Oxford Maternal & Perinatal
Health Institute
Green Templeton College

UNIVERSITY OF OXFORD

INTERGROWTH-21ST PROJECT

CONCEPTS, METHODS AND RESULTS

Dr Leila Cheikh Ismail

Project Leader

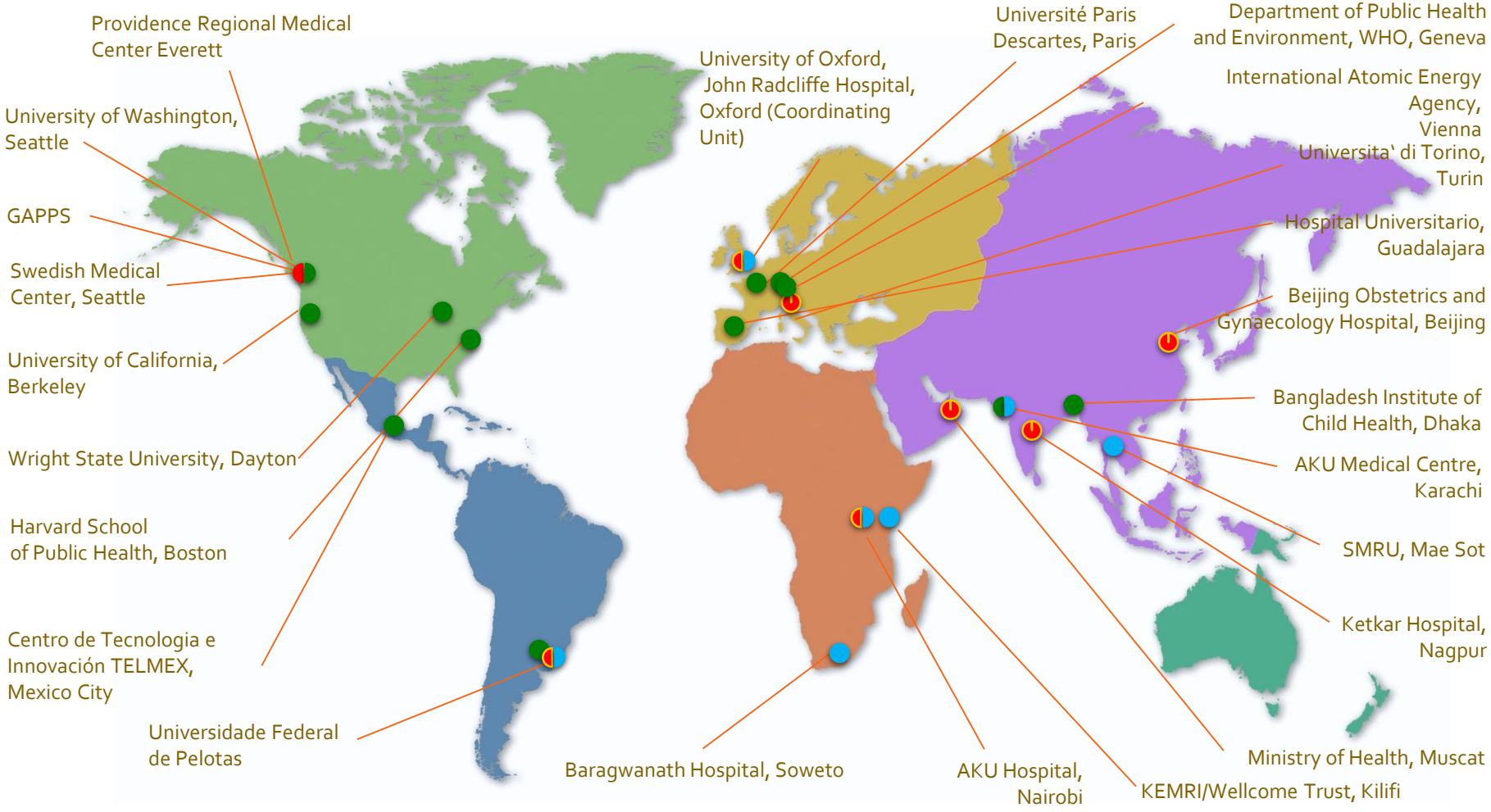
University of Oxford

on behalf of:

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

"Understanding early human growth and development across populations for better health and nutrition throughout life."

INTERGROWTH-21ST PROJECT NETWORK

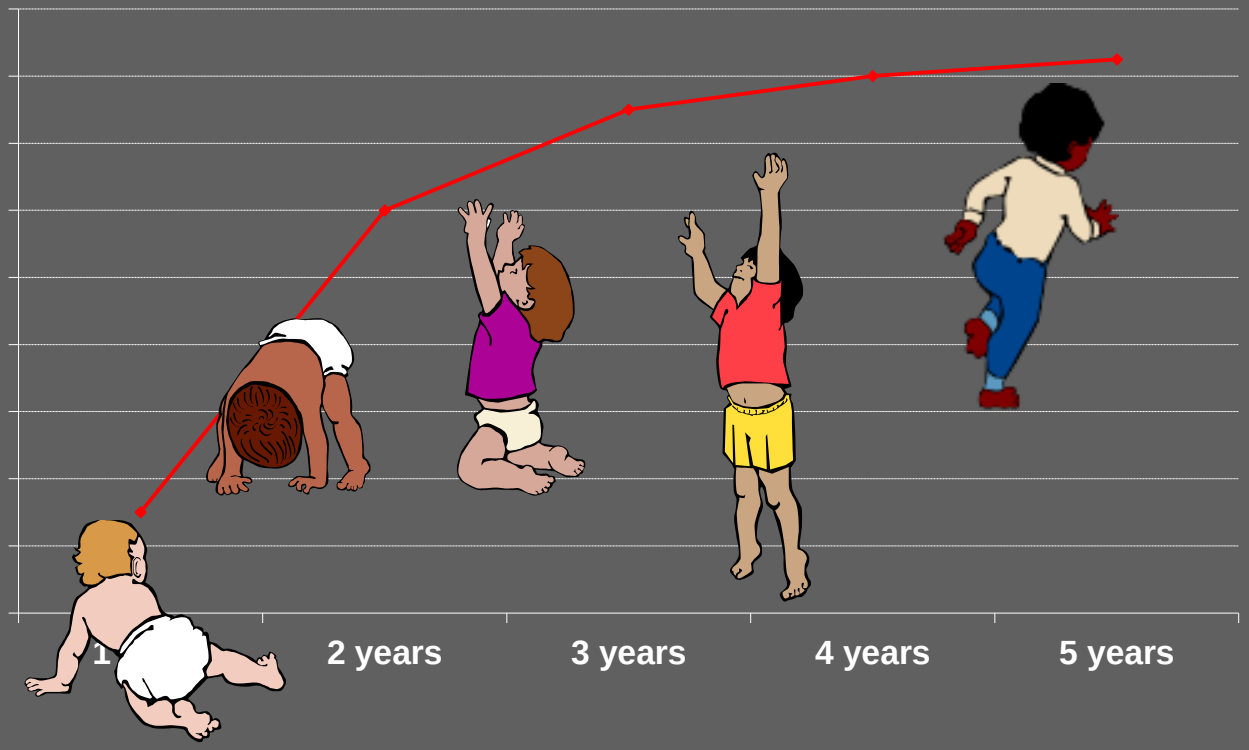


INTERGROWTH-21st Research Units | INTERGROWTH-21st – PIFS centres | INTERBIO-21st Research Units | Collaborating institutions

INTERGROWTH-21ST PROJECT

WHY?

WHO CHILD GROWTH STANDARDS



World Health Organization

WHO CHILD GROWTH STANDARDS

WHO child growth standards (0-60 months):

- Length/height-for-age
- Weight-for-age
- Weight-for-length/height
- BMI-for-age
- Head circumference-for-age
- Arm circumference-for-age
- Subscapular skinfold-for-age
- Triceps skinfold-for-age
- Motor development milestones

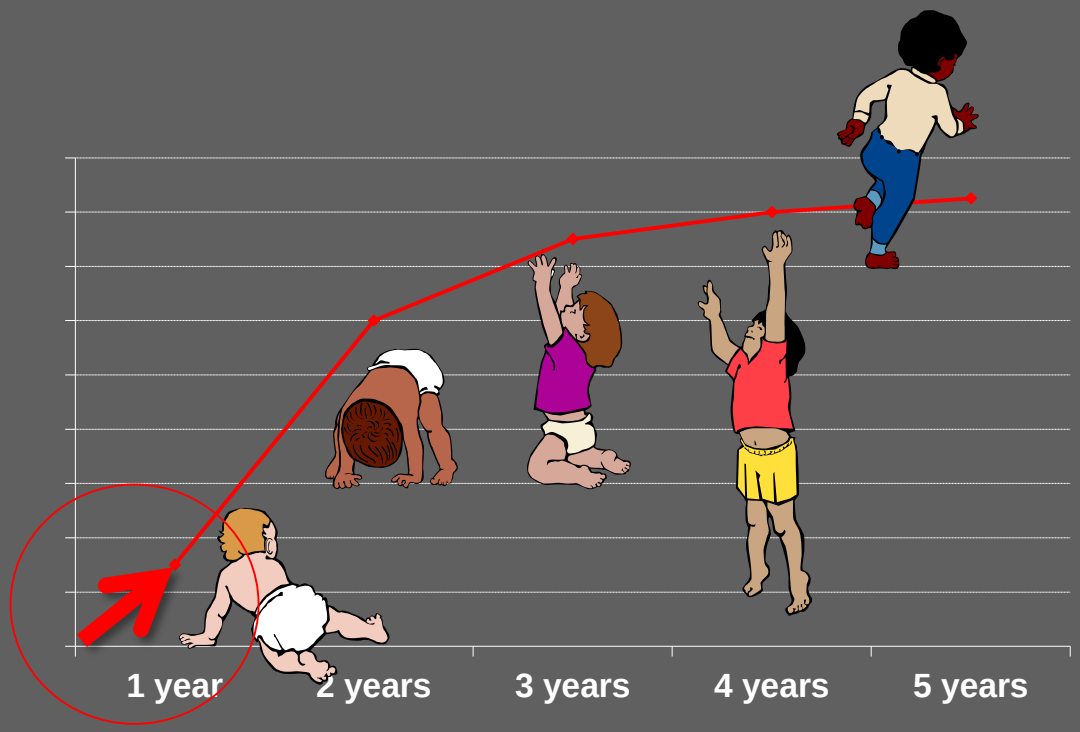
What is missing?

No information on:

- Growth during pregnancy
- Size at birth by GA
- Postnatal growth of preterm infants

INTERNATIONAL FETAL AND NEWBORN GROWTH CONSORTIUM FOR THE 21ST CENTURY

THE INTERGROWTH-21st Project



SYSTEMATIC REVIEWS

Crown-rump length / gestational age estimation - Napolitano R, Dhami J, Ohuma EO et al (2014) *BJOG*

Fetal growth monitoring by ultrasound - Ioannou C, Talbot K, Ohuma E et al (2012) *BJOG*

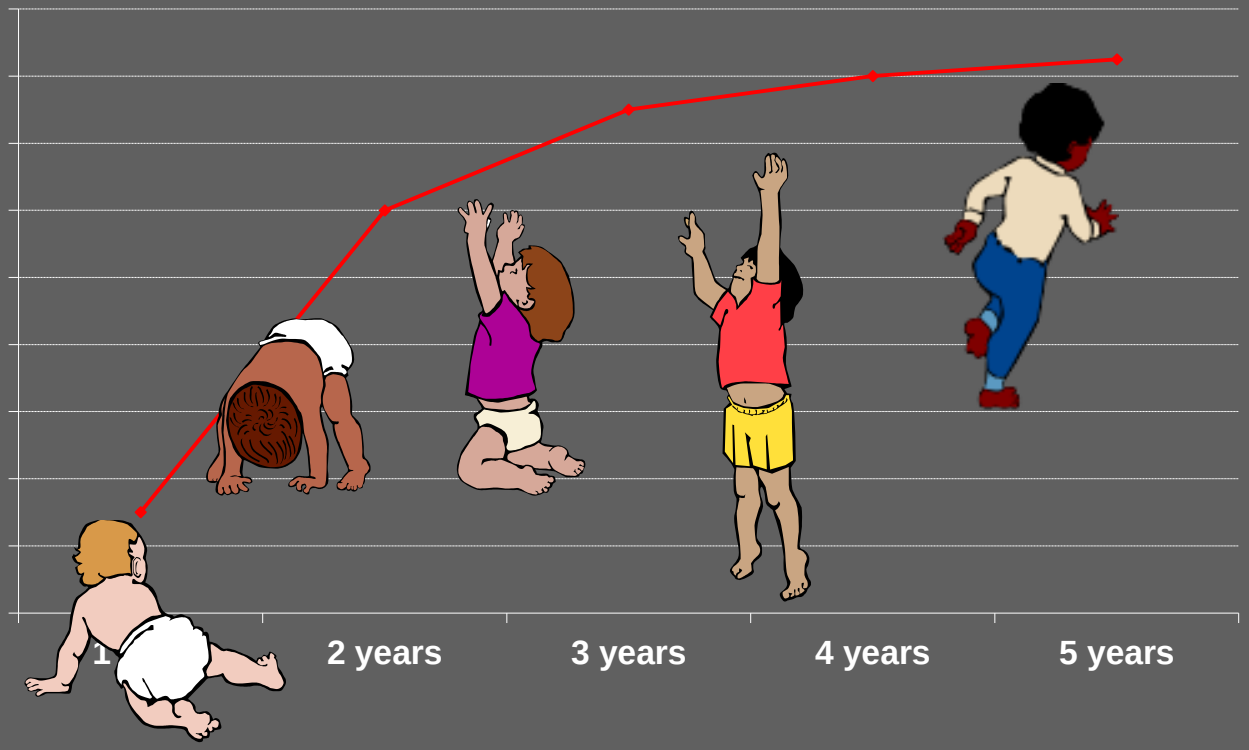
Birthweight charts - Giuliani F, Ohuma E, Spada E et al (2015) *Acta Paed*iatrica

Preterm postnatal growth charts - Giuliani F, Cheikh Ismail L, Bertino E et al (2016) *AJCN*

Gestational weight gain charts - Ohadike CO, Cheikh Ismail L, Ohuma EO et al (2016) *Adv Nutr*

Material available diverse and of variable quality

WHO CHILD GROWTH STANDARDS



World Health Organization

WHO RECOMMENDATION (1995)

Human growth worldwide should be evaluated using

international standards describing how individuals should grow

Report of WHO Expert Committee 1995
Physical Status: The Use and Interpretation of Anthropometry,
Technical Report Series No. 854

REFERENCES vs. STANDARDS

Reference charts describe how fetuses and newborns ***have*** grown at a particular time and/or place

International standards describe how fetuses and newborns ***should*** grow when nutritional, environmental and health constraints on growth are minimal

REFERENCES vs. STANDARDS

Reference charts describe how fetuses and newborns ***have*** grown at a particular time and/or place

International standards describe how fetuses and newborns ***should*** grow when nutritional, environmental and health constraints on growth are minimal

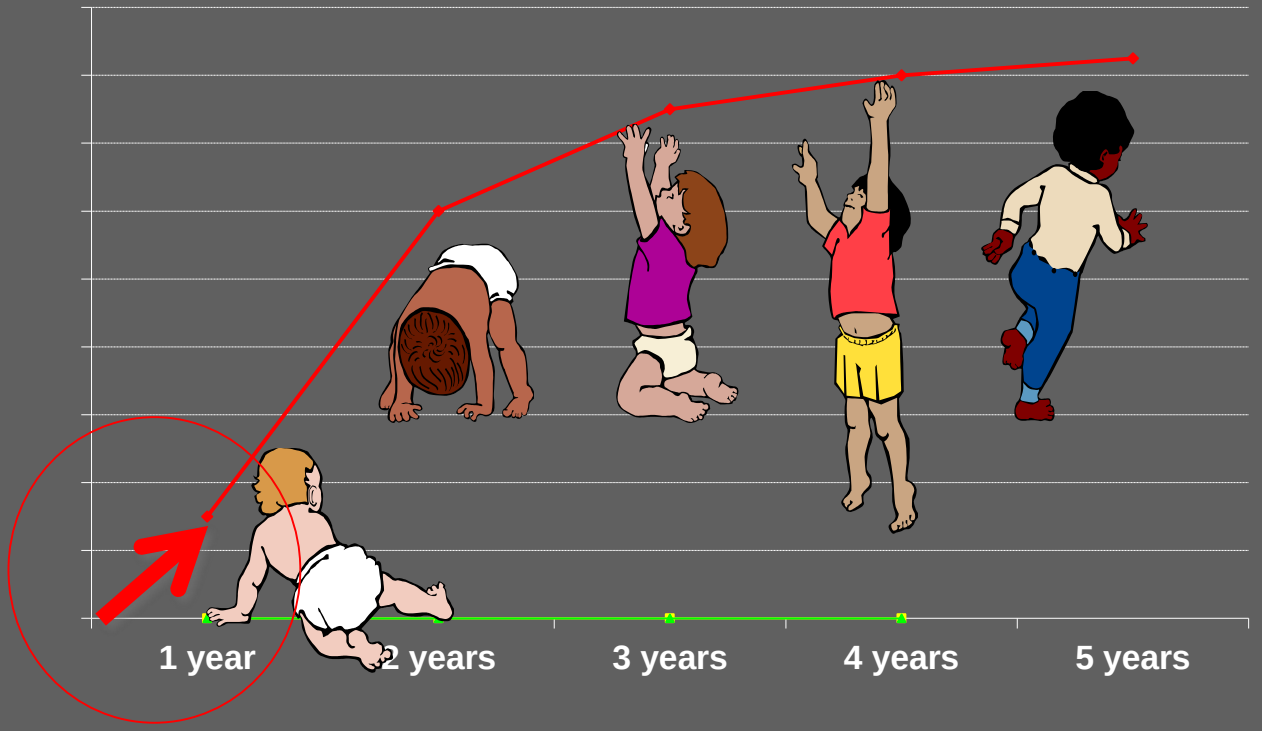
WHAT IS INTERGROWTH-21ST?

- Extend the concepts promoted by WHO MGRS into fetal and neonatal life

- Offer a conceptual continuity between the development and implementation of prenatal and postnatal growth standards

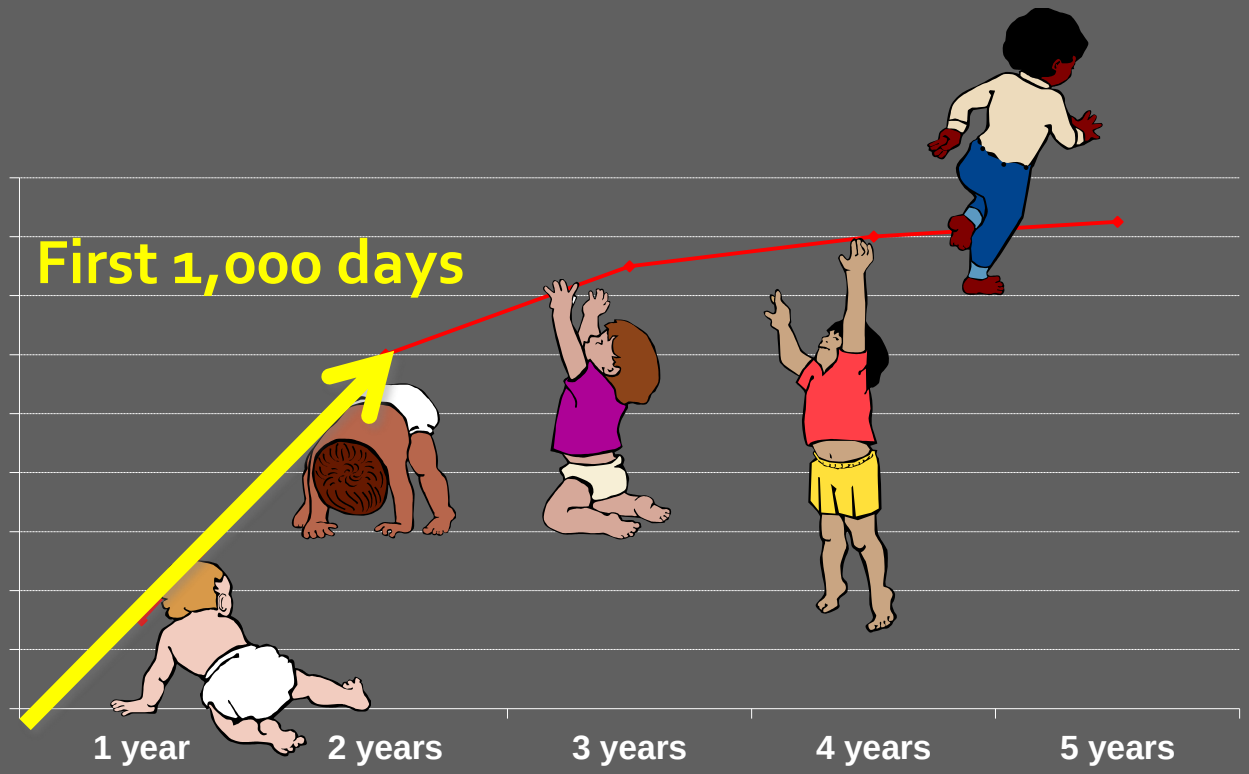
AIMS OF INTERGROWTH-21ST

(1) Develop new '<u>prescriptive</u>' standards describing normal fetal growth, preterm growth and newborn nutritional status



AIMS OF INTERGROWTH-21ST

(2) Look at post-natal growth of the preterm and term INTERGROWTH-21st infants up to 2 years



INTERGROWTH-21ST PROJECT

HOW?

CHALLENGES

Practical considerations:

Where?	→ Site selection
Who?	→ Population selection

Methodological considerations:

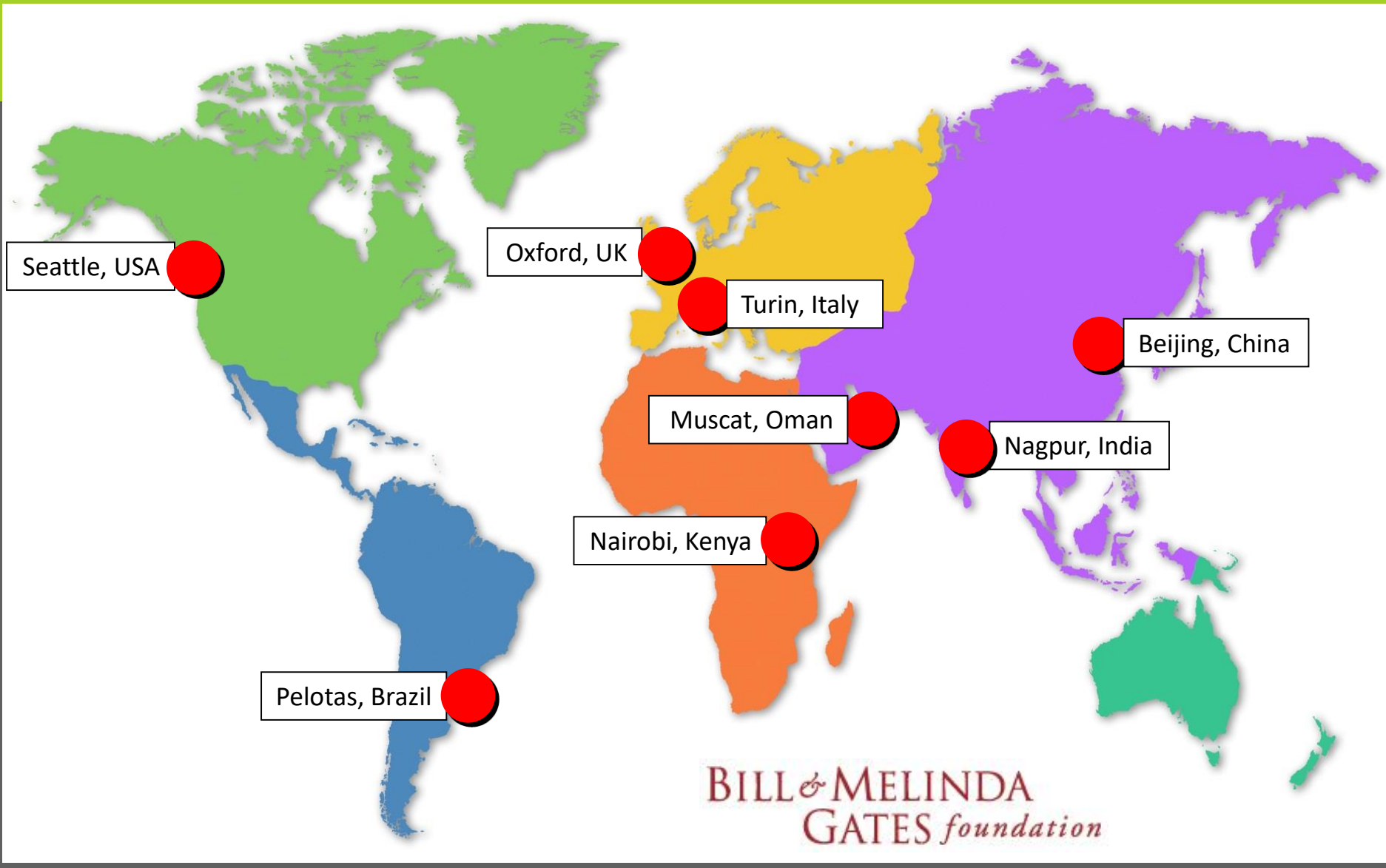
Multicentre study	→ Same equipment, protocols, level of care and recommendations
Complement WHO charts	→ Same anthropometric equipment and protocol
Pooling the results	→ Ensuring good data quality throughout the study and across sites

SITE SELECTION

"Healthy" environment criteria for FGLS site selection:

- Low-birthweight rate <10%
- Mean birth weight >3100g
- Perinatal mortality <20 per 1000 live births
- >75% mothers have attained an educational level/SES indicator greater than the locally defined cut-off points
- Lack of known, major, non-microbial environmental contaminants
- Altitude <1600m

