Which fetal growth charts should be used in France? Position of the French College of Obstetricians and Gynecologists (CNGOF)

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Received: 31 October 2023 | Revised: 15 January 2024 | Accepted: 17 January 2024

DOI: 10.1002/ijgo.15404

CLINICAL ARTICLE

Obstetrics

Which fetal growth charts should be used in France? Position of the French College of Obstetricians and Gynecologists (CNGOF)

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Abstract

Objective: To assess which fetal growth charts best describe intrauterine growth in France defined as the ability to classify 10% of fetuses below the 10th percentile (small for gestational age [SGA]) and above the 90th percentile (large for gestational age [LGA]) in the second and third trimesters.

Methods: We analyzed five studies on fetal ultrasound measurements using three French data sources. Two studies used second and third trimester ultrasound data from a nationwide birth cohort in 2011 (the ELFE study, $N = 13\,197$ and $N = 7747$); one study used third trimester ultrasound data from on a nationwide cross-sectional study (the 2016 French National Perinatal Survey, $N = 9940$); and the last two studies were from the "Flash study" 2014 which prospectively collected ultrasound data from routine visits in the second and third trimesters ($N = 4858$ and $N = 3522$). For each study, we reported the percentage of measurements below the 10th percentile or above the 90th percentile, using French, Hadlock's, WHO and Intergrowth (IG) charts.

Results: WHO classified 4.7% and 16.3% of fetuses as having an estimated fetal weight (EFW) <10th and >90th percentiles in the second trimester compared to 3.3% and 34.7% with IG. The percentage of fetuses in the third trimester with an EFW <10th and >90th percentiles, ranged from 9.1% to 9.4% and from 8.0% to 11.1%, respectively, for WHO, and from 3.9% to 4.1% and from 17.3% to 21.6%, respectively, for IG. The WHO and IG charts for head circumference were very similar and performed well. Compared to the WHO charts, the French and Hadlock's charts deviated more frequently from the target percentiles values for EFW and biometric measures.

Conclusion: It is recommended to use the WHO charts for the assessment of EFW and ultrasound biometric measurements in France (strong recommendation; low quality of evidence).

KEYWORDS
growth chart, large for gestational age, small for gestational age, WHO charts

1 | INTRODUCTION

The development of international intrauterine growth charts over the past decade has provided new options for countries wishing to update their national charts.[1,2] The use of international charts promotes international standardization, but the choice of chart is not clear. Both of the new international charts, the Intergrowth (IG) and the WHO charts, were constructed using populations of low-risk pregnancies in order to reflect normal growth. However, they show large differences in fetal growth assessment by gestational age between countries, with a range from 2%–3% to 50% of fetuses being classified below the 10th percentile.[3,4] These differences led the International Federation of Gynecology and Obstetrics (FIGO) to recommend the use of local charts or the validation of international charts before adoption.[5] Local validation was also recommended by the constructors of the WHO charts.[2]

In France, the existing charts had limitations because they were developed using clinical data from routine scans and are therefore clustered around the recommended scan times periods and are not available after 36/38 weeks of gestational.[6–8] In addition, French head circumference (HC) charts are outdated because the caliper settings differ from current international recommendations.[7,9,10] Therefore, the French College of Gynecologists and Obstetricians (CNGOF) met to consider whether the growth charts currently used were appropriate for the French population and, if not, which fetal growth charts should be adopted in France. The methodology was based on the FIGO recommendations[11] and aimed to identify French studies that assessed the percentage of small for gestational age (SGA) and large for gestational age (LGA) fetuses, according to the different growth charts. These datasets were used to determine which chart best described the distribution of fetal size in France and could identify nearly to 3% and 10% of fetuses below the third and 10th percentiles, respectively, that is, severe SGA and SGA, and those above the 97th and 90th percentiles, respectively, that is, severe LGA and LGA, at different gestational ages.

The full results of this study, together with the French recommendations on intrauterine, birth weight and postnatal growth charts have been published in the French literature.[12] This brief original report aims to summarize the main results regarding the fetal growth chart to be used in France; our approach might be extended to other countries wishing to adopt growth charts that best fit the distribution of fetal growth in their population.

