

The INTERGROWTH-21st Fetal and Newborn Growth Standards

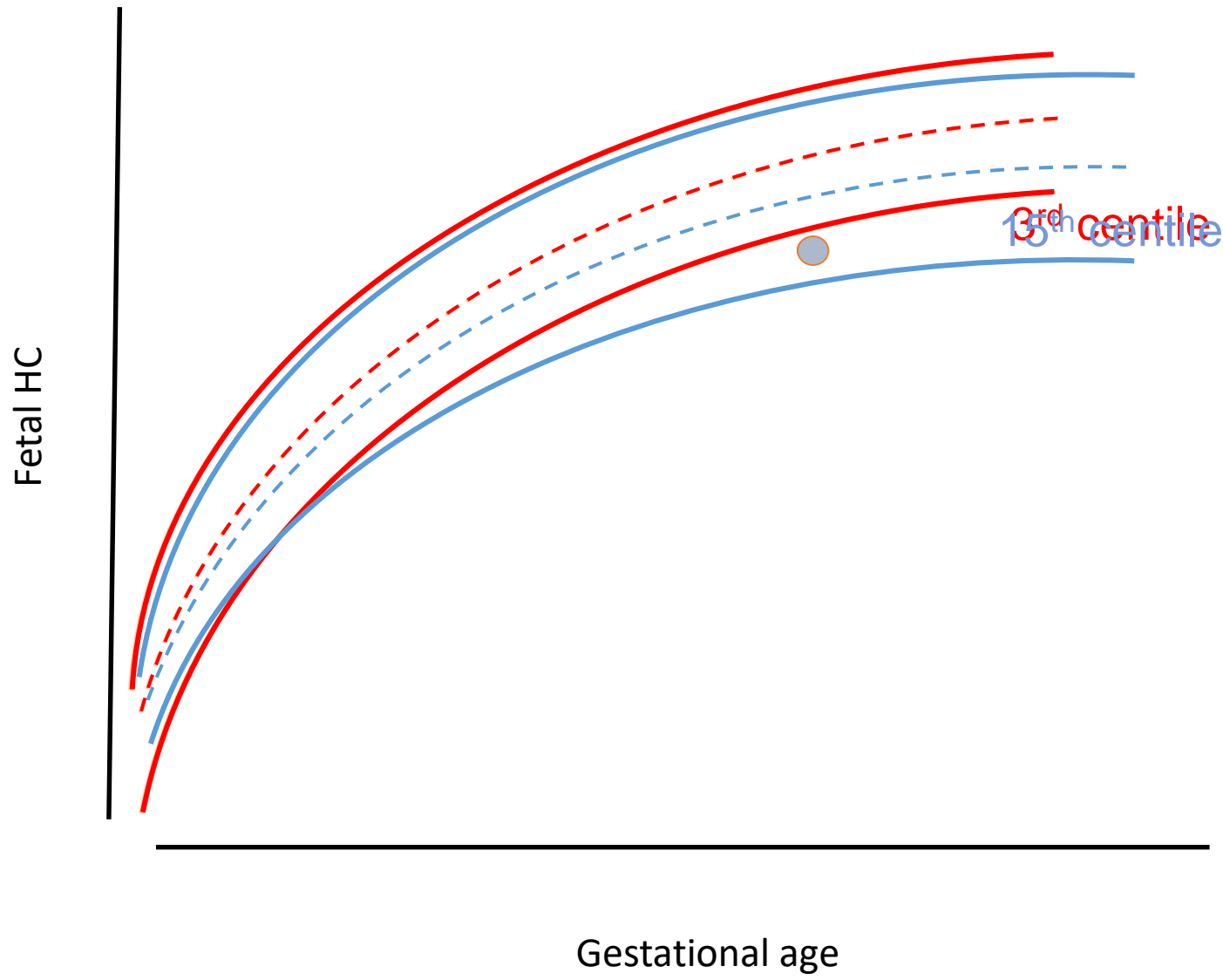
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MBBS MPH PhD FRANZCOG



Oxford Maternal & Perinatal
Health Institute
Green Templeton College





References v. Standards

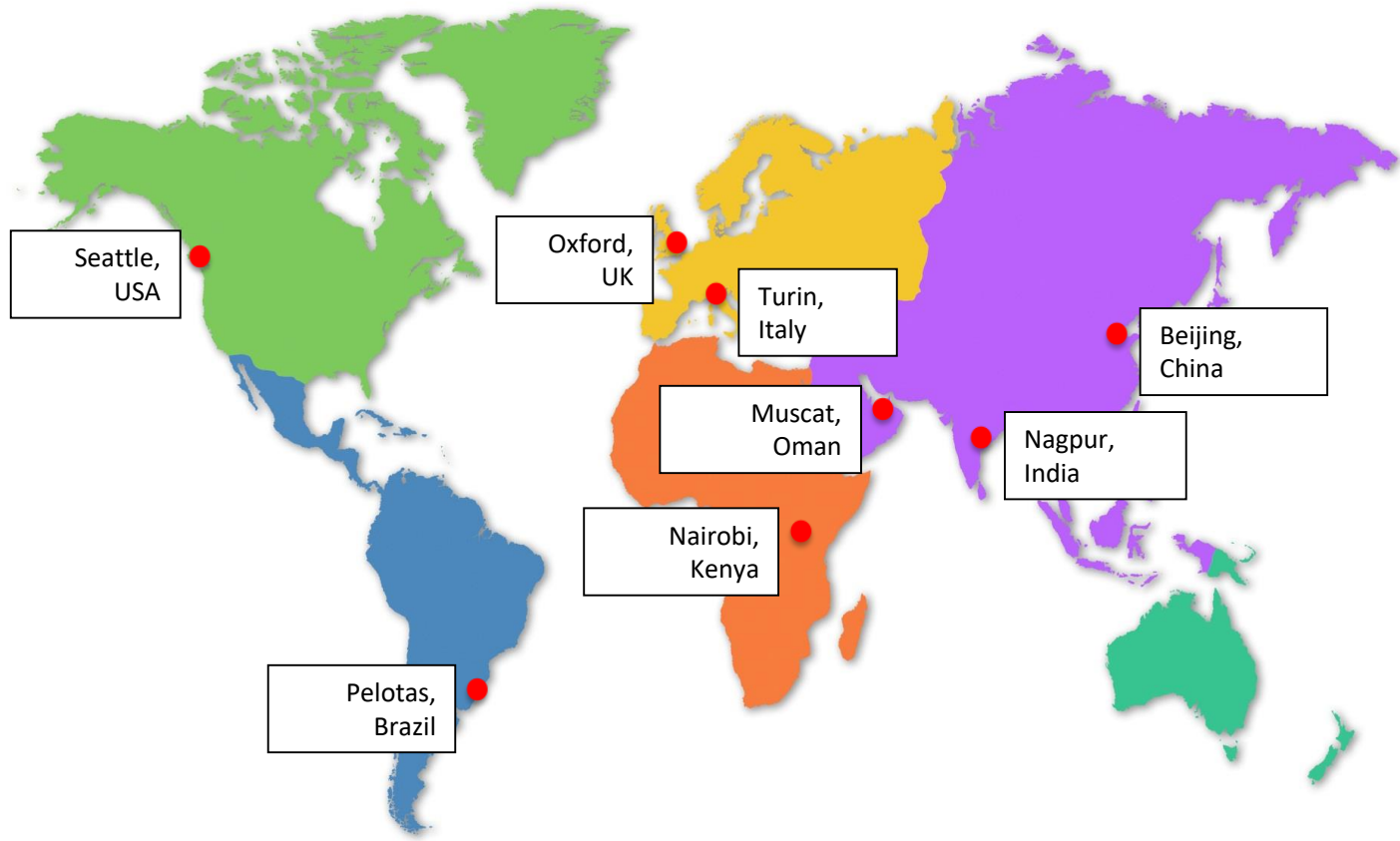
- **References** describe how fetuses, newborns and infants *have* grown at a particular time and/or place
- **Standards** describe how fetuses, newborns and infants *should* grow when nutritional, environmental and health constraints on growth are minimal
- The distribution of biometry within a population does **not** constitute a standard

How to create a standard?

