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Designation of small for gestational age according to seven fetal growth charts in England's National Health Service: population based cohort study of 3.2 million births

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ABSTRACT

OBJECTIVE
To investigate the screen positive rates of standards for fetal weight assessment in current use in England.

DESIGN
Population based cohort study of electronic data recorded as part of routine antenatal care.

SETTING
Integrated care boards of the National Health Service (NHS) in England.

PARTICIPANTS
3 201 199 women with singleton pregnancies delivered between 2015 and 2025.

MAIN OUTCOME MEASURES
Rates of small for gestational age (birth weight ‹3rd and ‹10th centile) and large for gestational age (birth weight ›90th and ›97th centile) according to seven fetal weight standards. Six of these standards are unadjustable for maternal characteristics: Hadlock (United States, single centre data), INTERGROWTH-21st (IG21, versions 2017 and 2020; eight country average), World Health Organization (WHO, 10 country average); Fetal Medicine Foundation (FMF, two NHS units average); GROW Lite (NHS population average); and GROW (NHS population, customised for each pregnancy according to maternal height, weight, parity, and ethnic origin).

RESULTS
Data were available for 38 (90%) of the 42 integrated care boards in England. Overall, maternal characteristics varied widely among integrated care boards, including ethnic origin (average proportion English: 65.6%, range 19.8-92.2) and high body mass index (≥30: mean 24.8%, range 16.3-29.4). The overall rate of babies identified as being small for gestational age (‹10th centile) varied widely according to the standard used, ranging from 5.5% with IG21-2017 to 18.7% with FMF. Large for gestational age (›90th centile) rates ranged from 4.9% for Hadlock to 17.7% for IG21-2017. Similarly, large variations were seen with cut-off points of ‹3rd centile and ›97th centile. Across all integrated care boards, the range of small for gestational age was wider with unadjustable standards and mostly reflected local population characteristics, including ethnicity and maternal weight. The customised GROW standard had small and large for gestational age rates of 13.4% and 8.4%, respectively, and the narrowest range of small for gestational age rates across integrated care boards (11.6-15.2%). For births at term (≥37+0 weeks), average small for gestational age rates were lowest for IG21-2017 (4.8%), highest for WHO and FMF (both 17.2%), and 12.3% for GROW.

CONCLUSION
One-size-fits-all fetal growth charts do not reflect birthweight average, distribution, and variation in our maternity population, and systematically fail to identify fetuses that are small or large for gestational age. These fetuses are potentially at risk because of restricted or accelerated growth. The heterogeneity in the NHS requires a customised standard based on the growth potential of each baby. Evidence based national guidelines are needed to standardise charts used for fetal growth assessment, for personalised and safe clinical care, and to enable proper audit and benchmarking of performance.

WHAT IS ALREADY KNOWN ON THIS TOPIC
Fetal growth restriction is the most common risk factor for stillbirth, and antenatal recognition of a small fetus and timely delivery are essential for prevention

A key part of surveillance in the third trimester is to undertake, when indicated, ultrasound assessment of fetal weight and determine the weight-for-gestational age centile using a chart

A variety of charts exist but there is no current national guidance on which one to use

WHAT THIS STUDY ADDS
One-size-fits all charts vary widely in the proportion of fetuses they designate small for gestational age, depending on the data they are derived from and the characteristics of the pregnancies they are applied to, such as maternal weight and ethnic origin

Customised charts better represent normal growth because they are adjusted for maternal characteristics and can assess fetal weight during pregnancy according to each baby's individual growth potential, thereby improving detection of fetal growth restriction while reducing false positive assessments

Introduction
Good perinatal care includes identifying the small for gestational age (SGA) fetus as a potential indicator of fetal growth restriction. Presence of SGA can be determined by ultrasound estimated fetal weight plotted on fetal growth charts. Antenatal detection of SGA can lead to prevention of stillbirth and other adverse outcomes by further investigations and timely delivery.[1]

Since 2016, the National Health Service (NHS) in England have been implementing versions of the Saving Babies' Lives care bundle,[2] which include guidelines for the detection and management of SGA. A key performance indicator that NHS trusts are currently required to report on, and gets published as monthly statistics,[3] relates to the gestational age at which SGA fetuses are delivered: fetuses identified antenatally with a weight <3rd centile should be delivered before 38+0 weeks, and those between the 3rd and 10th centile before 40+0 weeks. However the standard by which the centile is determined is not specified.[2] The Royal College of Obstetricians and Gynaecologists recommended using customised charts (GROW)[4 5] in both their previous guidelines.[6 7] With subsequent publication of other fetal weight standards,[8-10] the guideline authors decided not to endorse any standard in their latest update in 2024.[11] The number of different fetal weight charts in use in the NHS has increased since publication of the new guideline, in particular, charts produced by the INTERGROWTH-21st consortium.[8 12]

We set out to investigate how the use of different fetal weight standards affects rates of SGA and LGA (large for gestational age) in the maternity populations of NHS England.