2 | MATERIALS AND METHODS

Five studies were identified using three French data sources to compare the performance of international and local growth charts in detecting SGA and LGA neonates.[13–17] Detailed information of the studies are presented in Table 1. Two studies used second and third trimester ultrasound data from the ELFE birth cohort which included live births after 33 weeks of gestation in 349 maternity units randomly selected from the 544 public and private maternity units in metropolitan France in 2011.[14,15,19] The objectives of these two studies were to assess the applicability of the IG biometric charts and the WHO fetal growth charts in a French birth cohort in comparison to existing French and international charts. A total of 13 197 and 7747 singleton births were included, respectively. One study was based on the 2016 French National Perinatal Survey which included all births in French maternity units over a one-week period with third-trimester ultrasound data abstracted from medical records.[13,20] The specific objective of this study was to compare the performance of several EFW charts for the detection of SGA and LGA newborns with and without adverse birth outcomes; 9940 singleton live births were included. Finally, two studies used data from the "Flash study" of the French College of Fetal Ultrasound (College Français d'Echographie Foetale [CFEF]) and involved 120 sonographers which prospectively collected ultrasound data from routine visits in low-risk pregnancies according to IG criteria:[16,17] the first study aimed to assess the applicability of IG biometric charts in comparison to French charts in a sample of 4858 low-risk pregnancies and the second study, including 3522 low-risk pregnancies, aimed to assess the effect of applying Intergrowth dating in comparison to Robinson dating on the percentage of fetuses classified with low and high biometric measurements and EFW according to IG charts.

These studies had different aims, but all provided data on ultrasound measurements of fetal size (biometric measurements and estimated fetal weight [EFW]). The results presented in this new report focus on the percentages of SGA and LGA fetuses according to the new international charts (Intergrowth and WHO), the local charts currently used in France (CFEF) and Hadlock's charts. Hadlock's charts are also used in France and have recently been recommended by the Society for Maternal-Fetal Medicine (SMFM) in USA.[21]

Ethical approval was obtained from the National Council on Statistical Information (Comité du Label), the French Data Protection Authority (CNIL) and the INSERM (Institut National de la Santé et de la Recherche Médicale) Ethics Committee 2016X703SA (Comité du Label), 915 197 (CNIL) and IRB00003888 no. 14-191 (INSERM Ethics Committee), for the 2016 French Perinatal Survey.[13] The ELFE study received ethical approval from the Committee for the Protection of Persons, the National Consultative Committee for the processing of Information in the health sector, and the French National Data Protection Authority-CNIL.[14,15] The Flash study was carried out as part of routine care and did not change the patient's management. In accordance with French laws in force at the time the biometric data of the initial study were collected, such a study did not require an IRB.[16,17]

No cutoff for significance was used, as the analysis was descriptive, using data from the 2016 French Perinatal Survey,[13] the ELFE study,[14,15] and the Flash study.[16,17]

Statistical analyses were performed with STATA 15.0, STATA 14.0 and STATA 9. (StataCorp LP, College Station, TX, USA), respectively for 2016 French Perinatal Survey,[13] ELFE study[14,15] and the Flash study.[16,17]

TABLE 1 Five studies evaluating intrauterine growth charts using three data sources in France.