Step 1: Selecting “healthy” environment criteria

AT POPULATION LEVEL

for selection of sites in Fetal Growth Longitudinal Study



INTERGROWTH-21st sites

**BILL & MELINDA
GATES foundation**

Step 2: Selecting healthy women

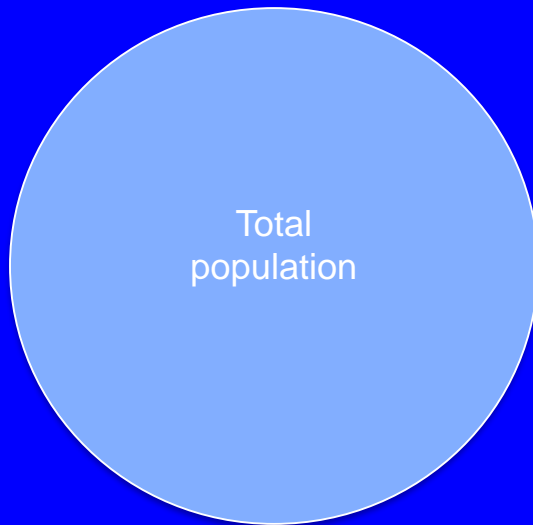
AT INDIVIDUAL LEVEL

INTERGROWTH-21st populations



All pregnancies in 8 sites

n = 59,137

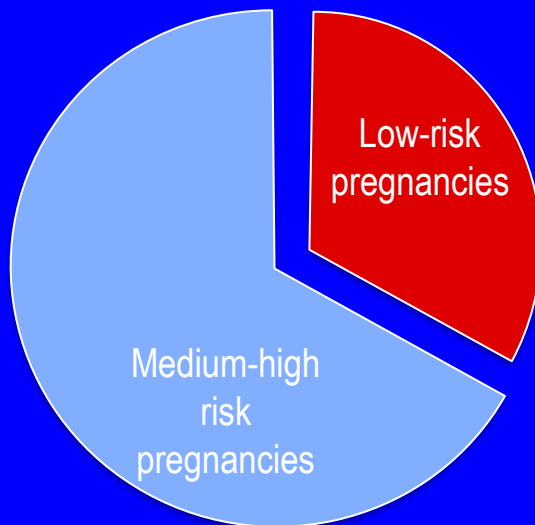


INTERGROWTH-21st populations



Low-risk pregnancies

n = 20,486



INTERGROWTH-21st populations

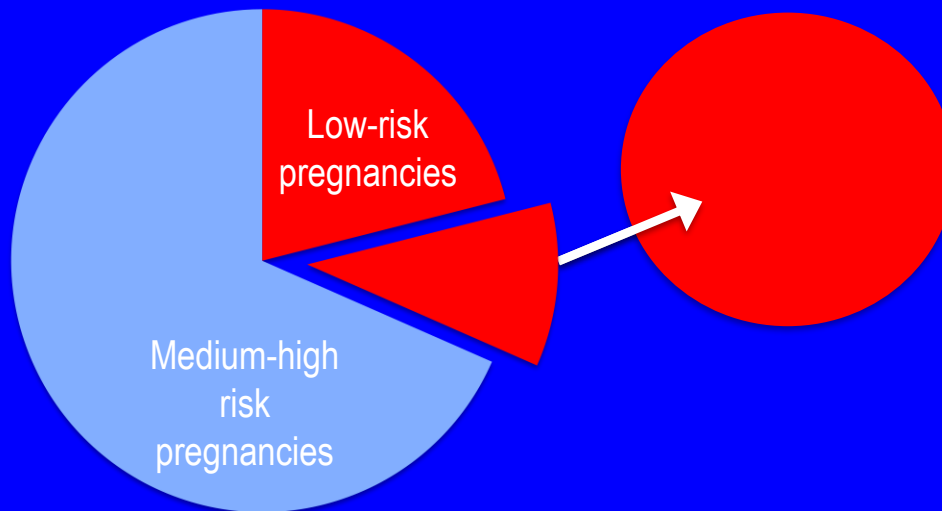


Low-risk pregnancies

n = 20,486

Fetal Growth Longitudinal Study

n = 4,607



INTERGROWTH-21st populations

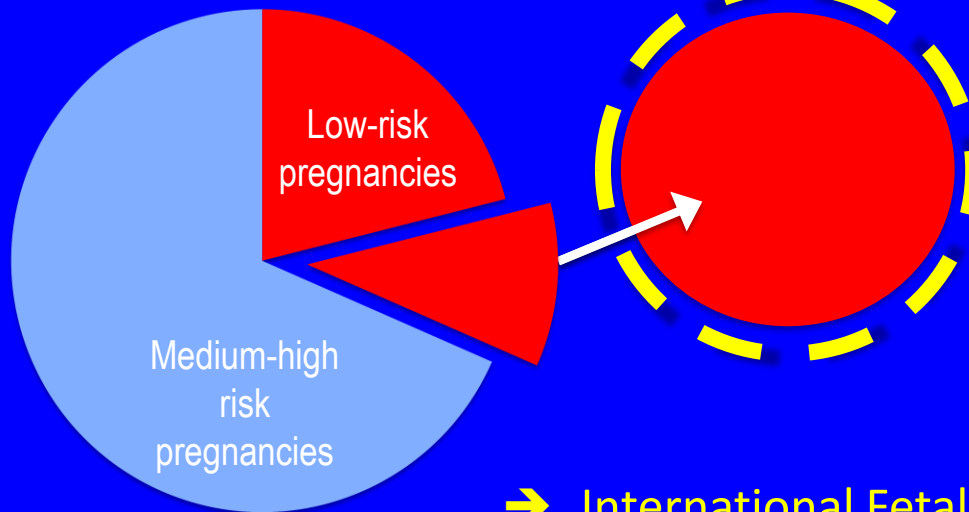


Low-risk pregnancies

n = 20,486

Fetal Growth Longitudinal Study

n = 4,607



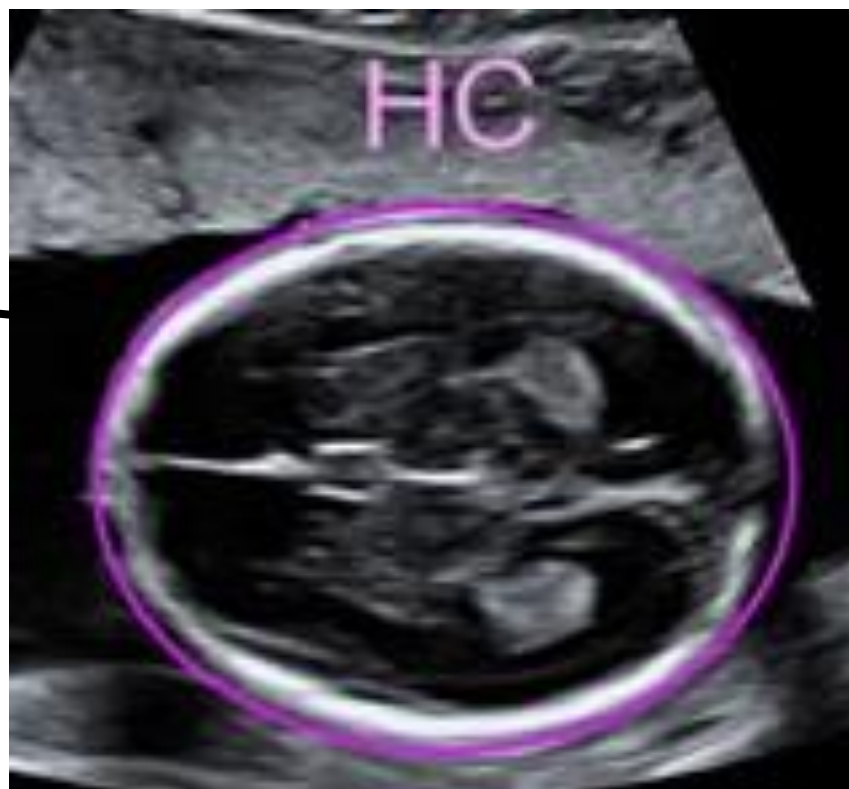
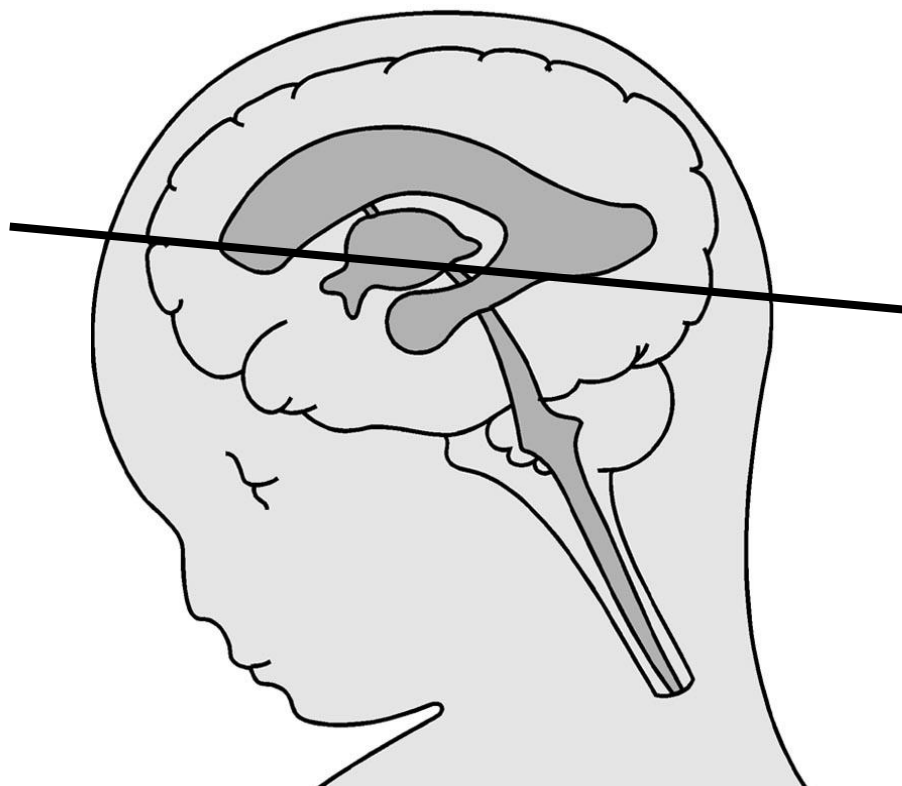
**Measurements at each scan >14+0 weeks,
every 5 +/- 1 week:**

- Biparietal diameter
- Occipito-frontal diameter
- Head circumference
- Transverse abdominal diameter
- Anterio-posterior abdominal diameter
- Abdominal circumference
- Femur length

