

Quelle(s) courbe(s) utiliser à la naissance? Le point de vue du pédiatre

Olivier Claris

Néonatalogie et réanimation néonatale, Hospices Civils Lyon
EA 4129, Université Claude Bernard Lyon I

29/01/2020

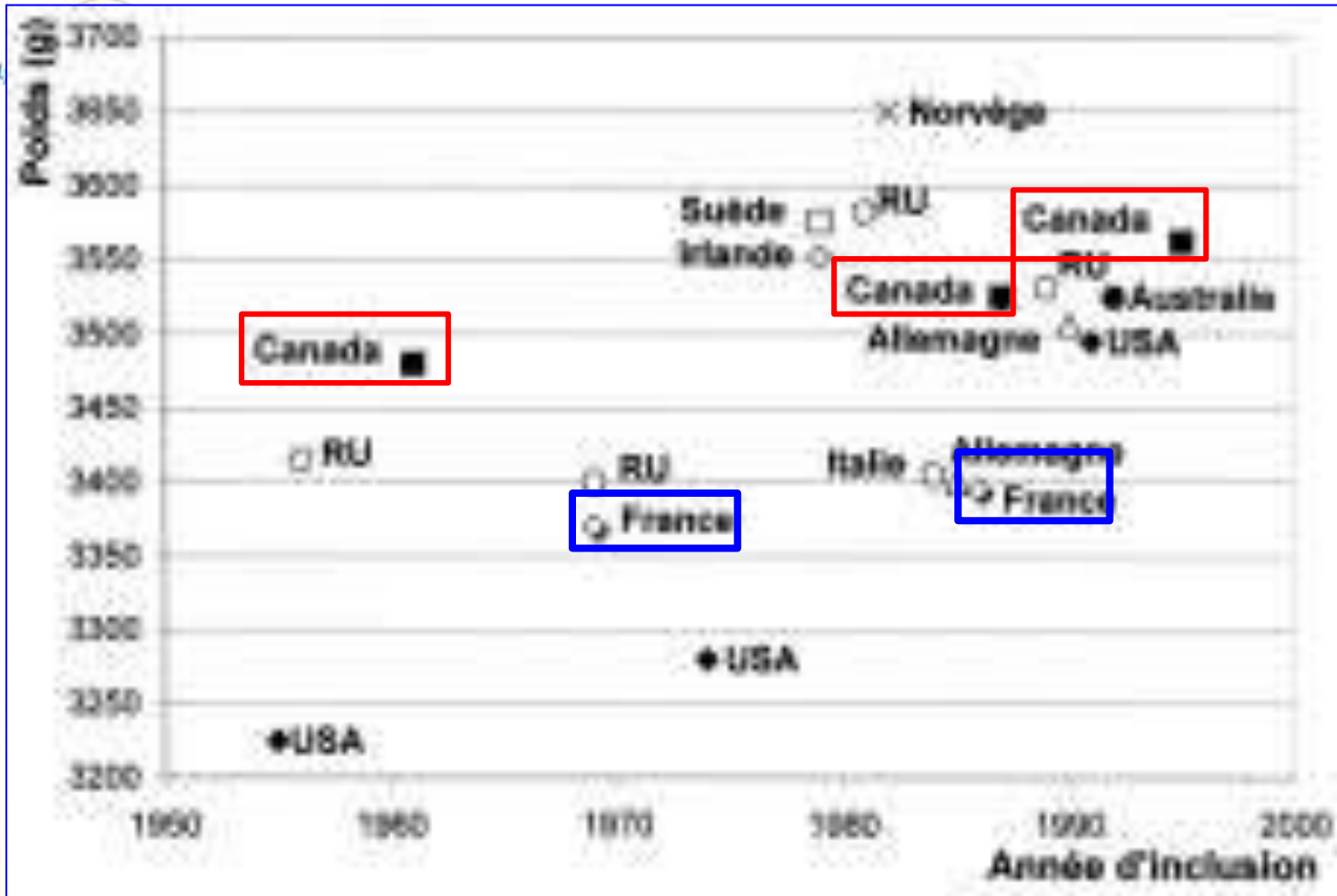
COURBES DE CROISSANCE

- Plus de 80 courbes de poids à la naissance
- Courbes obstétricales, courbes néonatales
- Moyenne, médiane, 50^e P
- La distribution du poids par AG suit une loi normale, 10^e et 3^e P sont éloignés de la moyenne de 1.282 et 1.881 DS
- Intérêt du z-score

$$Z\text{-score} = \frac{(\textit{individual weight} - \textit{cohort mean})}{\textit{cohort standard deviation}}$$

COURBES DE CROISSANCE (2)

- Population de référence
- Critères d'exclusion
- Seuil pathologique
- Méthodes de lissage



Courbe
croissanc
e

29/01/2020

Poids moyen (ou 50e percentile) à 40 semaines d'âge gestationnel suivant les années d'inclusion dans les courbes étudiées.

