FETAL GROWTH RESTRICTION

Definition, Epidemiology, Screening and Risk factors

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Introduction

Introduction to Fetal Growth Restriction

~10%
of pregnancies affected by FGR

8x
increased stillbirth risk if undetected

75–80%
of SGA newborns not detected antenatally

Definition

FGR occurs when the fetal genetic growth potential is not achieved due to an abnormality of maternal, fetal, or placental factors.

Key Clinical Significance

- Major contributor to **perinatal morbidity and mortality**
- Associated with **neurodevelopmental delay** in childhood
- Increased adult risks for **cardiovascular disease, dyslipidemia, and diabetes**

Introduction to Fetal Growth Restriction

Why Detection Matters

- Enables initiation of formal **fetal surveillance**

- Allows **optimized timing of delivery** to reduce stillbirth risk, preeclampsia, placental abruption, preterm birth, fetal hypoxia, metabolic acidemia, hypoxic ischemic encephalopathy

Assessment of Fetal Growth

Gestational Age Verification

- Ideally based on **crown-rump length (CRL)** in the first trimester
- Fetal biometry (BPD, FL) before **22+0 weeks** is acceptable
- Accurate dating is essential for correct growth assessment
- Approach to discordant biometry markers
- Cephalic index and head circumference
- Sub optimally dated pregnancies
- Pregnancies conceived by ART

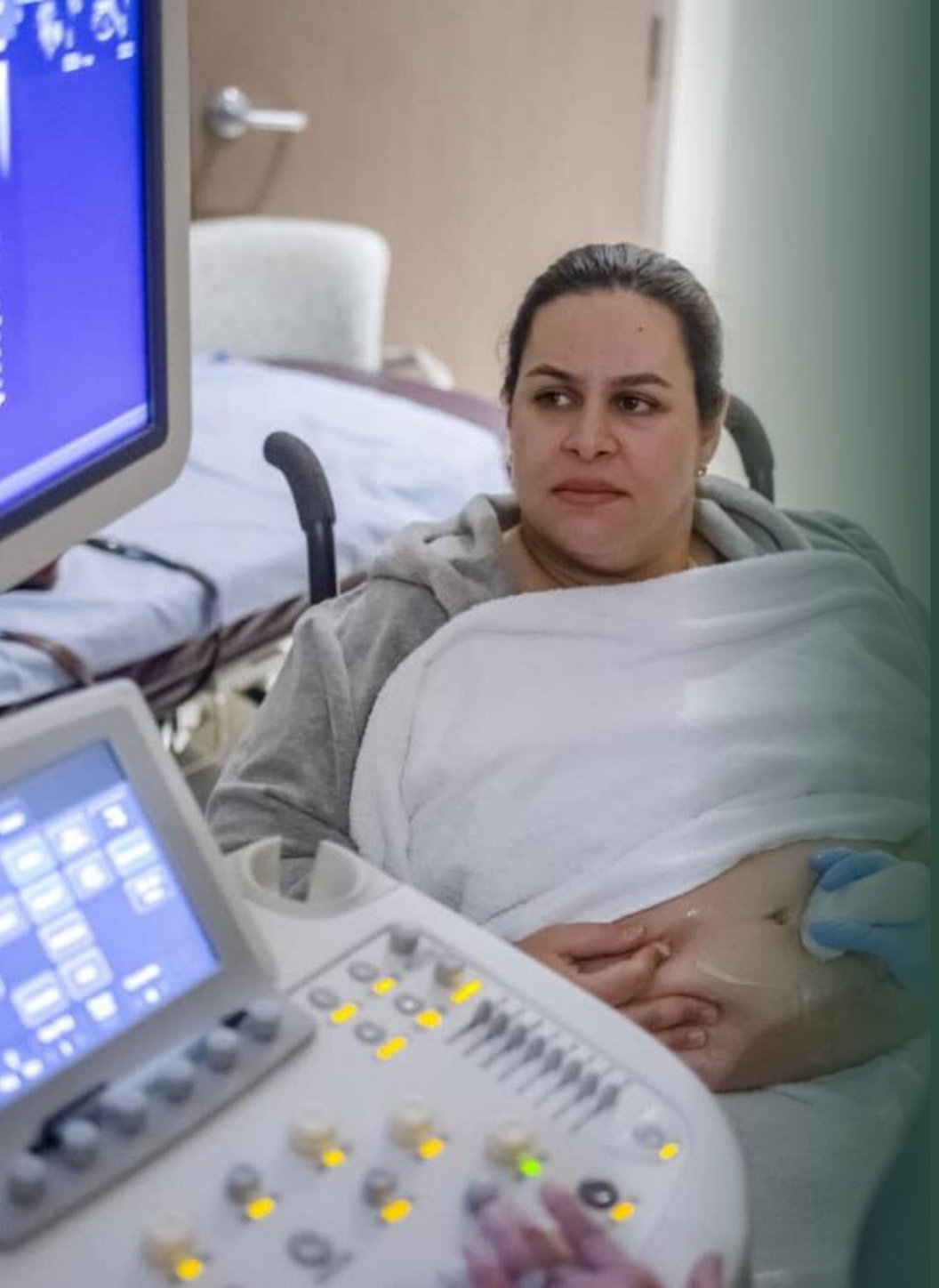
Clinical Consideration: Population-based standards (such as Hadlock in the United States) remain appropriate. Customized growth curves have shown conflicting data and are not universally recommended.