Methods

Data source

The study cohort originated from a database of routinely collected pregnancy data anonymised for research. The cohort comprised 3 201 199 singleton livebirths recorded from January 2015 to September 2025 in 92 of the 119 (77%) NHS trusts in England. Each trust was running the Growth Assessment Protocol (GAP), a comprehensive fetal growth surveillance programme.[13] The variables included maternal height, weight at first antenatal visit, parity, ethnic origin, as well as gestational age, birthweight, and sex of the newborn.[5] Maternal ethnicity was based on self-reported country of origin and presented in four main groups (English, South Asian, East European, and sub-Saharan African and Caribbean) and a miscellaneous category ("other"). The expected date of delivery was based on a dating scan performed routinely in the first trimester of pregnancy. Births before 24+0 weeks and after 42+0 weeks were excluded.

Each NHS trust was grouped into its respective planning and commissioning organisation, known as an integrated care board,[14] which contained one or more NHS trusts within their area. England has 42 integrated care boards, with an average of 13 517 births per year based on 567 708 live births in England in 2024.[15] Integrated care boards with less than 1000 pregnancies recorded during the study period were excluded from the analysis.

Fetal growth standards for calculating percentiles

Scans for estimated fetal weight are only routinely performed in high risk pregnancies; therefore, birthweight was used. The weight-for-gestation centiles were calculated to determine SGA (<3rd and <10th centile) and LGA (>90th and >97th centile) rates according to the following standards:

- Hadlock fetal weight standard based on cross sectional estimated fetal weight data in a United States college cohort[16] (Hadlock).
- INTERGROWTH-21st fetal weight standard based on longitudinal assessment of estimated fetal weights from low risk pregnancies in eight countries (IG21-2017).[8]
- Updated INTERGROWTH-21st fetal weight standard, using the same cohort as IG21-2017[8] but with Hadlock's[17] rather than INTERGROWTH's own fetal weight formula (IG21-2020).[12]
- World Health Organization fetal weight standard based on longitudinal assessment of estimated fetal weights from low risk pregnancies in 10 countries (WHO).[9]
- Fetal Medicine Foundation fetal weight standard based on selected estimated fetal weight assessments in two hospitals in London and Kent (FMF).[10]
- Gestation Related Optimal Weight: fetal weight chart derived from average birthweights of UK low risk pregnancies, combined with a proportionality fetal weight curve (GROW Lite).[18]
- Gestation Related Optimal Weight as above, but customised for maternal height, early pregnancy weight, parity, and ethnic origin (GROW).[5 19]

GROW Lite is not used in practice but was added to study the effect of a chart based on the same NHS derived dataset as in GROW, but without customisation for maternal variables.

When a fetal weight standard ended at 40+0 weeks (Hadlock, IG21-2017, WHO), or 41+0 weeks (IG21-2020), we projected the trajectory to 42+0 weeks according to the respective chart's formula.

The WHO and GROW standards include the option to adjust for sex of the fetus. However, for fair comparison and to reflect how the standards would be used antenatally, we did not adjust for sex.

Statistical analysis

We calculated rates of ethnicity, nulliparity, high and low body mass index, and prematurity with average maternal height, weight, and body mass index for the whole population and for each integrated care board. We then calculated the percentage of babies according to each of the seven definitions of SGA (<3rd and <10th centile) and LGA (>90th and >97th centile) within each integrated care board. Summary SGA and LGA rates, overall and at term, were then obtained by taking the unweighted mean of specific rates for each integrated care board, giving equal weight to each board regardless of size. For the integrated care board summary SGA and LGA rates we included the mean, standard deviation, and range, allowing us to describe the variation between integrated care boards while showing the full spread of the observed values and the degree of heterogeneity across boards. Analyses were performed using Excel (2025; Microsoft, Redmond, WA, USA) and SAS (version 9.4; SAS Institute, Cary, NC, USA).