Courbes ajustées individuelles

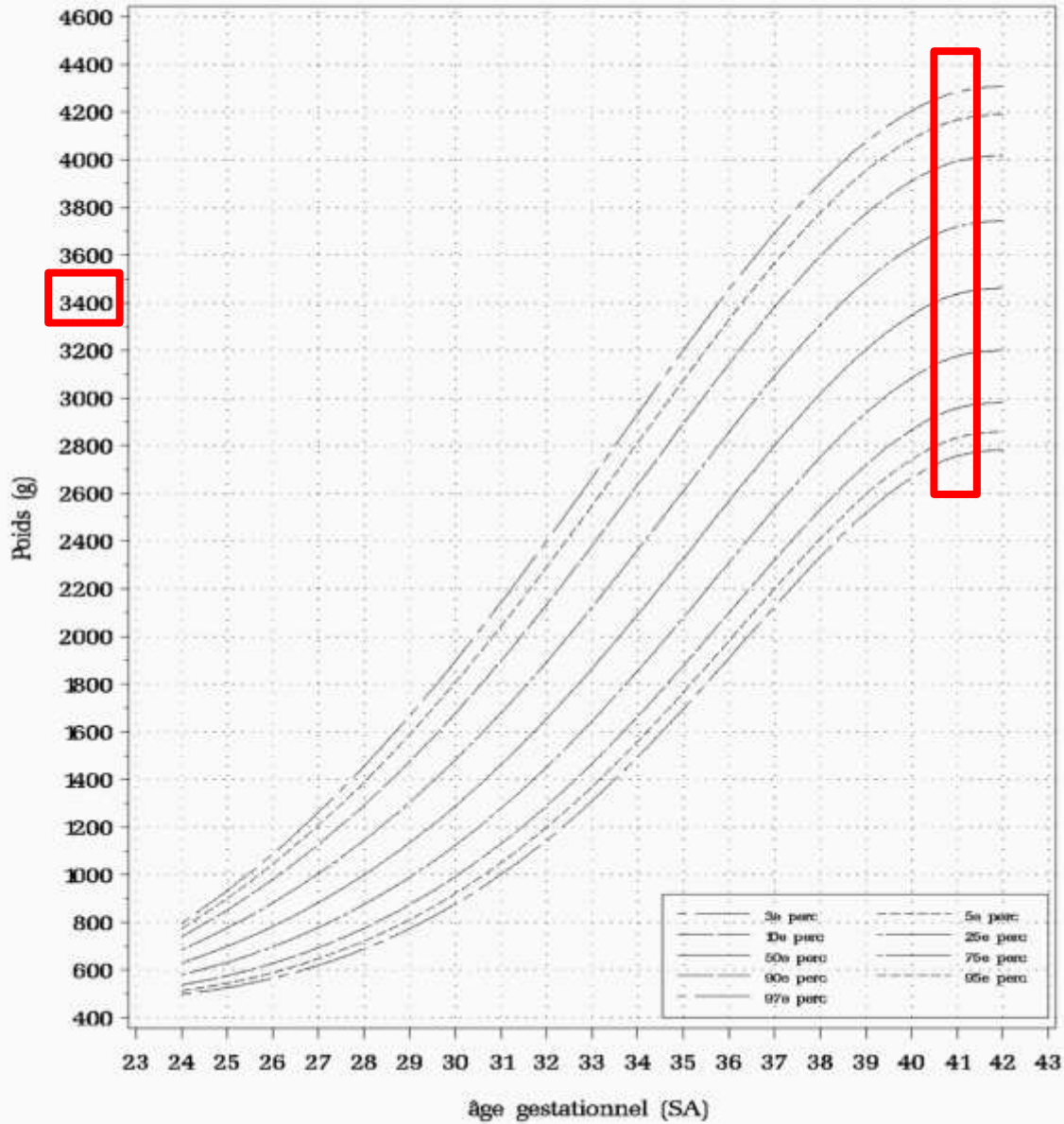
- Gardosi :
 - ✓ Allure sigmoïde de la croissance fœtale (Hadlock 1991), Pds et AG équation de 3^e d^o
 - ✓ La dispersion des valeurs de poids autour de la moyenne est constante, donc le rapport de l'écart-type sur la moyenne (ou coefficient de variation) est stable → calcul des percentiles par AG



POPULATION ET METHODES

- Modèles statistiques de poids et de taille :
banque de données AUDIPOG
1999-2005
203 062 données pour le poids
172 716 données pour la taille
168 100 données pour le périmètre crânien

Poids des filles



Courbe
croissance

29/01/2020

METHODES STATISTIQUES

Régression linéaire multiple pas à pas descendants,
technique des moindres carrés

variable dépendante : PN, ou TN

variables explicatives : AG, sexe, rang de naissance
âge, taille, poids habituel

maternels

Transformation logarithmique : pour normaliser la
distribution du PN (Log PN), et donner une déviation
standard [DS(Log PN)] raisonnablement

VALIDATION

- Modèle de croissance en poids explique 65% de la variance du PN
- Modèle de croissance en taille explique 55% de la variance de TN
- Pas d'amélioration du modèle avec l'ethnie et le tabac