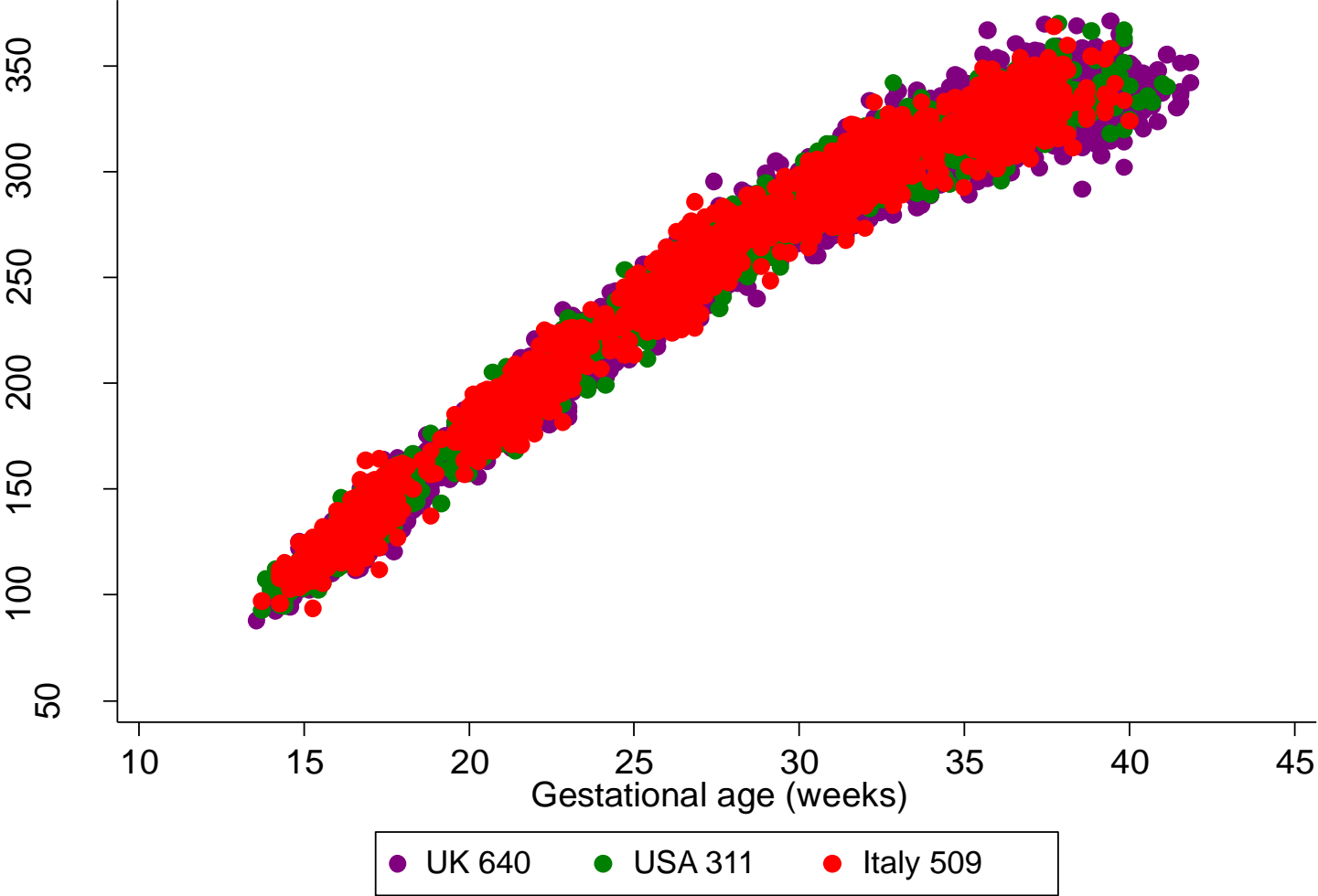


Philips HD9

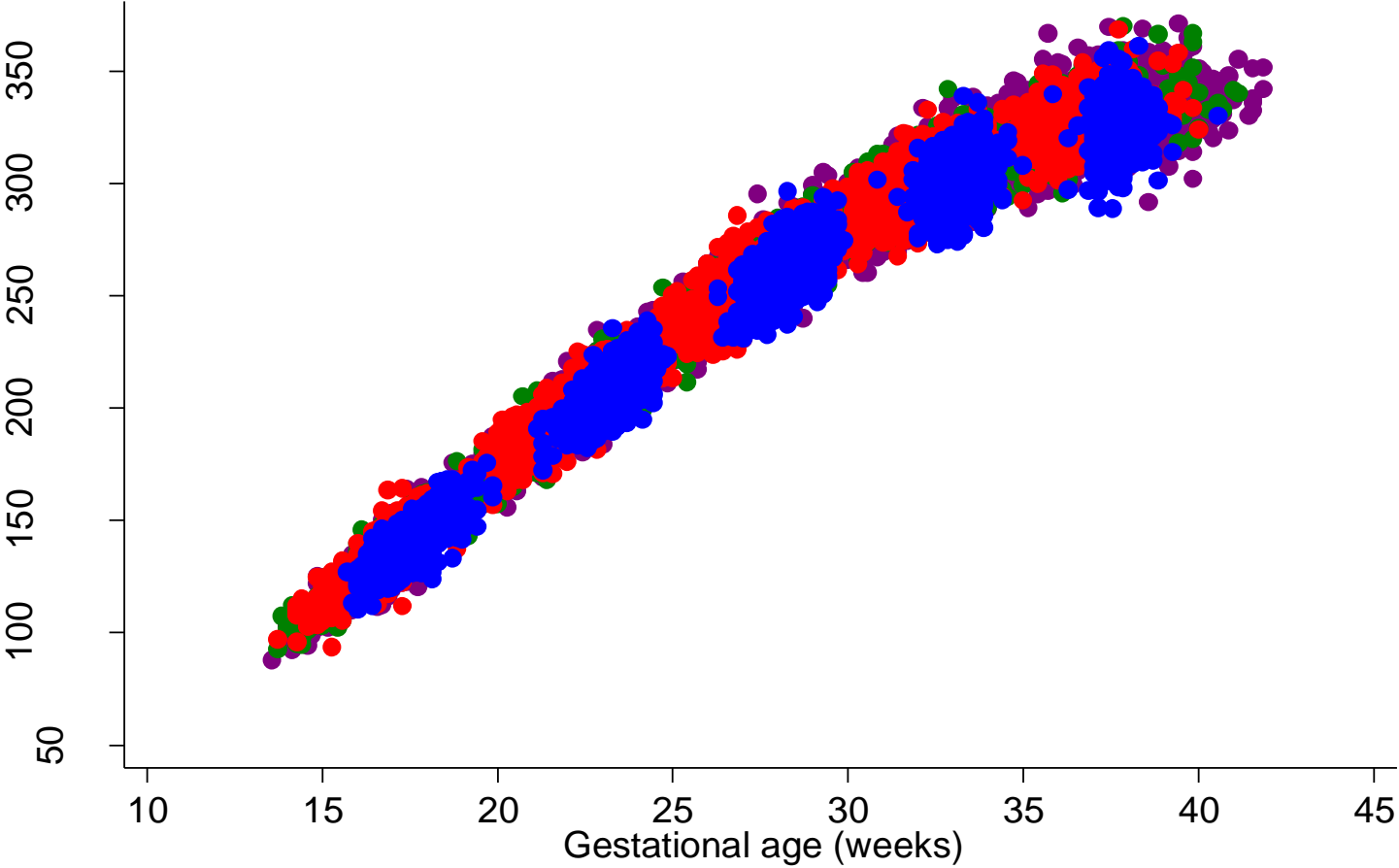
Measurements obtained 3 times from 3 separately obtained images of each structure in **blinded fashion (no measurement visible) and submitted electronically**