Assessment of Fetal Growth

Estimated Fetal Weight (EFW)

- Calculated using **Hadlock formula** incorporating BPD, HC, AC, FL
- Inherent error **>14%** at 95% CI vs. actual birth weight
- Both intraobserver and interobserver variability contribute to under- and overdiagnosis

Clinical Consideration: Population-based standards (such as Hadlock in the United States) remain appropriate. Customized growth curves have shown conflicting data and are not universally recommended.



Definitions

Classification criteria and diagnostic thresholds for FGR

Delphi Consensus Diagnostic Criteria

Early FGR (GA < 32 weeks) 30%

Either:

- AC/EFW **< 3rd centile**
- OR **UA-AEDF**

Or all three:

1. AC/EFW **< 10th centile with**
2. UtA-PI **> 95th centile**
3. UA-PI **> 95th centile**

Late FGR (GA ≥ 32 weeks) 70%

Either:

- AC/EFW **< 3rd centile**

Or at least 2 of 3:

1. AC/EFW **< 10th centile**
2. AC/EFW crossing centiles **> 2 quartiles**
3. **CPR < 5th centile** or UA-PI > 95th centile

Key Definitions: AC = abdominal circumference; EFW = estimated fetal weight; UA = umbilical artery; UtA = uterine artery; PI = pulsatility index; AEDF = absent end-diastolic flow; CPR = cerebroplacental ratio (MCA-PI / UA-PI)

Gordijn et al. Consensus definition of fetal growth restriction: a Delphi procedure. Ultrasound Obstet Gynecol 2016; 48: 333-339

Recommendation: The authors of this ISUOG guideline recommend the Delphi consensus criteria for definition of FGR. These criteria were validated and showed improved prediction of adverse neonatal outcome compared to EFW < 10th percentile alone.

SGA vs FGR: The Critical Distinction

Small-for-Gestational Age (SGA)

- EFW or AC **below 10th percentile** for GA
- Fetus may be **constitutionally normal**
- Not necessarily at increased risk
- May have normal Doppler findings

Fetal Growth Restriction (FGR)

- Fetus **failing to reach** growth potential
- **Increased risk** of adverse outcomes
- Can occur even **above 10th percentile**
- Needs biophysical parameters for diagnosis

Key Message: Fetal size alone is not sufficient to identify FGR. AC or EFW **below the 3rd percentile** can be used as an isolated criterion to define FGR at any gestational age. Additional tools (Doppler, growth velocity) are needed to distinguish SGA from FGR

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Risk Stratification by Percentile:

- Birth weight **below 10th percentile**: increased risk of stillbirth and perinatal mortality
- Birth weight **below 3rd percentile**: highest risk category
- Optimal birth weight for lowest perinatal mortality: **70th-90th percentiles**

Assessment of Fetal Growth

A drop in fetal growth velocity, i.e. drop in AC or EFW of >2quartiles or >50 percentiles (e.g. from 70th percentile to or below 20th percentile), should alert the physician to possible FGR

Doppler velocimetry of the uteroplacental and fetoplacental circulations may be used to distinguish between SGA and FGR

Clinical Consideration: Population-based standards (such as Hadlock in the United States) remain appropriate. Customized growth curves have shown conflicting data and are not universally recommended.