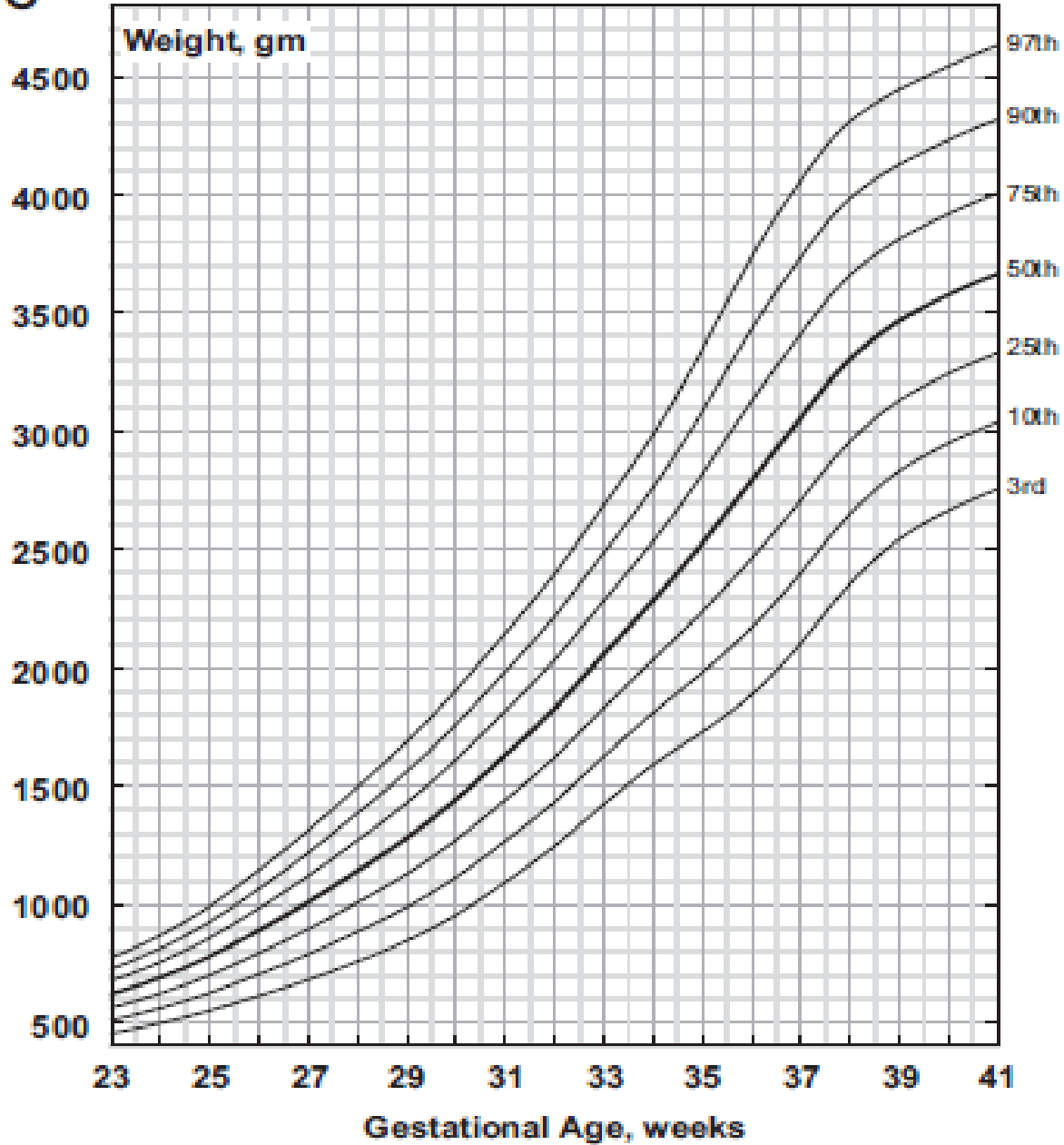
Courbes Olsen 2010

- Groupe Pediatrx 1998-2006
- 391 681 enfants 22-42 SA, 33 états, 248 hôpitaux
- Exclusions :
 - Grossesses multiples, altération croissance foetale, décès néonatal
- 257 855 enfants, 52% garçons
- 55% blancs, 14% noirs, 24% hispaniques

Courbe
croissanc
e

29/01/2020

C



Courbe croissance

29/01/2020



Hospic

| GA, wk | n | Birth Size | | Percentile | | | | | | |
|-----------|------|------------|-----|-----------------|------|------|------|------|------|-----------------|
| | | Mean | SD | 3rd | 10th | 25th | 50th | 75th | 90th | 97th |
| Weight, g | | | | | | | | | | |
| 23 | 153 | 622 | 74 | NA ^a | 509 | 563 | 621 | 677 | 727 | NA ^a |
| 24 | 451 | 689 | 96 | 497 | 561 | 623 | 690 | 756 | 813 | 869 |
| 25 | 722 | 777 | 116 | 550 | 626 | 700 | 780 | 857 | 926 | 992 |
| 26 | 881 | 888 | 145 | 613 | 704 | 794 | 890 | 983 | 1065 | 1145 |
| 27 | 1030 | 1001 | 170 | 680 | 789 | 895 | 1009 | 1120 | 1218 | 1312 |
| 28 | 1281 | 1138 | 203 | 758 | 884 | 1007 | 1141 | 1271 | 1385 | 1496 |
| 29 | 1505 | 1277 | 218 | 845 | 988 | 1128 | 1280 | 1429 | 1560 | 1688 |
| 30 | 1992 | 1435 | 261 | 955 | 1114 | 1272 | 1443 | 1612 | 1761 | 1906 |
| 31 | 2460 | 1633 | 275 | 1093 | 1267 | 1441 | 1631 | 1818 | 1984 | 2147 |
| 32 | 3677 | 1823 | 306 | 1246 | 1433 | 1622 | 1829 | 2034 | 2218 | 2398 |
| 33 | 5014 | 2058 | 341 | 1422 | 1625 | 1830 | 2057 | 2284 | 2488 | 2688 |
| 34 | 7291 | 2288 | 364 | 1589 | 1810 | 2035 | 2285 | 2536 | 2763 | 2987 |
| 35 | 6952 | 2529 | 433 | 1728 | 1980 | 2238 | 2527 | 2819 | 3084 | 3348 |
| 36 | 7011 | 2798 | 498 | 1886 | 2170 | 2462 | 2792 | 3127 | 3432 | 3737 |
| 37 | 6692 | 3058 | 518 | 2103 | 2401 | 2708 | 3056 | 3411 | 3736 | 4060 |
| 38 | 8786 | 3319 | 527 | 2356 | 2652 | 2959 | 3306 | 3661 | 3986 | 4312 |
| 39 | 8324 | 3476 | 498 | 2545 | 2833 | 3131 | 3469 | 3813 | 4129 | 4446 |
| 40 | 7235 | 3582 | 493 | 2666 | 2950 | 3245 | 3579 | 3919 | 4232 | 4545 |
| 41 | 2538 | 3691 | 518 | 2755 | 3039 | 3333 | 3666 | 4007 | 4319 | 4633 |

Cou
crois:
e
29/01/

the Newborn

Cross-Sectional Study of the INTERGROWTH-21st Project

- 8 zones urbaines (Brésil, Chine, Inde, Italie, Kenya, Oman, Royaume Uni et USA)
- Santé et nutrition maternelles satisfaisantes, soins antenataux
- LCC < 14 SA, anthropométrie < H12
- 2009-2013
- 59137 femmes éligibles, 20486 incluses

the Newborn

Cross-Sectional Study of the INTERGROWTH-21st Project

- Critères exclusion :

- Âge $< 18 > 35$
- Taille $< 1,53\text{m}$, BMI > 30
- Tabac
- Altitude > 1600 m
- ATCD enfant < 2500 g ou > 4500 g
- ATCD 2 FCS, mort-né, mort néonatale malformation
- Au moins 50 données par AG (limite 33 SA)