Data source[a] (year of birth)	Design and population of data source	First author (year of publication)	Main study objective	First author (year of publication)	Study population	Data collection	US measurements	Charts
ELFE (2011)	Population-based cohort of singleton or twin live births after 33 weeks' gestation occurring during 25 days in 2011 in 349 maternity units in metropolitan France	Heude et al. (2019)[14]	To compare the Intergrowth (IG) charts to existing French charts	Heude et al. (2019)[14]	13 197 singleton births with at least one US measure. Subset of 4997 low-risk pregnancies[b]	Retrospective	EFW, AC, FL in the second and third trimester US	French biometric charts and IG
		Hocquette et al. (2022)[15]	To assess the applicability of the WHO fetal growth charts in comparison to several fetal growth charts	Hocquette et al. (2022)[15]	7747 singleton births. Subset of 4427 low-risk pregnancies[b]		EFW, AC, FL in the second and third trimester US	French charts, Hadlock, WHO, Intergrowth-1 and 2
French National Perinatal Survey (2016)	Population-based study of all births after 22 weeks' gestation and/or with a birth weight over 500 g in all French maternity units over a one-week period in March 2016	Monier et al. (2022)[18]	To compare the effectiveness of several EFW charts for the detection of SGA and LGA newborns with and without adverse birth outcomes	Monier et al. (2022)[18]	9940 singleton live births	Retrospective	EFW in the third trimester US	French charts, Hadlock, FMF, WHO, Intergrowth-2, NICHD
"Flash" (2014)	120 sonographers members of the French College of Fetal Ultrasound participated to the study	Stirnemann et al. (2017)[16]	To assess the applicability of Intergrowth biometric charts in comparison to French charts	Stirnemann et al. (2017)[16]	4858 low-risk pregnancies[b]	Prospective	HC, AC, and FL in routine trimester US	French biometric charts and Intergrowth
		Fries et al. (2021)[17]	To assess the effect of using Intergrowth dating in comparison to Robinson dating on the percentage of low and high measurements of biometrics and EFW	Fries et al. (2021)[17]	3522 women with low-risk pregnancies[b] with data available on CRL measurements		EFW, AC, FL and HC in routine trimester US	Intergrowth and Robinson

Abbreviations: AC, abdominal circumference; CRL, crown-rump length; EFW, estimated fetal weight; FL, femur length; FMF, Fetal Medicine Foundation; HC, head circumference; LGA, large-for-gestational age; NICHD, National Institute of Child Health and Human Development; SGA, small-for-gestational age; US, ultrasound.

[a]See Methods for study description.

[b]According to Intergrowth criteria.[1]