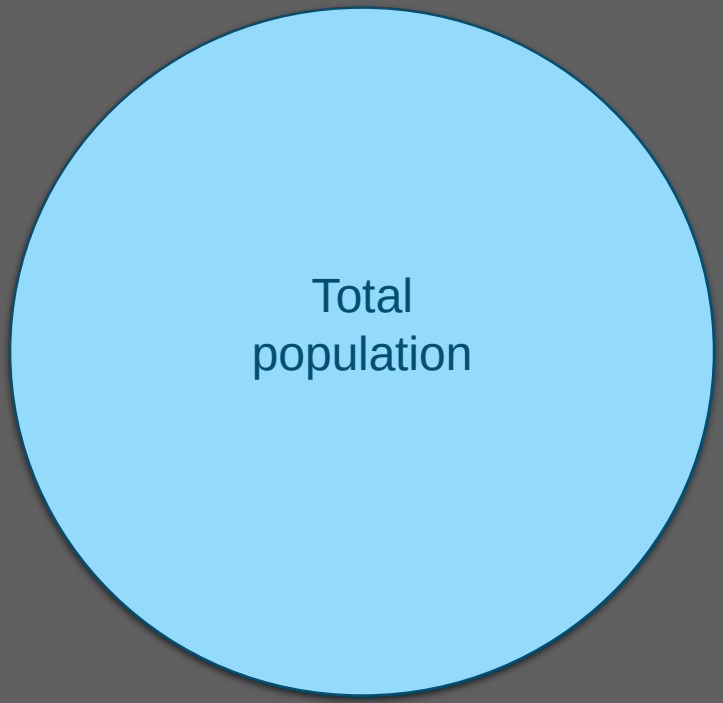
INTERGROWTH-21ST SITES



POPULATION SELECTION

All pregnancies in 8 sites

N = 60,268



Low-risk study population

+

Healthy and well-nourished

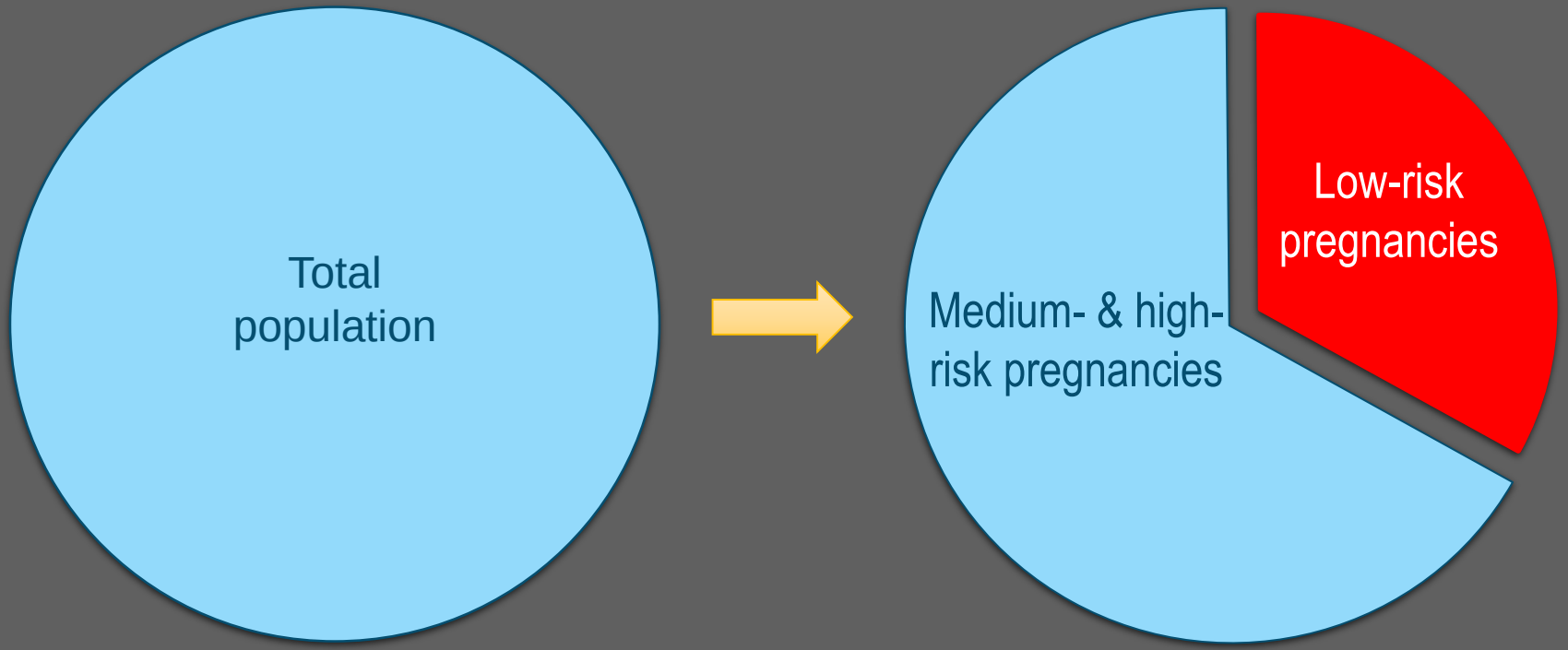
POPULATION SELECTION

All pregnancies in 8 sites

N = 60,268

Low-risk pregnancies

N = 20,486



POPULATION SELECTION
LOW-RISK PREGNANCY CRITERIA

a) aged ≥18 and ≤35 years;
b) BMI ≥18.5 and <30 kg/m^2;
c) height ≥ 153 cm;
d) singleton pregnancy;
e) a known LMP with regular cycles (defined as a 26-30 day cycle in the previous 3 months), without hormonal contraceptive use, pregnancy or breastfeeding in the 3 months before pregnancy;
f) natural conception
g) no relevant past medical history (refer to screening form), with no need for long-term medication (including fertility

Criteria defining a low-risk study population as healthy and well-nourished (both before and during pregnancy) to ensure that fetal growth is optimal

o) no clinically significant atypical red cell alloantibodies;
p) negative urinalysis;
q) systolic blood pressure <140 mmHg and diastolic blood pressure < 90 mmHg;
r) haemoglobin ≥11 g/dl;
s) negative syphilis test and no clinical evidence of any other sexually transmitted diseases, including clinical Trichomoniasis;
t) not in an occupation with risk of exposure to chemicals or toxic substances, or very physically demanding activity to be evaluated by local standards. Also women should not be conducting vigorous or contact sports, as well as scuba diving or similar activities

INTERGROWTH-21ST
THREE COMPLEMENTARY STUDIES

Newborn Cross-Sectional Study (**NCSS**) of all newborns in eight centres over 12 months

Fetal Growth Longitudinal Study (**FGLS**) from $<14^{+0}$ weeks of gestation to birth, with follow-up to age 2

Preterm Postnatal Follow-up Study (**PPFS**) of all preterm infants in FGLS to age 2

INTERGROWTH-21ST
THREE COMPLEMENTARY STUDIES

Newborn Cross-Sectional Study (NCSS)

- Birth weight, length and head circumference for gestational age standards
- Epidemiological studies

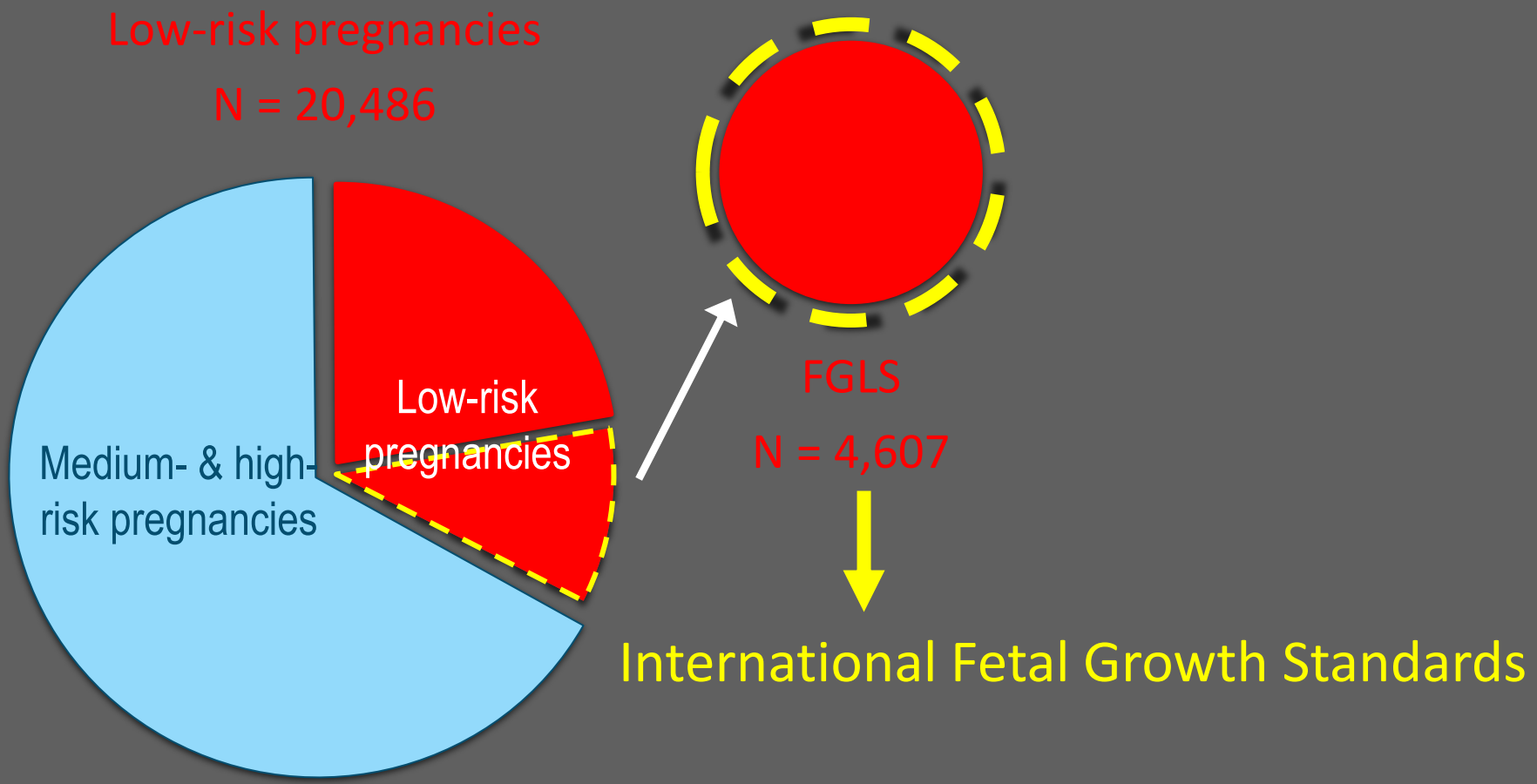
Fetal Growth Longitudinal Study (FGLS)

- International fetal growth standards

Preterm Postnatal Follow-up Study (PPFS)

- Preterm postnatal growth standards

FGLS
TO DEVELOP NEW FETAL GROWTH STANDARDS



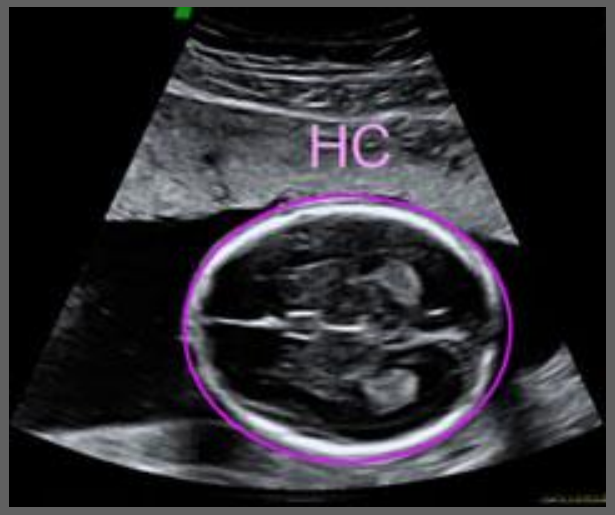
FGLS
TO DEVELOP NEW FETAL GROWTH STANDARDS

Screening Phase (<14 weeks' gestation)

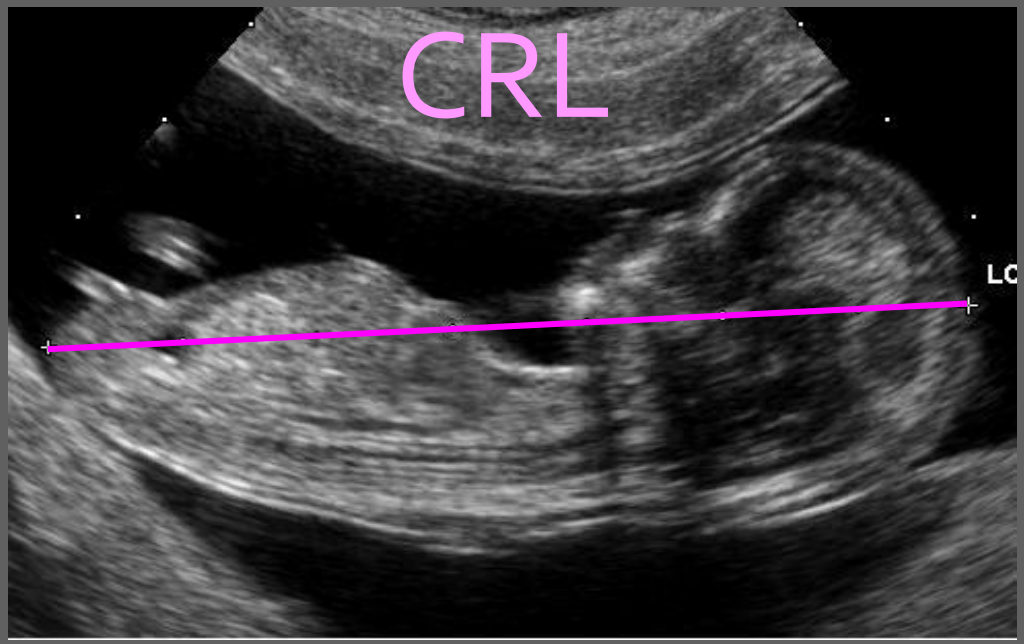
Follow-up Phase: visits every 5 (±1) weeks

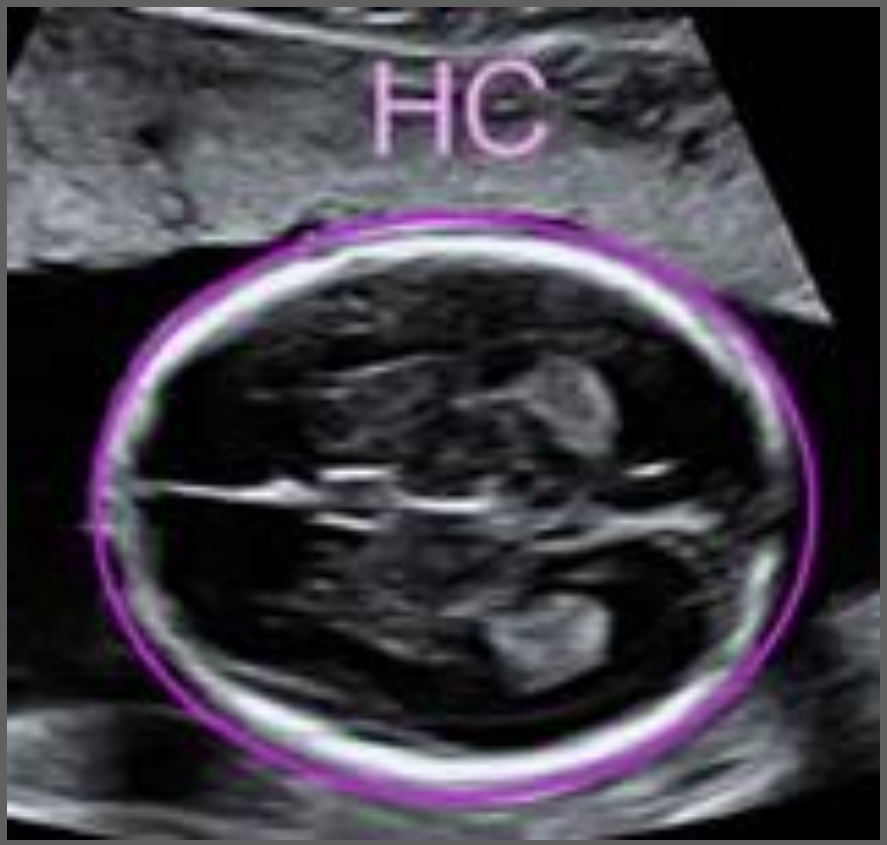
If the woman is referred to another level of care at any stage during her pregnancy, complete a Maternal referral/admission form.

Upon delivery, collect delivery information and anthropometry



ULTRASOUND MEASUREMENTS





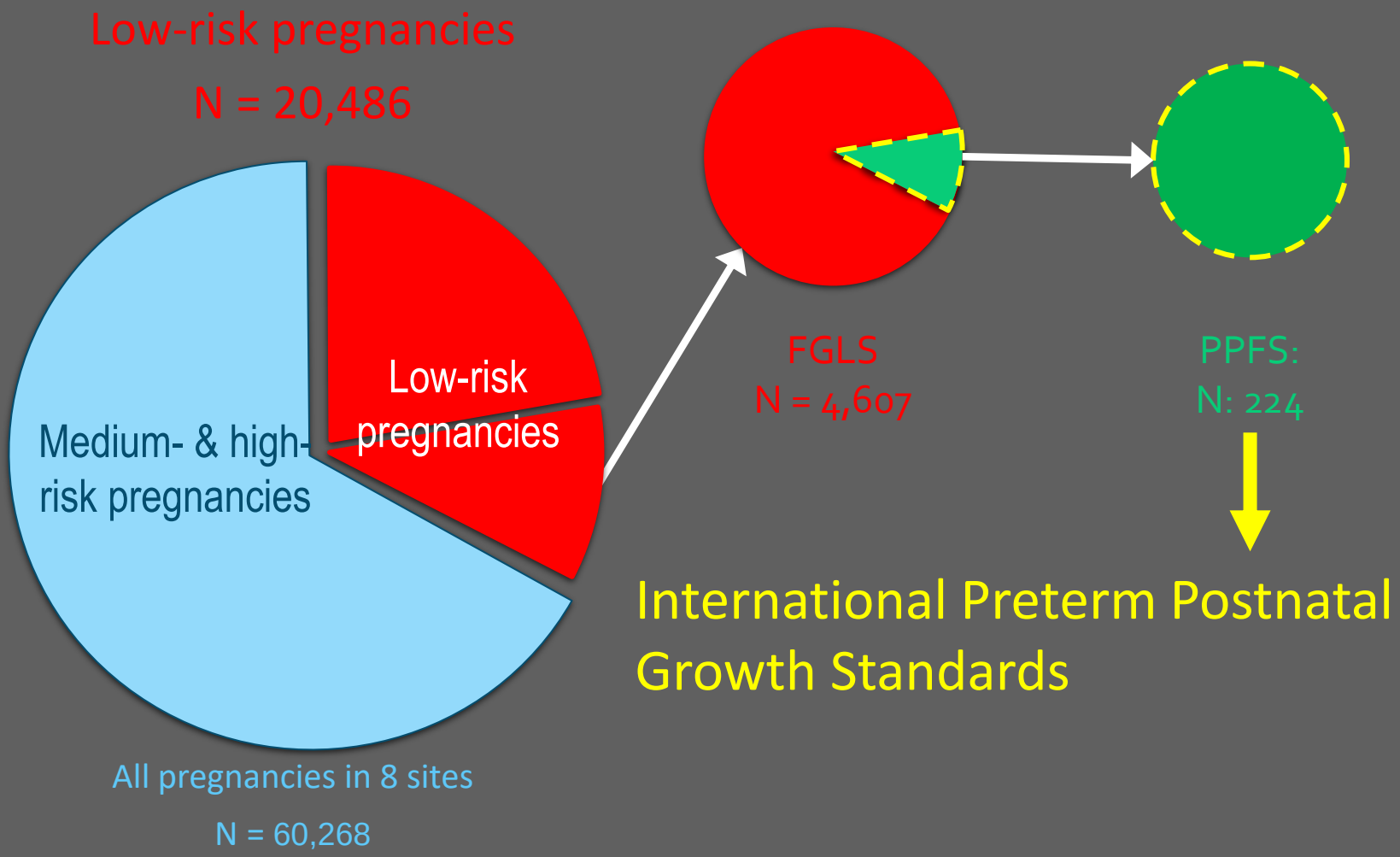
PEAPOD®
INFANT BODY COMPOSITION SYSTEM

COSMED
The Metabolic Company

- 7-minute test
- Estimates body composition by densitometry
- Calculates the amount of fat mass and the fat-free mass
- UK only

Villar et al (2016) JAMA Pediatr (submitted)

PPFS
TO DEVELOP NEW GROWTH STANDARDS FOR PRETERM INFANTS



PPFS
TO DEVELOP NEW GROWTH STANDARDS FOR PRETERM INFANTS

For all babies born to mothers in FGLS at ≥26^{+0} and <37^{+0} weeks of gestation at birth:

Collect delivery information and anthropometry (within 12 hours if possible)

↓

At 48-72 hours after birth, collect health information and anthropometry

↓

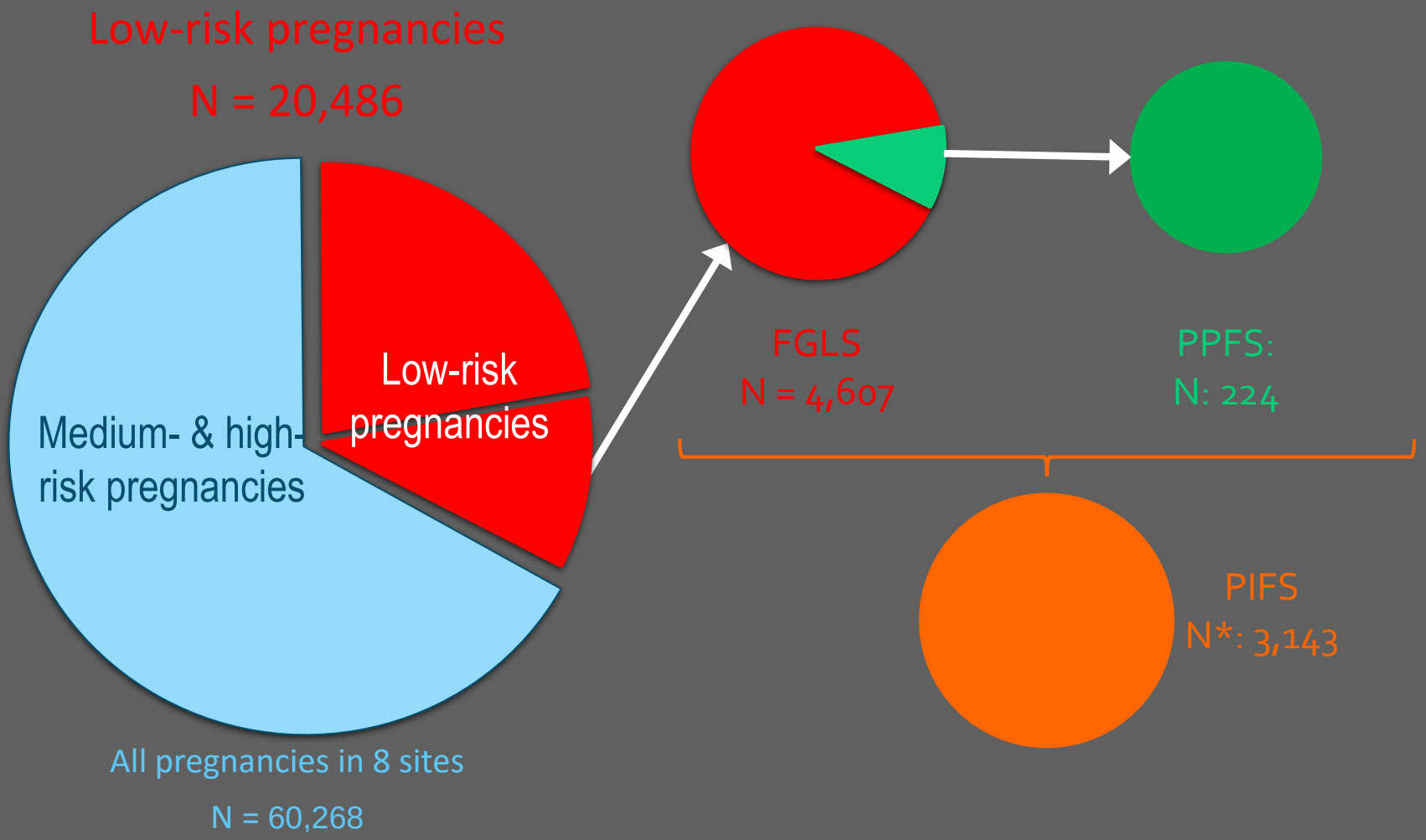
Follow-up visits for 2, 4, 6, and 8 weeks after birth. Collection of health and dietary information and anthropometry

↓

Follow-up visits for 3, 4, 5, 6, 7, and 8 months after birth. Collection of health and dietary information and anthropometry

PIFS

TO STUDY POSTNATAL GROWTH AND DEVELOPMENT UP TO 2 YEARS OF AGE



PIFS

TO STUDY POSTNATAL GROWTH AND DEVELOPMENT UP TO 2 YEARS OF AGE

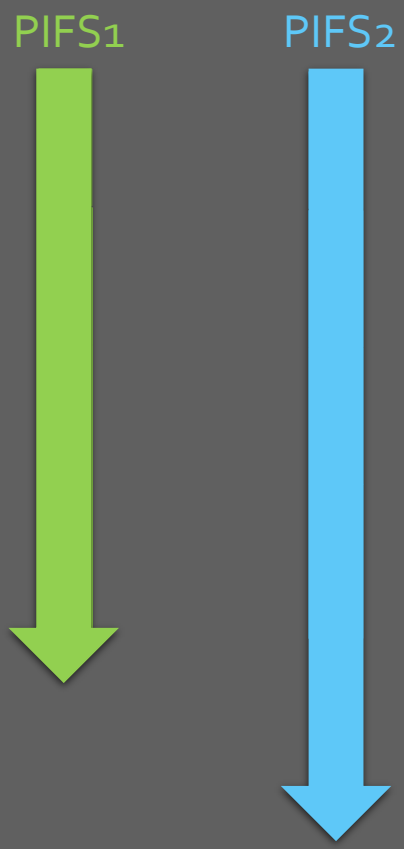
Follow-up visit at 1 year of age. Collect health and dietary information, anthropometry and motor development achievement