Fetal HC by gestational age for UK, USA & Italy

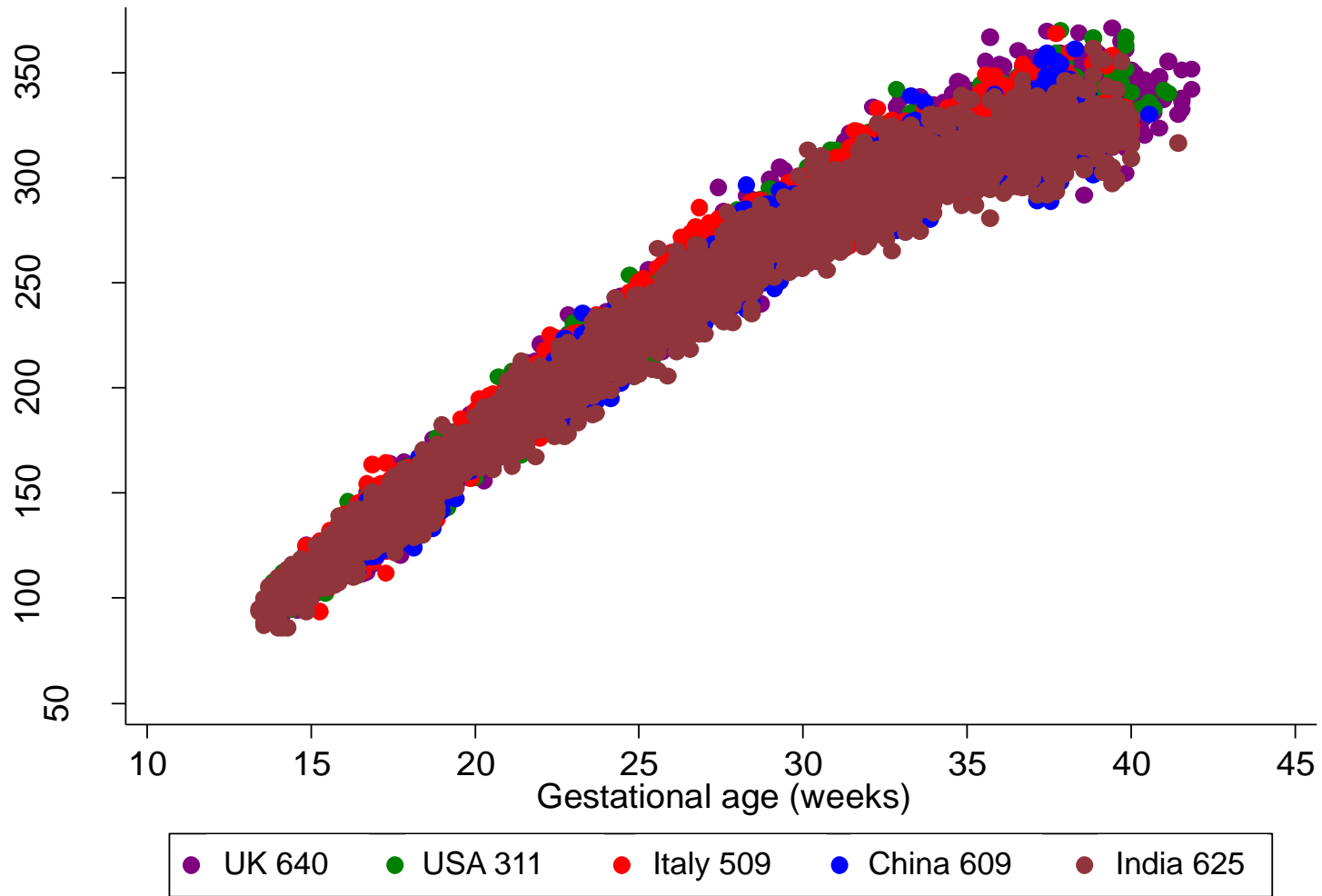


Fetal HC by gestational age for UK, USA, Italy & China

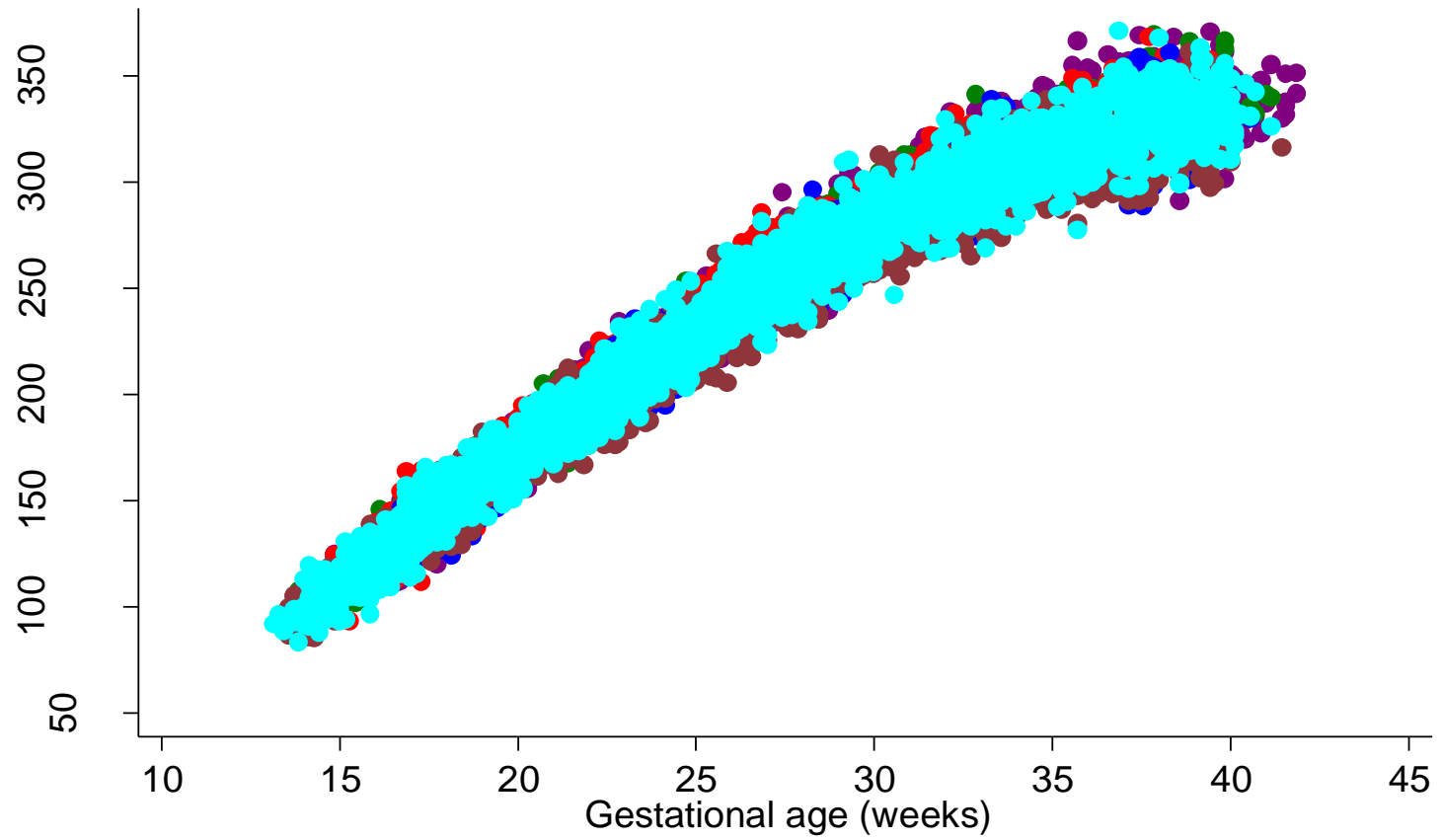


● UK 640 ● USA 311 ● Italy 509 ● China 609

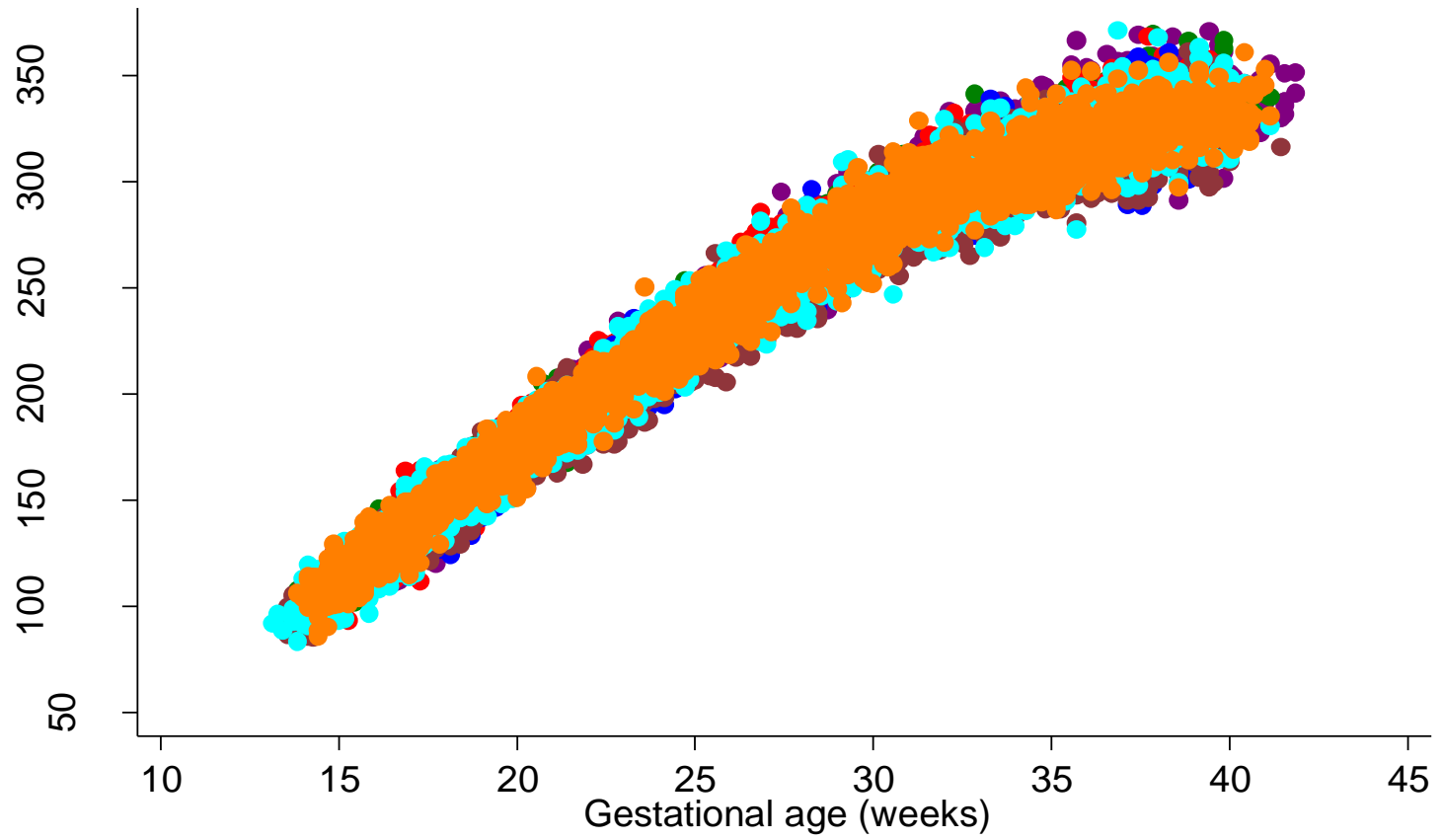
Fetal HC by gestational age for UK, USA, Italy, China & India



Fetal HC by gestational age for UK, USA, Italy, China, India & Kenya

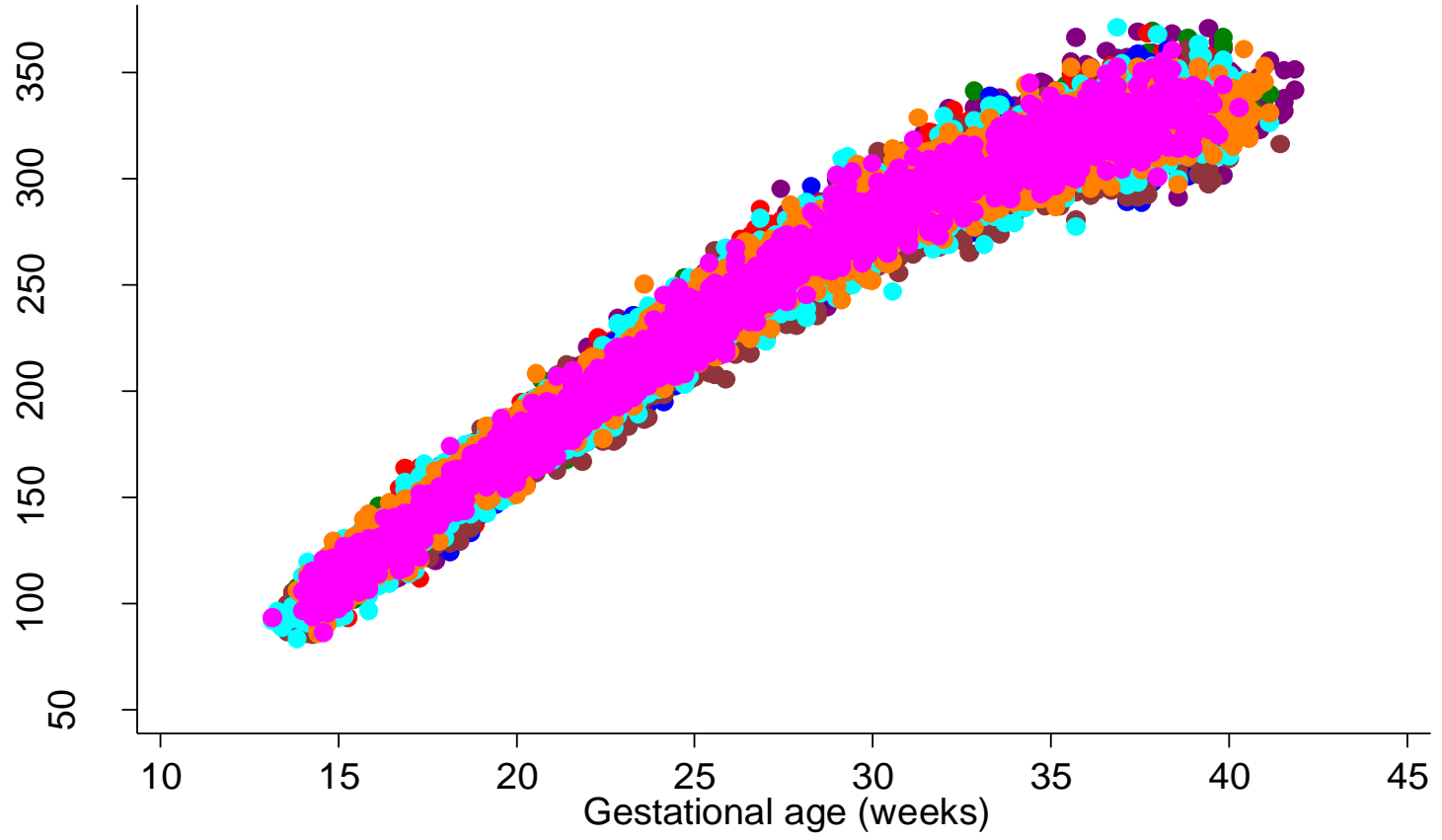


Fetal HC by gestational age for UK, USA, Italy, China, India, Kenya & Oman



● UK 640	● USA 311	● Italy 509	● China 609
● India 625	● Kenya 617	● Oman 599	

Fetal HC by gestational age for UK, USA, Italy, China, India, Kenya, Oman & Brazil



● UK 640	● USA 311	● Italy 509	● China 609
● India 625	● Kenya 617	● Oman 599	● Brazil 411