Patient and public involvement

The study was motivated by a recent increase in parents with lived experience of stillbirth contacting the Perinatal Institute's clinical team with questions about their loss, often labelled "unexplained" by their health service. A frequent theme was inappropriate assessment of fetal growth and choice of growth charts. The parents of Maia Devlin Corfield, stillborn at 41 weeks with unrecognised growth restriction, conducted a nationwide freedom of information survey,[20] which found that, contrary to Royal College guidelines,[11] many NHS trusts failed to assess the appropriateness of their charts for their population. Such information and sad personal stories spurred the authors on to conduct this study.

Results

Of the 42 integrated care boards in England, sufficient data were found for 38 (90%) after four were excluded for having less than the preset limit of 1000 births recorded (supplementary tables S1-S4). The number of births for each integrated care board varied depending on whether none, one, or more hospitals in the GAP programme were within their catchment area, and the proportion of time over the study period that they were in the GAP programme and contributed data. Supplementary table S1 displays a wide variation in maternal characteristics among integrated care boards, including ethnic origin, maternal height, weight and body mass index, and prematurity rate. Table 1 summarises these characteristics and presents them as averages with integrated care board ranges. The "other" maternal ethnicity category includes South European, Middle Eastern, South East Asian, North African, and other groups that are small in number nationally but well represented in some integrated care boards, especially in London (supplementary table S1).

Table 2 lists the SGA rates (<10th and <3rd centile) for all pregnancies and for term pregnancies by the seven different fetal growth standards. IG21-2017 had the lowest rates at 5.5% and 1.5%, respectively, while FMF had the highest rates at 18.7% and 10.0%, respectively. The six unadjustable standards (Hadlock, IG21-2017, IG21-2020, WHO, FMF, and GROW Lite) had a wide range of SGA rates, the highest being for FMF (15.6-26.0%), while customised GROW had the lowest range (11.6-15.2%). Supplementary tables S2 and S3 show the SGA rates for individual integrated care boards.

Table 3 lists LGA rates (>90th and >97th centile) for the 38 integrated care boards. IG21-2017 had the highest average rates at 17.7% and 7.4%, respectively, and Hadlock had the lowest at 4.9% and 1.5%, respectively. Again, the ranges between integrated care boards were widest for the unadjustable standards, with IG21-2017 LGA >90th centile rates ranging from 12.2% to 20.6%. Supplementary table S4 shows the LGA rates for each integrated care board.

Supplementary figure S1 illustrates the means and ranges according to the seven fetal weight charts for SGA and LGA rates at term, as listed in table 2 and table 3.

Figure 1 shows the centile distributions by decile bands for each of the standards. Bars in the >90th and <10th centile bands indicate the range of average LGA or SGA rates between integrated care boards. Figure 2 shows the differences between the 10th centile lines of the charts derived from different populations.

Table 1 | Characteristics given as averages and ranges for integrated care boards

Characteristics	Average (n=3 201 199)	Integrated care board % range
Maternal ethnicity		
English	2 100 092 (65.6)	19.8-92.2
South Asian	386 827 (12.1)	0.6-40.0
East European	224 550 (7.0)	2.3-17.9
Sub-Saharan African and Caribbean	147 338 (4.6)	0.5-12.4
Other	342 392 (10.7)	4.3-35.7
Nulliparity	1 374 965 (43.0)	38.8-50.4
Maternal height (cm), mean (SD)	164 (6.7)	161-166
Maternal weight (kg), mean (SD)	72.2 (17.4)	67.6-75.0
Maternal weight (kg), median (IQR)	69 (60-81)	65-71
Body mass index, mean (SD)	26.7 (6.1)	25.3-27.5
Body mass index, median (IQR)	25.5 (22.4-29.9)	24.2-26.2
<18.5	90 162 (2.8)	1.7-3.8
≥30	793 946 (24.8)	16.3-29.4
≥35	321 874 (10.1)	5.3-13.3
Gestational age <37 weeks	201 753 (6.3)	4.4-7.2

Data are numbers (%) unless stated otherwise.
IQR=interquartile range; SD=standard deviation.