Follow-up visit at 2 year of age. Collect health and dietary information, anthropometry, motor development achievement and neurodevelopment assessment

DATA COLLECTED

- Retrospective severe and chronic morbidities, hospital admission and treatments
- Weight, length and head circumference
- 24h Infant Food Recall and Food Frequency Questionnaire
- Milestones achievement

- + Neurodevelopment assessment



NEURODEVELOPMENTAL ASSESSMENT AT 2 YEARS

1. Gross motor function
2. Cognition, language development, behaviour and fine motor skills
3. Vision
4. Hearing
5. Sleep

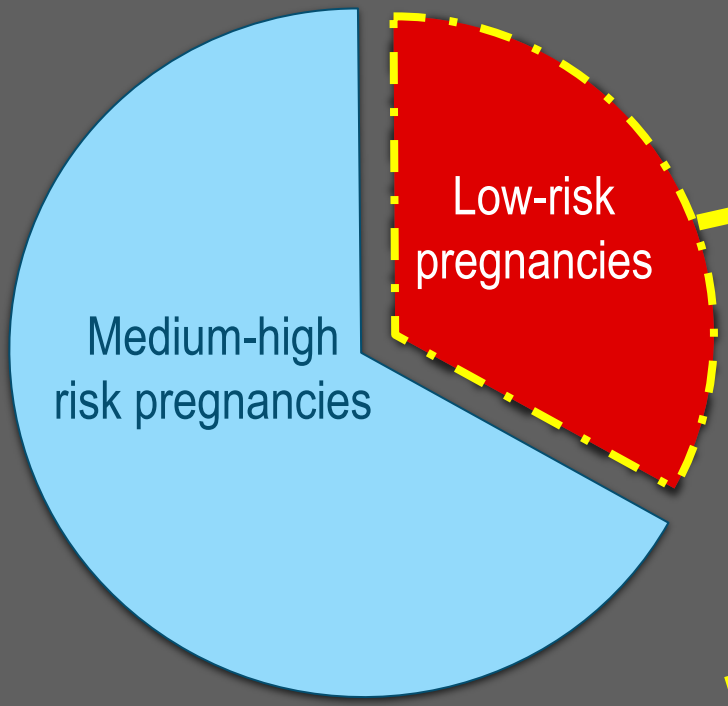
Fernandes et al. (2014) PLoS ONE 9(11)

NCSS

TO PRODUCE SIZE AT BIRTH OR GESTATIONAL AGE STANDARDS AND EPIDEMIOLOGICAL STUDIES

Low-risk pregnancies

n = 20,486



International Newborn Size for Gestational Age/Sex Standards (Birthweight, length and head circumference)

Epidemiological studies*

All pregnancies in 8 sites

N = 60,268

** Barros (2015) JAMA Pediatr 169(3)*
Victora et al. (2015) JAMA Pediatr 169(7)

NCSS
TO PRODUCE SIZE AT BIRTH OR GESTATIONAL AGE STANDARDS AND EPIDEMIOLOGICAL STUDIES

For every baby born in each hospital during the 12 month NCSS period the Pregnancy and Delivery form will be completed:

Anthropometric measurements (weight, length and head circumference) within 12 hours of birth (no later than 24 hours)

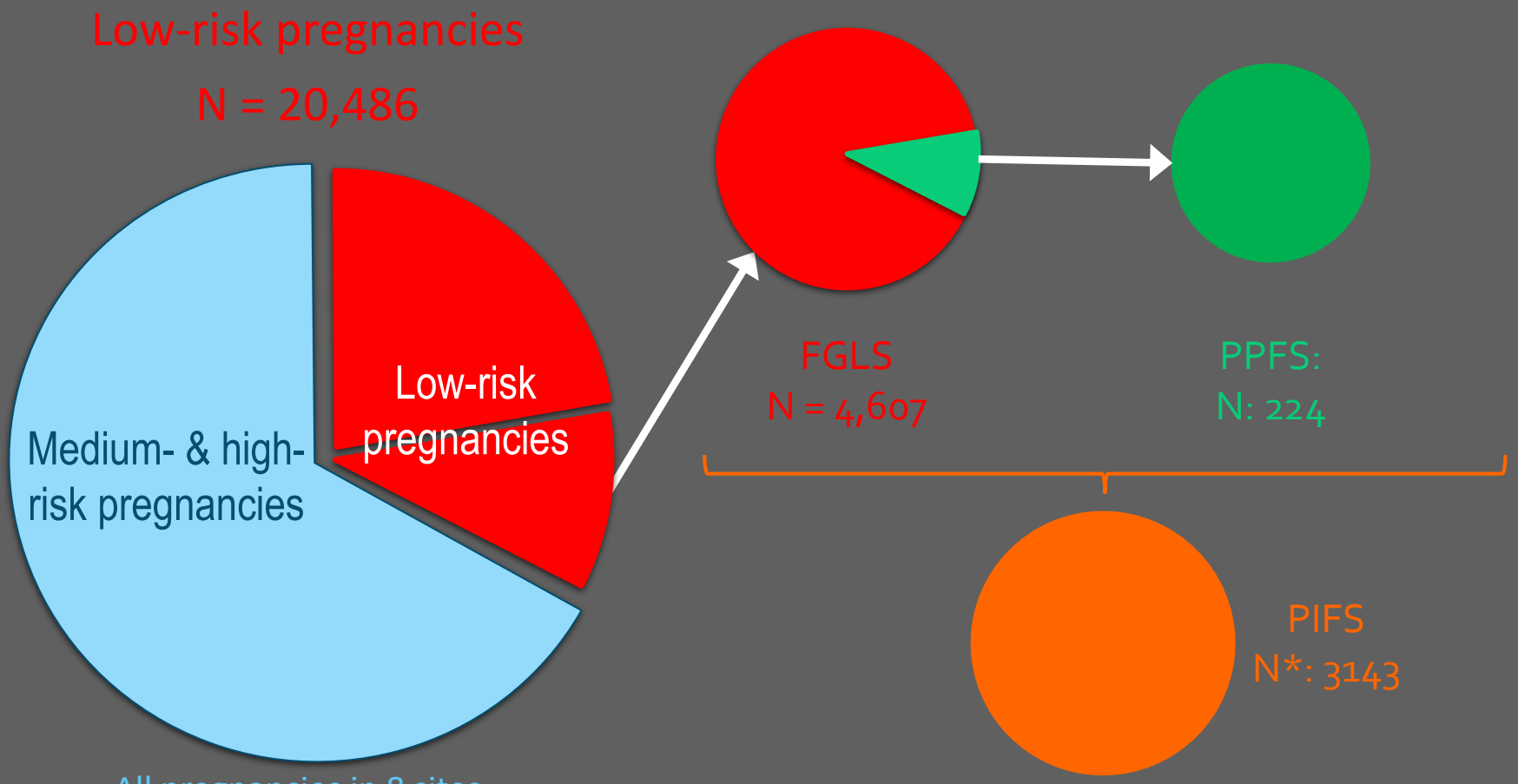
↓

After delivery, collect delivery information

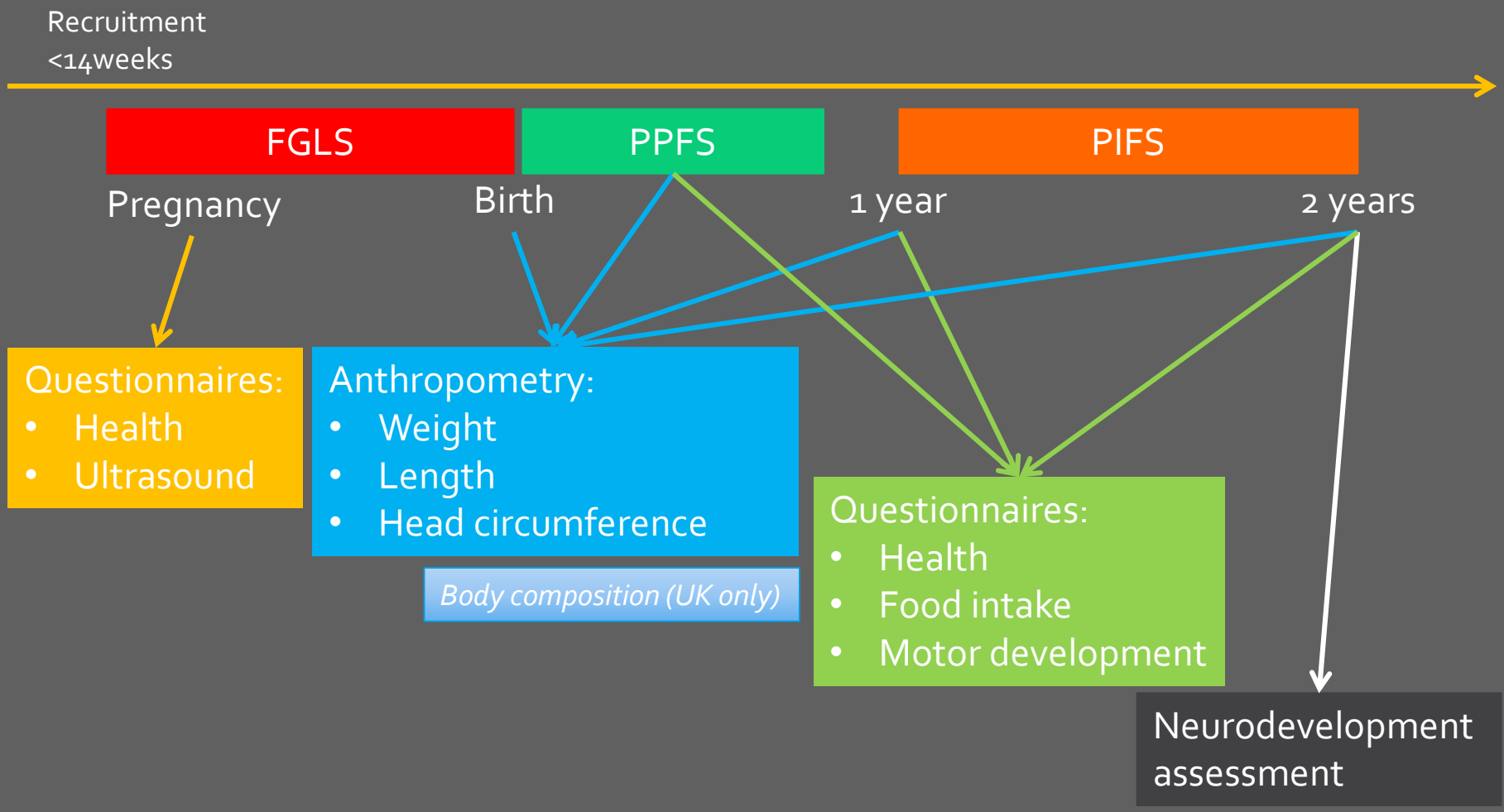
↓

NO FURTHER follow-up of these babies required after hospital discharge

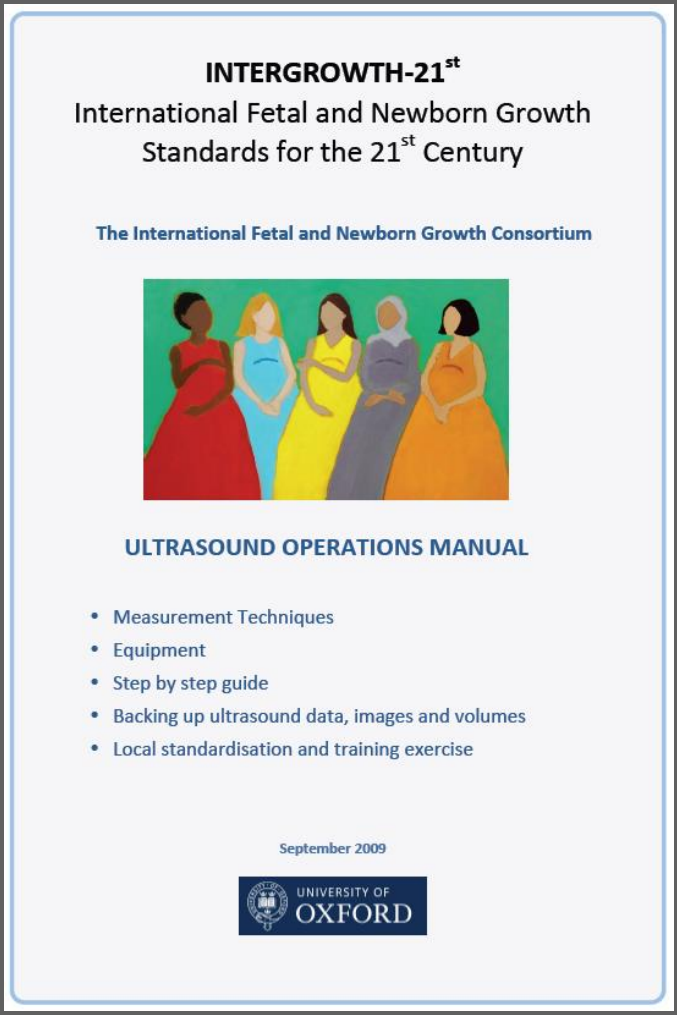
INTERGROWTH-21ST POPULATIONS



TIMELINE


Recruitment
<14weeks
FGLS
PPFS
PIFS
Pregnancy
Birth
1 year
2 years
Questionnaires:
• Health
• Ultrasound
Anthropometry:
• Weight
• Length
• Head circumference
Body composition (UK only)
Questionnaires:
• Health
• Food intake
• Motor development
Neurodevelopment assessment

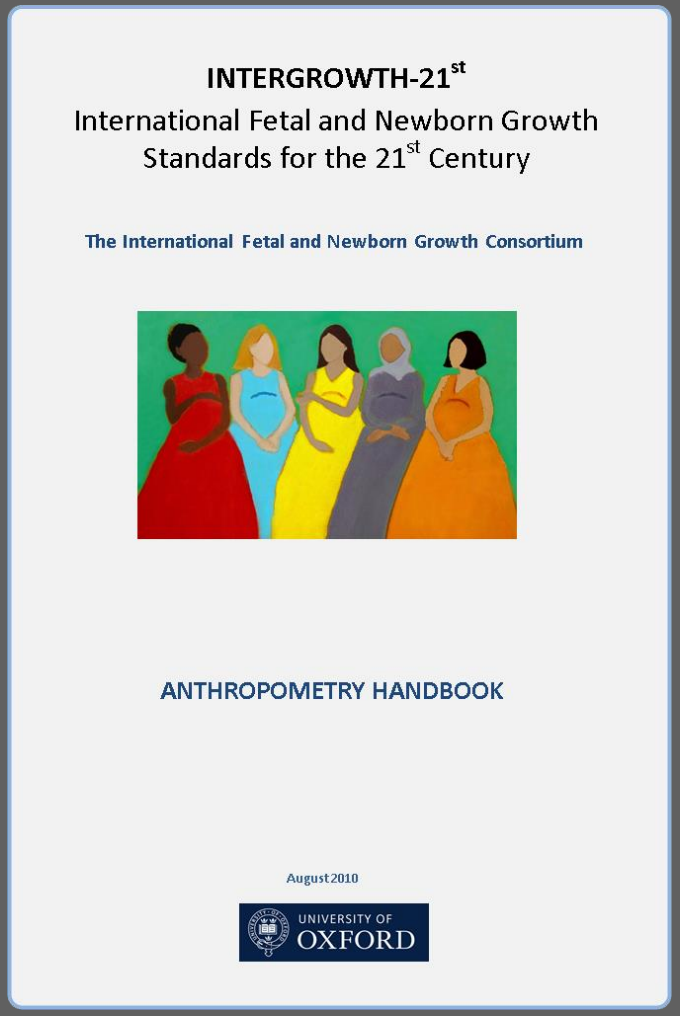
ULTRASOUND OPERATIONS MANUAL



Detailed instructions on:

- Measurement techniques
- Equipment
- Step-by-step guide
- Data management
- Local standardisation and training exercises

ANTHROPOMETRY HANDBOOK



Detailed instructions on:

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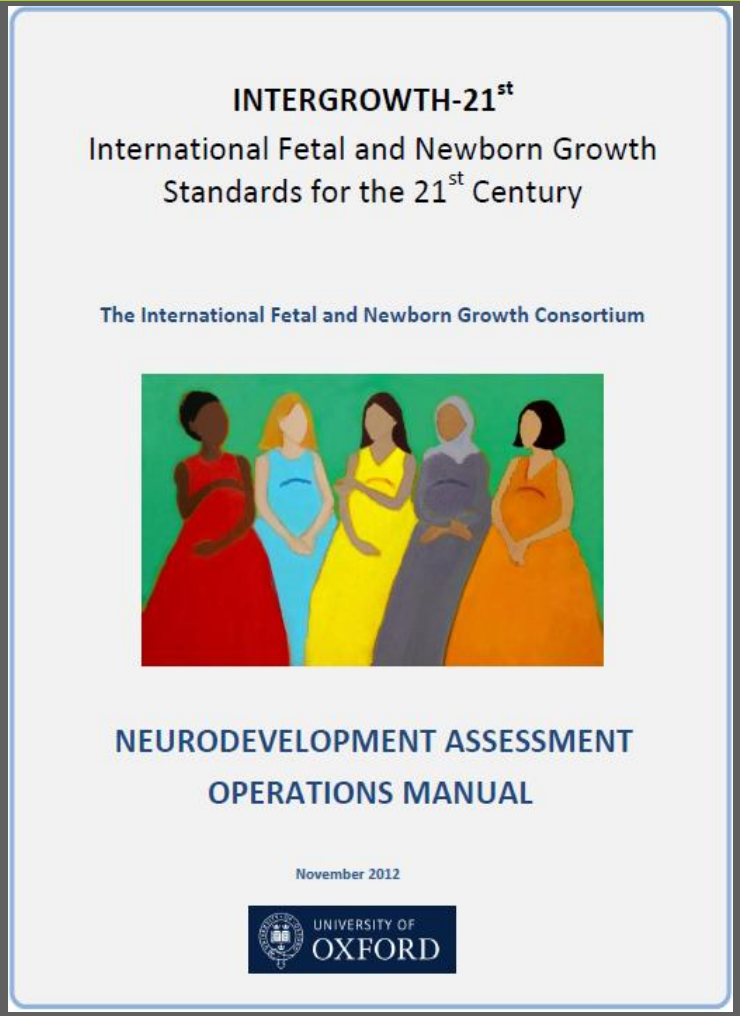
NEURODEVELOPMENT ASSESSMENT MANUAL OF OPERATIONS



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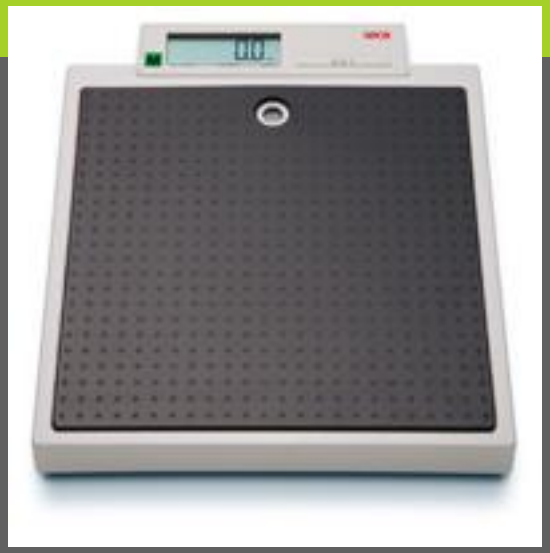
ANTHROPOMETRIC MEASUREMENTS

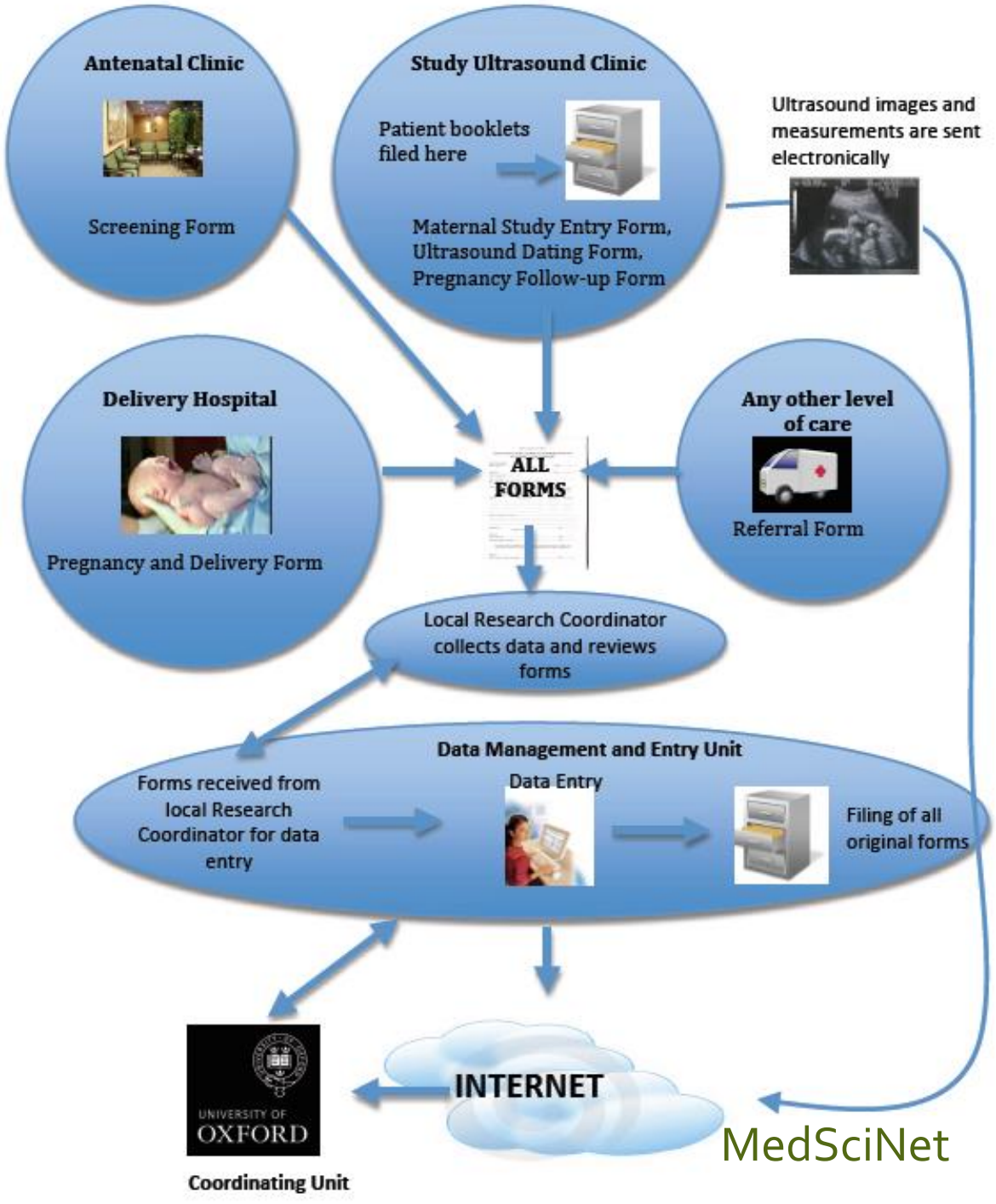


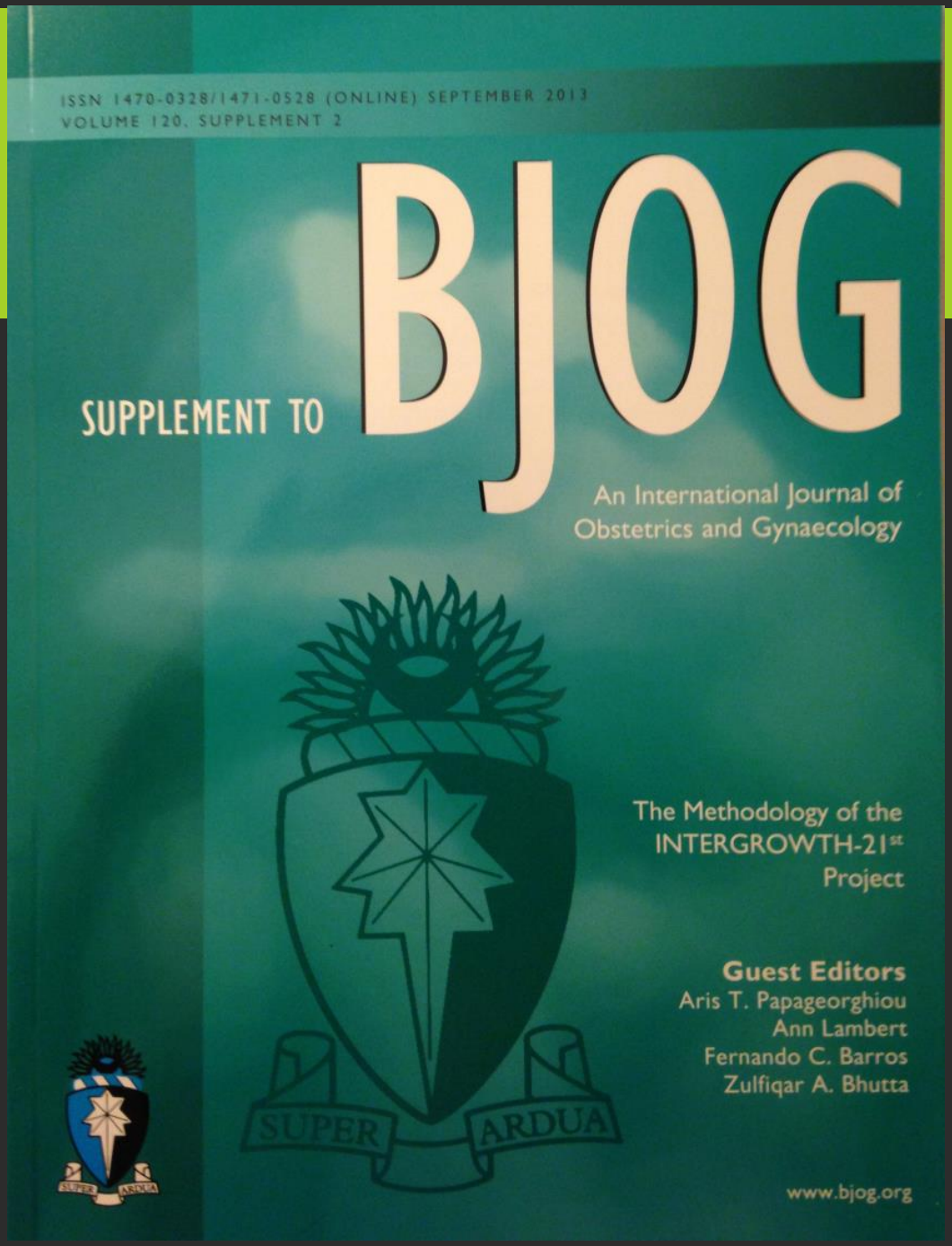
QUALITY CONTROL PROCEDURES

For example, for anthropometry:

- Validations in database
- QC (5% or 10%)
- Anthropometry repetition rates
- Anthropometry rounding rates
- Measurement windows – check that visits are within pre-set ranges
- Anthropometric standardisation every 3 months

DATA MANAGEMENT





The Methodology of the INTERGROWTH-21st Project

21 papers

- Concepts and rationale
- Study protocol
- Statistical issues
- Training methods
- Standardisation processes
- Quality control measures
- Country-specific papers
- Data management

***BJOG* Vol.120 Suppl 2**
(16 Sept 2013)
Available freely online
www.bjog.org

A rapid questionnaire assessment of environmental exposures to pregnant women in the INTERGROWTH-21st Project

B Eskenazi,[a] A Bradman,[a] D Finkton,[b] M Purwar,[c] JA Noble,[d] R Pang,[e] O Burnham,[b] L Cheikh Ismail,[b] F Farhi,[b] FC Barros,[f,g] A Lambert,[b] AT Papageorghiou,[b] M Carvalho,[h] YA Jaffer,[i] E Bertino,[j] MG Gravett,[k] DG Altman,[l] EO Ohuma,[b] SH Kennedy,[b,*] ZA Bhutta,[m,*] J Villar,[b,*] for the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st)

[a] Center for Environmental Research and Children's Health (CERCH), School of Public Health, University of California, Berkeley, CA, USA [b] Nuffield Department of Obstetrics & Gynaecology and Oxford Maternal & Perinatal Health Institute, University of Oxford, Oxford, UK [c] Nagpur INTERGROWTH Research Centre, Ketkar Hospital, Nagpur, India [d] Department of Engineering Science, University of Oxford, Oxford, UK [e] School of Public Health, Peking University, Beijing, China [f] Programa de Pós-Graduação em Saúde e Comportamento, Universidade Católica de Pelotas, [g] Programa de Pós-Graduação em Epidemiologia, Universidade Federal de Pelotas, Pelotas, Brazil [h] Faculty of Health Sciences, Aga Khan University, Nairobi, Kenya [i] Department of Family & Community Health, Ministry of Health, Muscat, Sultanate of Oman [j] Dipartimento di Scienze Pediatriche e dell'Adolescenza, Cattedra di Neonatologia, Università degli Studi di Torino, Torino, Italy [k] University of Washington School of Medicine, Seattle, WA, USA [l] Centre for Statistics in Medicine, University of Oxford, Oxford, UK [m] Division of Women & Child Health, The Aga Khan University, Karachi, Pakistan

Eskenazi (2013) BJOG 120 (Suppl 2): 129-38

Standardisation and quality control of ultrasound measurements taken in the INTERGROWTH-21st Project

I Sarris,[a] C Ioannou,[a] EO Ohuma,[a,b] DG Altman,[b] L Hoch,[a] C Cosgrove,[a] S Fathima,[a,c] LJ Salomon,[d] AT Papageorghiou,[a] for the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st)

[a] Nuffield Department of Obstetrics & Gynaecology and Oxford Maternal & Perinatal Health Institute, Green Templeton College, University of Oxford, Oxford, UK [b] Centre for Statistics in Medicine, University of Oxford, Oxford, UK [c] Department of Engineering Science, Institute of Biomedical Engineering, University of Oxford, Oxford, UK [d] Université Paris V—René Descartes, Maternité Hôpital Necker-Enfants Malades, AP-HP, Paris, France

Correspondence: Dr AT Papageorghiou, Nuffield Department of Obstetrics & Gynaecology, University of Oxford, Women's Centre, Level 3, John Radcliffe Hospital, Oxford, OX3 9DU, UK. Email aris.papageorghiou@obs-gyn.ox.ac.uk

Sarris (2013) BJOG 120 (Suppl 2): 33-7

Anthropometric standardisation and quality control protocols for the construction of new, international, fetal and newborn growth standards: the INTERGROWTH-21st Project

L Cheikh Ismail,[a] HE Knight,[a] EO Ohuma,[a] L Hoch,[a] WC Chumlea,[b] for the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st)

[a] Nuffield Department of Obstetrics & Gynaecology, and Oxford Maternal & Perinatal Health Institute, Green Templeton College, University of Oxford, Oxford, UK [b] Lifespan Health Research Center, Departments of Community Health and Pediatrics, Boonshoft School of Medicine, Wright State University, Dayton, OH, USA

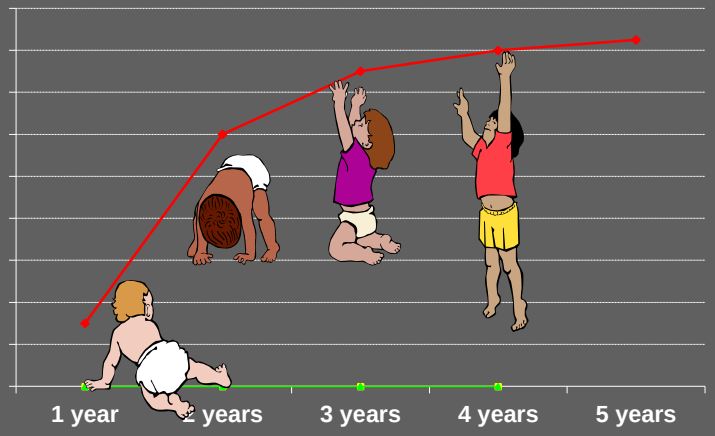
Correspondence: Dr L Cheikh Ismail, Nuffield Department of Obstetrics & Gynaecology, University of Oxford, Women's Centre, Level 3, John Radcliffe Hospital, Headington, Oxford OX3 9DU, UK. Email leila.cheikhismail@obs-gyn.ox.ac.uk

Cheikh Ismail (2013) BJOG 120 (Suppl 2): 48-55

INTERGROWTH-21ST PRODUCTS

WHO CHILD GROWTH STANDARDS

'The new growth standards are referable to all children everywhere, clearly show that all children in the world can and should grow equally well, and also demonstrate that in today's world adequate nutrition, environment, and health are stronger determinants of growth than are gender or ethnicity'.



international pediatric association
association internationale de pédiatrie
asociación internacional de pediatría

20th April 2006

World Health Organization

de Onis et al. (2006) *Acta Paediatr* 450:1-101

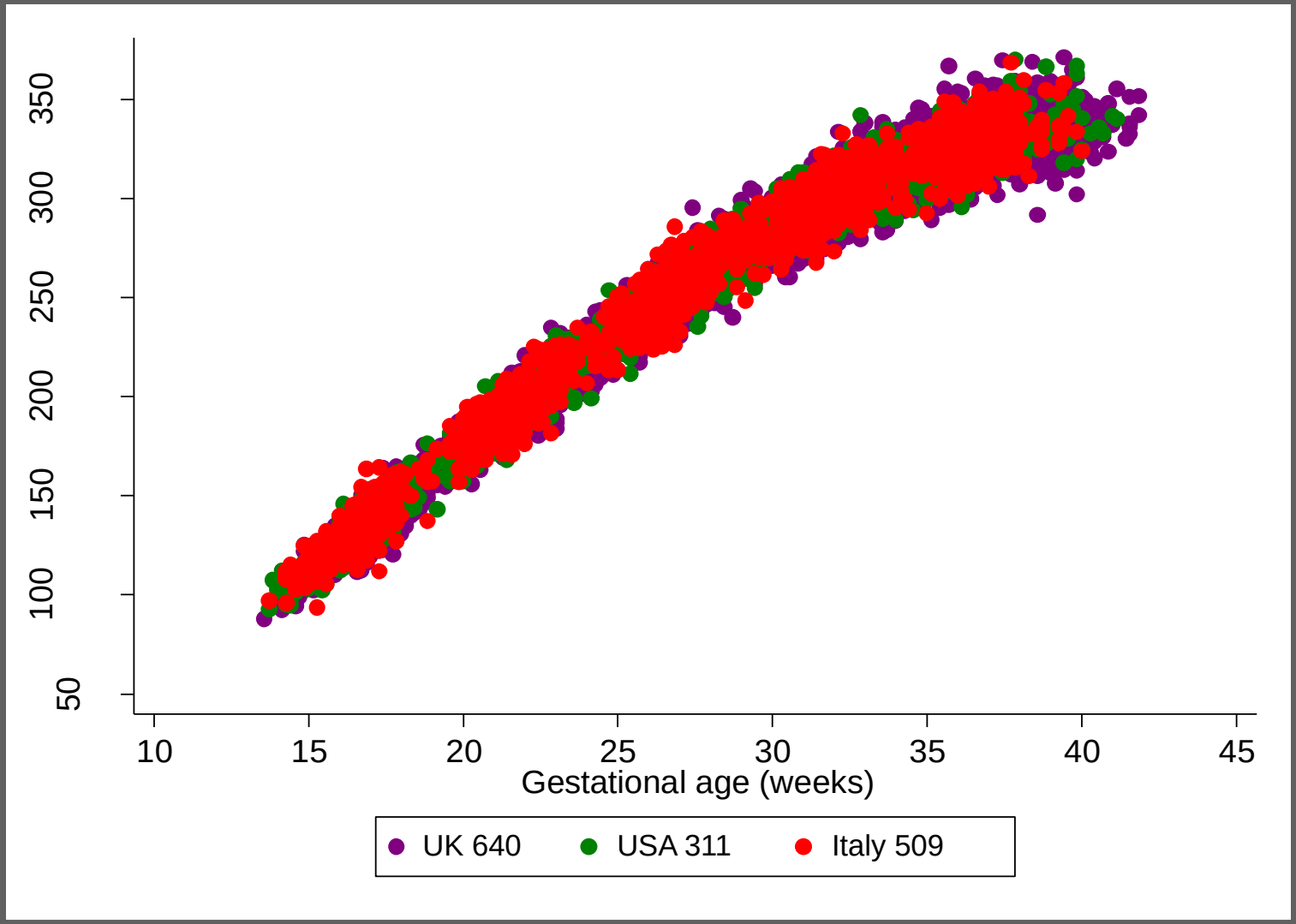
DATA POOLING

Large differences exist in size at birth and in rates of impaired fetal growth worldwide.

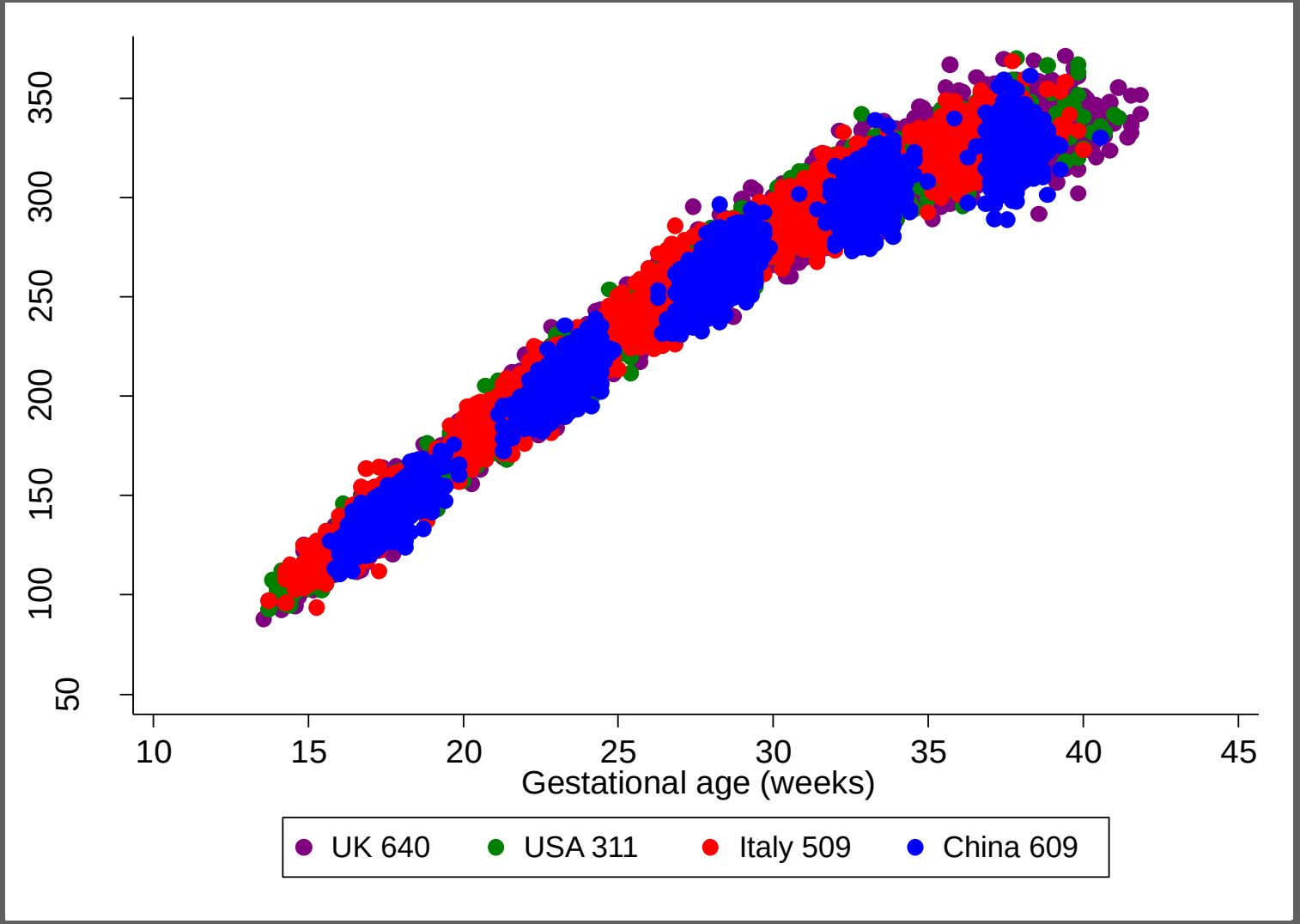
Could the INTERGROWTH-21ST Project data be pooled together?

Fetal HC by gestational age

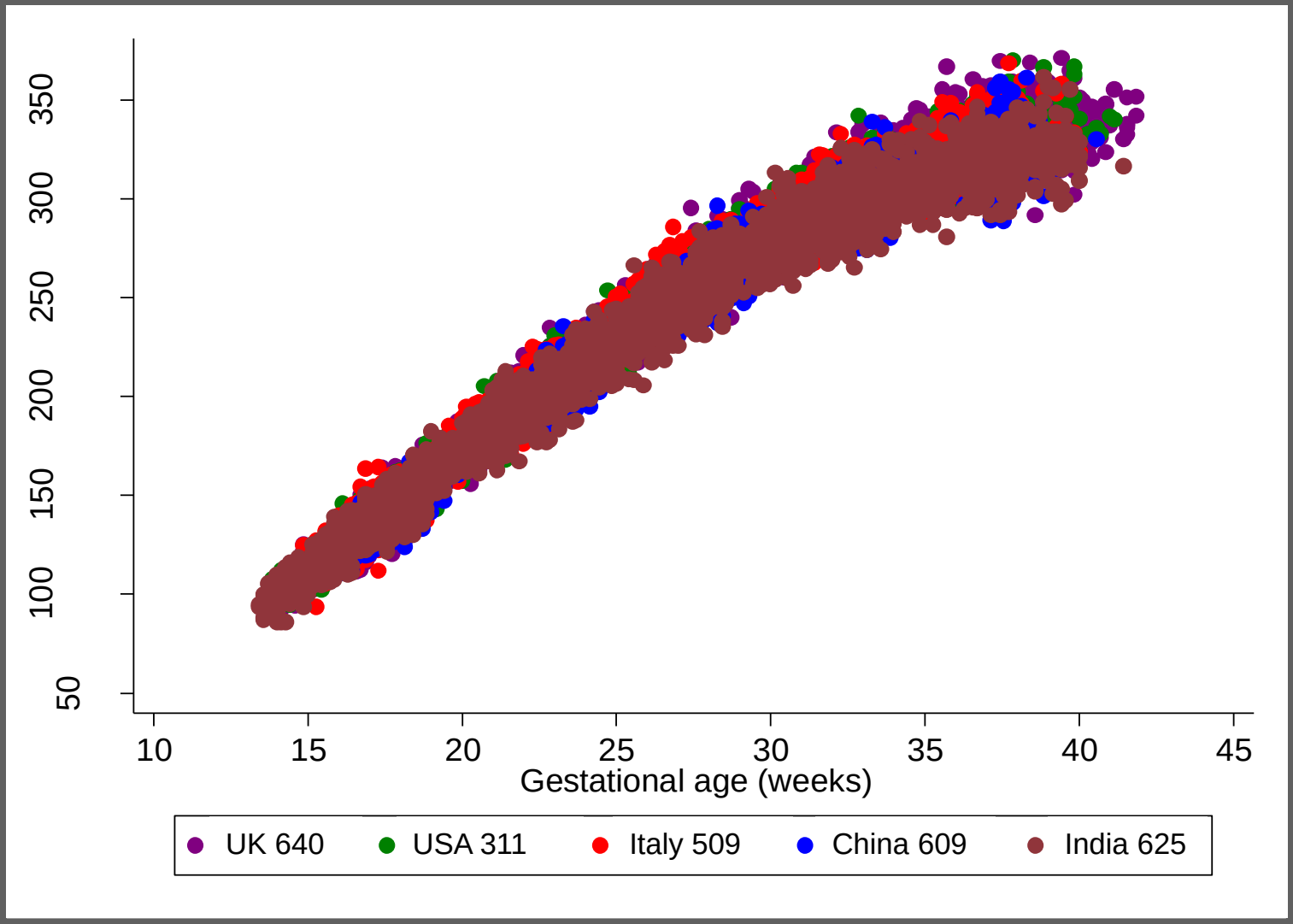
Fetal HC by gestational age for UK, USA & Italy



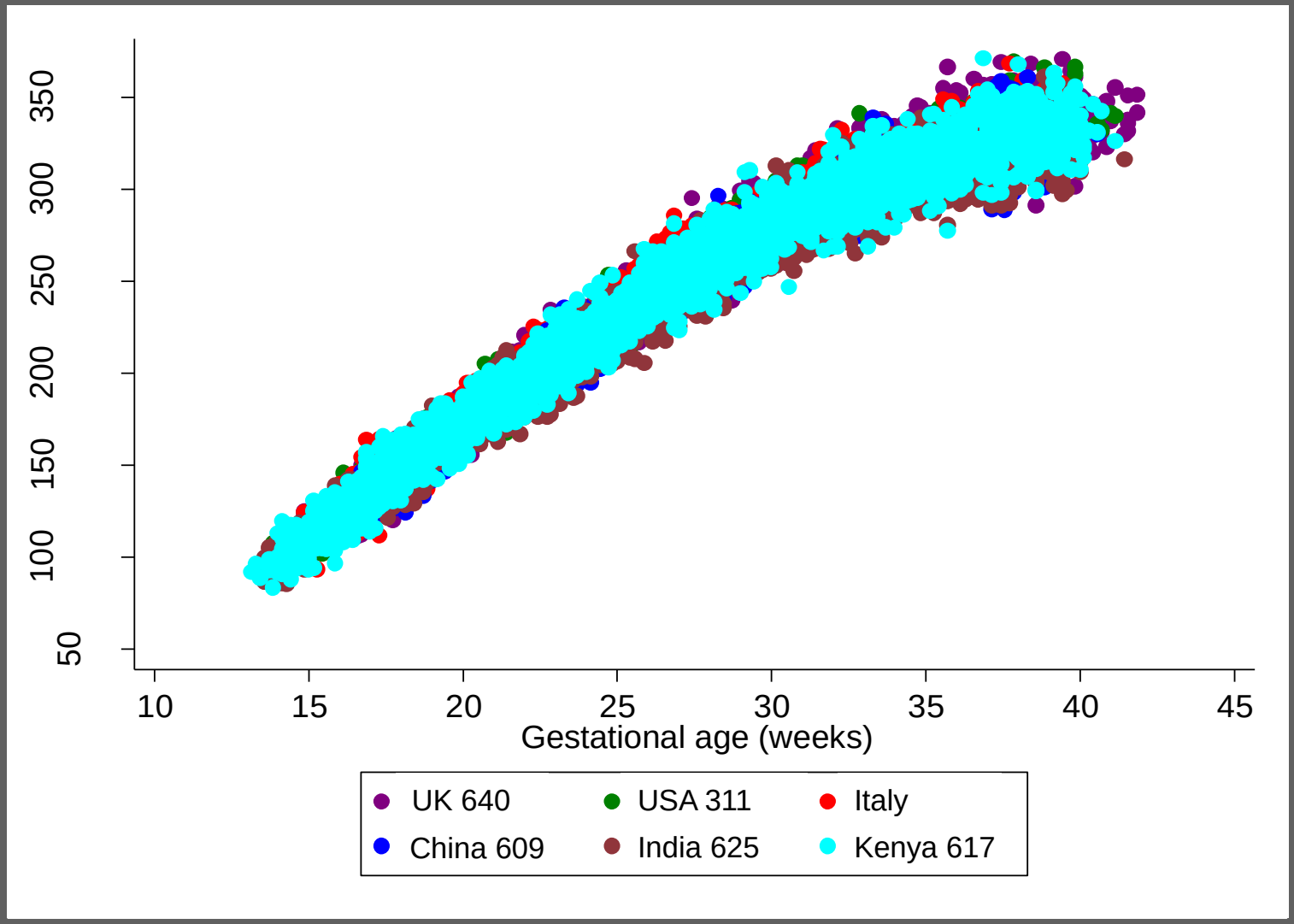
Fetal HC by gestational age for UK, USA, Italy & China



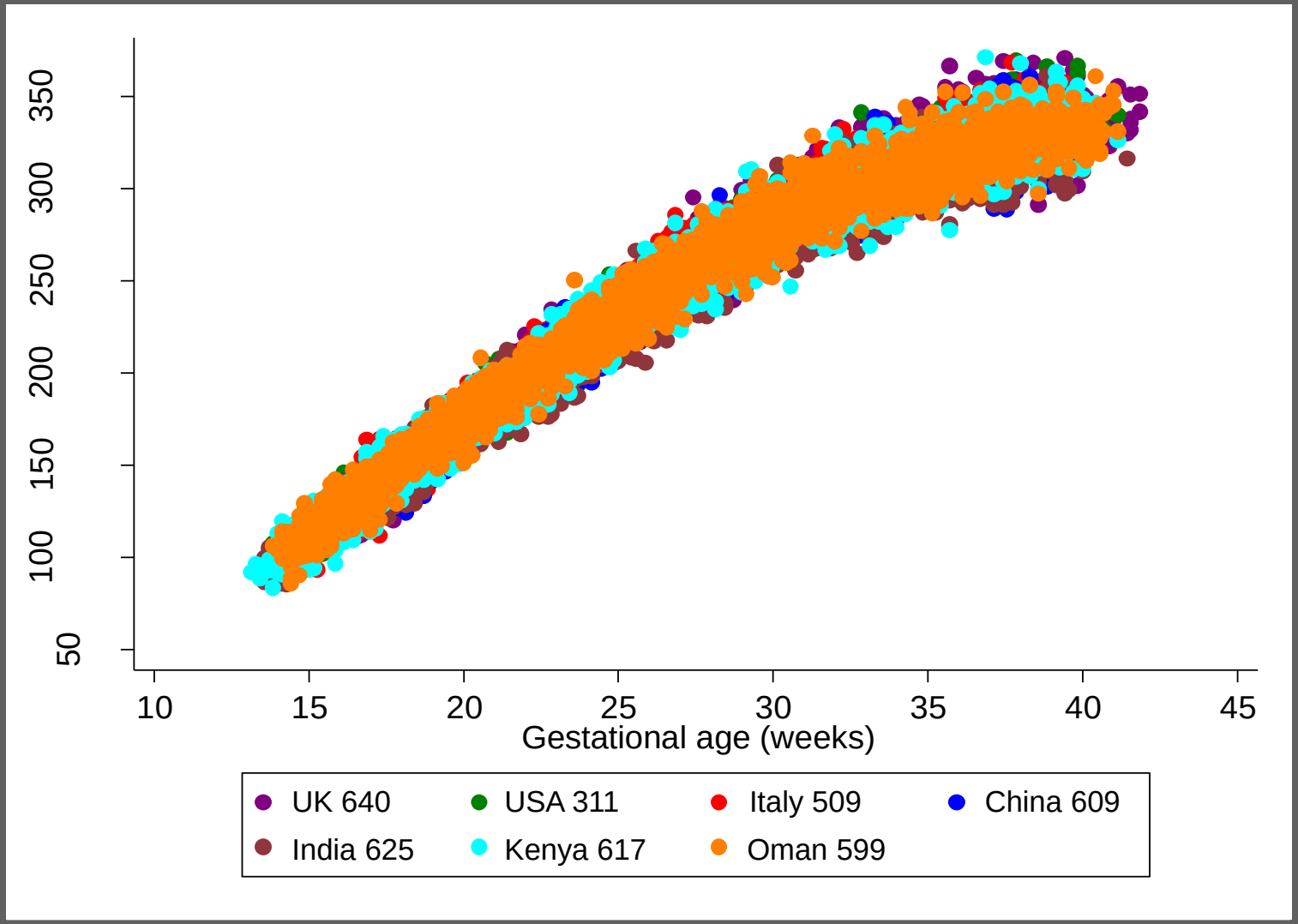
Fetal HC by gestational age for UK, USA, Italy, China & India