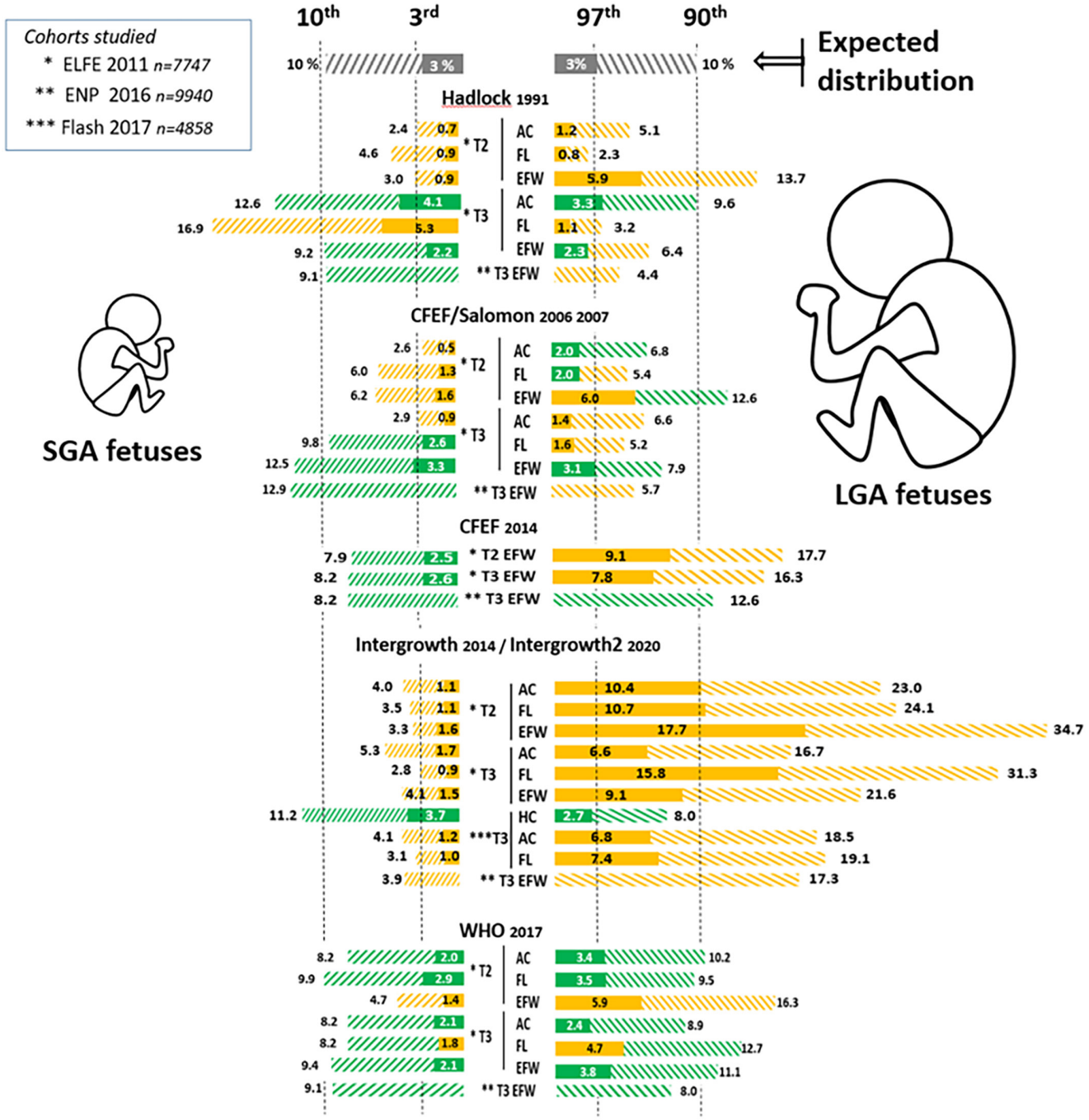

FIGURE 1 Percentage of small and large for gestational age fetuses (estimated fetal weight or biometric measures) <3rd, <10th, >97th and >90th percentiles for multiple intrauterine growth charts in studies. AC, abdominal circumference; EFW, estimated fetal weight; FL, femoral length; T2 second trimester ultrasound; T3, third trimester scan. Green color illustrates an adequate proportion of fetuses classified as <3rd, <10th, >97th, >90th percentile, defined as a difference between the expected proportion (10% for the 10th and the 90th percentiles, and 3% for the third and the 97th percentiles) and the observed proportion below 33%. Yellow color indicates an inadequate percentage of fetuses classified as <3rd, <10th, >97th, >90th percentiles, defined as the difference between the expected proportion (10% for the 10th and the 90th percentiles, and 3% for the third and the 97th percentiles) and the observed percentage above 33%.

3 | RESULTS

The methods of the five studies evaluating fetal growth charts in the French population varied; not all studies included all ultrasound measurements or EFW or covered all trimesters of pregnancy and did not evaluate all charts (Table 1). In particular, only the "Flash" study in 2014[16,17] had data on HC measurements; WHO charts for HC were not evaluated in this study since they were only published in 2017.[2]

Figure 1 summarizes the results from these studies; studies using the same databases gave similar results, so only one study from each database is shown. The WHO charts for EFW, abdominal

circumference (AC) and femoral length (FL) performed well in their ability to classify approximately 10% of fetuses with low and high values. Intergrowth charts for EFW classified a low percentage of fetuses with measurements <10th percentile (from 3.3% to 4.1%) and a high percentage of fetuses with measurements >90th percentile (from 17.3% to 34.7%). Similarly, Intergrowth charts classified a low proportion of fetuses with AC and FL <10th percentile (from 2.8% and 5.3%) and a high proportion of fetuses with AC and FL >90th percentile (from 16.7% to 31.3%). Even when using the Intergrowth dating formula, the second "Flash" study found similar results.[17] The French local charts classified almost 10% of fetuses with an EFW and FL <10th percentile in the third trimester, but values were far from 10% for AC and for all measurements in the second trimester. Hadlock had a good fit for third trimester EFW <10th percentile but provided values far from the expected 10% for other measures. Similar trends were found for studies assessing the proportions of fetuses with measurements <3rd and >97th percentiles.