Discussion

Principal findings

We found that most one-size-fits-all fetal growth charts in current use in England do not represent the national average birthweight in our population, and vary substantially in screen positive rates for SGA and LGA (table 2 and table 3). INTERGROWTH charts (2017[8] and 2020[12]) result in a large underestimation of SGA and overestimation of LGA rates. WHO charts[9] show the opposite effect, overestimating SGA and underestimating LGA rates, while with FMF charts,[10] SGA and LGA rates are high. Hadlock[16] had acceptable SGA but low LGA rates. GROW Lite[18] and GROW[19] standards, based on the UK's NHS population, produced more realistic rates.

We also found considerable heterogeneity between integrated care boards; all unadjustable charts, including GROW Lite, showed wide ranges in SGA and LGA rates because of the varied population. A much narrower screen positive range was obtained with the customised GROW chart, which is adjusted for individual maternal characteristics, thereby improving identification of abnormal growth.

Strengths and limitations

A strength of the study is the large database of routinely collected information covering 38 (90%) of the 42 integrated care boards that constitute the NHS areas in England. The remaining four integrated care boards did not have a hospital in their catchment area running the GAP programme, but we could compare the characteristics of their populations with similar ones (see supplementary table S1) to infer their approximate LGA and SGA rates with different charts.

Table 2 | Fetal weight standard <10th and <3rd centile rates for England average and range across integrated care boards for all births and term births only (≥37 weeks)

Fetal growth standard and pregnancies	<10th centile			<3rd centile		
	Mean	SD	Range	Mean	SD	Range
Hadlock[16]						
All	13.6	2.2	11.1-19.6	3.6	0.8	2.7-5.6
Term	12.6	2.2	10.1-18.5	2.9	0.7	2.1-4.7
IG21-2017[8]						
All	5.5	1.1	4.3-8.5	1.5	0.4	1.1-2.3
Term	4.8	1.1	3.6-7.7	1.0	0.3	0.7-1.7
IG21-2020[12]						
All	8.4	1.6	6.6-12.6	2.9	0.6	2.2-4.5
Term	7.5	1.5	5.8-11.6	2.2	0.6	1.6-3.7
WHO[9]						
All	18.1	2.6	15.2-25.4	5.2	1.1	4.1-8.0
Term	17.2	2.6	14.3-24.5	4.4	1.0	3.3-7.2
FMF[10]						
All	18.7	2.8	15.6-26.0	10.0	1.8	7.9-14.7
Term	17.2	2.7	14.1-24.5	8.7	1.7	6.7-13.2
GROW Lite[18]						
All	12.3	2.1	10.0-17.8	3.9	0.8	2.9-6.0
Term	11.2	2.0	9.0-16.7	3.1	0.7	2.2-5.1
GROW[19]						
All	13.4	0.9	11.6-15.2	4.3	0.5	3.5-5.3
Term	12.3	0.9	10.5-13.9	3.5	0.4	2.8-4.3

FMF=Fetal Medicine Foundation; IG21=INTERGROWTH-21st; IQR=interquartile range; SD=standard deviation; WHO=World Health Organization.

As a retrospective analysis, assessment of pregnancy outcomes would have been affected by treatment paradox and so we focused on SGA screen positive rates because these are management triggers recommended by the Royal College of Obstetricians and Gynaecologists[11] and NHS England's national Saving Babies' Lives care bundle guidelines.[2] A potential limitation could be that we assessed fetal weight charts by birthweight; however, this was the only way in which a representative sample of the population could be studied because scans are not done routinely in the third trimester, but selectively in pregnancies considered at increased risk. Even if routine scan data were available, ultrasound assessment can have substantial error in estimating fetal weight, especially at the LGA and SGA ends of the distribution, and accuracy is further affected by factors such as maternal body mass index.[21]

Comparison with other studies

Comparative studies of large cohorts in Australia[22] and Europe[23] have highlighted the differences in

Table 3 | Fetal weight standard >90th and >97th centile rates for England average and range across integrated care boards for all births and term only births (≥37 weeks)