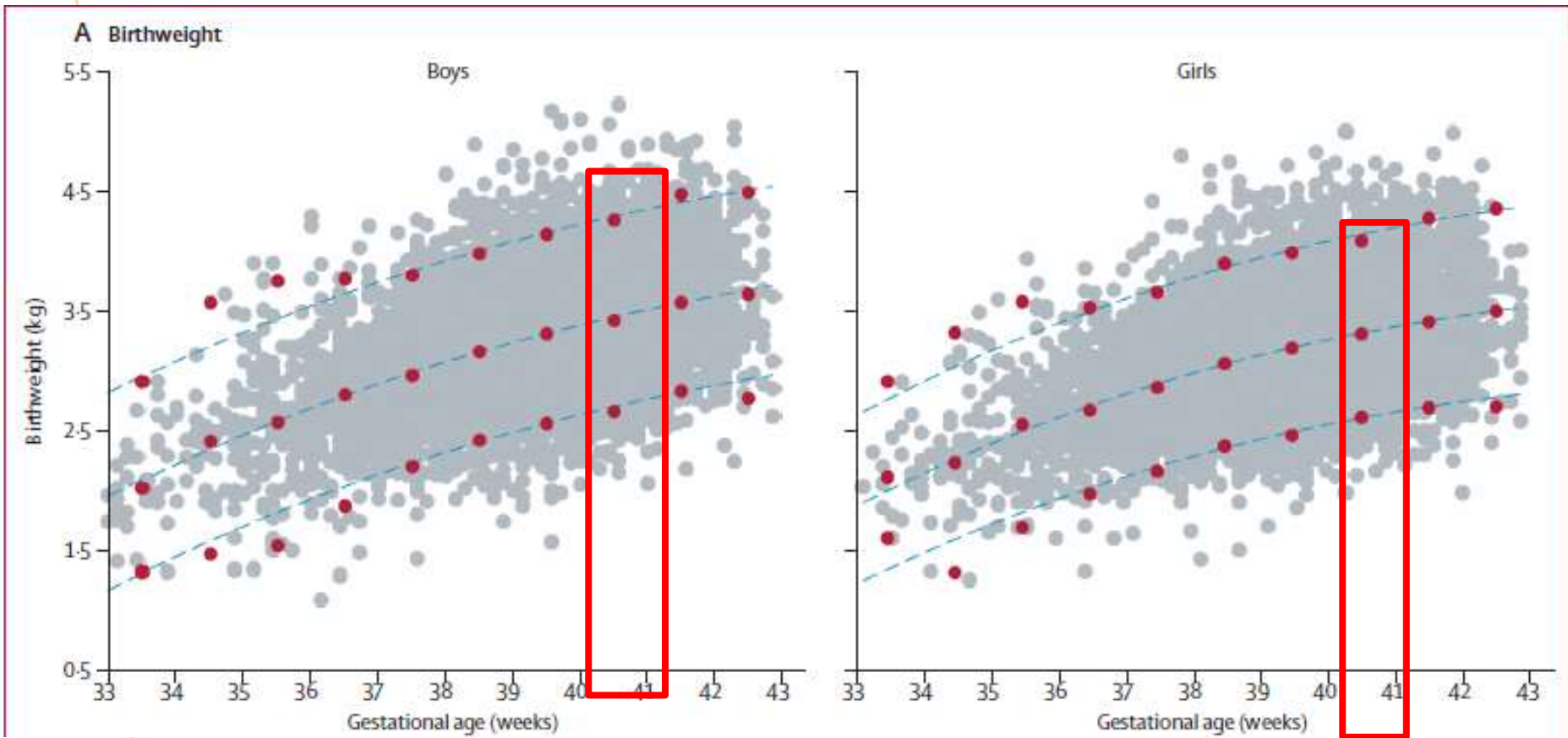
the Newborn

Cross-Sectional Study of the INTERGROWTH-21st Project

- **Résultats:**
 - 51% garçons
 - Pré-éclampsie : 1.2% (0.2-3.5%)
 - c/s : 14-65%
 - Prématurité : 5.5% (3.4-10%)
 - 3300 g, 49.3 cm, 33.9 cm

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

| | Brazil (n=1595) | China (n=3551) | India (n=2493) | Italy (n=2358) | Kenya (n=3702) | Oman (n=2821) | UK (n=2939) | USA (n=1027) | Total (n=20 486) |
|---|--------------------|-------------------|-------------------|-------------------|-------------------|------------------|----------------|-----------------|---------------------|
| Maternal age (years) | 26.4 (4.8) | 26.3 (3.0) | 27.5 (3.3) | 29.9 (4.0) | 28.8 (3.5) | 26.9 (4.0) | 29.1 (4.3) | 29.5 (3.9) | 28.0 (4.0) |
| Maternal height (cm) | 162.5 (5.4) | 161.7 (4.5) | 157.6 (3.3) | 163.3 (5.6) | 162.3 (5.5) | 158.8 (4.1) | 165.3 (6.1) | 164.8 (6.2) | 161.8 (5.6) |
| Maternal weight (kg) | 63.2 (8.4) | 58.8 (7.6) | 57.0 (7.7) | 60.4 (7.9) | 63.6 (8.5) | 60.7 (8.5) | 64.4 (8.8) | 63.7 (9.0) | 61.3 (8.6) |
| Maternal body-mass index (kg/m ²) | 23.9 (2.8) | 22.5 (2.7) | 22.9 (2.9) | 22.6 (2.6) | 24.1 (2.9) | 24.1 (3.1) | 23.5 (2.8) | 23.4 (2.8) | 23.4 (2.9) |