Diagnostic Tools for FGR Assessment

Fetal Growth Velocity

Drop in AC or EFW of **> 50 percentiles** or > 2 quartiles between scans should alert to possible FGR

Doppler Velocimetry

UA-PI, MCA-PI, ductus venosus, uterine artery. CPR < 5th centile or UA-PI > 95th centile are key criteria

Biophysical Profile (BPP)

Score **≤ 4** associated with fetal pH ≤ 7.20. Score < 2 has **100% sensitivity** for acidemia

Computerized CTG (cCTG)

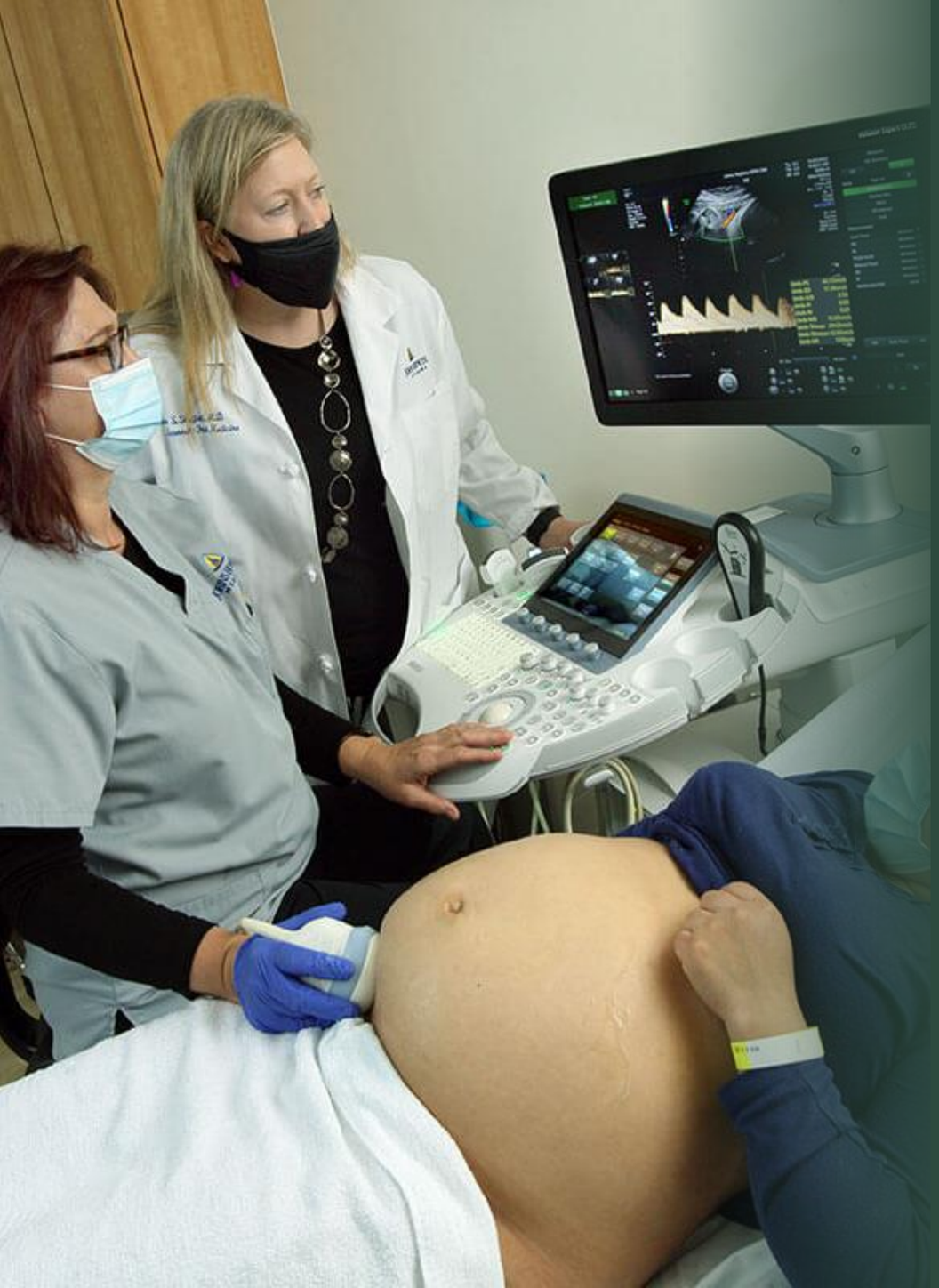
Short-term variation (STV) is the **only objective measure** of fetal heart rate. Reduced STV indicates hypoxemia