Fetal weight standard and pregnancies	>90th centile			>97th centile		
	Mean	SD	Range	Mean	SD	Range
Hadlock[16]						
All	4.9	0.7	3.0-6.0	1.5	0.2	0.9-2.0
Term	4.9	0.7	2.8-6.0	1.5	0.2	0.8-1.9
IG21-2017[8]						
All	17.7	2.2	12.2-20.6	7.4	1.1	4.7-8.9
Term	18.2	2.3	12.1-21.2	7.5	1.1	4.6-9.1
IG21-2020[12]						
All	12.3	1.5	8.3-14.6	4.2	0.6	2.6-5.3
Term	12.3	1.6	7.9-14.5	4.0	0.6	2.3-5.1
WHO[9]						
All	7.6	1.0	4.9-9.2	2.2	0.3	1.3-2.8
Term	7.5	1.0	4.6-9.1	2.0	0.3	1.1-2.6
FMF[10]						
All	16.2	2.0	11.0-18.8	7.4	1.1	4.7-8.9
Term	16.5	2.0	10.8-19.2	7.5	1.1	4.6-9.0
GROW Lite[18]						
All	9.9	1.3	6.5-11.7	3.9	0.6	2.3-4.8
Term	10.0	1.3	6.3-11.8	3.8	0.6	2.2-4.8
GROW[19]						
All	8.4	0.5	7.3-9.3	3.1	0.3	2.6-3.7
Term	8.4	0.5	7.5-9.3	3.0	0.3	2.5-3.6

FMF=Fetal Medicine Foundation; IG21=INTERGROWTH-21st; IQR=interquartile range; SD=standard deviation; WHO=World Health Organization.