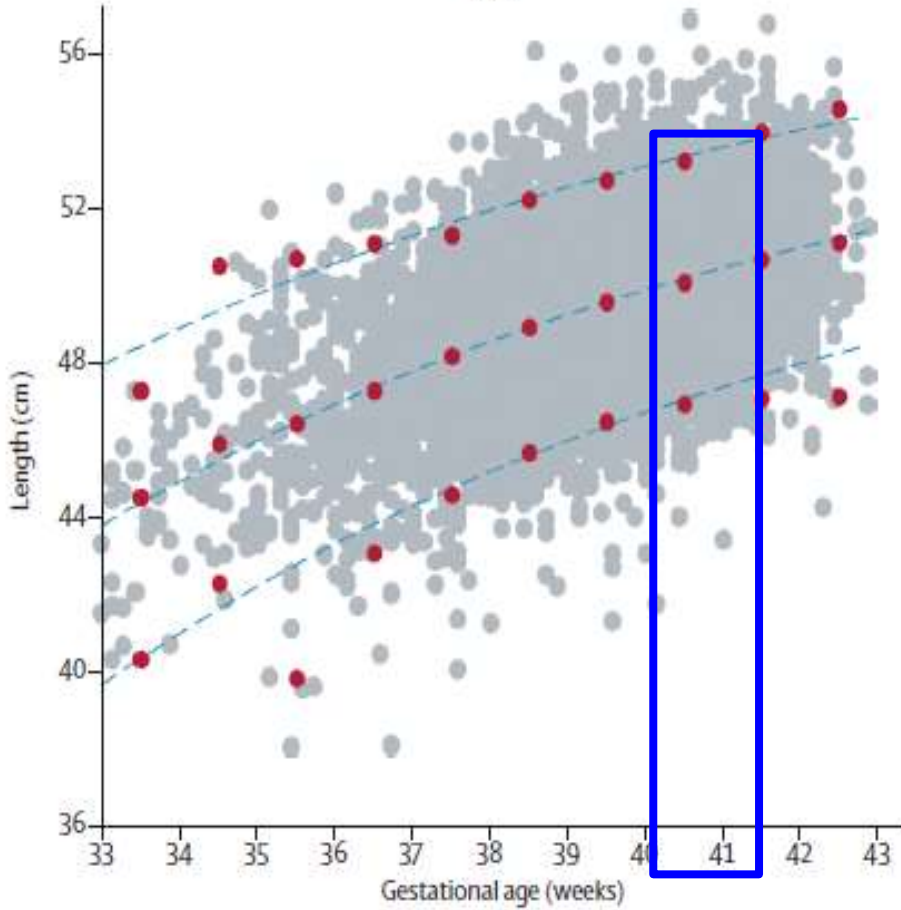


29/01/2020

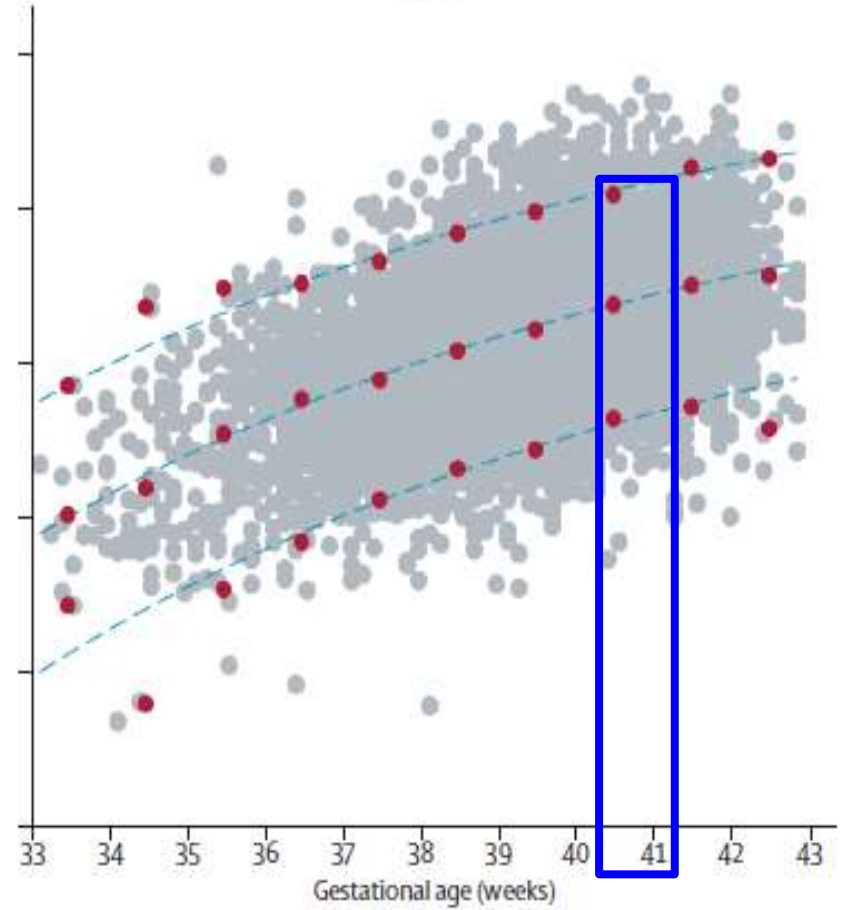


B Birth length