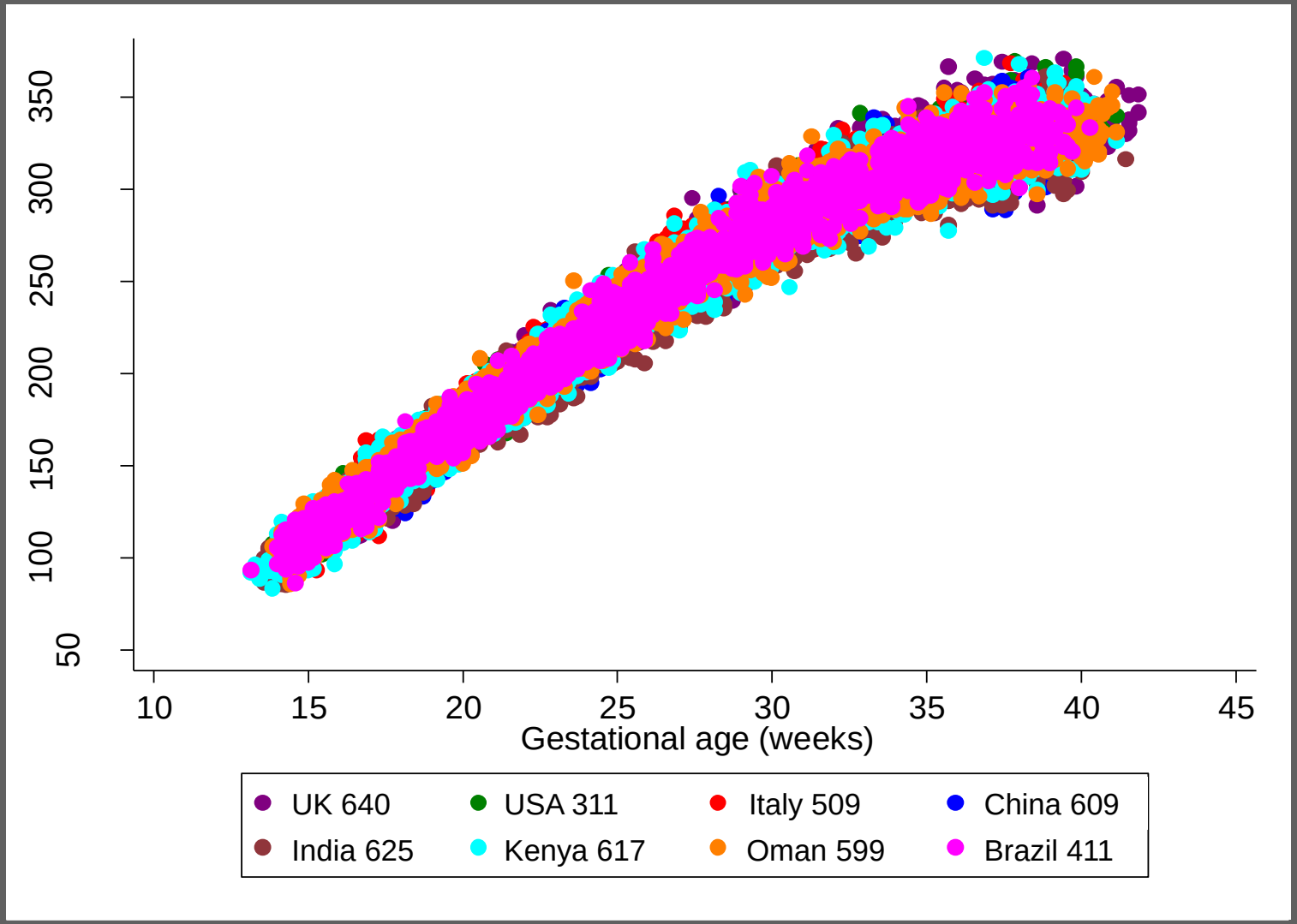
Fetal HC by gestational age for UK, USA, Italy, China, India & Kenya



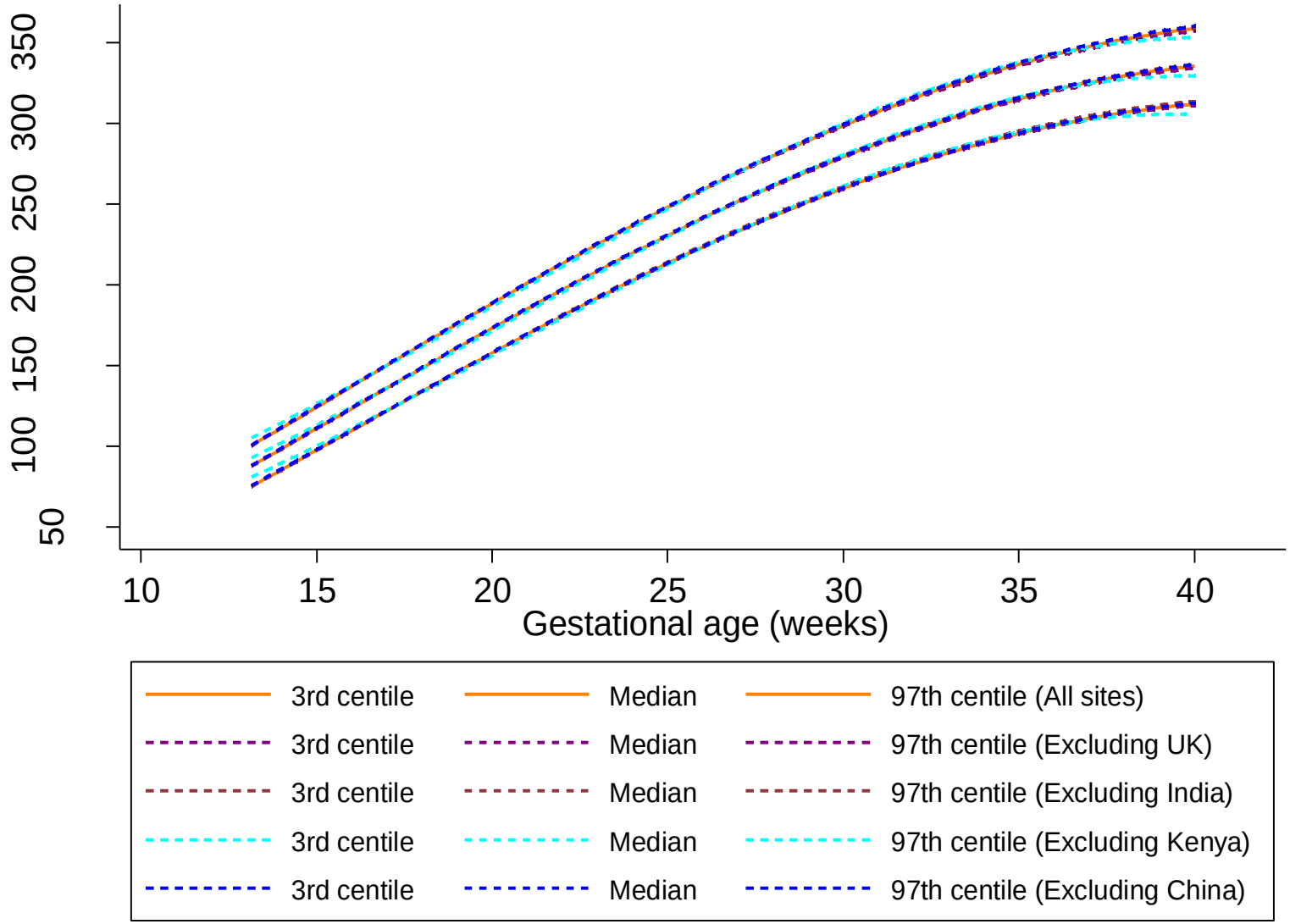
Fetal HC by gestational age for UK, USA, Italy, China, India, Kenya & Oman



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

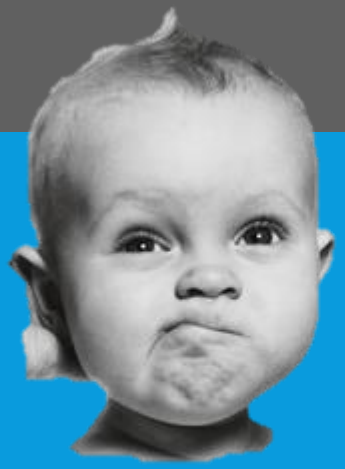


Sensitivity analysis for fetal HC measures: All 8 sites, excluding UK, India, China & Kenya separately



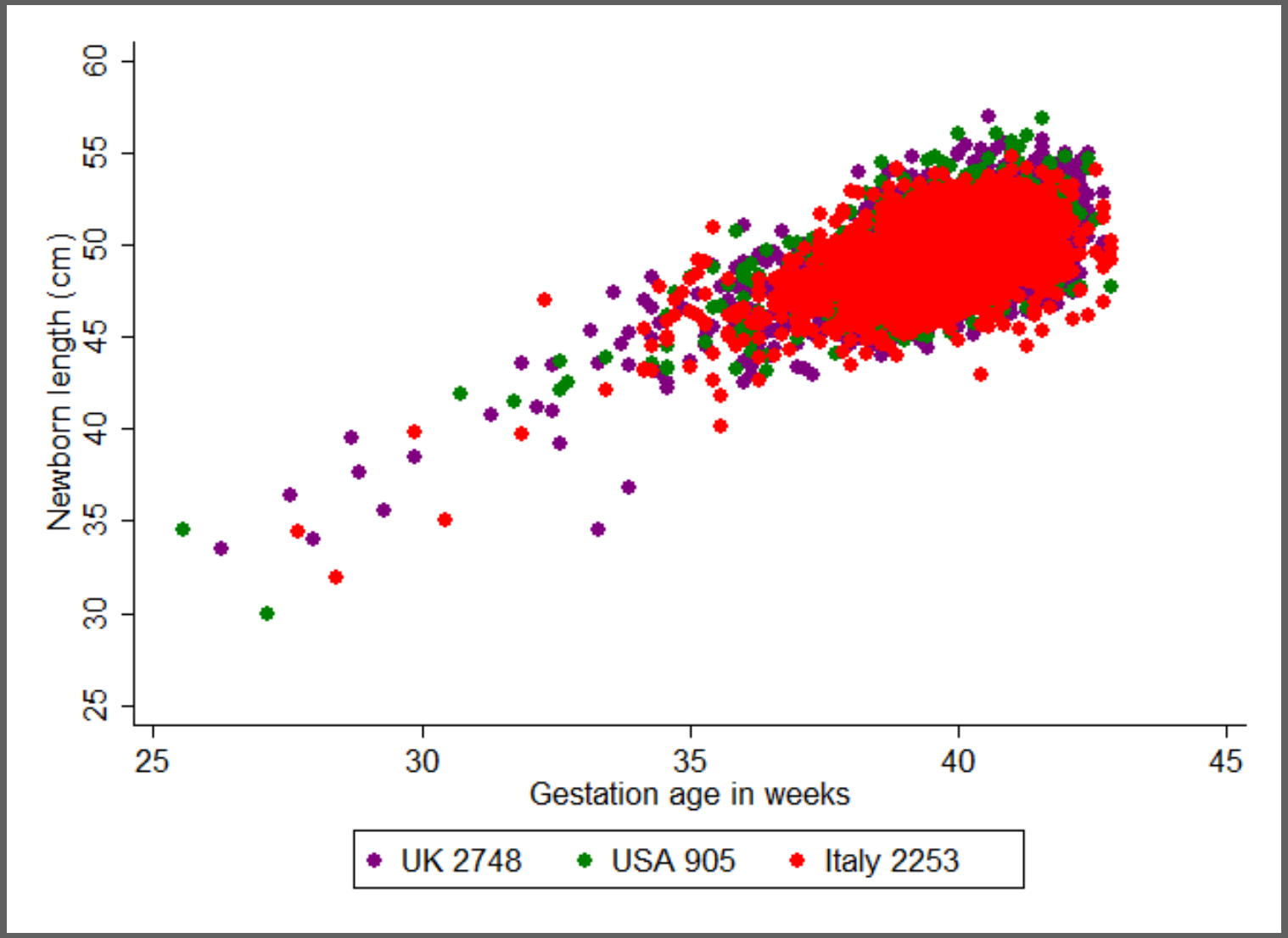
Fetal growth is similar across diverse geographical settings when mothers' nutritional and health needs are met, and environmental constraints on growth are low

?

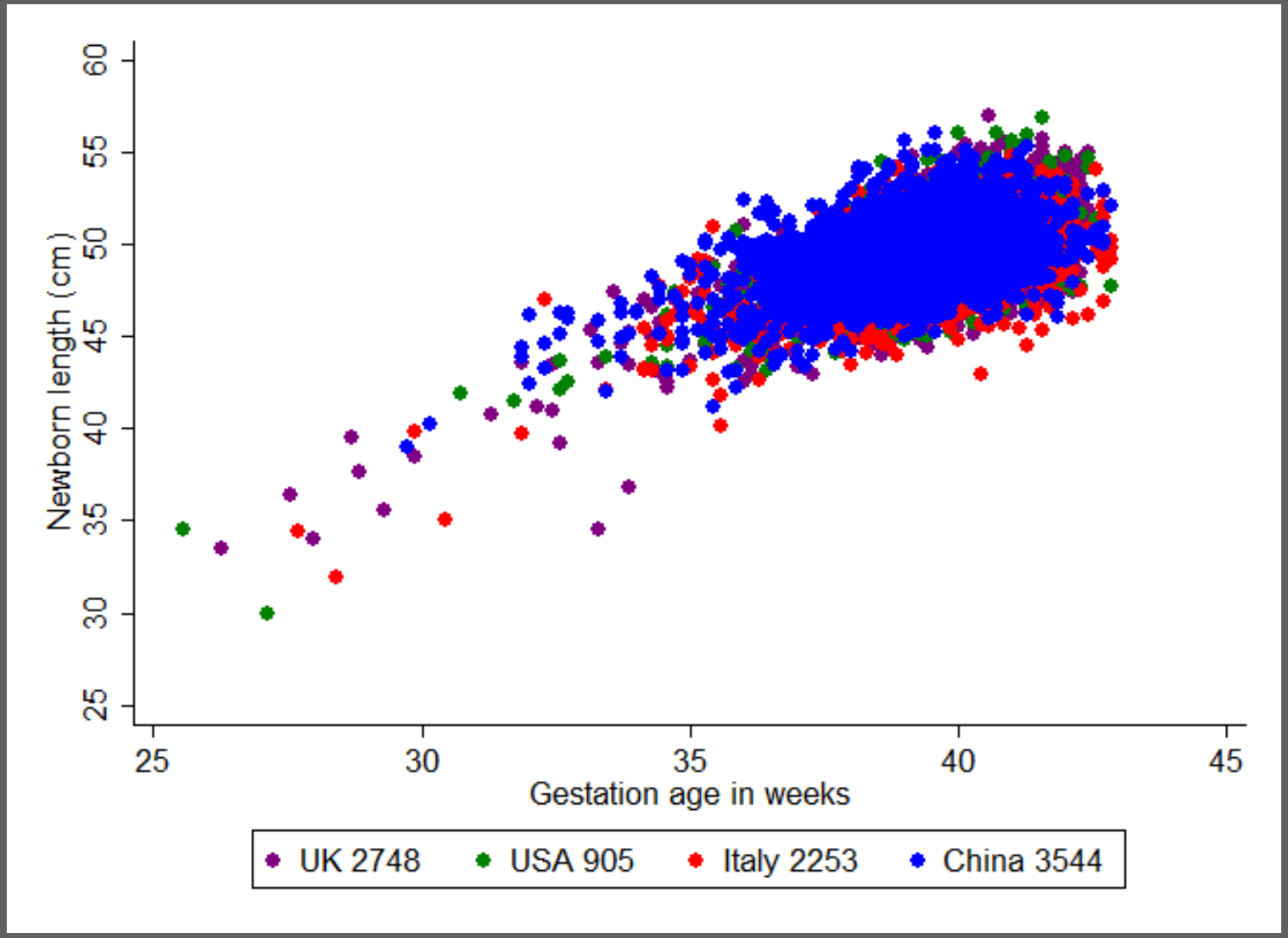


WHAT ABOUT SIZE AT BIRTH?

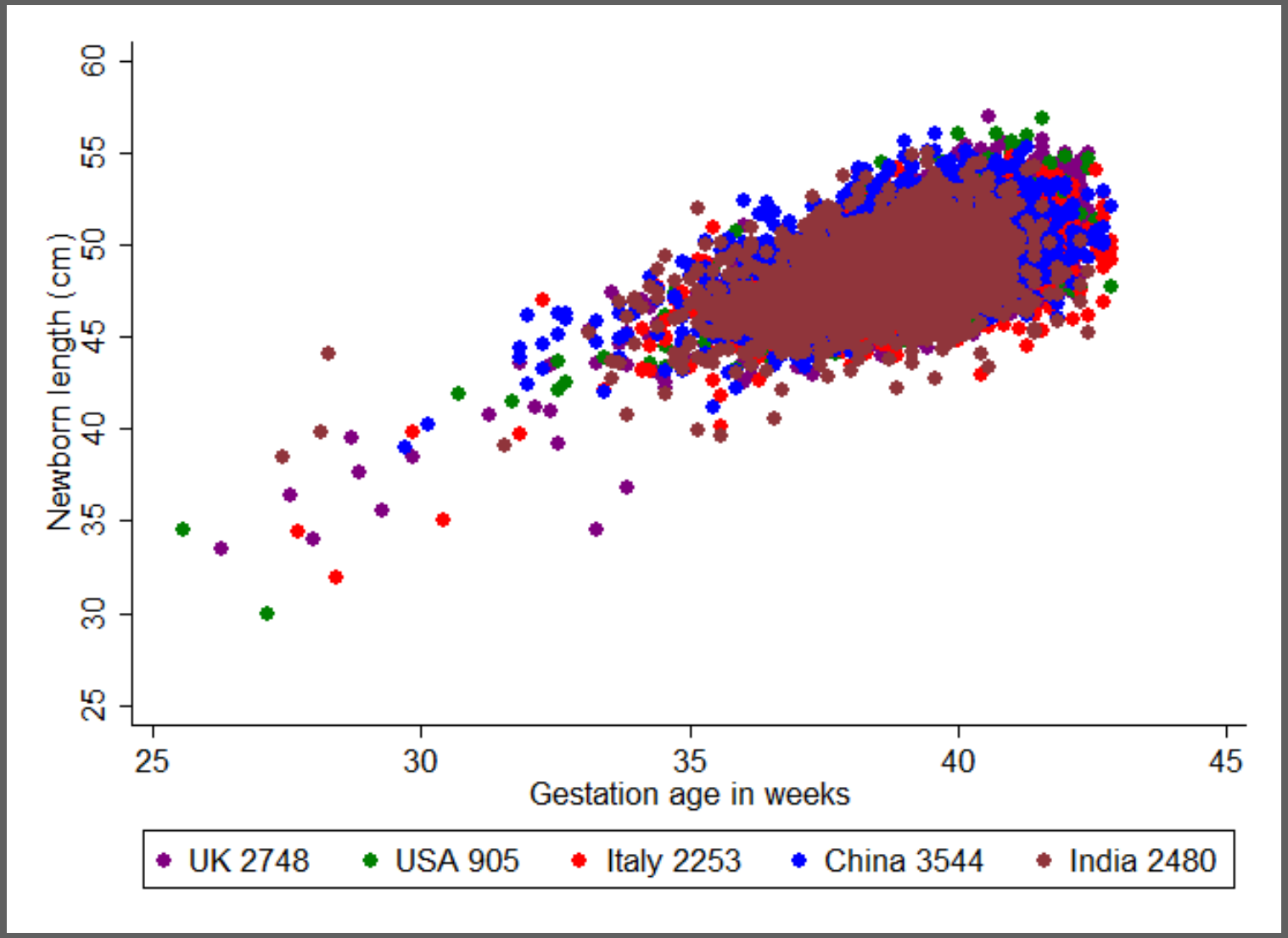
Newborn length by gestational age for UK, USA and Italy



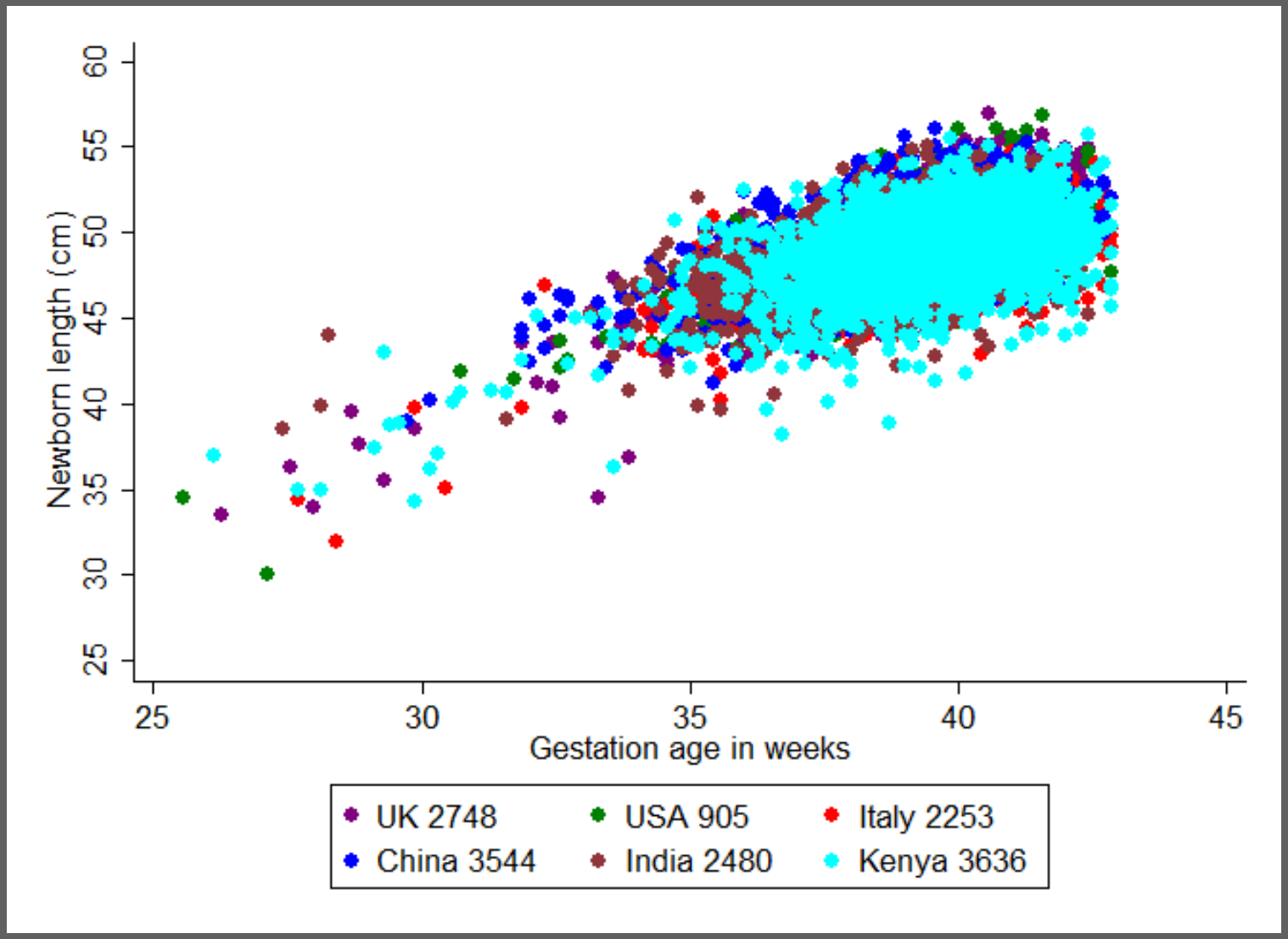
Newborn length by gestational age for UK, USA, Italy and China