Biomarkers

sFlt-1/PlGF ratio may help differentiate SGA from FGR, but lacks interventional trial data for routine use

Recommendations (Grade A)

- Multimodal assessment is recommended for suspected FGR: **cCTG or BPP scoring** should be used in combination with **Doppler velocimetry**
- Doppler of uteroplacental and fetoplacental circulations may be used to distinguish between SGA and FGR



Risk Factors

Maternal, fetal, and placental contributors to growth restriction

Risk Factors for FGR

Placental Factors

Placental insufficiency — most common

Also: velamentous insertion, circumvallate placenta, single umbilical artery

Maternal Factors

Medical conditions:

- Chronic hypertension, kidney disease
- Diabetes, collagen vascular disease
- Antiphospholipid syndrome

Modifiable:

- Tobacco, cocaine, alcohol, opioids
- Certain anti-seizure and chemo meds

Fetal Factors

Genetic/Syndromic:

- Genetic abnormalities
- Congenital anomalies

Infections (5-10% of cases):

- Malaria, CMV, syphilis
- Rubella, varicella, toxoplasmosis

Note: Maternal, fetal, and placental factors are not necessarily independent. Maternal vascular disease can result in placental changes leading to placental insufficiency.

Prevention Considerations

- For individuals at increased risk for **preeclampsia**, low-dose aspirin prophylaxis should be started **prior to 16 weeks** of gestation
- The use of enoxaparin in addition to standard high-risk care does not reduce the risk of recurrence of preeclampsia and small-for-gestational-age infants in a subsequent pregnancy

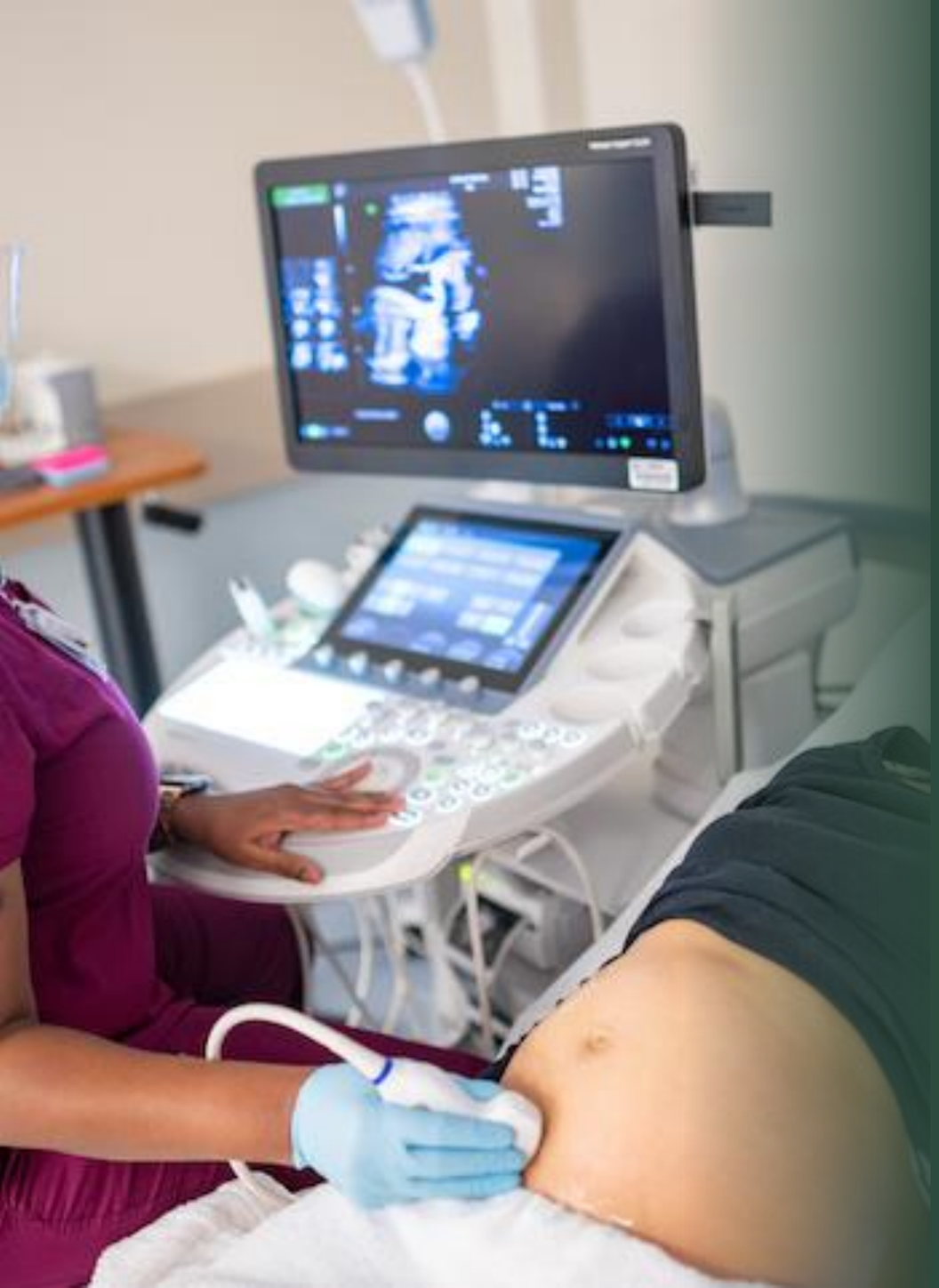
Table 1. Clinical Risk Assessment for Preeclampsia*