Intergrowth charts for HC performed well with 8%–11% of fetuses classified as having HC <10th and >90th percentiles. In the absence of a direct application of the WHO charts for HC to the French data, we compared the WHO chart with the Intergrowth chart by plotting the 10th and the 90th percentiles. This comparison shows that the two charts are very similar. In contrast, French HC charts (CFEF) were much lower and became steeper towards the end of pregnancy (Figure 2).

4 | DISCUSSION

The results from the five studies included in this review were consistent in showing that the WHO charts provided the best description of the distribution of fetal size measurements in France, leading to the decision by the CNGOF to abandon the current French CFEF charts and to recommend the WHO charts for use in clinical practice. The WHO charts classified almost to 10% of fetuses as SGA and LGA in the second and third trimesters, whereas the Intergrowth charts identified a low percentage of fetuses with measurements <10th percentile and a high percentage of fetuses with measurements >90th percentile. The French and Hadlock charts for EFW had a good fit to the French population, but the fit was poorer for AC and FL. We were unable to evaluate the WHO charts for HC, but these charts are very similar to the Intergrowth chart which was found to be appropriate for the French population.

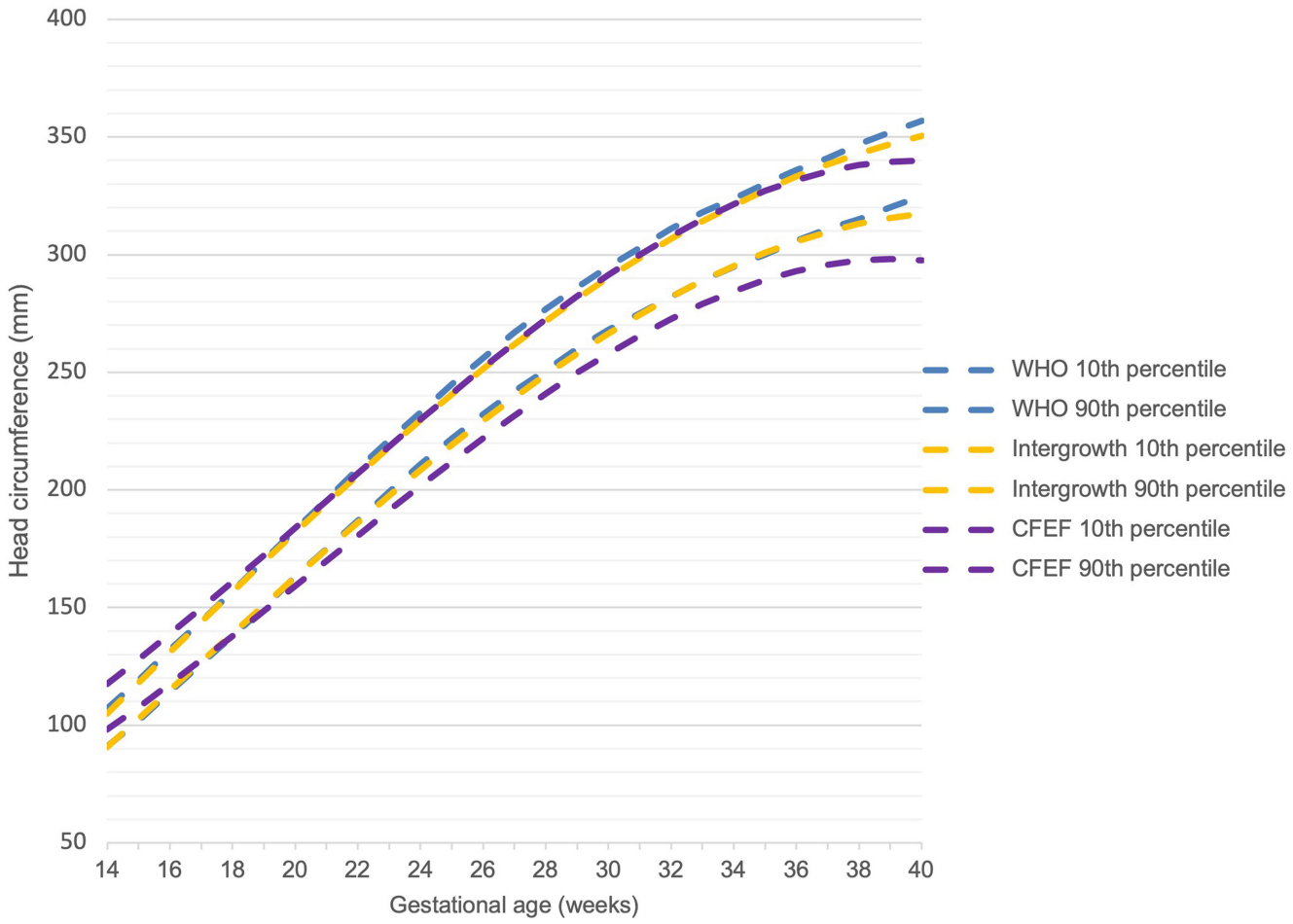

FIGURE 2 Comparison of the 10th and the 90th percentiles of the French CFEF, the WHO and Intergrowth charts for head circumference.

Other French studies have provided additional support for the use of the WHO charts. Results from the 2016 French National Perinatal Survey showed that the WHO charts performed well compared with other charts in detecting SGA and LGA fetuses with poor neonatal outcomes.[13] In addition, the WHO produced sex-specific charts which is of interest because a recent French study suggested that using sex-specific charts may increase SGA detection rates in boys and decrease false-positive results in girls.[18] Moreover, the coefficients for the WHO fetal growth charts with a ReadMe-pdf was made available online in March 2023: https://github.com/jcarvalho45/WhoFetalGrowth. Finally, the results in France were consistent with those of many international studies that have shown better detection of SGA fetuses with WHO and Hadlock's charts compared with Intergrowth.[22–26]