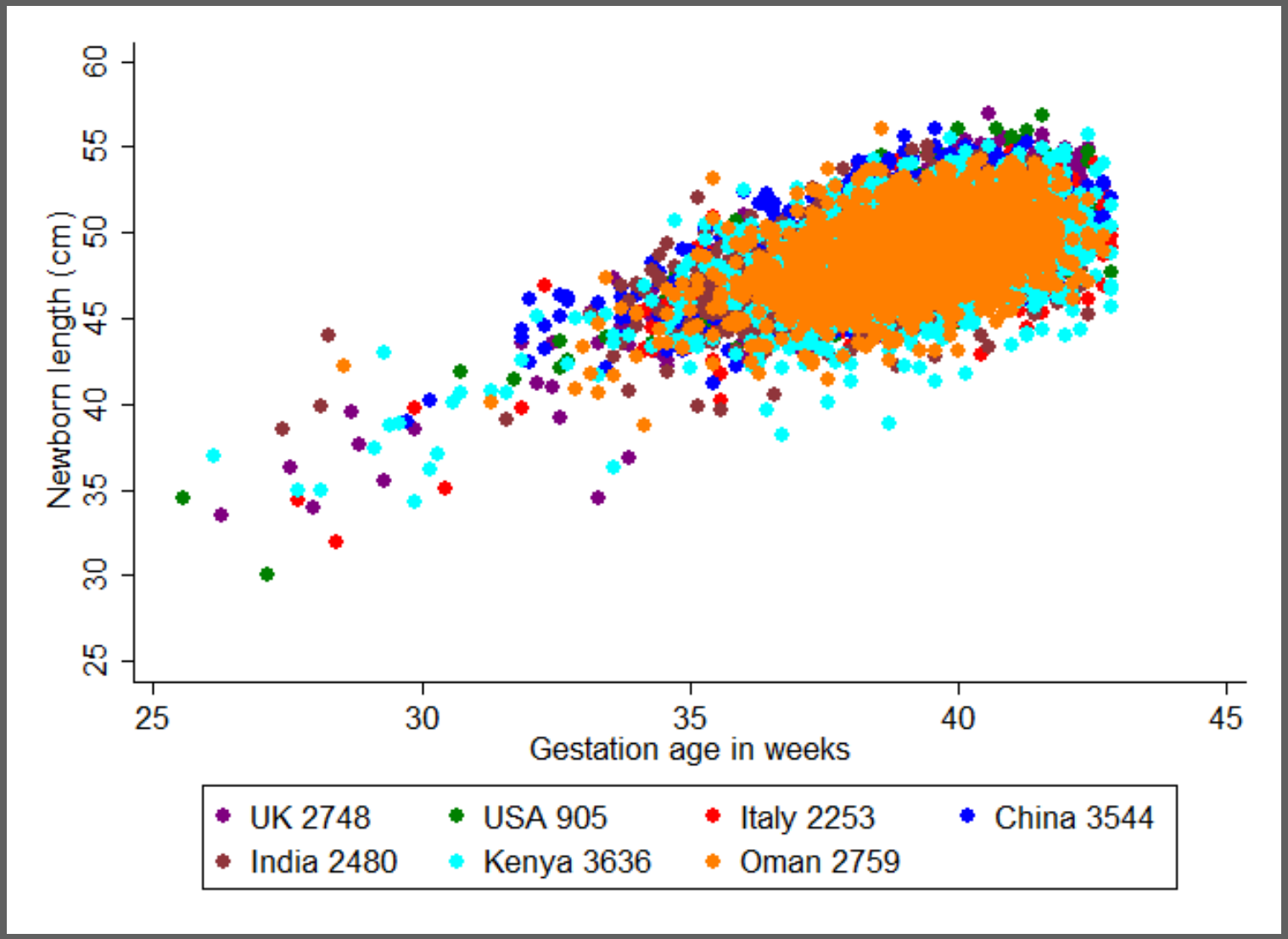
Newborn length by gestational age for UK, USA, Italy, China and India



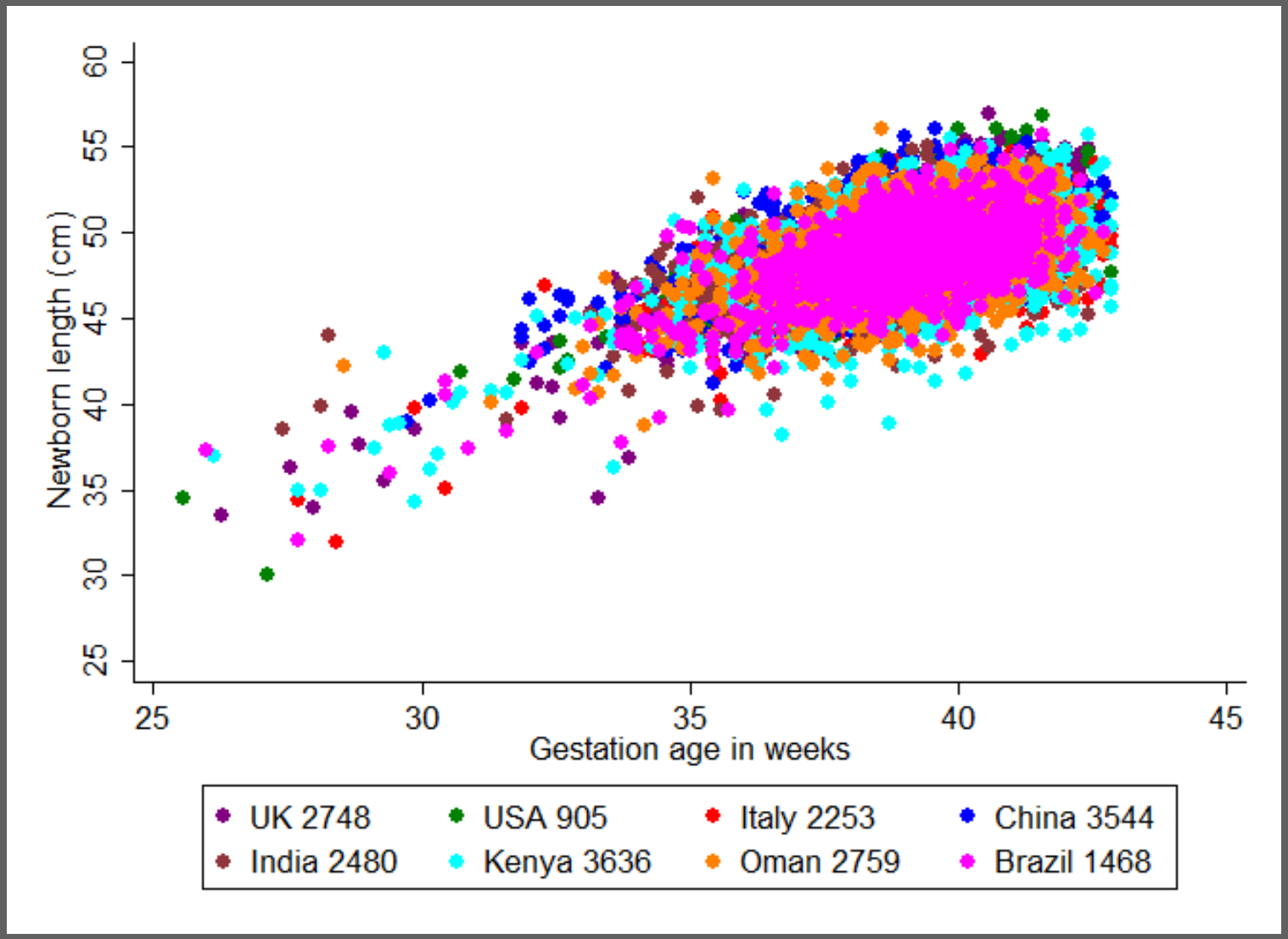
Newborn length by gestational age for UK, USA, Italy, China, India and Kenya



Newborn length by gestational age for UK, USA, Italy, China, India, Kenya and Oman



Newborn length by gestational age for UK, USA, Italy, China, India, Kenya, Oman & Brazil



Fetal growth and neonatal length are similar across diverse geographical settings when mothers' nutritional and health needs are met, and environmental constraints on growth are low

The likeness of fetal growth and newborn size across non-isolated populations in the INTERGROWTH-21st Project: the Fetal Growth Longitudinal Study and Newborn Cross-Sectional Study

José Villar, Aris T Papageorghiou, Ruyan Pang, Eric O Ohuma, Leila Cheikh Ismail, Fernando C Barros, Ann Lambert, Maria Carvalho, Yasmin A Jaffer, Enrico Bertino, Michael G Gravett, Doug G Altman, Manorama Purwar, Ihunnaya O Frederick, Julia A Noble, Cesar G Victora, Zulfiqar A Bhutta, Stephen H Kennedy*, for the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st)*

Villar (2014) Lancet Diabetes Endocrinol 2(10):781-92

'The new growth standards are referable to all children everywhere, clearly show that all children in the world can and should grow equally well, and also demonstrate that in today's world adequate nutrition, environment, and health are stronger determinants of growth than are gender or ethnicity'.

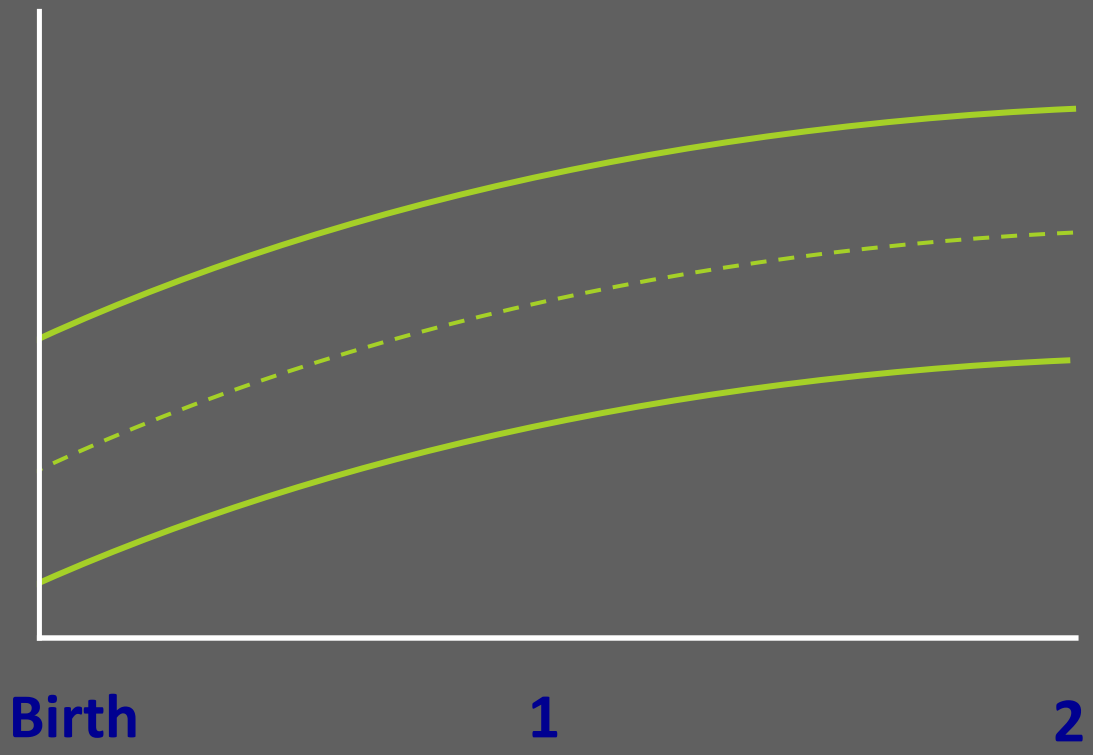
World Health Organization

de Onis et al. (2006) *Acta Paediatr* 450:1-101

'Fetal skeletal growth and newborn linear size are strikingly similar among geographically diverse populations when mothers' environmental, health, and nutritional conditions are met... [those differences] are more likely due to environmental and socioeconomic differences than genetic variation'.

Villar (2014) Lancet Diabetes Endocrinol 2(10):781-92

Healthy, well-nourished, educated women, living in environments without constraints on fetal growth, who are receiving adequate antenatal care, have babies of similar size, irrespective of ethnicity/race.



World Health Organization

World Health Organization

Intrauterine life ⟶ Birth 1 2

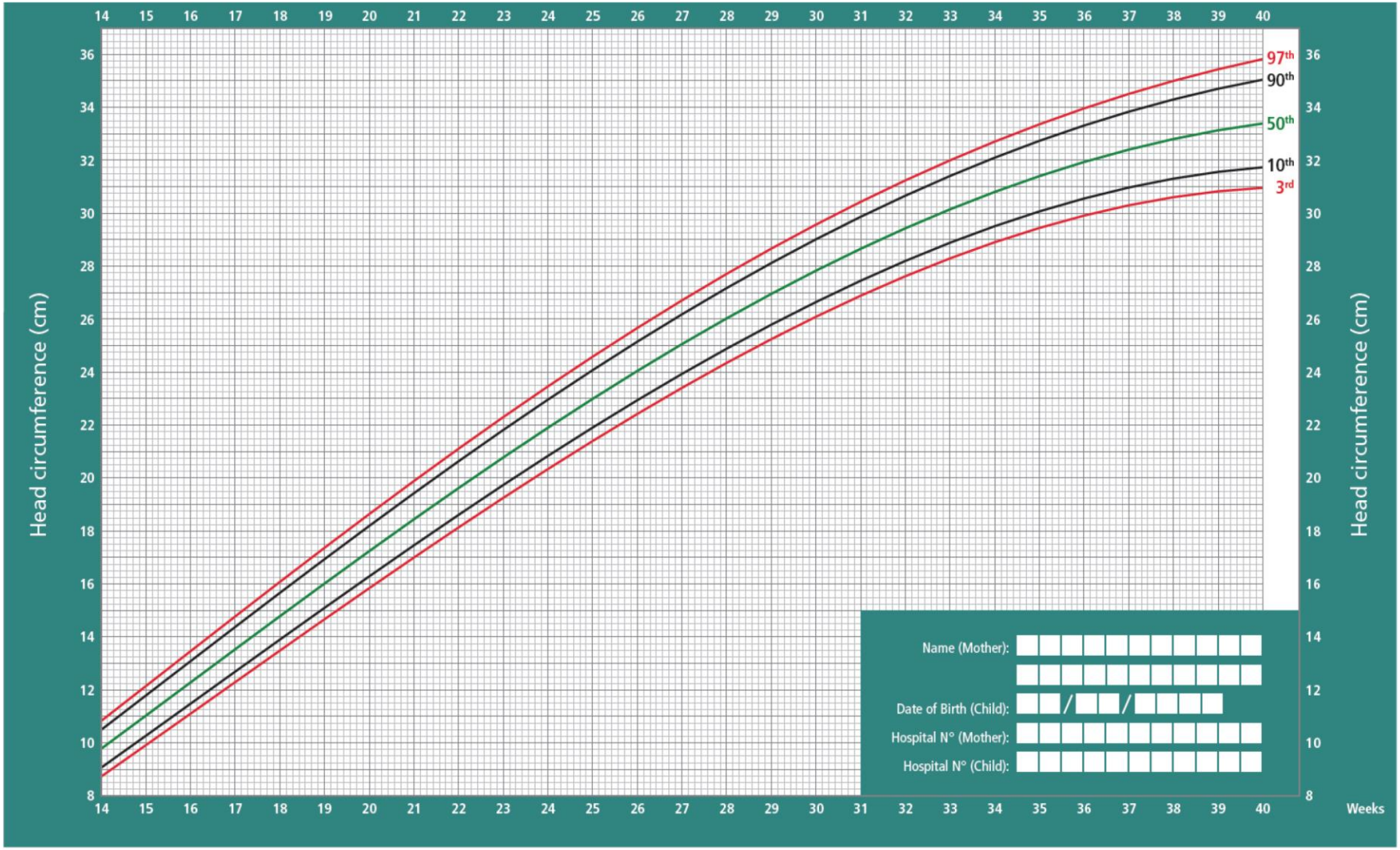
International standards for fetal growth based on serial ultrasound measurements: the Fetal Growth Longitudinal Study of the INTERGROWTH-21st Project

Aris T Papageorghiou, Eric O Ohuma, Douglas G Altman, Tullia Todros, Leila Cheikh Ismail, Ann Lambert, Yasmin A Jaffer, Enrico Bertino, Michael G Gravett, Manorama Purwar, J Alison Noble, Ruyan Pang, Cesar G Victora, Fernando C Barros, Maria Carvalho, Laurent J Salomon, Zulfiqar A Bhutta, Stephen H Kennedy*, José Villar*, for the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st)†*

Papageorghiou (2014) Lancet 384: 869-79

International Fetal Growth Standards
Head circumference

INTERGROWTH-21st



© University of Oxford

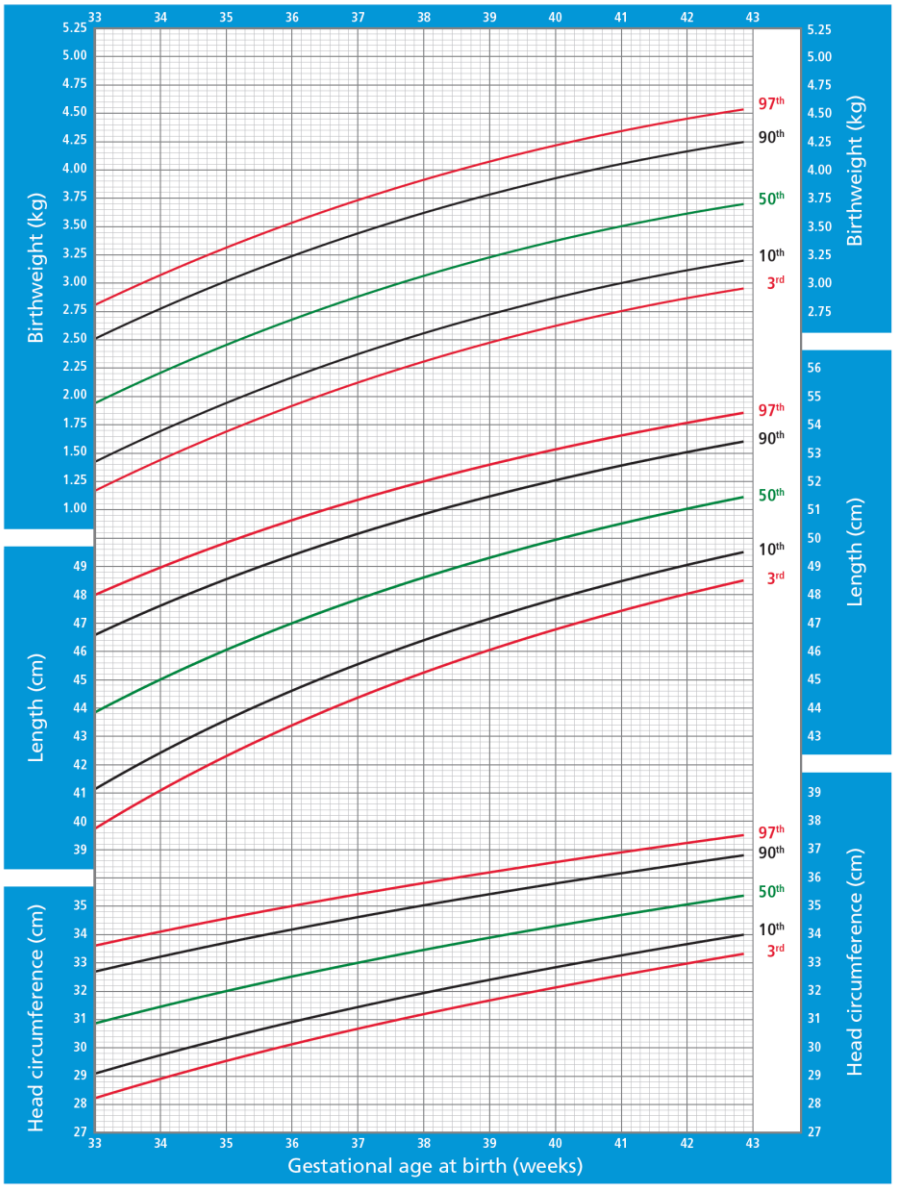
Ref: Papageorghiou AT et al. Lancet 2014; 384: 869-79.

International standards for newborn weight, length, and head circumference by gestational age and sex: the Newborn Cross-Sectional Study of the INTERGROWTH-21st Project

José Villar, Leila Cheikh Ismail, Cesar G Victora, Eric O Ohuma, Enrico Bertino, Doug G Altman, Ann Lambert, Aris T Papageorghiou, Maria Carvalho, Yasmin A Jaffer, Michael G Gravett, Manorama Purwar, Ihunnaya O Frederick, Alison J Noble, Ruyan Pang, Fernando C Barros, Cameron Chumlea, Zulfiqar A Bhutta, Stephen H Kennedy*, for the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st)†*

Villar (2014) Lancet 384: 857-68

International Standards for Size at Birth (Boys)



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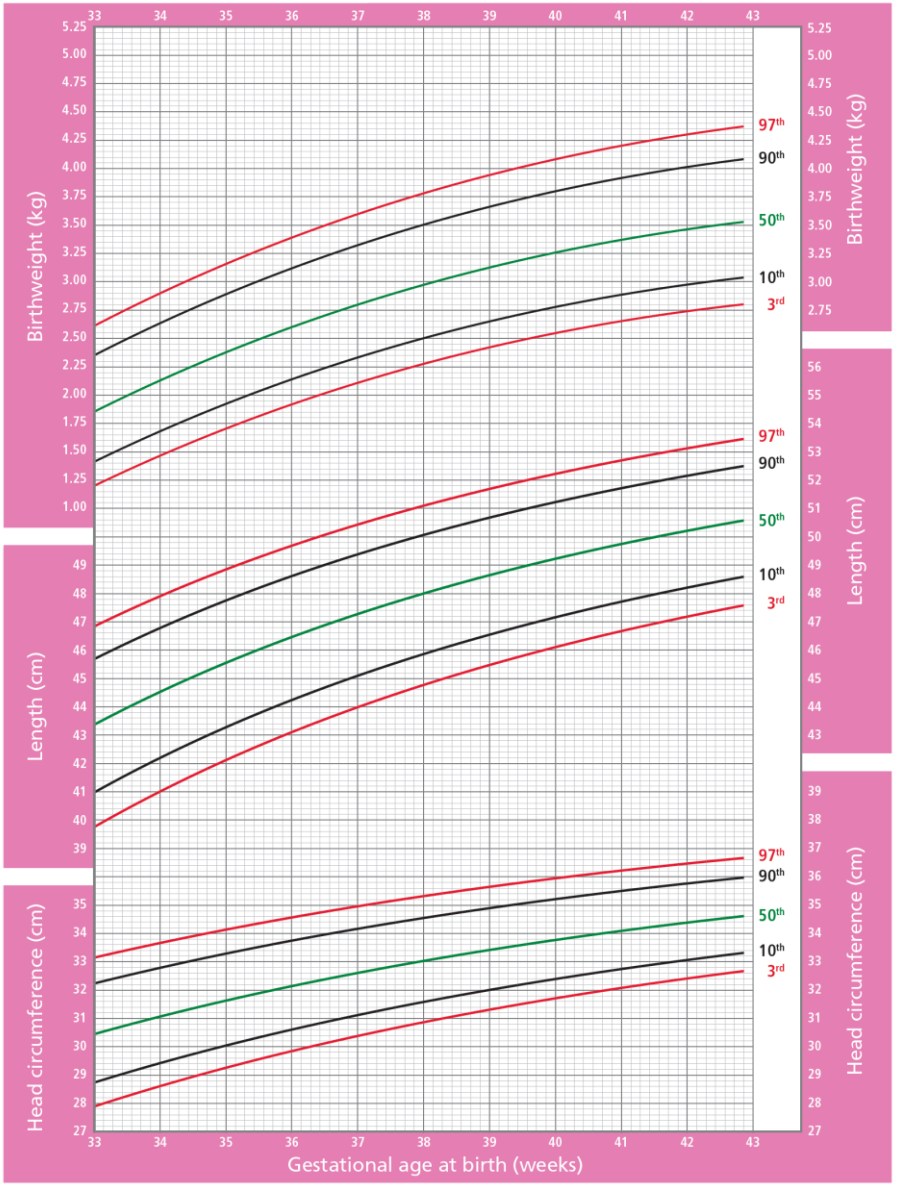
Ref: Villar J et al. Lancet 2014; 384: 857-868

International Standards for Size at Birth (Girls)



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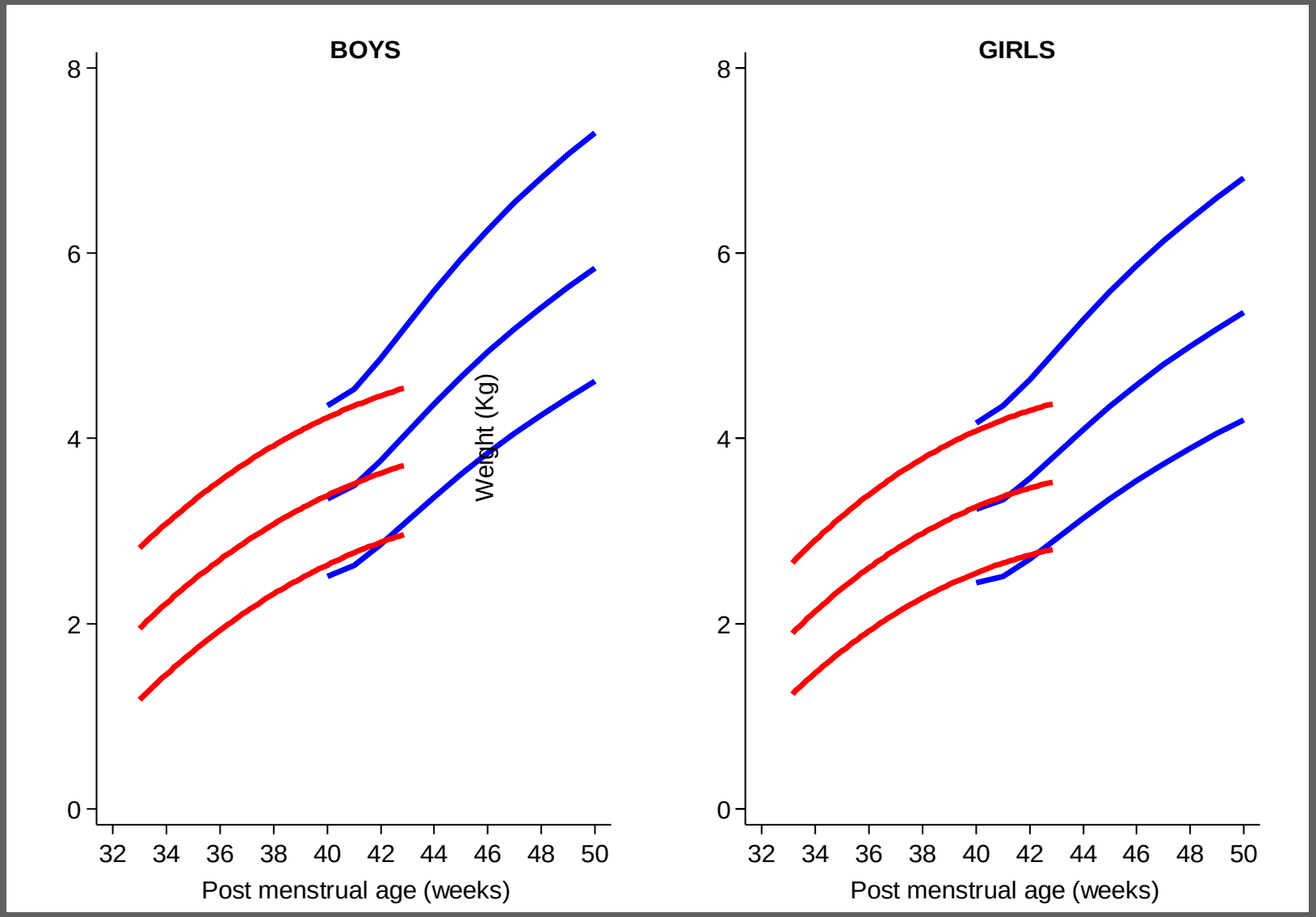
Ref: Villar J et al. Lancet 2014; 384: 857-868