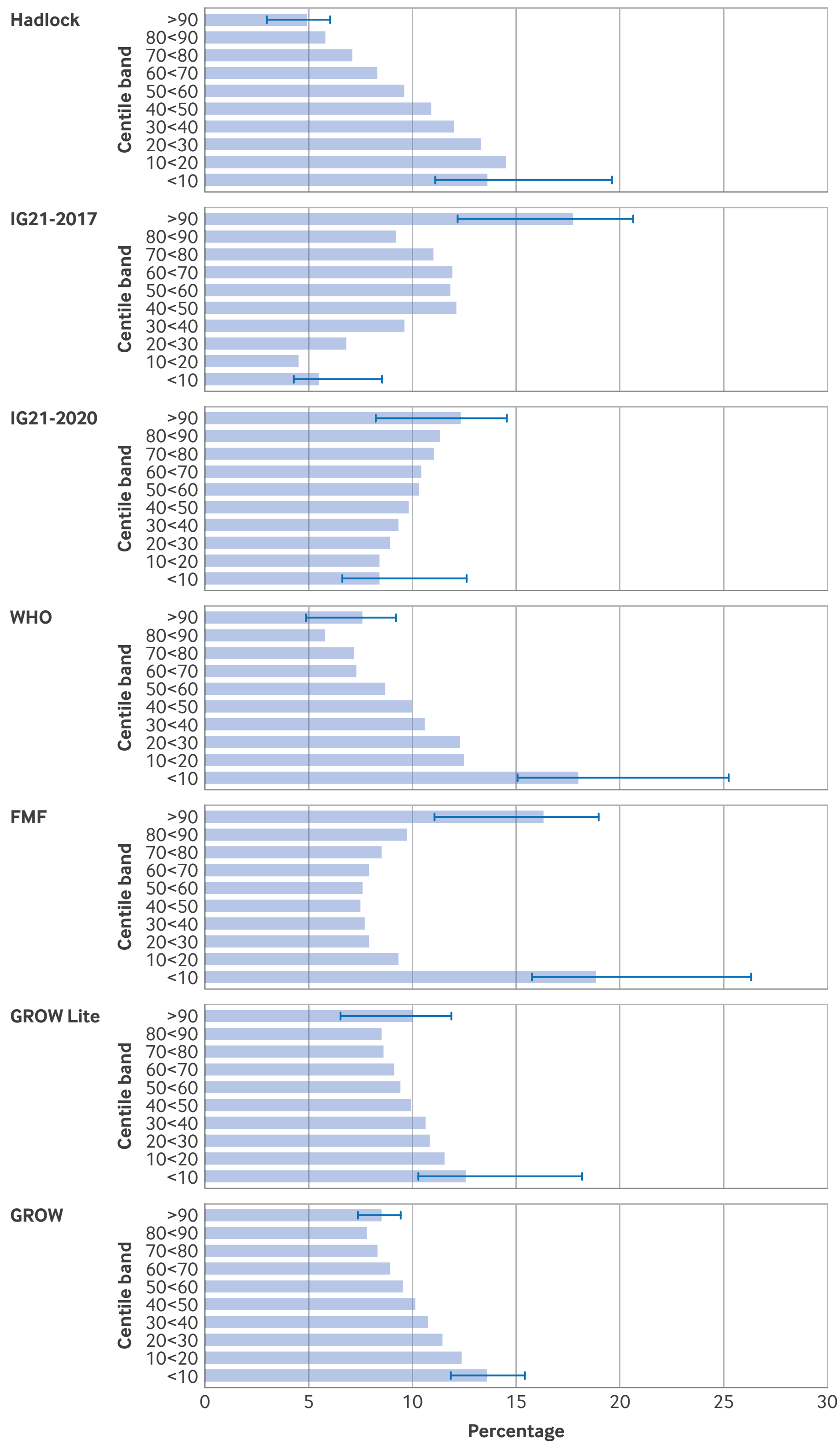

Fig 1 | Weights in centile bands according to seven fetal growth standards, with error bars in >90th and <10th centile bands indicating variation between NHS integrated care boards. FMF=Fetal Medicine Foundation; IG21=INTERGROWTH-21st; WHO=World Health Organization

screen positive rates between charts, questioned the appropriateness of universal standards, and called for the use of national or regional population based charts. However, our study shows that even between relatively small areas within our health service, such as integrated care boards with an average of less than 15 000 births per year, application of unadjustable growth standards results in substantial variation of SGA and LGA rates.

The discrepancies could be because of the varied methods used to develop the charts, but one main reason is the difference in populations from which standards are derived and to which they are applied. INTERGROWTH was based on 1556 pregnancies from eight countries, which included low, middle and high income countries including England. The authors maintained that because they selected women who were well nourished and had low risk pregnancies, their babies' growth and weight ought to be a valid standard universally. However, the IG21 publications' own tables show substantial differences in average birthweight between the contributing countries' research datasets, as well as between the contributing countries and the overall average.[24] A number of studies have since reported that the INTERGROWTH fetal and neonatal standards do not perform well even in countries that had contributed the data, including Brazil,[25] China,[26 27] India,[28] Italy,[29] and the US.[30 31] Similar observations were reported from Canada,[32] Denmark,[33] Norway,[34] Poland,[35] Lithuania,[36] Spain,[37 38] Hong Kong,[39] Australia,[40] and New Zealand,[41] questioning the validity and usefulness of a universal standard. In UK studies, IG21 is inferior in predicting infants requiring neonatal unit admission[42] and misses most pregnancies at risk of stillbirth.[43] Despite such evidence, the INTERGROWTH formulae are in electronic applications for assessing fetal growth and size, and their uptake has increased since the latest Royal College of Obstetricians and Gynaecologists guideline left it open for each hospital to decide which chart to use.[11]

The WHO standard is also based on low risk pregnancies and includes data from 1387 women from