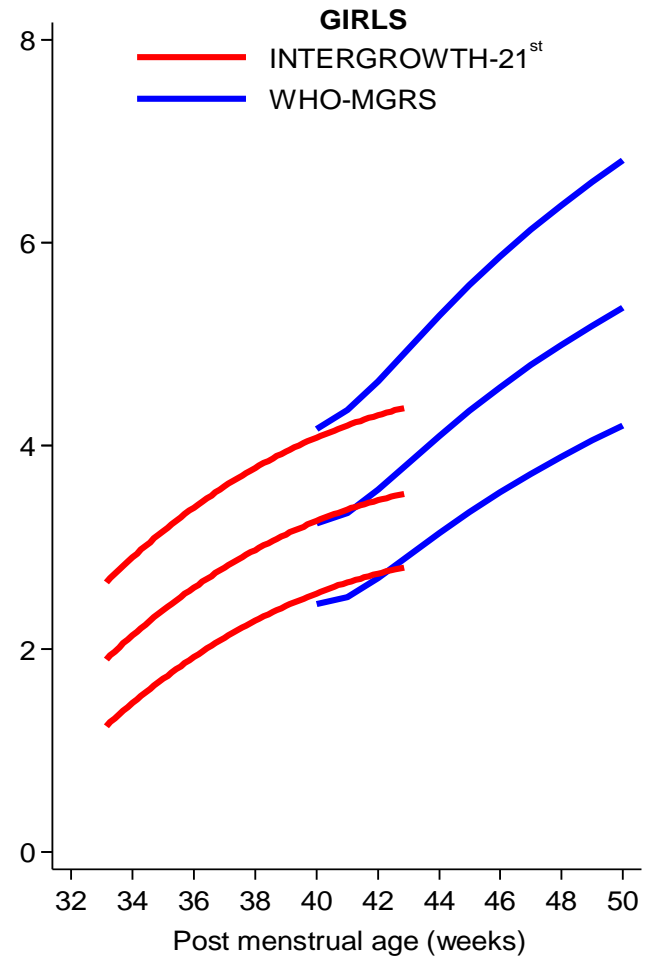
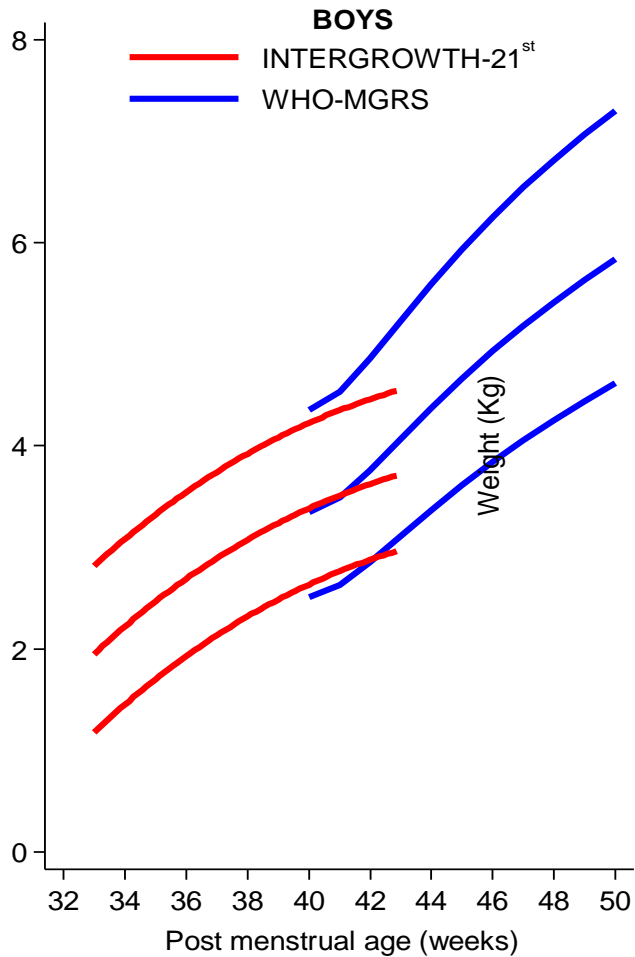
Anthropometric measurements at birth



Skeletal growth variance between populations and among individuals

	Fetal CRL	Fetal HC	Newborn length	Preterm Infant length	Infant length WHO-MGRS (2006)	Child Height Habicht (1974)
Variance between study sites	1.9%	2.6%	3.5%	0.2%	3.4%	3.0%
Variance among individuals within a site	-	18.6%	-	57.1%	70.0%	-
Unexplained variance	98.1%	78.8%	96.5%	42.7%	26.6%	-

INTERGROWTH-21st concepts overlap with WHO Child Growth Standards



There are no major differences in growth potential between populations

Nearly one in four British children overweight or obese, claims study

UK has second-highest proportion of overweight under-fives after Ireland in 28 countries studied, while body dissatisfaction prevalent in young age groups



Thursday 7 May 2015 00.16 BST

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Health

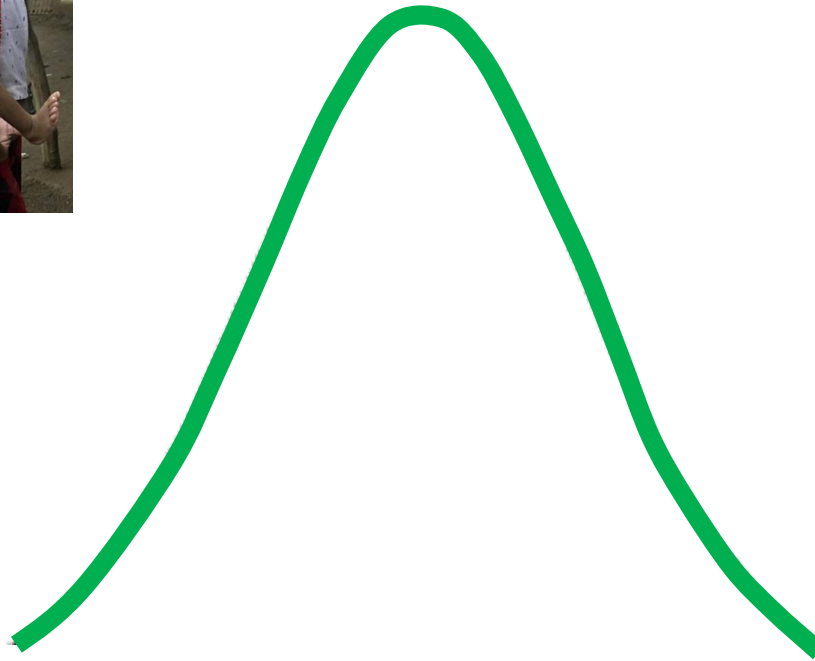
UK children becoming obese at younger ages

By Michelle Roberts
Health editor, BBC News online

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Healthy population INTERGROWTH



Percent

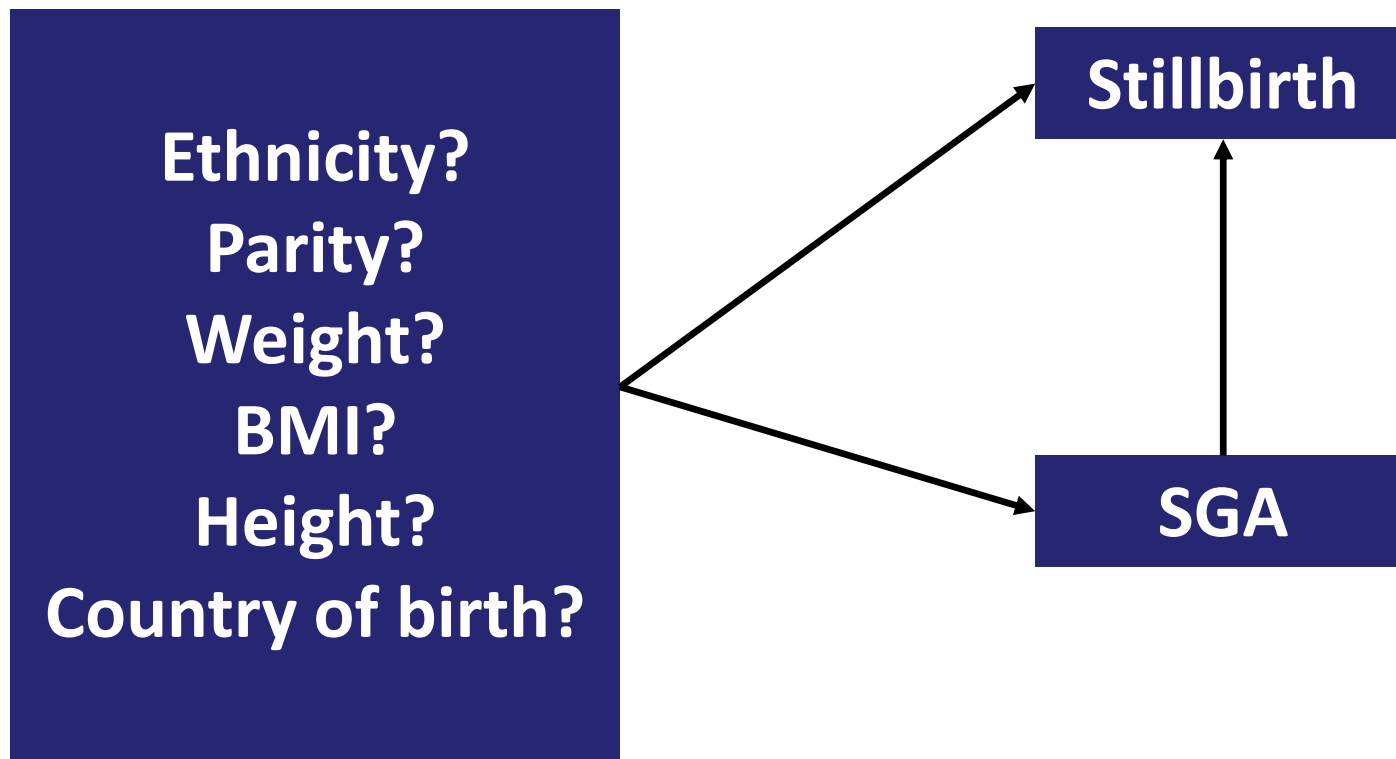
Birth weight

INTERGROWTH-21st Project

International standards

- 1st trimester dating (*Ultrasound Obstet Gynecol* 2014)
- Late pregnancy dating (*Ultrasound Obstet Gynecol* 2015)
- Fetal growth by ultrasound (*Lancet* 2014)
- Newborn size for gestational age and sex (*Lancet* 2014)
- Postnatal growth of preterms (*Lancet Glob Health* 2015)
- Preterm phenotypes (*JAMA Ped* 2015)
- SGA phenotypes (*JAMA Ped* 2015)
- Maternal weight gain in pregnancy (*BMJ* 2016)