Comparison between INTERGROWTH-21st data and WHO Child Growth Standards at birth in term babies

	INTERGROWTH-21st	WHO
Birth weight	3.3 (0.5) kg	3.3 (0.5) kg
Birth length	49.3 (1.8) cm	49.5 (1.9) cm

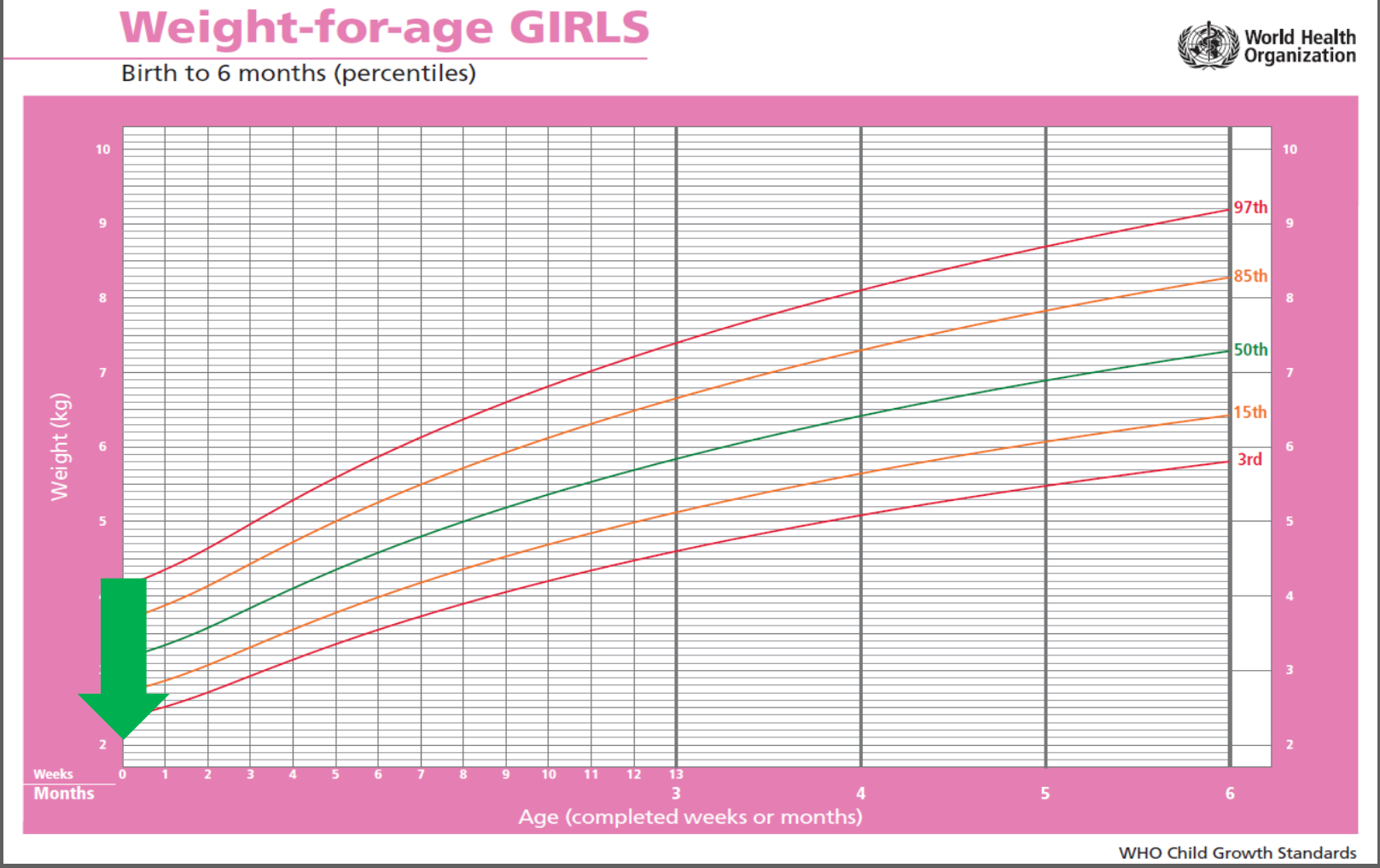
INTERGROWTH-21st Newborn Size Standard
WHO Child Growth Standard



Villar (2015) *Am J Obstet Gynecol* 213: 494-9

WHO CHARTS

FROM BIRTH UNTIL 5 YEARS OF AGE BUT NO DISTINCTION AT BIRTH BY GA



USING THE WHO'S CHARTS

Baby Melissa's (X) birthweight: 2.82kg

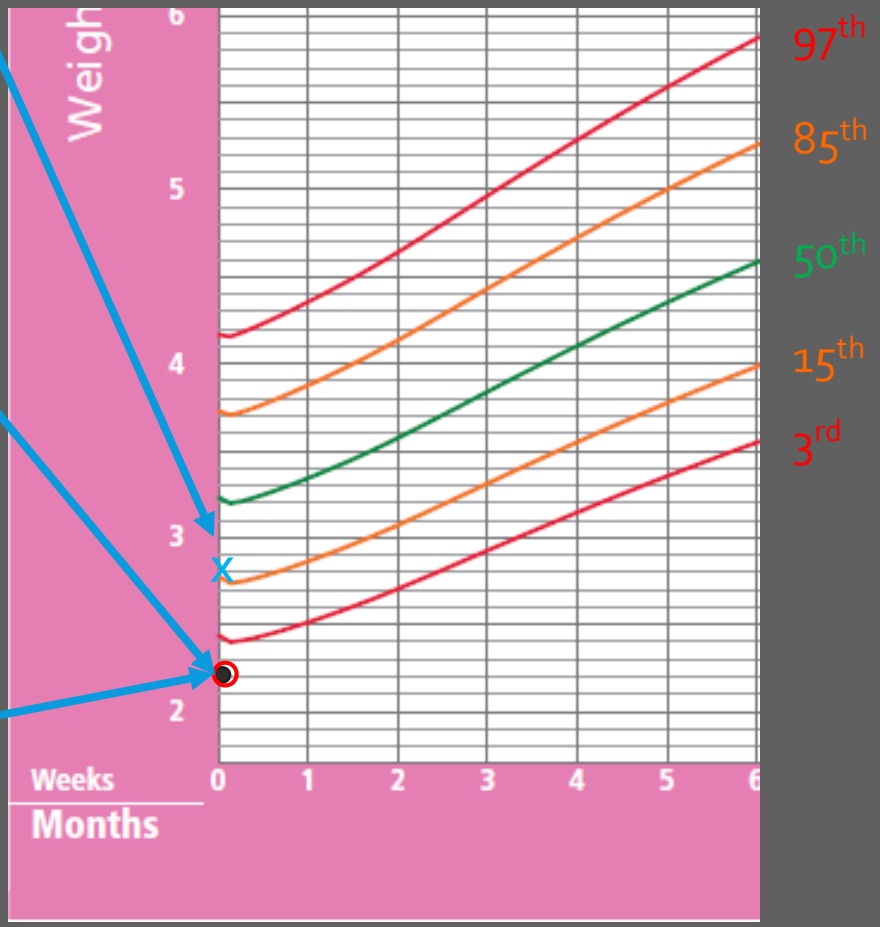
→ Gestational age: 36+5 weeks

Baby Sophie's (●) birthweight: 2.17kg

→ Gestational age: 40+1 weeks

Baby Michelle (○)'s birthweight: 2.19kg

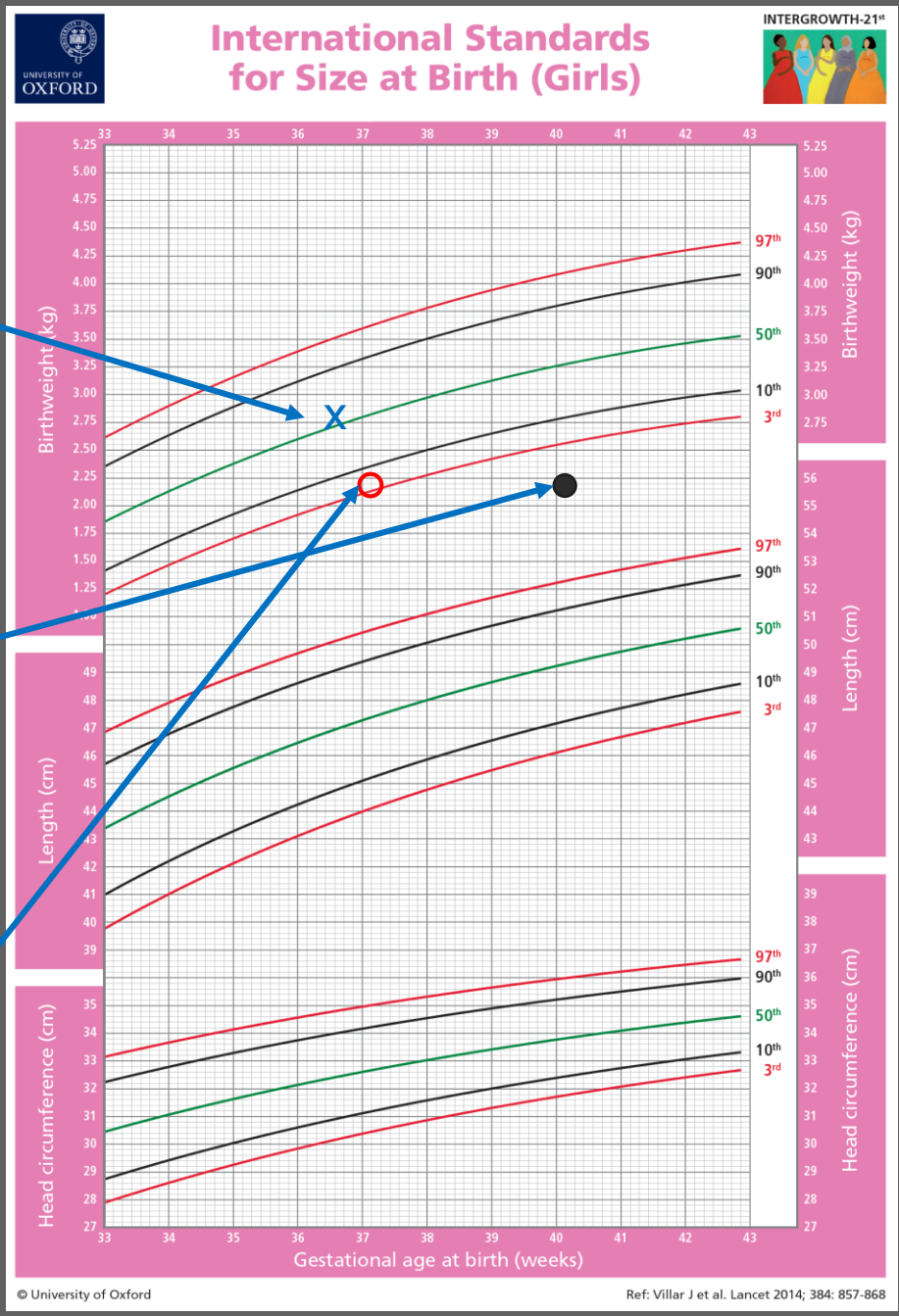
→ Gestational age: 37+1 weeks



Baby Melissa's (X) birthweight: 2.82kg
And GA: 36+5 weeks

Baby Sophie's (●) birthweight: 2.17kg
and GA: 40+1 weeks

Baby Michelle's (○) birthweight: 2.19kg
And GA: 37+1 weeks



Postnatal growth standards for preterm infants: the Preterm Postnatal Follow-up Study of the INTERGROWTH-21st Project

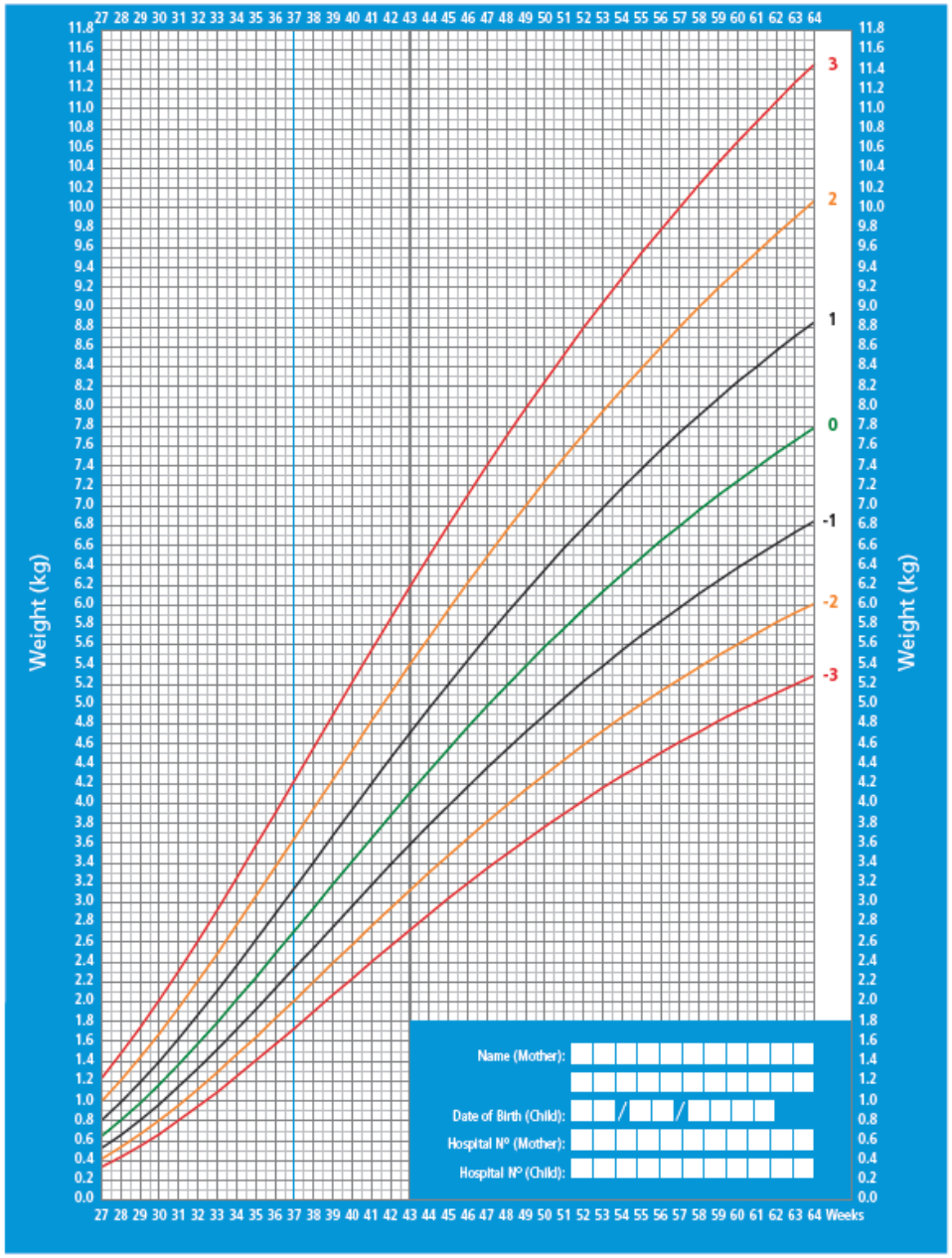
José Villar, Francesca Giuliani, Zulfiqar A Bhutta, Enrico Bertino, Eric O Ohuma, Leila Cheikh Ismail, Fernando C Barros, Douglas G Altman, Cesar Victora, Julia A Noble, Michael G Gravett, Manorama Purwar, Ruyan Pang, Ann Lambert, Aris T Papageorghiou, Roseline Ochieng, Yasmin A Jaffer, and Stephen H Kennedy, for the International Fetal and Newborn Growth Consortium for the 21st Century (INTERGROWTH-21st)

CrossMark

oa OPEN ACCESS

International Postnatal Growth Standards for Preterm Infants (Boys)

INTERGROWTH-21st



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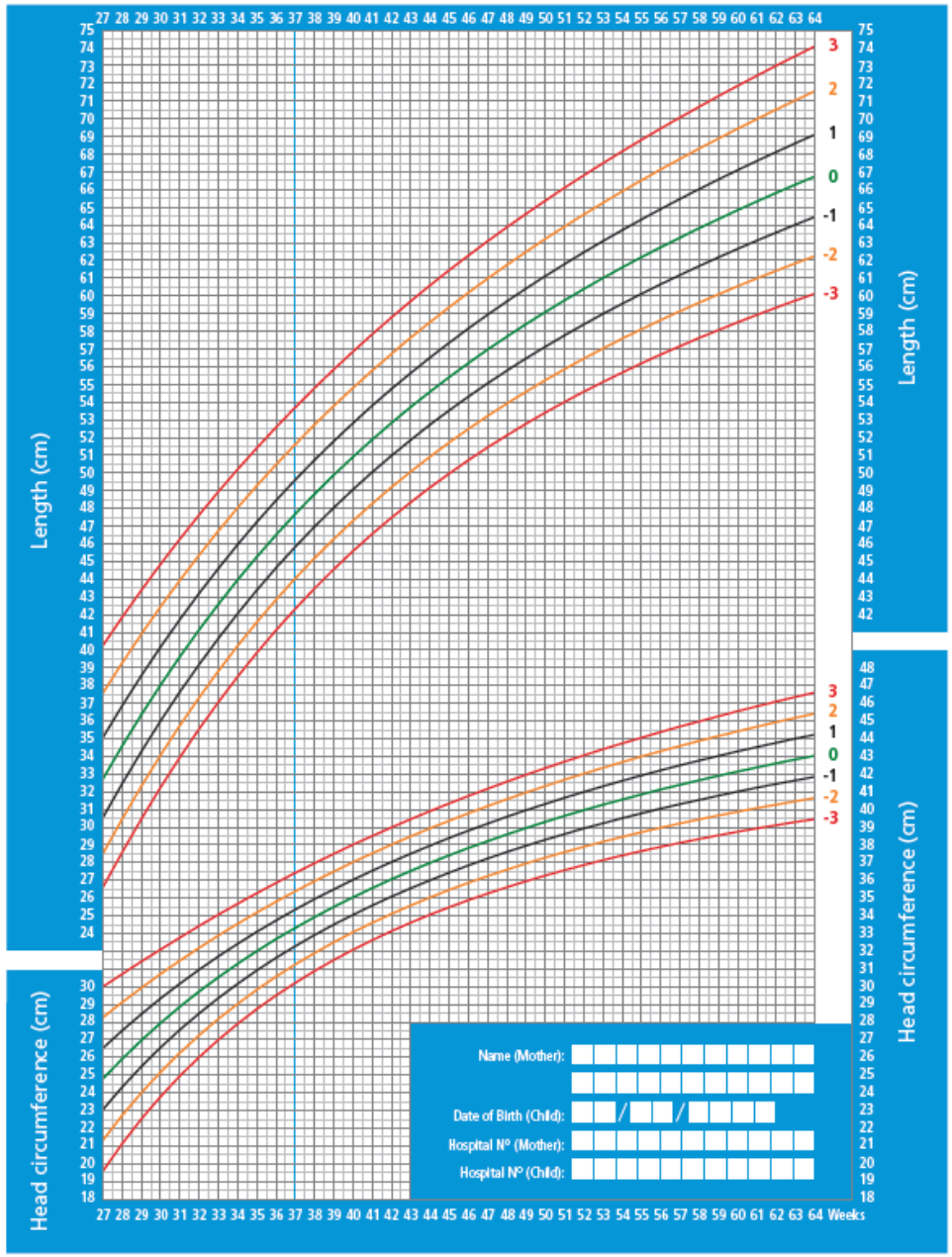
Ref: Villar et al *Lancet Glob Heath* 2015;3:e681-91.

International Postnatal Growth Standards for Preterm Infants (Boys)

INTERGROWTH-21st



© University of Oxford

Ref: Villar et al *Lancet Glob Heath* 2015;3:e681-91.

OPEN ACCESS

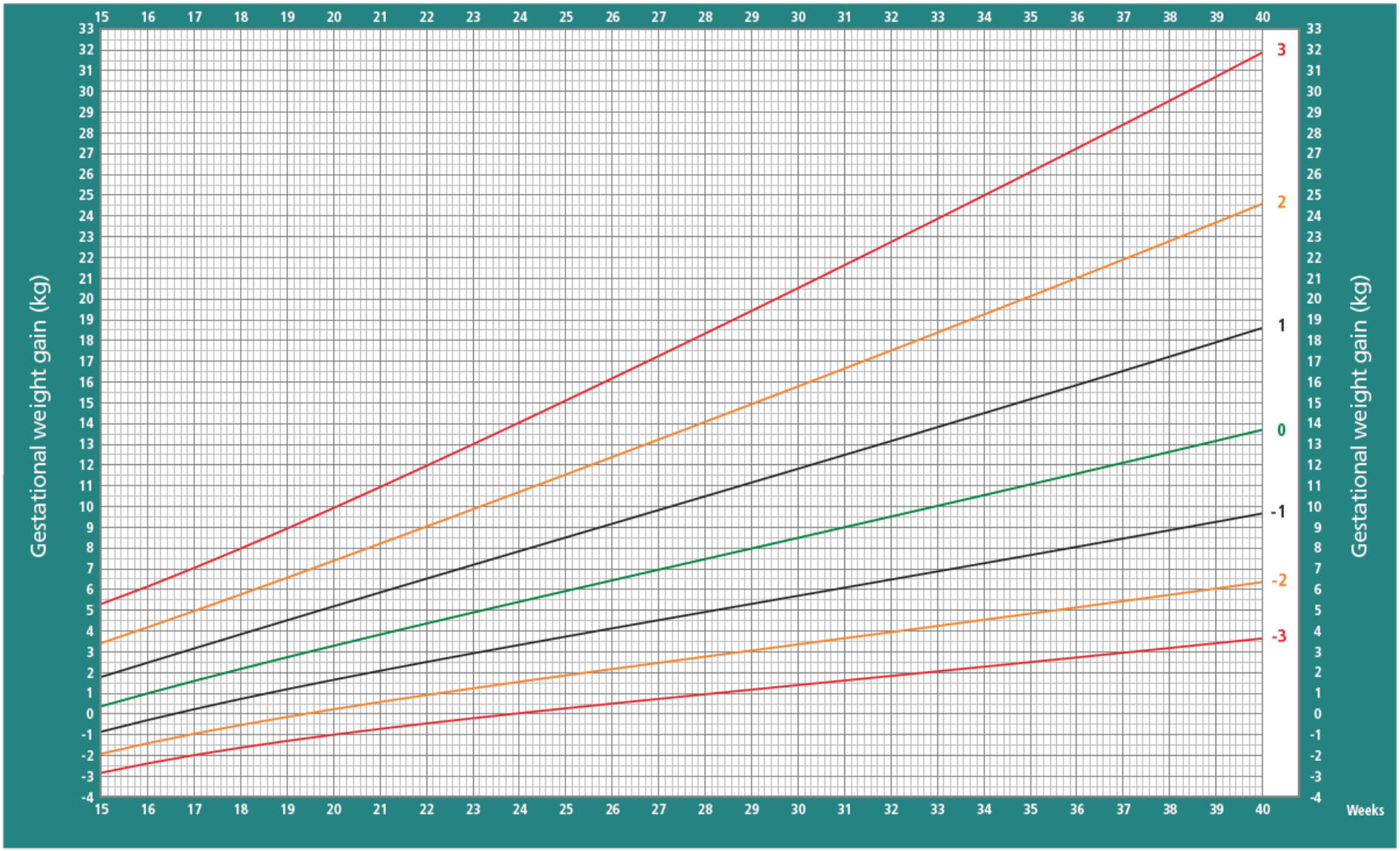
Gestational weight gain standards based on women enrolled in the Fetal Growth Longitudinal Study of the INTERGROWTH-21st Project: a prospective longitudinal cohort study

Leila Cheikh Ismail,[1] Deborah C Bishop,[1] Ruyan Pang,[2] Eric O Ohuma,[1,3] Gilberto Kac,[4] Barbara Abrams,[5] Kathleen Rasmussen,[6] Fernando C Barros,[7,8] Jane E Hirst,[1] Ann Lambert,[1] Aris T Papageorghiou,[1] William Stones,[9,10] Yasmin A Jaffer,[11] Douglas G Altman,[3] J Alison Noble,[12] Maria Rosa Giolito,[13] Michael G Gravett,[14] Manorama Purwar,[15] Stephen H Kennedy,[1] Zulfiqar A Bhutta,[16,17] José Villar[1]

UNIVERSITY OF OXFORD

The International Gestational Weight Gain Standards

INTERGROWTH-21st



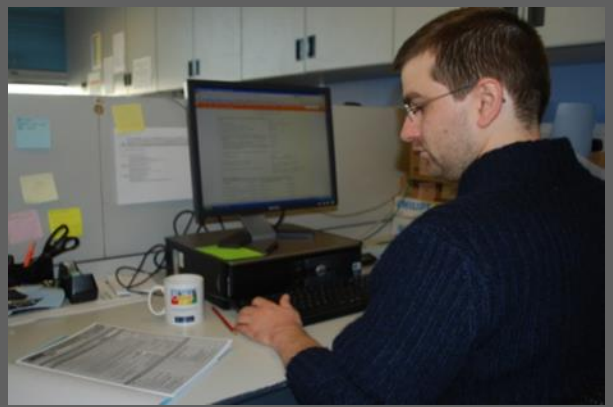
© University of Oxford

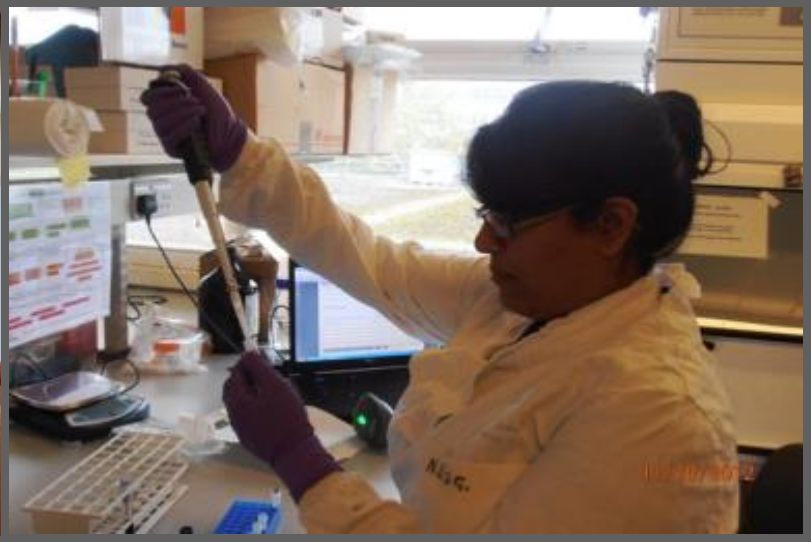
Ref: Cheikh Ismail et al. BMJ 2016; 352: i555