Boys



Girls

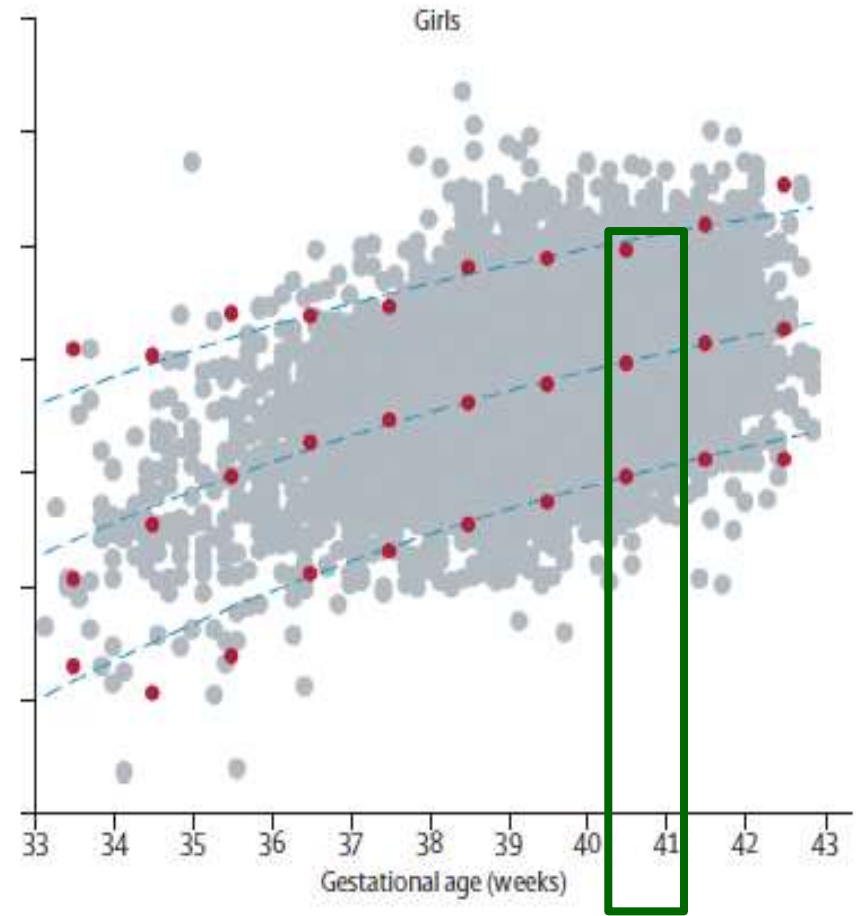
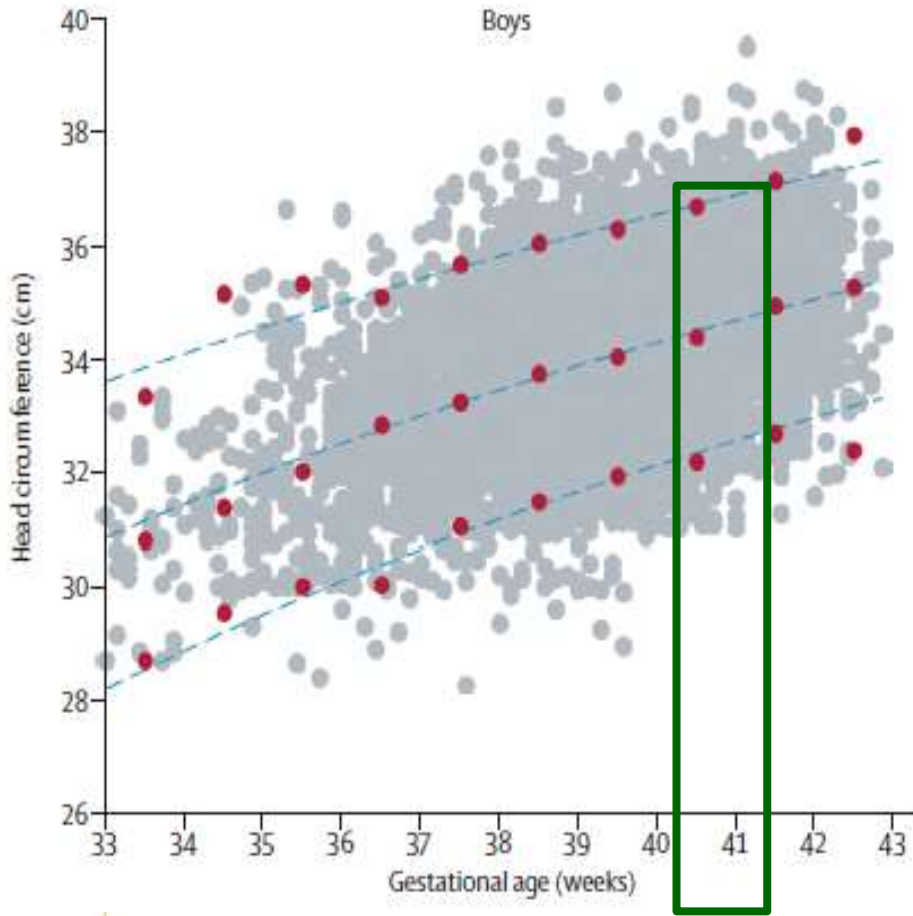