Risk Level	Risk Factors	Recommendation
High†	• History of preeclampsia, especially when accompanied by an adverse outcome • Multifetal gestation • Chronic hypertension • Type 1 or 2 diabetes • Renal disease • Autoimmune disease (systemic lupus erythematosus, antiphospholipid syndrome)	Recommend low-dose aspirin if the patient has one or more of these high-risk factors
Moderate‡	• Nulliparity • Obesity (body mass index greater than 30) • Family history of preeclampsia (mother or sister) • Sociodemographic characteristics (African American race, low socioeconomic status) • Age 35 years or older • Personal history factors (eg, low birthweight or small for gestational age, previous adverse pregnancy outcome, more than 10-year pregnancy interval)	Consider low-dose aspirin if the patient has more than one of these moderate-risk factors§
ow	• Previous uncomplicated full-term delivery	Do not recommend low-dose aspirin

ludes only risk factors that can be obtained from the patient's medical history. Clinical measures, such as uterine artery Doppler ultrasonography, are not included.

le risk factors that are consistently associated with the greatest risk of preeclampsia. The preeclampsia incidence rate would be approximately 8% or more in a pregnant en with one or more of these risk factors.

These risk factors are independently associated with



Screening Strategies

Approaches to antenatal detection of fetal growth restriction

Screening: Benefits, Harms & Evidence

Benefits

- Enables initiation of formal **fetal surveillance**
- Maintains pregnancy as long as **safely possible**
- Decreases risk for **adverse outcome or stillbirth**
- Allows optimized timing of delivery when indicated

Harms

- **Overdiagnosis** leading to parental anxiety
- Unnecessary, costly interventions
- Increased antenatal fetal testing
- **Iatrogenic preterm birth** from unnecessary induction

Evidence on Routine Ultrasound Screening

Outcome	Relative Risk	95% Confidence Interval
Perinatal mortality	1.01	0.67 – 1.54 (no significant reduction)
Preterm birth	0.96	0.85 – 1.08 (no significant reduction)
Induction of labor	0.93	0.81 – 1.07 (no significant reduction)
Cesarean birth	1.02	0.97 – 1.09 (not clearly harmful)