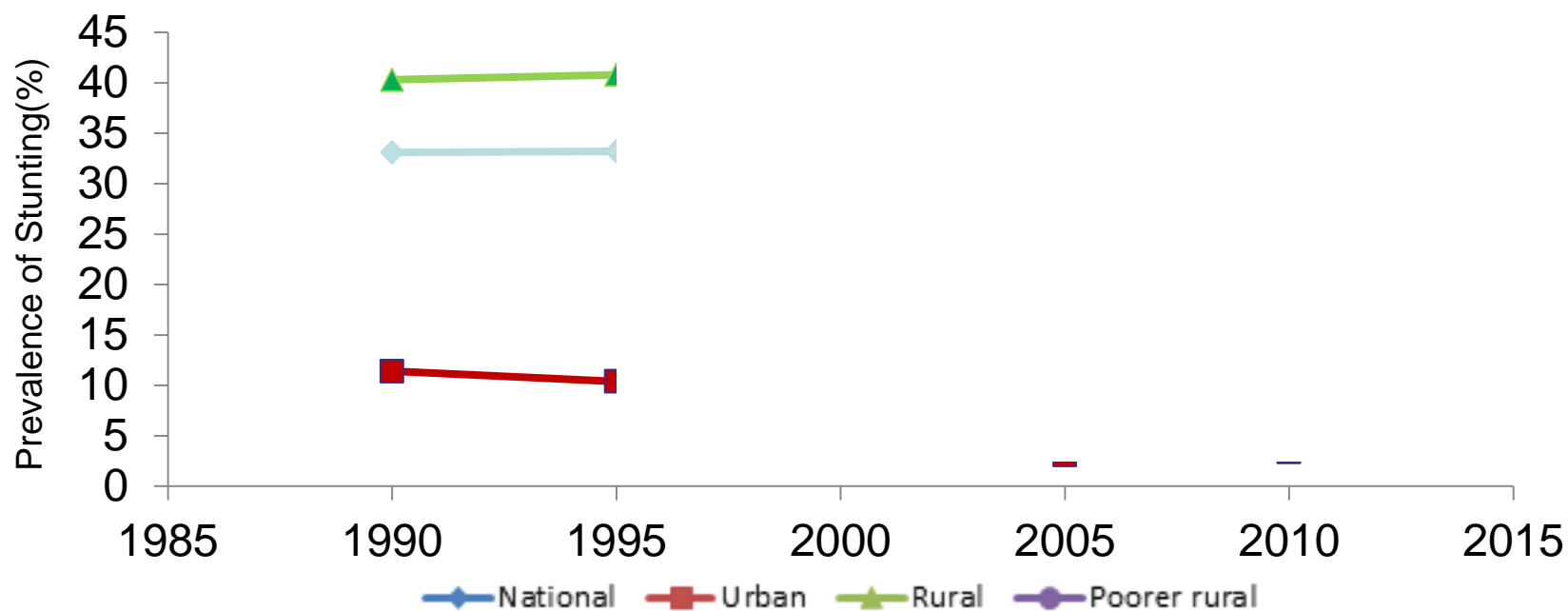
Is it better to adjust for maternal factors?



The trouble with adjusting...

The trouble with adjusting: Height is inconstant and a marker of poverty

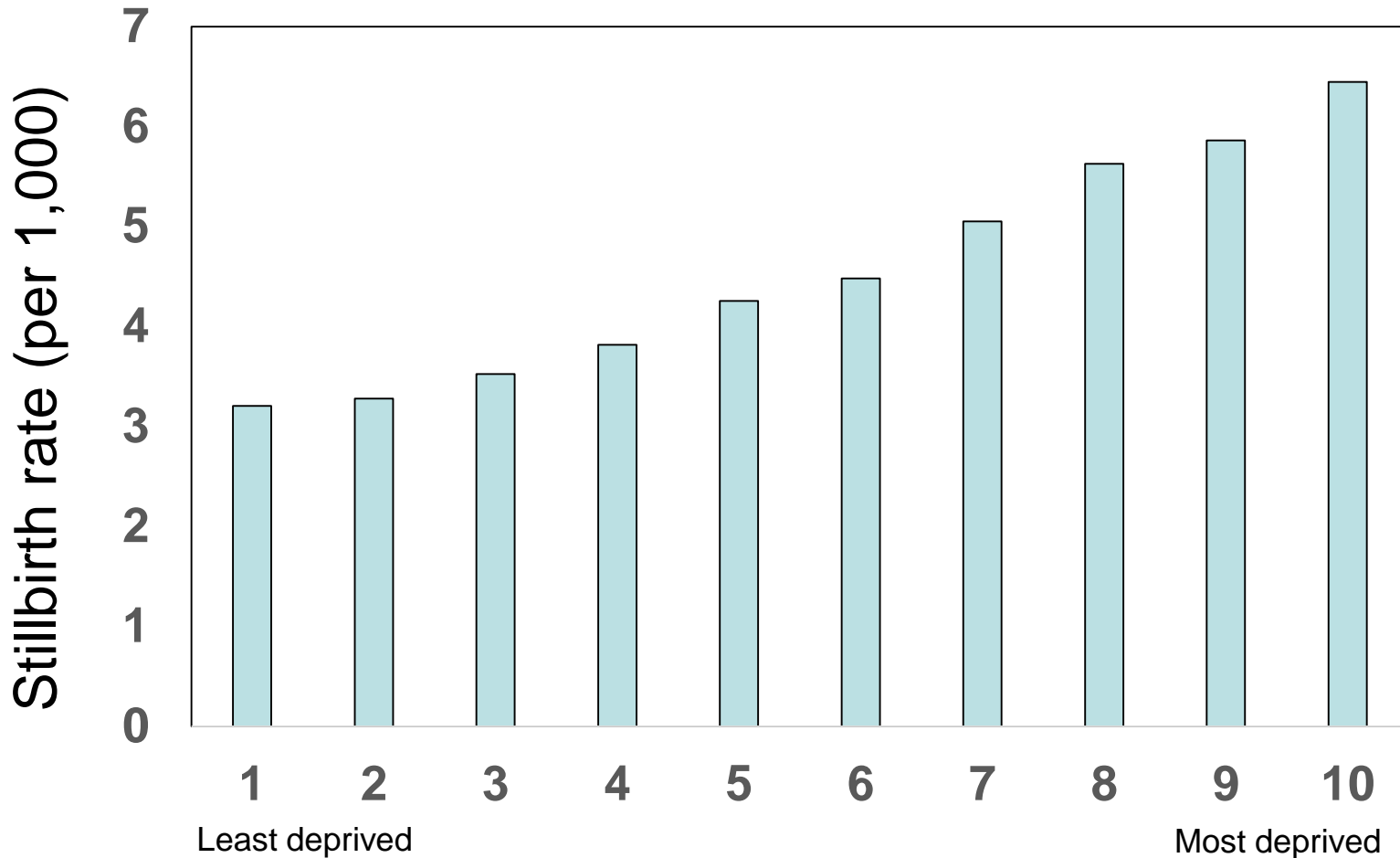
Prevalence of stunting among children under 5 years, China



The trouble with adjusting: Lack of agreement on proposed factors

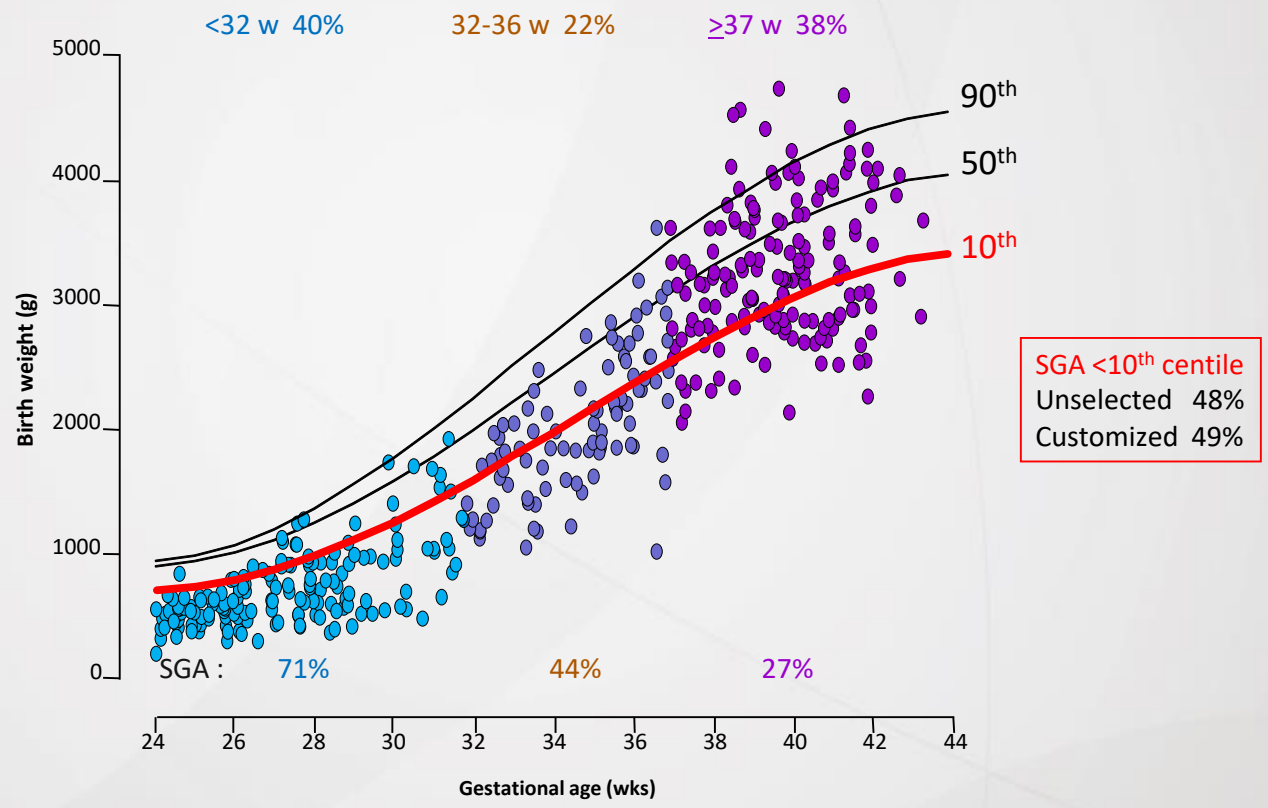
	YES	NO
Kiserud et al other	Country of birth and fetal sex	Height, weight, parity,
Gardosi et al	Ethnicity, Weight, Height, Parity	Country of birth, fetal sex
Kallen et al	Maternal BMI, height	Ethnicity, parity,
Buck Louis et al	4 ethnic groups	Weight, Height, Parity