Co
croi

29/0

18

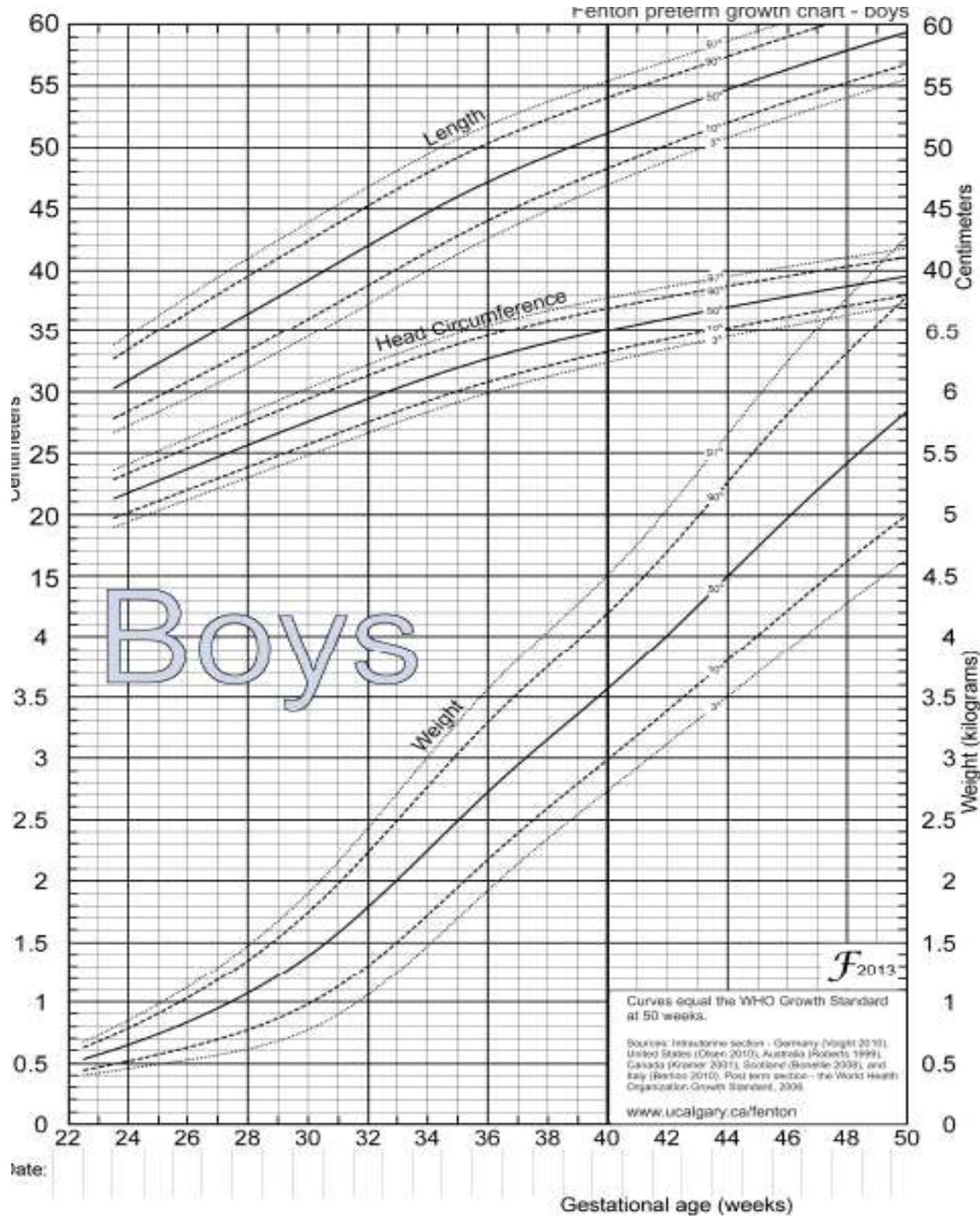
C Head circumference



Cou
crois
(
29/01

| | Boys | | | | | Girls | | | | | | |
|----------|------------------------|-------------------------------|------|------|------|-------|------------------------|-------------------------------|------|------|------|------|
| | Number of observations | Centiles for birthweight (kg) | | | | | Number of observations | Centiles for birthweight (kg) | | | | |
| | | 3rd | 10th | 50th | 90th | 97th | | 3rd | 10th | 50th | 90th | 97th |
| 33 weeks | 34 | 1.18 | 1.43 | 1.95 | 2.52 | 2.82 | 17 | 1.20 | 1.41 | 1.86 | 2.35 | 2.61 |
| 34 weeks | 48 | 1.45 | 1.71 | 2.22 | 2.79 | 3.08 | 65 | 1.47 | 1.68 | 2.13 | 2.64 | 2.90 |
| 35 weeks | 128 | 1.70 | 1.95 | 2.47 | 3.03 | 3.32 | 114 | 1.71 | 1.92 | 2.38 | 2.89 | 3.16 |
| 36 weeks | 323 | 1.93 | 2.18 | 2.69 | 3.25 | 3.54 | 293 | 1.92 | 2.14 | 2.60 | 3.12 | 3.39 |
| 37 weeks | 857 | 2.13 | 2.38 | 2.89 | 3.45 | 3.74 | 803 | 2.11 | 2.33 | 2.80 | 3.32 | 3.60 |
| 38 weeks | 2045 | 2.32 | 2.57 | 3.07 | 3.63 | 3.92 | 1802 | 2.28 | 2.50 | 2.97 | 3.51 | 3.78 |
| 39 weeks | 3009 | 2.49 | 2.73 | 3.24 | 3.79 | 4.08 | 2869 | 2.42 | 2.65 | 3.13 | 3.66 | 3.94 |
| 40 weeks | 2568 | 2.63 | 2.88 | 3.38 | 3.94 | 4.22 | 2523 | 2.55 | 2.78 | 3.26 | 3.80 | 4.08 |
| 41 weeks | 1179 | 2.76 | 3.01 | 3.51 | 4.06 | 4.35 | 1195 | 2.65 | 2.89 | 3.37 | 3.92 | 4.20 |
| 42 weeks | 206 | 2.88 | 3.12 | 3.62 | 4.17 | 4.46 | 224 | 2.74 | 2.98 | 3.46 | 4.01 | 4.30 |
| Total | 10397 | .. | .. | .. | .. | .. | 9905 | .. | .. | .. | .. | .. |

Table 2: Smoothed centiles for birthweight of boys and girls according to gestational age




Courbe
croissance

29/01/2020



Determination of birth-weight centile thresholds associated with adverse perinatal outcomes using population, customised, and Intergrowth charts: A Swedish population-based cohort study

Matias C. Vieira ^{1,2}, Sophie Relph ¹, Martina Persson ³, Paul T. Seed ¹,
Dharmintra Pasupathy ^{1*}

PLOS Medicine | <https://doi.org/10.1371/journal.pmed.1002902> September 20, 2019

Population (n=233,379)

439 missing gestational age or birthweight
12,152 premature birth (before 37 weeks)
296 deliveries at or after 43 weeks

Term pregnancies (n=220,613)

7,309 fetuses with congenital abnormalities
1,250 multiple pregnancies

Study population (n=212,101)



Thresholds for risk in small infants

| Adverse outcome ^a | Thresholds for risk in small infants | | |
|---------------------------------|--------------------------------------|------------|-------------|
| | Population | Customised | Intergrowth |
| All CSs | <5th | <5th | <10th |
| Emergency CSs | <15th | <10th | <30th |
| Apgar < 7 at 5 minutes | <15th | <20th | <25th |
| Neonatal morbidity ^b | - | - | <5th |
| Perinatal mortality | <15th | <10th | <35th |

Courbe
croissanc
e

29/01/2020



The performance of these three charts to detect infants with adverse outcomes, such as perinatal mortality, was similar when thresholds that reflect a false-positive rate of 10% were used for each chart.