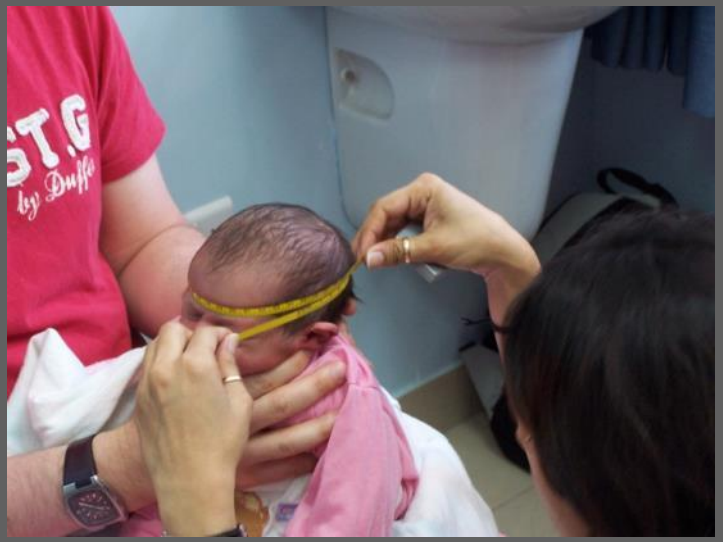
CONCLUSIONS

- Fetal, newborn and infant growth are similar across populations when constraints on growth are minimal, justifying the construction of **International Growth Standards**
- The INTERGROWTH-21st & WHO Child Growth Standards monitor growth up to 5 years of age using the same instruments
- Growth monitoring promotes continuity of care from the womb to the classroom worldwide

UK TEAM







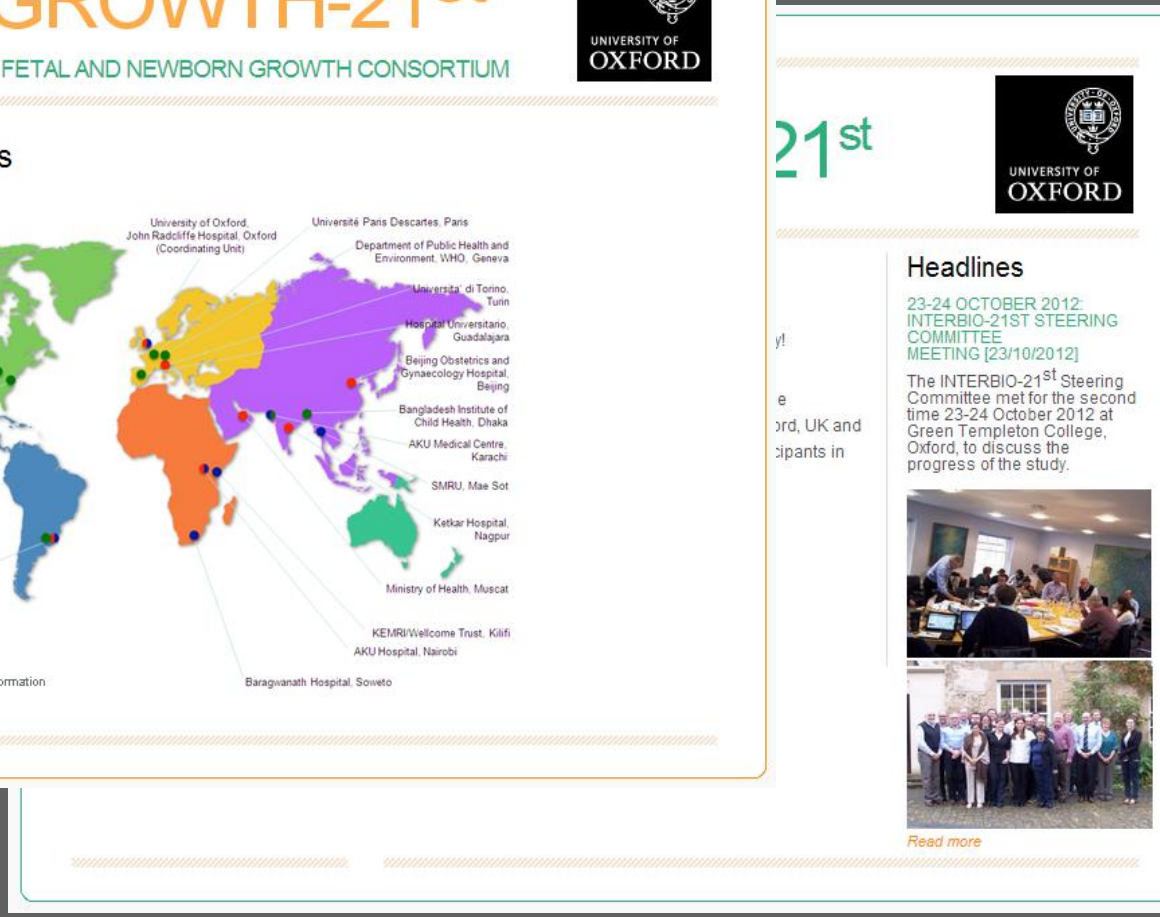
16/10/2012

FIELD WORK

PROJECT WEBSITES:

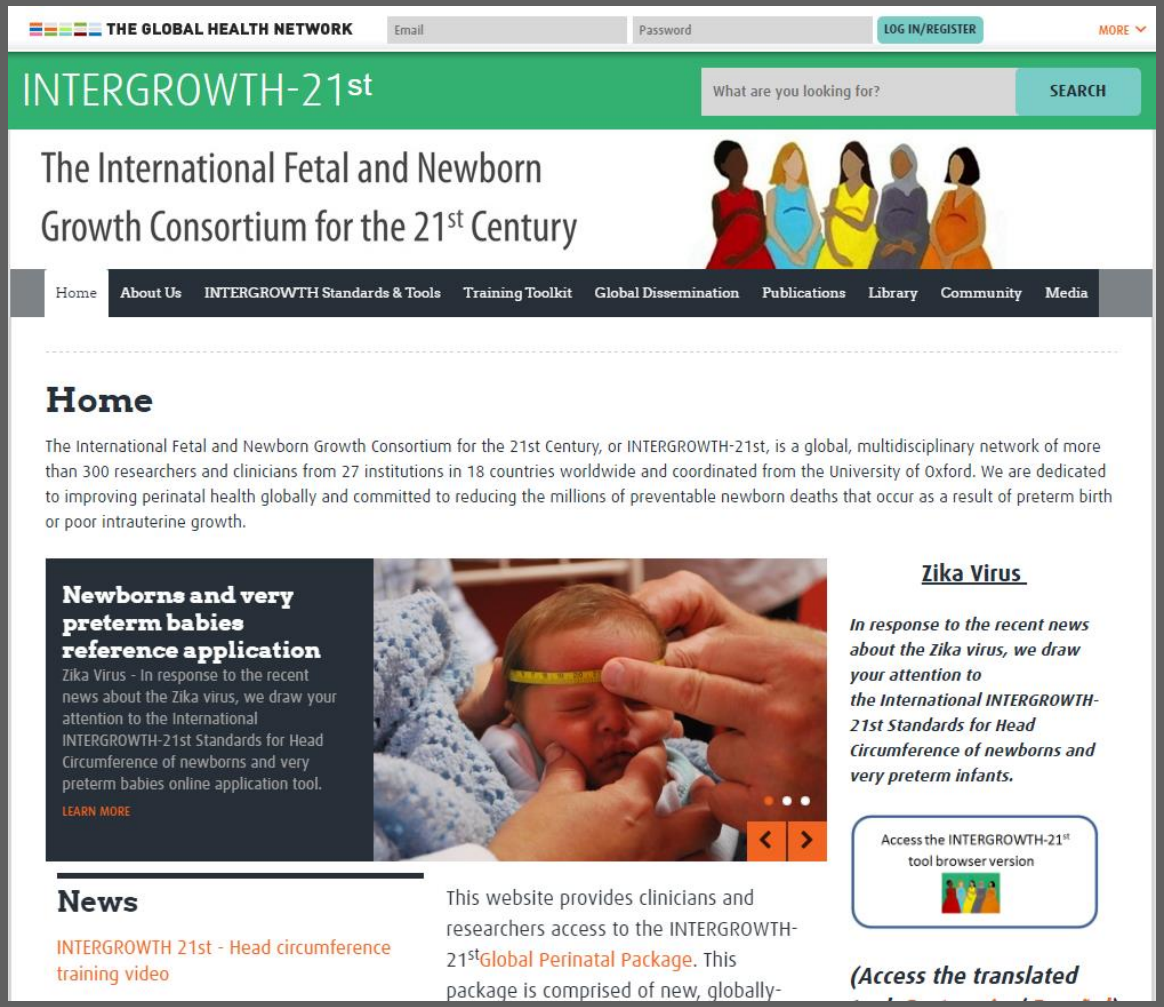
WWW.INTERGROWTH21.ORG.UK

WWW.INTERBIO21.ORG.UK



THE GLOBAL HEALTH NETWORK:

HTTPS://INTERGROWTH21.TGHN.ORG/



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

Home

The International Fet… for the 21st Century, or INTERGROWTH-21st, is a global, multidisciplinary network of more than 300 researchers … in 18 countries worldwide and coordinated from the University of Oxford. We are dedicated to improving perinat… reducing the millions of preventable newborn deaths that occur as a result of preterm birth or poor intrauterine …

Newborns … preterm ba… reference …

Zika Virus - In respo… news about the Zik… attention to the International INTERGROWTH-21st Standards for Head Circumference of newborns and very preterm babies online application tool.

LEARN MORE

Zika Virus

In response to the recent news about the Zika virus, we draw your attention to the International INTERGROWTH-21st Standards for Head Circumference of newborns and very preterm infants.

Access the INTERGROWTH-21st tool browser version

(Access the translated tool: Português / Español)

Download INTERGROWTH-21st Standards & Tools Below

FETAL GROWTH

News

INTERGROWTH 21st - Head circumference training video

Head circumference training video now available to support and enhance use of the latest INTERGROWTH-21st head circumference measurement tools

READ MORE

Z-score calculator for fetal growth standards

This website provides clinicians and researchers access to the INTERGROWTH-21stGlobal Perinatal Package. This package is comprised of new, globally-validated standards and practical training resources. To download the standards please use the download links to the right of this page.

These standards are paired with an expanding Training Toolkit and a rich body of literature on our methods

Press F11 to exit full screen

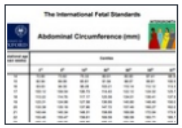
News

INTERGROWTH 21st - Head circumference training video

Head circumference training video now available to support and enhance use of the latest INTERGROWTH-21st head circumference measurement tools

READ MORE

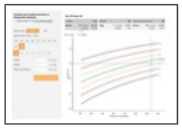
Z-score calculator for fetal growth standards now available



This tool is currently available in Excel format and will be updated by a web and PC/MAC application developed early in 2016.

READ MORE

INTERGROWTH-21st Newborn Size Application Tool - Mac and web versions now available.



The INTERGROWTH-21st Newborn Size Application Tool for calculating centiles and z-scores for birth weight, length and head circumference is now available for download for Windows and Mac users, along with a web browser version.

READ MORE

Read more news stories from INTERGROWTH-21st here.

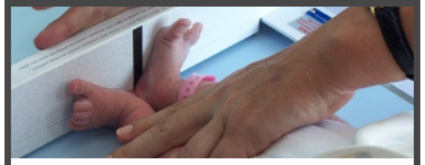
This website provides clinicians and researchers access to the INTERGROWTH-21st Global Perinatal Package. This package is comprised of new, globally-validated standards and practical training resources. To download the standards please use the download links to the right of this page.

These standards are paired with an expanding Training Toolkit and a rich body of literature on our methods.

Policymakers may be interested in learning our progress with dissemination so far, and the implications of our new standards for health policy.

A selection of INTERGROWTH-21st-related news articles from around the world and information regarding press inquiries is available on our Media page.

FEATURED



Global Health Training Centre

INTERGROWTH-21st course on maternal, fetal and newborn growth monitoring

This three module course communicates the methodology of maternal, fetal and newborn growth monitoring and the application of the INTERGROWTH-21st international growth standards to make

Access the INTERGROWTH-21st tool browser version

(Access the translated tool: Português / Español)

Download INTERGROWTH-21st Standards & Tools Below

FETAL GROWTH

POSTNATAL GROWTH

NEWBORN SIZE AT BIRTH

MATERNAL HEALTH

PREGNANCY DATING

Tweets by @intergrowth21st

INTERGROWTH-21st @intergrowth21st

INTERGROWTH-21st very preterm size at birth reference charts thelancet.com/pdfs/journals/... and in the media dailymail.co.uk/health/article...

New growth charts a val...
Experts at the University o...
dailymail.co.uk

22 Feb

INTERGROWTH-21st

Compare your newborn biometry to Intergrowth standards:

○ Upload data or ◉ Enter data manually

Newborn Sex: Boy | Girl

Gestional age (weeks + days):

33	34	35	36	37	38	39	40
41	42						

0	1	2	3	4	5	6

Length: 50 cm

Weight: 3 kg

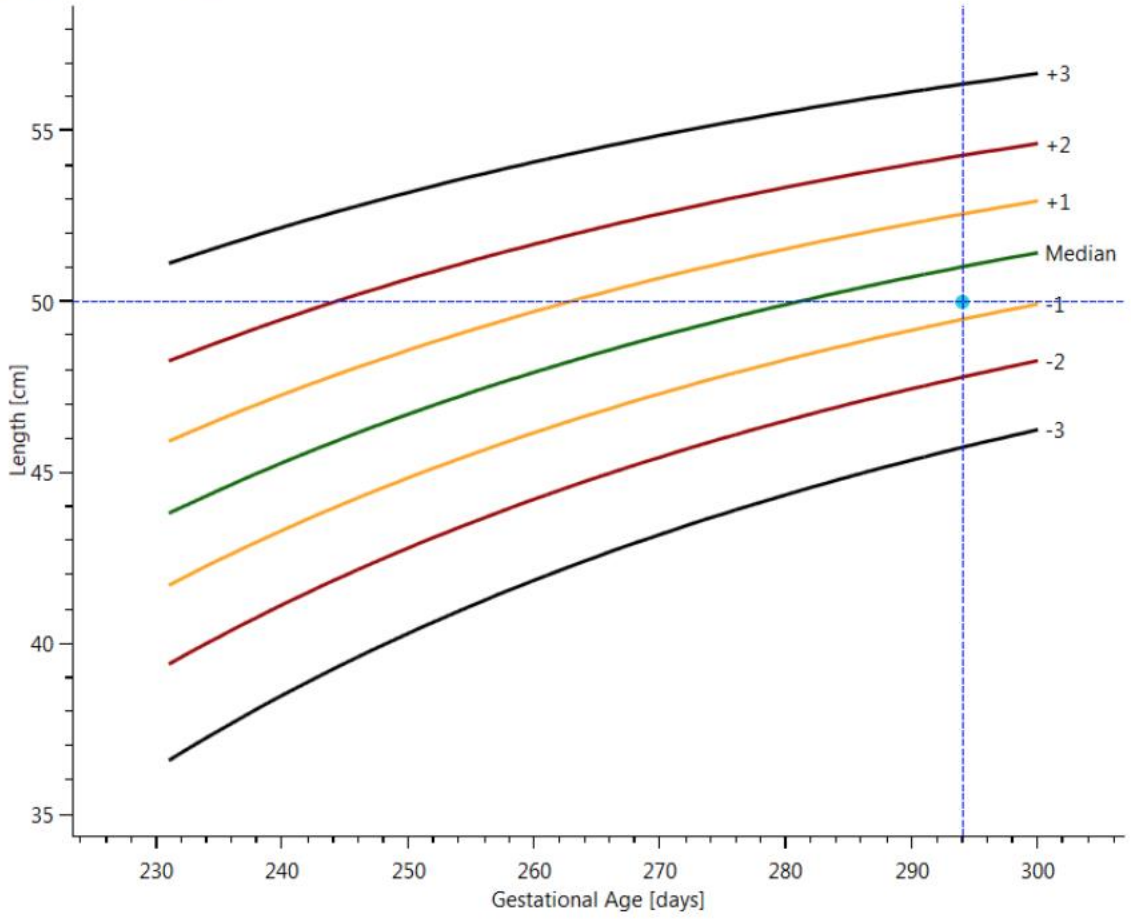
Head circumference: 34 cm

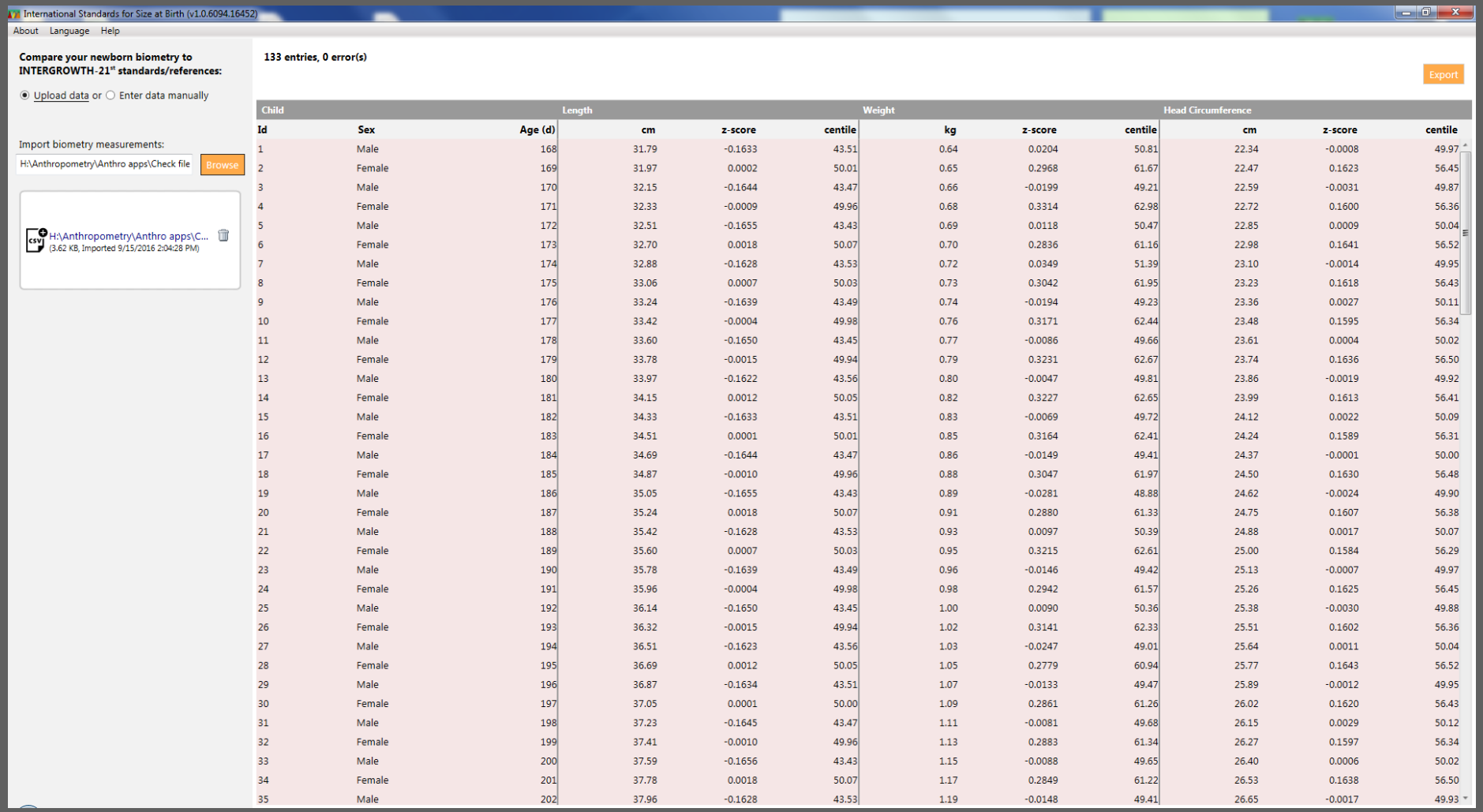
Compare to standards ▸

Boy 294 days old

Length	Weight	Head circumference
50 cm	**3 kg**	**34 cm**
z-score: -0.6738	z-score: -1.5897	z-score: -0.9885
centile: 25.02	centile: 5.59	centile: 16.14

◉ z-score ○ centile





Child			Length			Weight			Head Circumference		
Id	Sex	Age (d)	cm	z-score	centile	kg	z-score	centile	cm	z-score	centile
1	Male	168	31.79	-0.1633	43.51	0.64	0.0204	50.81	22.34	-0.0008	49.97
2	Female	169	31.97	0.0002	50.01	0.65	0.2968	61.67	22.47	0.1623	56.45
3	Male	170	32.15	-0.1644	43.47	0.66	-0.0199	49.21	22.59	-0.0031	49.87
4	Female	171	32.33	-0.0009	49.96	0.68	0.3314	62.98	22.72	0.1600	56.36
5	Male	172	32.51	-0.1655	43.43	0.69	0.0118	50.47	22.85	0.0009	50.04
6	Female	173	32.70	0.0018	50.07	0.70	0.2836	61.16	22.98	0.1641	56.52
7	Male	174	32.88	-0.1628	43.53	0.72	0.0349	51.39	23.10	-0.0014	49.95
8	Female	175	33.06	0.0007	50.03	0.73	0.3042	61.95	23.23	0.1618	56.43
9	Male	176	33.24	-0.1639	43.49	0.74	-0.0194	49.23	23.36	0.0027	50.11
10	Female	177	33.42	-0.0004	49.98	0.76	0.3171	62.44	23.48	0.1595	56.34
11	Male	178	33.60	-0.1650	43.45	0.77	-0.0086	49.66	23.61	0.0004	50.02
12	Female	179	33.78	-0.0015	49.94	0.79	0.3231	62.67	23.74	0.1636	56.50
13	Male	180	33.97	-0.1622	43.56	0.80	-0.0047	49.81	23.86	-0.0019	49.92
14	Female	181	34.15	0.0012	50.05	0.82	0.3227	62.65	23.99	0.1613	56.41
15	Male	182	34.33	-0.1633	43.51	0.83	-0.0069	49.72	24.12	0.0022	50.09
16	Female	183	34.51	0.0001	50.01	0.85	0.3164	62.41	24.24	0.1589	56.31
17	Male	184	34.69	-0.1644	43.47	0.86	-0.0149	49.41	24.37	-0.0001	50.00
18	Female	185	34.87	-0.0010	49.96	0.88	0.3047	61.97	24.50	0.1630	56.48
19	Male	186	35.05	-0.1655	43.43	0.89	-0.0281	48.88	24.62	-0.0024	49.90
20	Female	187	35.24	0.0018	50.07	0.91	0.2880	61.33	24.75	0.1607	56.38
21	Male	188	35.42	-0.1628	43.53	0.93	0.0097	50.39	24.88	0.0017	50.07
22	Female	189	35.60	0.0007	50.03	0.95	0.3215	62.61	25.00	0.1584	56.29
23	Male	190	35.78	-0.1639	43.49	0.96	-0.0146	49.42	25.13	-0.0007	49.97
24	Female	191	35.96	-0.0004	49.98	0.98	0.2942	61.57	25.26	0.1625	56.45
25	Male	192	36.14	-0.1650	43.45	1.00	0.0090	50.36	25.38	-0.0030	49.88
26	Female	193	36.32	-0.0015	49.94	1.02	0.3141	62.33	25.51	0.1602	56.36
27	Male	194	36.51	-0.1623	43.56	1.03	-0.0247	49.01	25.64	0.0011	50.04
28	Female	195	36.69	0.0012	50.05	1.05	0.2779	60.94	25.77	0.1643	56.52
29	Male	196	36.87	-0.1634	43.51	1.07	-0.0133	49.47	25.89	-0.0012	49.95
30	Female	197	37.05	0.0001	50.00	1.09	0.2861	61.26	26.02	0.1620	56.43
31	Male	198	37.23	-0.1645	43.47	1.11	-0.0081	49.68	26.15	0.0029	50.12
32	Female	199	37.41	-0.0010	49.96	1.13	0.2883	61.34	26.27	0.1597	56.34
33	Male	200	37.59	-0.1656	43.43	1.15	-0.0088	49.65	26.40	0.0006	50.02
34	Female	201	37.78	0.0018	50.07	1.17	0.2849	61.22	26.53	0.1638	56.50
35	Male	202	37.96	-0.1628	43.53	1.19	-0.0148	49.41	26.65	-0.0017	49.93

Similar tools for fetal growth and preterm postnatal growth are being developed

And like our babies, INTERGROWTH-21st keeps on growing…

IN 2016, WE STILL BELIEVE IN GLOBAL SOLUTIONS TO GLOBAL HEALTH PROBLEMS

INTERGROWTH-21ST Steering Committee Meeting

Turin, 25th - 27th September 2011

“MEN’S NATURES ARE ALIKE, IT IS THEIR HABITS THAT CARRY THEM APART”

Confucius, 479 BC