Association of stillbirth with socioeconomic status



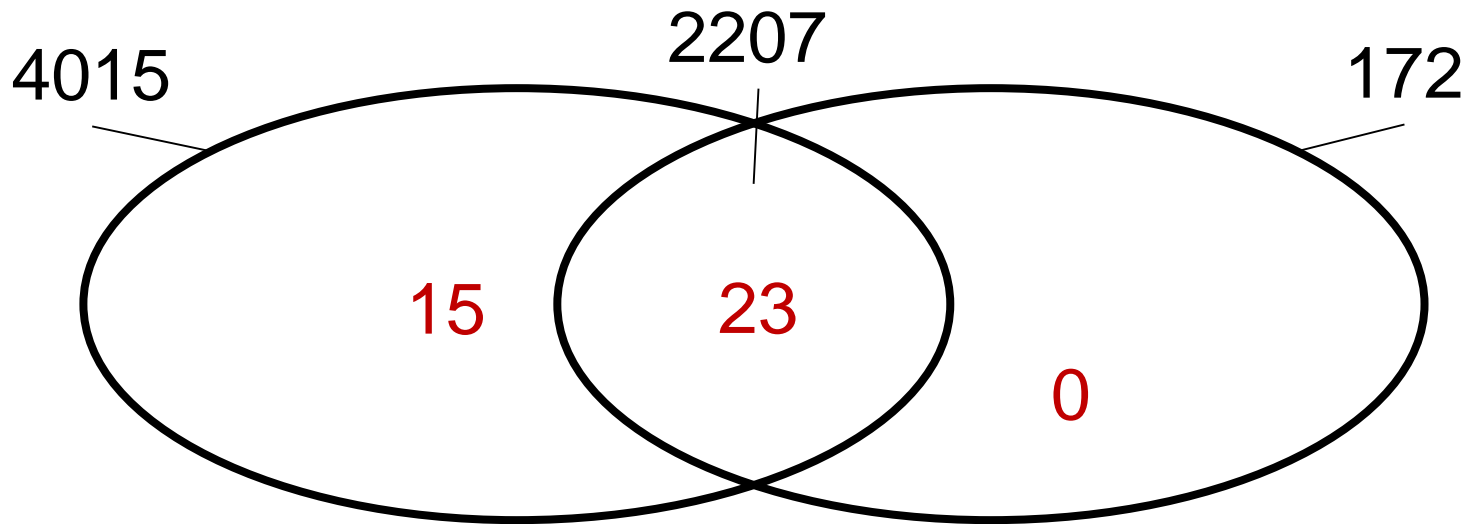
Stillbirth – antepartum (88% total)

SGA vs non-SGA



SGA-Customised

SGA - INTERGROWTH



38 / 6222

23 / 2379

Likelihood ratio:

3.37

5.89

(2.63 - 4.32)

(4.16 - 8.35)

The INTERGROWTH-21st standard in Viet Nam

- Preliminary analysis from the first 2873 births in the PBB study
- Hospital-based sample from Tu Du Hospital
- Outcomes very good with only 6 stillbirths (study stillbirth rate 2 per 1000 births)

Distribution of birthweights

Centiles	Frequency	Percentage
<10th (SGA)	168	5.69
10th-90th (AGA)	2468	83.58
>90th (LGA)	237	8.03
Missing	80	2.71

Stillbirths in PBB cohort

	n	Odds Ratio of fetal death (95% CI)	P value
All babies	2873		
<10th (SGA)	164	18.14 (2.35-140.00)	<u>0.005</u>
10th-90th (AGA)	2461	1.00 (ref)	
>90th (LGA)	236	1.56 (0.05-52.73)	0.804

IUD	Gestation (weeks)	Centile	Complication
1	37.57	<1	-
2	34.00	9.61	Fetal congenital birth defect
3	33.00	12.24	-
4	25.14	<1	Severe PET, GDM
5	29.57	25.94	-
6	26.43	<1	-

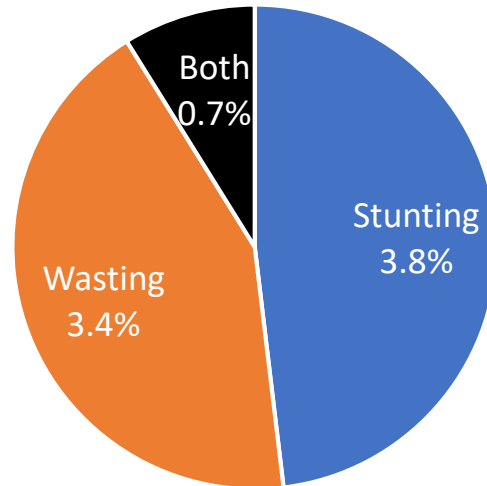
Growth Phenotypes: From the womb to the classroom

- **Stunting, wasting** and **overweight** are widely used to assess nutritional status in children
- These conditions can originate in utero

Original Investigation

**Anthropometric Characterization of Impaired Fetal Growth
Risk Factors for and Prognosis of Newborns
With Stunting or Wasting**

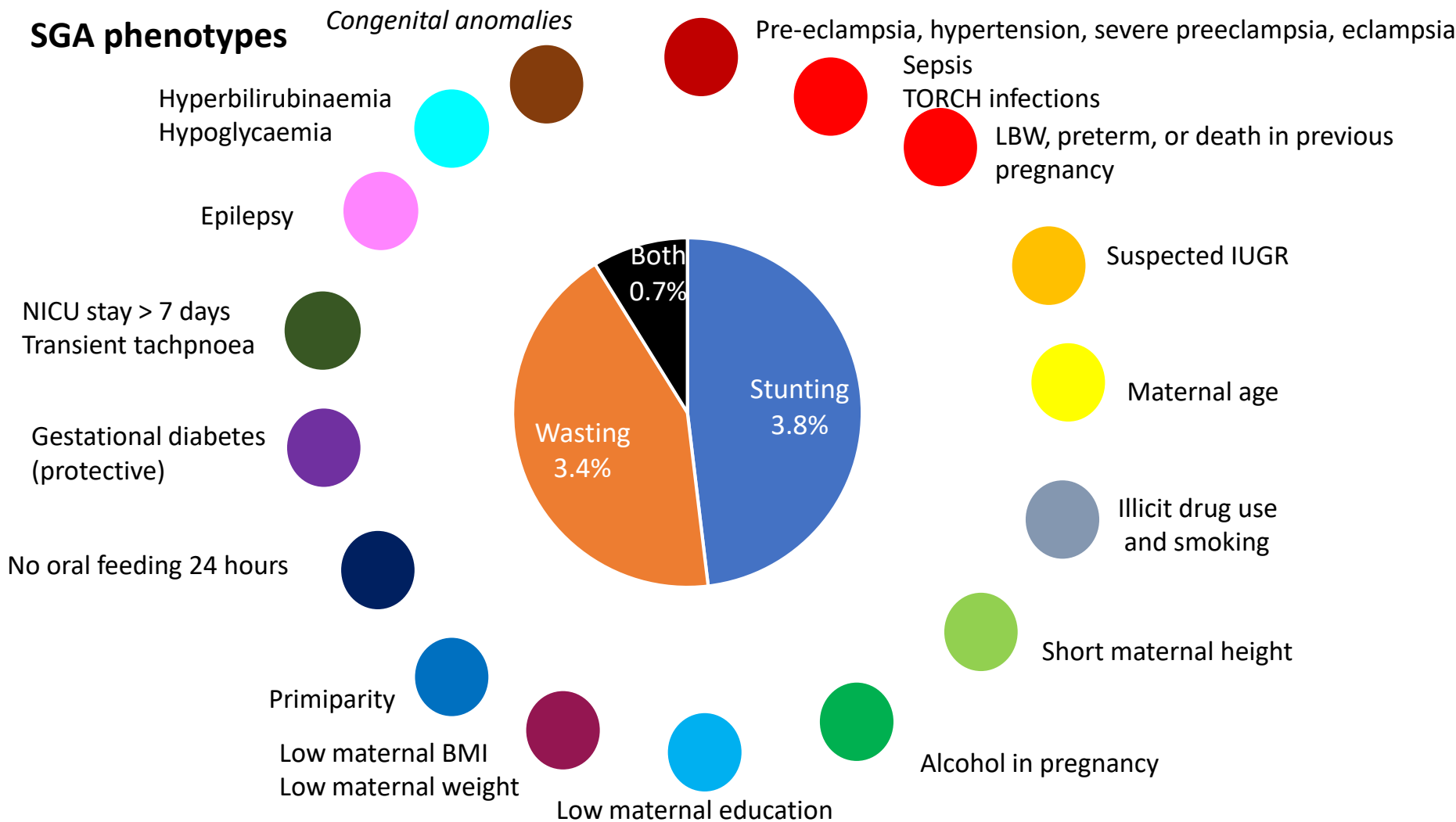
Victora et al, 2015 *JAMA Pediatr*



Stunting = birth length <3rd centile

Wasting = birth BMI <3rd centile

SGA phenotypes



SGA phenotypes

Congenital anomalies

Hyperbilirubinaemia
Hypoglycaemia

Epilepsy

NICU stay > 7 days
Transient tachpnoea

Gestational diabetes
(protective)

No oral feeding 24 hours

Primiparity

Low maternal BMI
Low maternal weight

Low maternal education

Pre-eclampsia, hypertension, severe preeclampsia, eclampsia

Sepsis
TORCH infections

LBW, preterm, or death in previous pregnancy

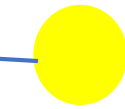
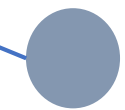
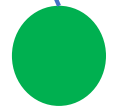
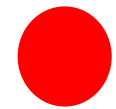
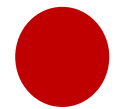
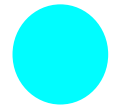
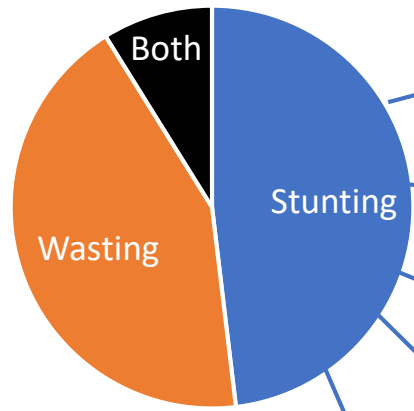
Suspected IUGR