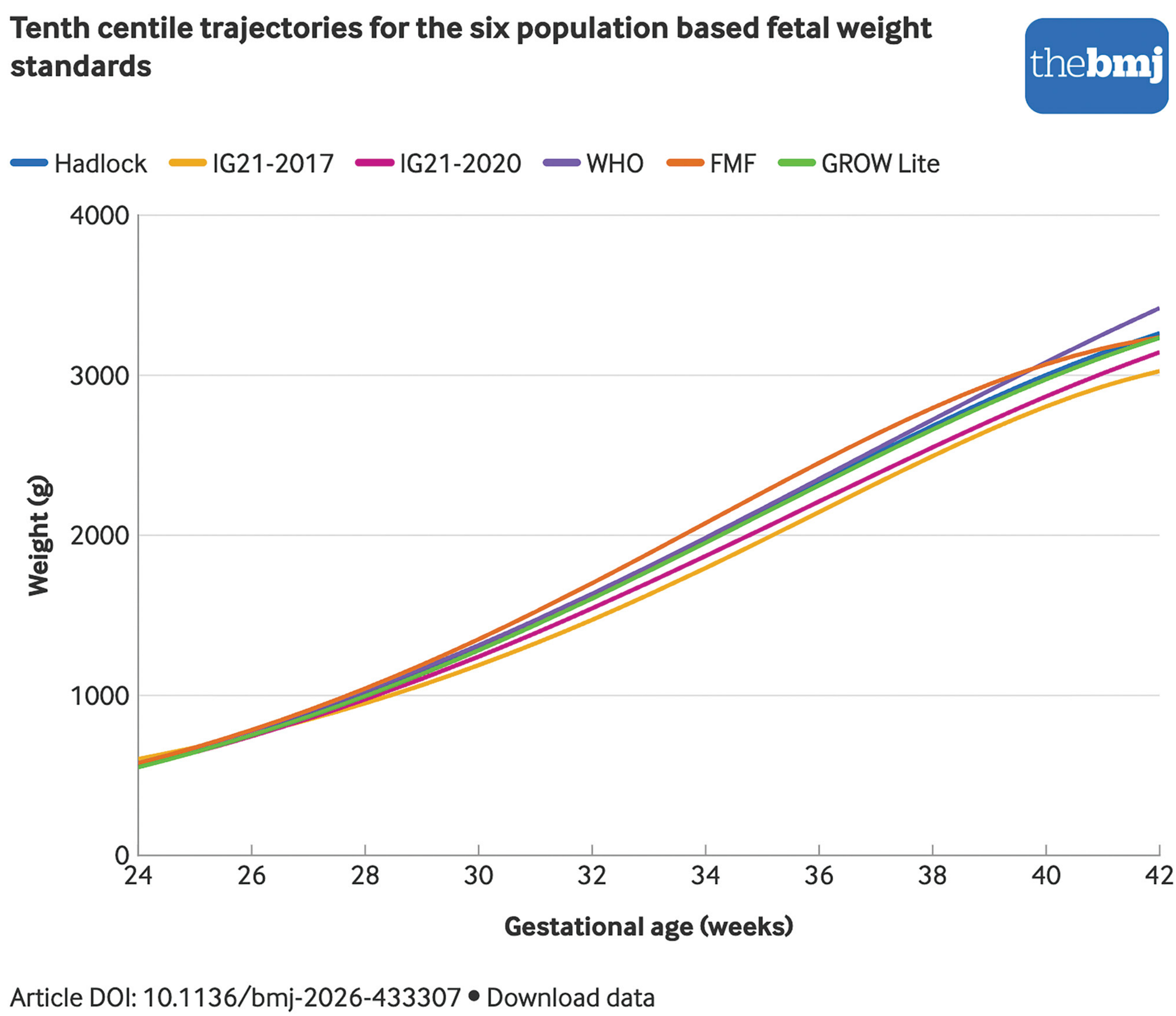

Fig 2 | Tenth centile trajectories for the six population based fetal weight standards (Hadlock,[16] INTERGROWTH-21st (IG21)-2017,[8] IG21-2020,[12] World Health Organization (WHO),[9] Fetal Medicine Foundation (FMF),[10] and GROW Lite[18]). An interactive version of this graphic is available at https://public.flourish.studio/visualisation/29322929/

10 countries, with none from the UK.[9] This chart has a higher 10th centile line (fig 2) and results in high SGA rates (18.1%) in our population (table 2). The FMF standard[10] is derived from two trusts in London and Kent, yet its application results in high SGA and high LGA rates in our UK wide cohort.

GROW Lite uses NHS data with normal pregnancy outcome and shows SGA and LGA rates closer to those expected with 10th and 90th centile cut-off points. Below 10th centile rates are expected to be higher than 10% because factors restricting fetal growth (eg, placental insufficiency) are more common than factors that accelerate growth (eg, maternal diabetes). A growth restricting influence is present across the spectrum of fetal weight, therefore we observed a negative skewness across the centile distribution, as shown in figure 1. When pregnancies with potential pathology are excluded, the SGA rate is closer to the 10th centile. For example, exclusion of preterm births, which are known to be associated with fetal growth restriction,[44] results in an SGA (<10th centile) rate of 11.2% at term (table 2).

A further reason for the large differences in SGA and LGA rates between integrated care boards, as shown in supplementary table S1, relates to variations in maternal constitutional characteristics such as ethnicity, height and weight, which influence normal growth.[5 45-48] The varying SGA rates according to one-size-fits-all standards reflect the differences in maternal constitutional characteristics of integrated care boards' varied populations.