75–80% of SGA newborns may not be detected antenatally

Screening Approach & Methods

Screening strategies differ among countries Optimum strategy is unclear

Low-Risk Pregnancies

- **Fundal height measurements** beginning at 24 weeks
- Ultrasound if **>=4 cm lag** in fundal height or inadequate assessment
- Ultrasound assesses fetal size, EFW, amniotic fluid, and placenta

High-Risk Pregnancies

- **Growth scan from 28 weeks** to determine EFW and assess amniotic fluid
- Follow-up every **3–4 weeks** based on risk profile
- Avoid scans <=2 weeks apart due to measurement variability

Fundal Height Measurement

- Simple and inexpensive screening tool
- Use **unmarked side** of tape measure to reduce clinician bias
- Measure from upper border of pubic symphysis to top of uterus
- Sensitivity ranges from **17–86%**
- Serial measurements by same provider improves performance

Third-Trimester Screening Timing

- **Single screen:** Perform at **36 weeks** (better SGA detection than 32 weeks)
- **Two screens:** Time for **32 and 36 weeks**

Factors Affecting Fundal Height Accuracy

Obesity · Uterine fibroids · Bladder filling · Extremes of amniotic fluid volume (oligohydramnios and polyhydramnios)

Beyond 24 weeks, measurement in cm (+/- 3 cm) approximates gestational age in weeks

Supporting Characteristics & Special Populations

Supporting Diagnostic Features

<3rd Percentile Risk

Stillbirth risk **3x higher** than 3rd–5th percentile, **4–7x higher** than 5th–10th percentile. Even with normal Dopplers and term birth.

Oligohydramnios

Presumably from decreased fetal urination due to blood flow redistribution. Associated with adverse outcome when EFW <3rd percentile.

Abnormal Doppler Velocimetry

Abnormal uterine arteries and fetal vessels (umbilical, MCA, ductus venosus) suggest reduced perfusion of placental villous vasculature.

Special Populations

Uncertain Gestational Age

Serial ultrasounds **>=2 weeks apart** required. Include fetal biometry, amniotic fluid assessment, and umbilical artery Doppler.

Multiple Gestation

Growth curves similar to singletons until ~32 weeks, then growth velocity slows.

Dichorionic twins: Each fetus has independent FGR risk

Monochorionic twins: Higher risk from discordant placental sharing

Uterine Artery Doppler: Second-trimester abnormal uterine artery Doppler PI with notching predicted overall FGR with LR 9.1 (95% CI 5.0–16.7) and severe FGR with LR 14.6 (95% CI 7.8–26.3). However, a subsequent RCT in an unselected population failed to show benefit.

Summary & Recommendations

DIAGNOSIS

Diagnosis based on **EFW <10th percentile** or **AC <10th percentile** on population-based or customized growth curves. FGR highly likely with EFW or AC **<3rd percentile** regardless of gestational age. Between 3rd–10th percentile, abnormal Doppler and decreasing trajectory support placenta-based pathologic FGR.

Screening Approach

- **High-risk:** Periodic ultrasound examinations from 28 weeks
- **Low-risk:** Fundal height measurements from 24 weeks
- Ultrasound if **>=4 cm lag** or inadequate assessment
- Follow-up scans every **3–4 weeks** for high-risk

Benefits vs. Harms

- **Benefits:** Enables fetal surveillance, optimizes delivery timing, reduces stillbirth risk
- **Harms:** Overdiagnosis, parental anxiety, unnecessary interventions, iatrogenic preterm birth

Key Clinical Reminders

- The **<3rd percentile** threshold identifies fetuses at highest risk — even with normal Dopplers and term birth
- Doppler velocimetry (uterine, umbilical, MCA, ductus venosus) is essential for differentiating constitutional from pathologic growth restriction
- Both SMFM and ISUOG criteria have **limited ability** to predict adverse neonatal outcomes — clinical judgment remains essential

KEY TAKEAWAYS

Early Detection Saves Lives

Optimal screening combines :

- **risk-based assessment** with fundal height surveillance

The **<3rd percentile** threshold identifies fetuses at highest risk

Doppler velocimetry is essential for differentiating constitutional from pathologic growth restriction

Clinical judgment remains paramount — criteria alone have limited predictive value

Based on UpToDate — Fetal Growth Restriction: Screening and Diagnosis

Jena Miller, MD | Literature review current through: Jan 2026