Maternal age

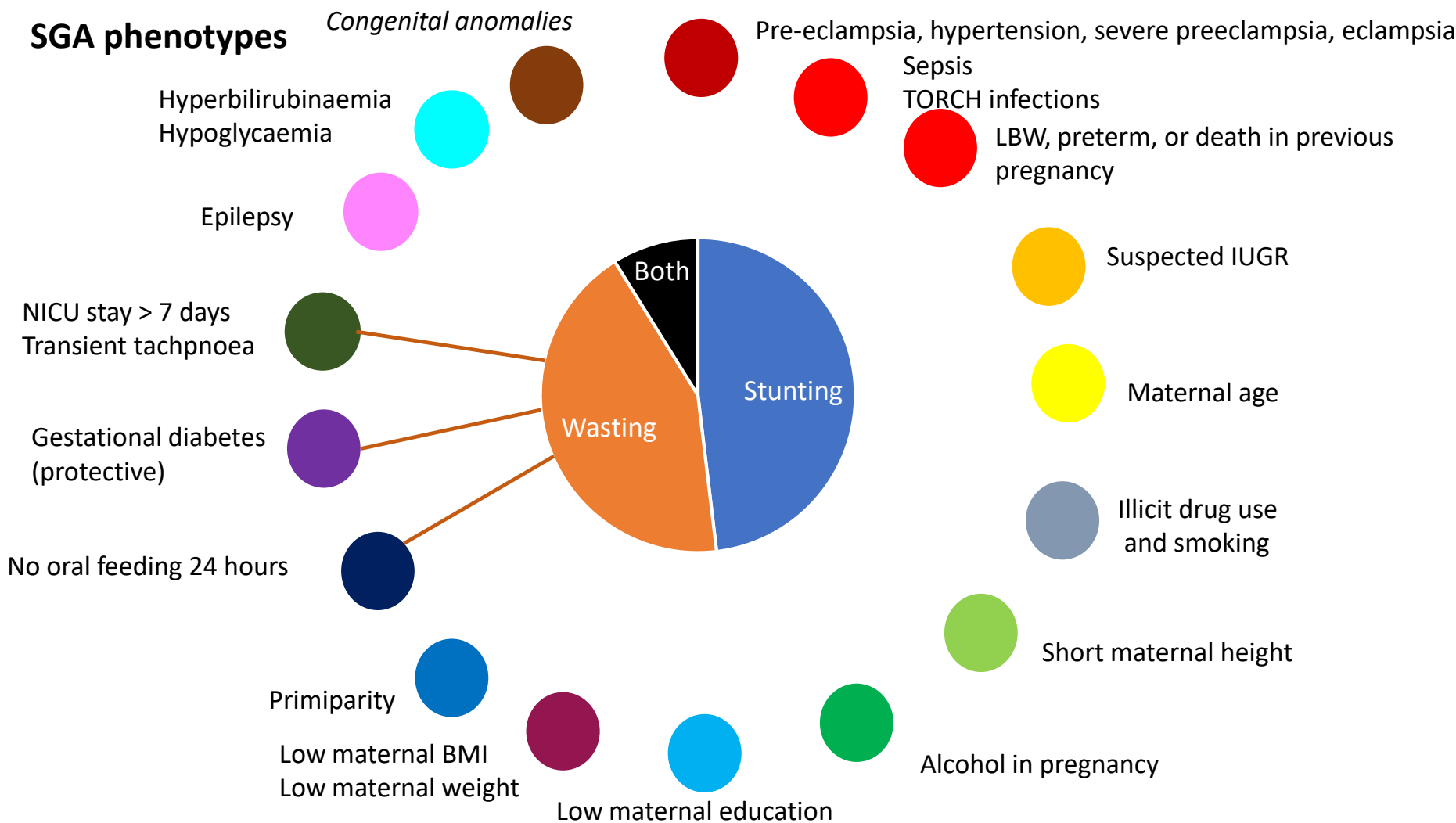
Illicit drug use
and smoking

Short maternal height

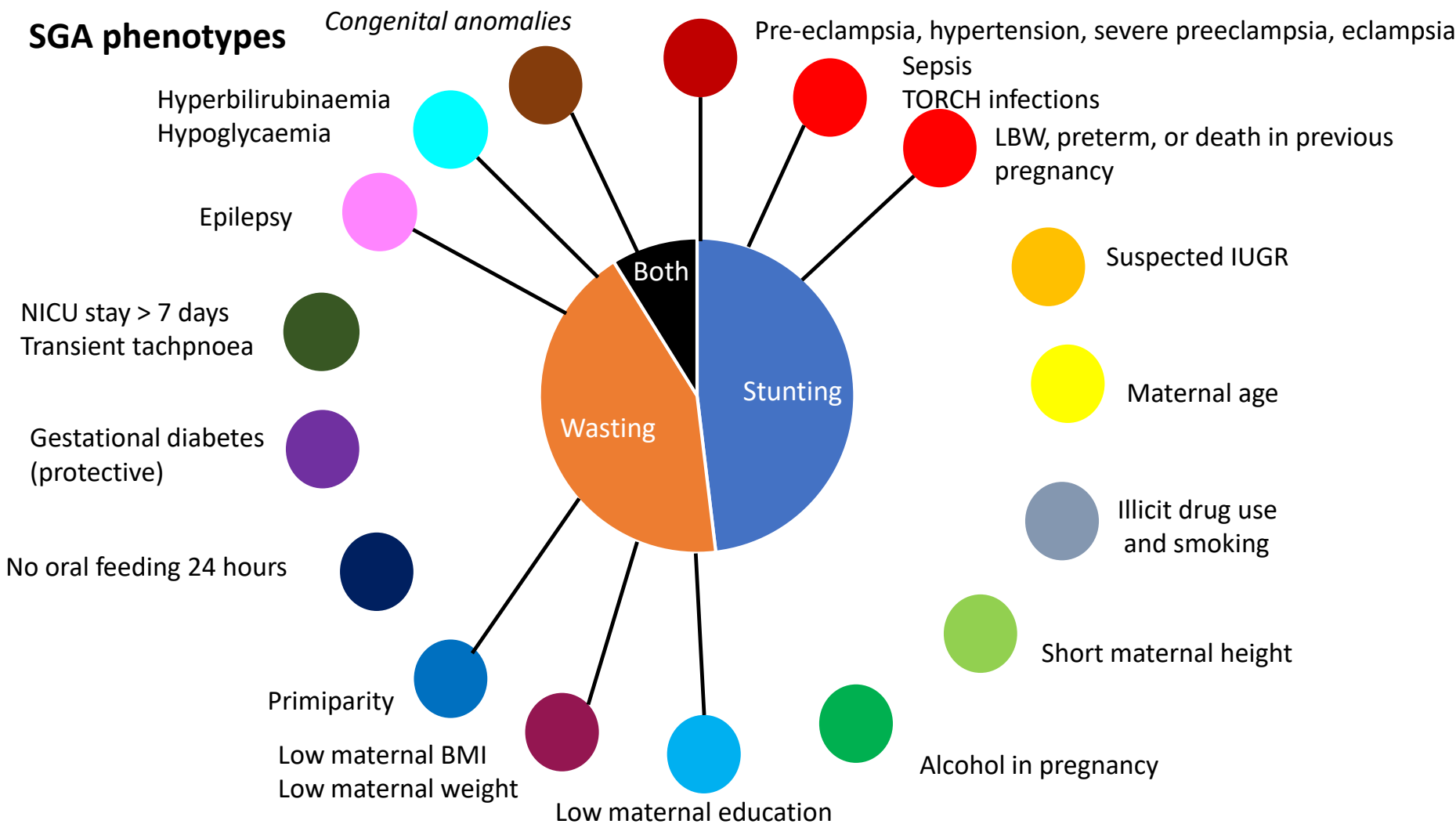
Alcohol in pregnancy



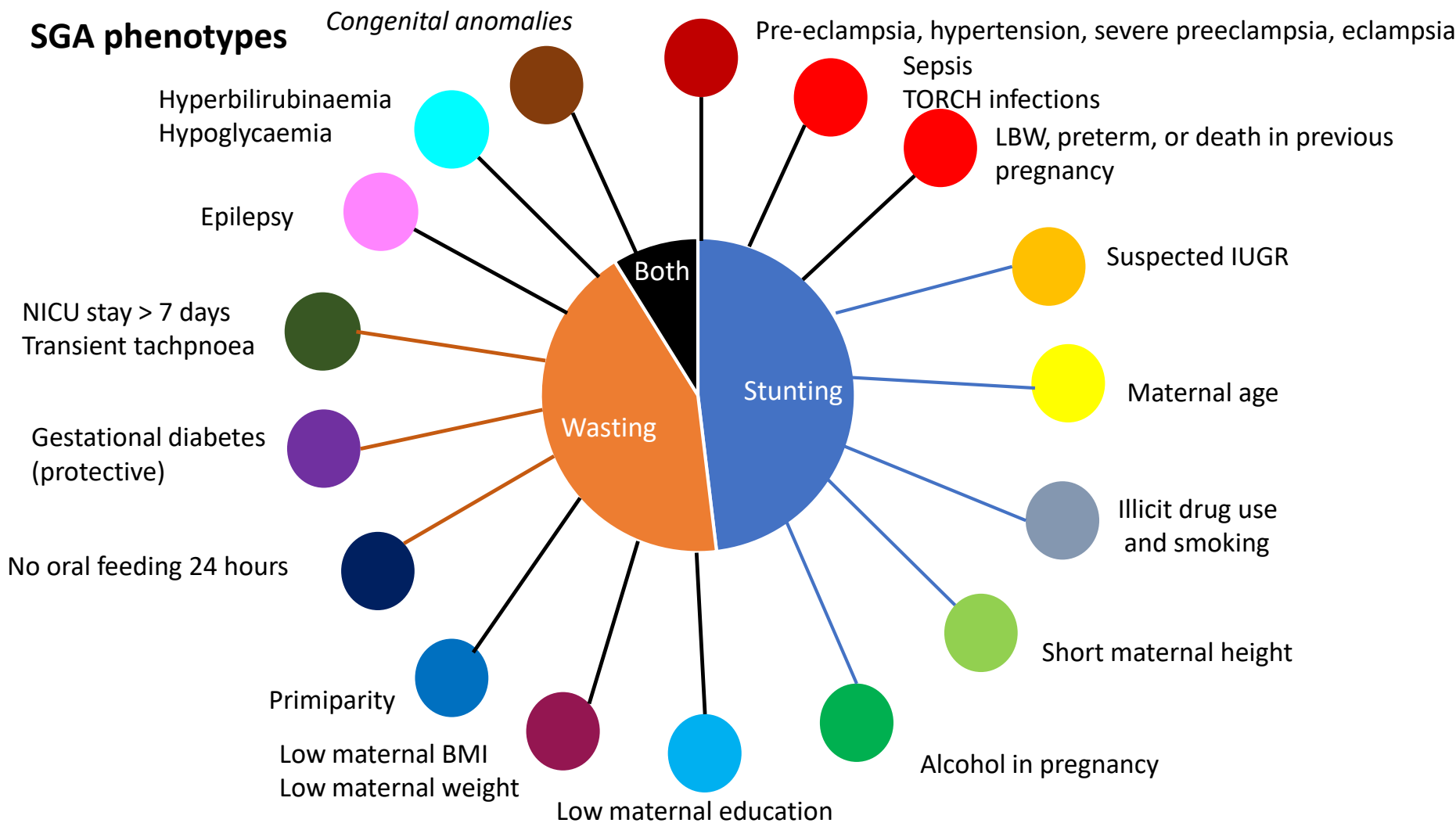
SGA phenotypes



SGA phenotypes



SGA phenotypes



INTERGROWTH-21st

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The International Fetal and Newborn Growth Consortium for the 21st Century



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Preterm Phenotypes

The first application of a novel new approach for preventing preterm birth syndrome through a phenotypic classification system.

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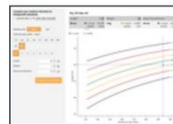


We are a **global network** of over 300 researchers and health care professionals dedicated to improving maternal and newborn health in 27 countries.

This website provides clinicians and researchers access to the INTERGROWTH-21st **Global Perinatal Package**. This package is comprised of new, globally-validated standards and practical training resources. The following standards

News

New INTERGROWTH-21st tool for calculating centiles and z-scores for Birthweight, Birth length and Birth Head circumference available for download



New tool for calculating centiles and z-scores for Birthweight, Birth length and Birth Head circumference available for download

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New systematic review [@UniofOxford](#) on the association between IUGR + neurodevelopmental outcomes in childhood bit.ly/1HIHpR9
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Interesting research by

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