Ethnicity has a well established physiological effect on growth, as shown in international studies of low risk pregnancies.[49-52] A 10 country cohort study of 1.25 million term pregnancies showed that SGA rates by the INTERGROWTH standard varied with ethnic origin and maternal size, and failed to reflect stillbirth risk.[53] In the UK, an ethnic specific neonatal standard has been proposed for South Asians[54] because their birthweight was consistently lower than the British population average newborn chart[55] in normal outcome pregnancies, resulting in high SGA rates. In a more recent cohort of nearly three million births, South Asian babies were found to have a 47% higher SGA rate when ethnicity was not adjusted for, and these additional SGA pregnancies did not have a higher stillbirth risk than those that were not SGA.[56]

In the current study, SGA rates can be seen to vary widely according to the ethnic mix of the local population. For example, in North East London, where South Asians make up the largest ethnic group (40%, supplementary table S1), the SGA rate is highest of all integrated care boards according to each of the six unadjustable standards, reaching 25.4% with WHO and 26.0% with FMF, while the GROW customised centile shows an SGA rate of 13.3% (supplementary table S2).

Artificially inflated SGA rates may lead to unnecessary investigations and interventions, and divert the attention of clinicians and health services from other causes of increased perinatal mortality rates, such as health inequalities and social deprivation. Other potential implications for a baby misclassified as small is overfeeding during infancy, which increases the risk of obesity and adult cardiovascular diseases.[54]

Making charts ethnicity specific only, however, would ignore physiological and pathological variation in maternal size within each ethnic group. Analysis by different maternal height and weight groups within normal body mass index limits showed that stillbirth rates remained similar in all groups, as did SGA rates, when using GROW customised for height and weight. However, with GROW not customised, as in GROW Lite, or with unadjustable standards such as Hadlock, INTERGROWTH, or WHO, the SGA rates were consistently higher for small mothers and lower for large mothers, not reflecting stillbirth rates and resulting in false positive and false negative assessments.[57 58] High body mass index pregnancies are at increased risk of stillbirth, which is associated with higher SGA rates, identified by GROW but masked by each of the unadjustable standards.[58] These effects were also observed when the analysis was repeated for South Asian pregnancies.[58]

While many comparative studies have stillbirth as the primary outcome, antenatal growth problems are also associated with neonatal morbidity and mortality. In an analysis of a state wide cohort in Washington, term birthweight defined as SGA by GROW compared with INTERGROWTH was significantly better associated with stillbirth risk and neonatal indicators including low Apgar score, newborn seizures, and need for a higher level of intensive care.[31]

Policy implications

Comparison of SGA detection rates among hospitals and clinical networks can be misleading if different fetal weight and birthweight charts are used.[59] The inconsistencies are evident in NHS Digital's monthly publication[3] of maternity units' self-reported performance indicators. NHS England's Saving Babies' Lives guideline[2] stipulates that fetuses identified antenatally with a weight <3rd centile should be delivered before 38+0 weeks, and those between the 3rd and 10th centile before 40+0 weeks, without specifying which standard to use. This lack of standardisation affects the usefulness of audit and is likely to be a reason for the continued absence of an authoritative, peer reviewed national report on NHS England's performance under its Saving Babies' Lives guidelines. More immediately in clinical practice, inappropriate charts can lead to false positive diagnoses and unnecessary interventions, or failure to recognise fetal growth restriction, and represent a systematic risk to patient safety in our maternity services.

Conclusion

Fetal growth restriction is the most frequent precursor of adverse perinatal outcome. Fetal weights <10th and <3rd centiles are important trigger points for clinical management, including further investigations and decisions about timing of delivery. However, such cut-off points are meaningless without defining the fetal weight standard by which they are to be determined because one-size-fits-all charts are based on different methods and derived from different populations. SGA and LGA rates can vary substantially within normal ranges of maternal characteristics, and adjustment for such physiological variation provides a personalised chart that predicts the growth potential of each baby, improves identification of risk, and reduces false positive alerts. Standardisation is the only means by which the health service can meaningfully audit and benchmark performance of fetal growth assessment at local and national levels.

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Ethical approval: The study received approval by the East Midlands-Derby Research Ethics Committee (REC reference 25/EM/0271, IRAS Project ID 365709).

Data sharing: Data sharing will be available on reasonable request. Codes used in the analysis are included in a public repository: https://github.com/olihugh/ICB-SGA-Designation

Transparency: The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Dissemination to participants and related patient and public communities: The results of the study will be disseminated through conferences and social media platforms to people receiving maternity care, their health service providers, clinicians and clinical networks in the NHS and internationally, guideline developers, as well as integrated care boards and other commissioners and planners of health care.

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Web appendix: Supplementary material