The strength of our approach is the comparison of charts using multiple data sources to synthesize the evidence supporting the choice of a chart. In addition, the studies used large samples of French births with data abstracted from medical records on ultrasound measurements which are well-standardized in France according to national guidelines.[27] A limitation is that the ELFE study and the French National Perinatal Survey collected data retrospectively, in contrast to the Flash study which collected data prospectively. Nevertheless, results were similar between studies despite the different methodological approaches. Finally, not all fetal outcome measures or charts could be compared in all the studies.

5 | CONCLUSION

Compared with the French, Hadlock's and Intergrowth charts, the WHO charts performed best in classifying about 10% of fetuses as SGA and LGA in the second and third trimesters of pregnancy in the French population. The French College of Gynecologists and Obstetricians (CNGOF) has therefore recommended the use of WHO fetal growth charts for EFW and ultrasound biometric measurements in France (strong recommendation; low quality of evidence). Our data highlight the importance of validating fetal growth charts prior to their use in a local setting, as has also been suggested by FIGO and WHO.[2,5]

AUTHOR CONTRIBUTIONS

Eric Verspyck: Designed, carried out and revised the manuscript. Marie-Victoire Senat: Revised the manuscript. Isabelle Monier: Designed, carried out, performed data analysis and drafted the manuscript. Anne Ego: Revised the manuscript. Jennifer Zeitlin: Designed, carried out, performed data analysis and revised the manuscript. Damien Subtil: Revised the manuscript. Gerard H. A. Visser: Designed and revised the manuscript. Christophe Vayssière: Designed, carried out and revised the manuscript.

FUNDING INFORMATION

No funding was received for this study.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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How to cite this article: Verspyck E, Senat M-V, Monier I, et al. Which fetal growth charts should be used in France? Position of the French College of Obstetricians and Gynecologists (CNGOF). *Int J Gynecol Obstet*. 2024;00:1-7. doi:10.1002/ijgo.15404