Our findings suggest that either of the three charts in this study could be used in clinical practice, each having a similar ability to identify babies with adverse outcomes if thresholds that are specific to each individual chart are used.



Cou
crois
e

29/01/2020

25



Identification of the optimal growth charts for use in a preterm population: An Australian state-wide retrospective cohort study

Natasha L. Pritchard ^{1,2}, Richard J. Hiscock ^{1,2}, Elizabeth Lockie ¹,
Michael Permezel^{1,2}, Monica F. G. McGauren², Amber L. Kennedy ^{1,2}, Brittany Green ¹,
Susan P. Walker^{1,2,3} *, Anthea C. Lindquist ^{1,2,3} *

PLOS Medicine | <https://doi.org/10.1371/journal.pmed.1002923> October 4, 2019

Courbe
croissanc
e
29/01/2020



We performed a state-wide retrospective cohort analysis that included data on 28,968 preterm births from Victoria, Australia, during the period 2005–2015.

Using <10th centile as the cut-off for SGA, our analysis compared the sensitivity and specificity of 5 growth charts—2 birthweight charts and 3 intrauterine charts—for still-birth and other adverse perinatal outcomes.

Our study found that intrauterine charts classify a significantly greater proportion of the preterm population as SGA compared with birthweight charts at this gestation. Of the fetal charts, INTERGROWTH classified a smaller proportion as SGA, but this cohort had the greatest risk of perinatal mortality and morbidity.

WHO and GROW charts classified an additional subgroup that was also at increased risk of perinatal mortality and morbidity, with GROW charts shown to be the most sensitive in the detection of SGA infants at increased risk of adverse perinatal outcomes.

Our findings highlight the trade-off that exists between the greater specificity of INTER-GROWTH fetal charts and the higher sensitivity of WHO and GROW growth charts.

The differences between these growth charts are likely to be the result, at least in part, of differences in the development of the charts and the techniques and assumptions that underpin them.

Cour
croiss
e

29/01/2020

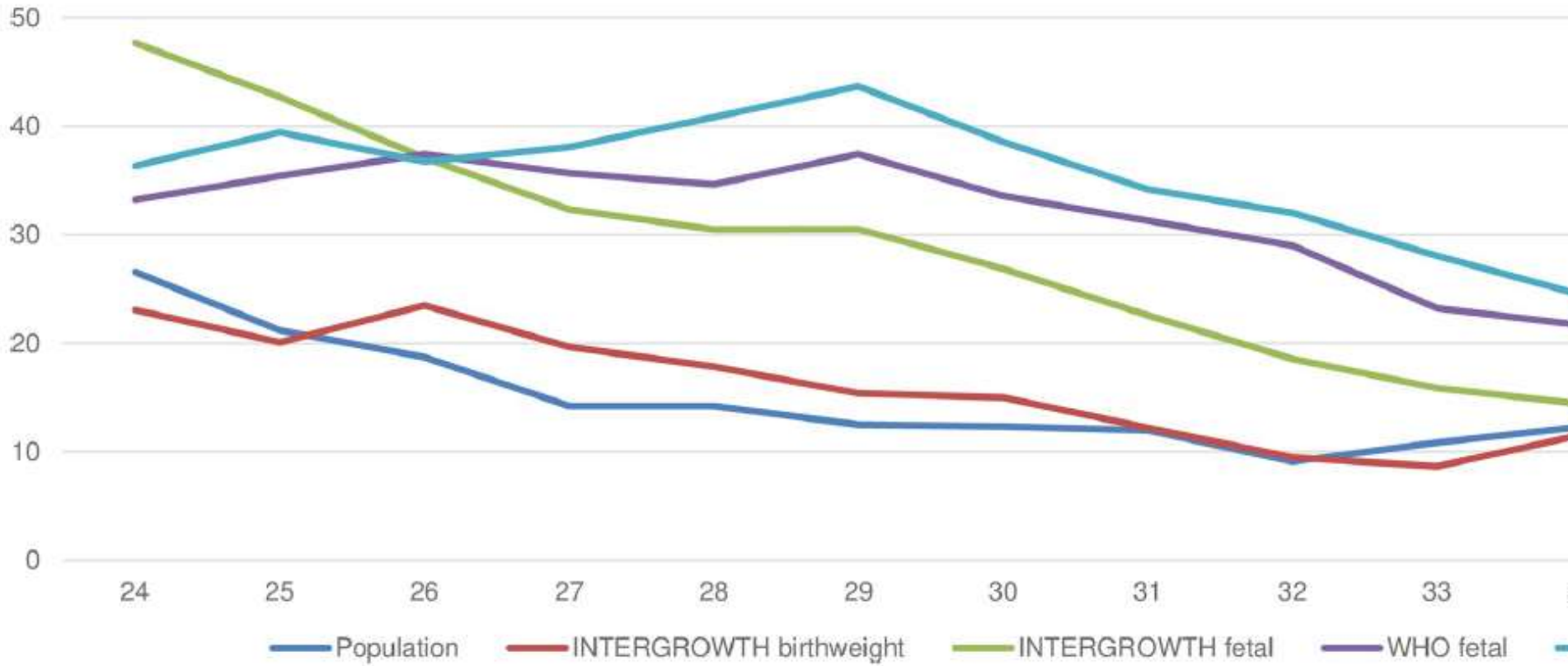


Fig 2. Proportion classified as SGA by each chart by week of gestation. GROW, Gestation Related Optimal Weight; SGA, small for gestational age.

Conclusion

- Nécessité de courbes fiables pour définir une population à risque
- Préciser critères d'exclusion et de validation
- Intérêt des courbes customisées
- Qu'attend-on d'une courbe??