CI]	False positives % aRR [95% CI]	True negatives % aRR [95% CI]	
Total (*n*)	133	694	117	9196	
Obstetric management					
Caesarean section	28.5	18.7	21.6	16.7	0.001
	2.6 [1.8–3.7]	1.6 [1.3–2.0]	1.7 [1.1–2.5]	Ref	
Pre-labour caesarean	12.0	6.6	14.5	8.3	0.012
	2.6 [1.5–4.5]	1.3 [0.9–1.8]	2.5 [1.5–4.2]	Ref	
Caesarean after onset of labour	18.4	12.8	8.1	9.0	<0.001
	2.9 [1.8–4.7]	1.9 [1.4–2.5]	1.0 [0.5–2.2]	Ref	
Provider-initiated delivery <37 weeks	6.8	1.0	4.3	0.5	<0.001*
	13.3 [4.4–40.1]	0.3 [0.1–2.6]	6.8 [2.0–22.8]	Ref	
Provider-initiated delivery <39 weeks	27.1	4.2	23.9	6.7	<0.001
	5.7 [3.7–8.7]	0.8 [0.5–1.2]	4.2 [2.8–6.4]	Ref	
Neonatal outcomes					
Late fetal death, *n* (%)***	0	4 (0.6)	0	12 (0.1)	0.095*
Preterm births (<37 weeks)	6.8	1.1	6.0	1.8	<0.001
	7.6 [3.4–17.3]	0.3 [0.1–1.4]	3.4 [1.4–8.5]	Ref	
Apgar score <7 at 5 minutes	1.5	1.3	0.9	0.6	0.029*
	1.4 [0.1–12.0]	1.3 [0.4–4.0]	2.1 [0.3–15.6]	Ref	
Resuscitation	1.6	1.0	3.5	0.6	0.005*
	2.2 [0.4–11.1]	1.1 [0.4–3.4]	4.9 [1.5–16.3]	Ref	
Admission to a neonatal unit	23.1	6.6	9.5	4.3	<0.001
	5.6 [3.5–9.0]	1.5 [1.0–2.2]	1.7 [0.8–3.6]	Ref	

CI, confidence interval.
*Fisher's exact test.
**Risk ratios were adjusted (aRR) for risk level, fetal sex, the birthweight ratio, maternal age, parity, body mass index, education, smoking in the third trimester and inadequate prenatal care.
***Late fetal death was defined as stillbirth at or after 28 weeks of gestation, expressed as *n* (%).

Gynaecologists (CAOG) thought that, in practice, 51–60% of isolated IUGR were detected antenatally.[41]

We found higher rates of provider-initiated preterm and early term deliveries for the true positive group, as found by other studies;[18,34] this result is expected as the initiation of birth if the fetal condition worsens may prevent the risk of hypoxia and major morbidities. However, we also found that rates of these interventions were of the same magnitude for false positives. Similar results were observed for our low-risk group of women without previous medical conditions or complications of the current pregnancy, suggesting that the increased risk of provider-initiated delivery was related to the antenatal suspicion of FGR. Our analysis of the indications for induction and pre-labour caesareans also support this interpretation. One previous study from the 1990s also documented higher rates of caesarean section among false positives in two tertiary centres.[42]

The benefits of antenatal suspicion of FGR on neonatal outcomes were not clear in our study. False negatives had a higher frequency of caesarean section after the onset of labour, suggesting that they may show more signs of non-reassuring fetal status during labour. However, in the overall sample, other health outcomes were not worse compared with the true positives, as has been shown in several other studies.[20,23,34] In contrast, four late fetal deaths were observed in the group of low-risk pregnant women with unsuspected SGA compared with none in suspected SGA infants, although this difference was not significant. This is consistent with other research showing that failure to detect FGR may be associated with higher rates of stillbirth.[23,35]

One-half of all infants suspected of FGR had a birthweight over the 10th percentile and had higher rates of caesarean delivery, resuscitation and admission to a neonatal unit than normal birthweight infants without suspicion of FGR. These findings raise the alarming possibility that screening for FGR has an iatrogenic impact with nontrivial health consequences for mothers and infants. Negative effects of false positives may also include maternal anxiety about the baby's health,[43] which we were unable to measure. A major conclusion of our study is therefore that

Table 4. Indications for induction of labour or pre-labour caesarean

	SGA		Non-SGA		*P*
	True positives *n* (%)	False negatives *n* (%)	False positives *n* (%)	True negatives *n* (%)	
Total (*n*)	265	954	271	12 610	
Induction of labour					
Prolonged or postdate pregnancy	13 (4.9)	56 (5.9)	10 (3.7)	793 (6.3)	0.256
Premature rupture of membranes	5 (1.9)	38 (4.0)	6 (2.2)	567 (4.5)	0.051
Fetal indications	68 (25.7)	47 (4.9)	36 (13.3)	313 (2.5)	<0.001
Maternal conditions or causes	17 (6.4)	38 (4.0)	17 (6.3)	635 (5.0)	0.247
No medical indication	1 (0.4)	12 (1.2)	6 (2.2)	379 (3.0)	<0.001*
Pre-labour caesarean					
Placental abnormalities	0	2 (0.2)	1 (0.4)	42 (0.3)	0.850*
Breech presentation	0	11 (1.1)	3 (1.1)	184 (1.5)	0.167*
Fetal indications	33 (12.4)	13 (1.4)	26 (9.6)	84 (0.7)	<0.001
Maternal conditions or causes	29 (10.9)	57 (6.0)	43 (15.9)	911 (7.2)	<0.001
No medical indication	0	5 (0.5)	2 (0.7)	29 (0.2)	0.093*

*Fisher's exact test.

non-SGA infants must be included in studies evaluating the health impact of screening for FGR. The inclusion of all infants in these evaluations would also make it possible to address the issue of growth faltering in the absence of SGA, a topic which has been neglected in previous studies and recommendations on the management of FGR.

Conclusion

Suspicion of FGR among SGA infants was low in France despite the systematic use of third trimester ultrasound, and one-half of infants with suspected FGR had a normal birthweight. Higher rates of obstetric interventions in infants suspected of FGR with normal birthweight raise questions about whether screening for FGR creates iatrogenic risks for the mother and infant. Further assessment of the health impact of current screening practices is needed for both SGA and non-SGA infants.

Disclosure of interests

The authors declare no conflicts of interest.

Contribution to authorship

IM and JZ analysed the data and drafted the manuscript. AE, BB, FG and MK participated in the interpretation of the results and made suggestions for revisions. BB contributed to the design of the study and of the National Perinatal Survey.

Details of ethics approval

The National Council on Statistical Information (Comité du Label) and the French Commission on Information Technology and Liberties (CNIL) approved this survey (registration number 909003).

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Maternal and neonatal characteristics by suspicion and SGA status in low-risk pregnancies.

Table S2. Obstetric management and neonatal outcomes by suspicion and SGA status, entire sample.

Table S3. Obstetric management and neonatal outcomes by suspicion and SGA status, low-risk pregnancies.

Table S4. Maternal and neonatal characteristics by suspicion status among severe SGA infants (birthweight <3rd percentile).

Table S5. Obstetric management and neonatal outcomes by suspicion status among severe SGA infants (birthweight <3rd percentile). ■

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