

Effect of INTERGROWTH-21st charts on stillbirths rates in England: retrospective cohort study

Jason Gardosi, MD FRCOG ^{1,2}; Oliver Hugh, PhD ¹; Amanda Merricks, BEd ¹; Emily Butler, BSc (Hons) ¹; Hanna Ellson, BSc (Hons) ¹

¹ Perinatal Institute, Birmingham, UK

² Division of Reproductive Health, University of Warwick, UK

Corresponding author:

Professor Jason Gardosi

Perinatal Institute,

5-6 Greenfield Crescent,

Edgbaston, Birmingham B15 3BE

United Kingdom

T: 0121 607 0101; M: 07711 788 789

jgardosi@perinatal.org.uk

<https://orcid.org/0000-0002-3230-1292>

ABSTRACT

Background

Prevention of stillbirths relies on antenatal identification of babies at-risk due to growth restriction. Fetal growth charts vary in antenatal screen positive rates for smallness for gestational age (SGA), with INTERGROWTH–21st charts recording the lowest SGA rates. We wanted to investigate the effect the introduction of INTERGROWTH had on stillbirth rates.

Methods

We studied the North East & North Cumbria (NENC) region of the National Health Service (NHS), whose 8 maternity hospitals moved in April 2024 from customised GROW to INTERGROWTH fetal weight charts. We assessed screen positive rates for SGA, defined as <10th centile, according to published maternity services statistics for 3 month periods before and after the March/April 2024 change over. Annual stillbirth rates for 2023 and 2024 for these hospitals were obtained from the Office for National Statistics. We also compared as a control group the SGA and stillbirth rates with 8 pre-selected, birthrate-matched hospitals that continued with GROW charts over the same time period.

Findings

The average SGA screen positive rate in NENC dropped by 49%, from 9.7% to 4.9%, after the change from GROW to INTERGROWTH charts, and stayed at similar levels (11.7% and 11.3%) in the birthrate-matched hospitals that continued with GROW in 2024. Stillbirth rates (per 1000) in NENC increased from 3.15 in 2023 to 4.16 in 2024 ($p<0.05$), representing a 31.9% increase. In the matched group, the stillbirth rate reduced slightly from 3.36 to 3.09 (-8.1%; $p=0.46$). NENC's stillbirth rate (3.15) was similar to that of the matched hospitals (3.36) in 2023 (-6.3%, $p=0.65$) but rose in 2024 to 4.16, 34.5% higher than that in the matched hospitals (3.09; $p<0.05$). Examination by Bradford Hill criteria indicated that the increase in stillbirth rates was causally related to the drop in screen positive rates.

Interpretation

INTERGROWTH fetal weight charts miss babies at risk of fetal growth restriction. Their use can result in an increased rate of stillbirth and therefore cannot be recommended for growth surveillance in maternity populations where their application results in a low screen positive rate.

Funding: None

RESEARCH IN CONTEXT

- Evidence before

Small for gestational age (SGA) fetuses are at increased risk of stillbirth, and early recognition reduces the risk by prompting further investigations and timely delivery. Observational studies have shown that the international INTERGROWTH fetal weight chart identifies fewer fetuses and newborns than the customised GROW chart used in the majority of NHS hospitals.

- Added Value

The screen positive rate of SGA reduced significantly by nearly a half (49%) in the hospitals that switched from GROW to INTERGROWTH charts. Over the same period, the stillbirth rate increased significantly in the INTERGROWTH using hospitals, while they remained at the same level in the hospitals that continued with GROW.

- Implications of all the available evidence

INTERGROWTH charts are not suitable for the UK NHS population as they fail to recognise a large proportion of fetuses at risk due to possible FGR. Standards for fetal growth assessment need to represent local populations, and be individually adjustable for maternal constitutional variation which affects normal fetal size and growth.

INTRODUCTION

Stillbirth prevention is a central aim of antenatal care¹, and fetal growth restriction (FGR) is a frequent antecedent of fetal demise and found in many cases of stillbirth that were previously designated unexplained and, by implication, unavoidable². A small-for-gestational age (SGA) fetus has an eight-fold increased risk of stillbirth, and antenatal detection reduces this risk by half³. Antenatal recognition of SGA can prompt further investigation and, where indicated, timely delivery of the at-risk fetus.⁴

Improved antenatal detection of the SGA fetus has therefore been a key target in the UK's national health service (NHS), with programmes like the Growth Assessment Protocol (GAP)⁵ and NHS England's Saving Babies' Lives Care Bundle⁶ having contributed to year-on-year reductions in stillbirth rates over the last decade, after having been stagnant for many years⁷. The 2013 Royal College of Obstetricians and Gynaecologists' (RCOG) FGR guideline⁸ helped further by emphasising early pregnancy risk assessment and recommending serial third trimester scans for pregnancies at risk. It also endorsed customised growth charts (GROW – gestation related optimal weight)^{9 10}. GROW is provided as an integral part of the UK GAP programme as well as to centres internationally, to personalise assessment of fetal weight and birthweight by adjusting for constitutional variation affecting fetal size, including maternal height, early pregnancy weight and ethnic origin.

Several population-average, one size-fits all standards have since been published, including those by the INTERGROWTH-21st consortium for birthweight¹¹, ultrasound fetal growth parameters¹² and estimated fetal weight¹³. The RCOG in its latest FGR guideline¹⁴ summarised and referenced a number of charts but decided not to endorse any, and instead recommended that NHS hospitals should check whether the chart they used was appropriate for their local maternity population. Since the RCOG no longer recommended a specific chart to use, a number of hospitals switched from GROW to INTERGROWTH charts, the latter being freely available as a formula integrated into ultrasound and maternity information systems, and not requiring the licensed GROW app software with algorithm to customise charts for each pregnancy.

Since publication of the new RCOG guideline¹⁴, informal reports of missed at-risk cases emerged from clinicians whose hospitals had taken up INTERGROWTH charts. In one NHS hospital the sad stillbirth of baby girl Maia Devlin Corfield due to unrecognised fetal growth restriction at term prompted her bereaved parents to investigate the role of the INTERGROWTH charts used in her care. They believed that the charts painted an inaccurate picture of Maia's health. They subsequently undertook a Freedom of Information (FOI) survey¹⁵ of all NHS hospitals to ascertain what charts they use, since when, and whether the chart was tested by the hospitals for suitability in their populations, as

stipulated in the RCOG guidelines¹⁴. Their survey found that only a small proportion of hospitals using INTERGROWTH charts reported to be following RCOG guidance to ensure they were identifying the right proportion of small fetuses. Subsequent analysis of hospitals' own reports published in NHS England's Maternity Services Monthly Statistics (MSMS)¹⁶ showed that a change from GROW to INTERGROWTH charts resulted in an average drop of screen positive rates by 44%¹⁷.

We set out to investigate the effect this reduction in antenatally designated SGA cases may have on stillbirth rates as recorded by the Office for National Statistics (ONS), with the hypothesis that they may increase if babies at risk due to being SGA are not recognised antenatally. We examined ONS data covering the 8 NHS hospitals of North East and North Cumbria, which moved together as a regional fetomaternal medicine network from GROW to INTERGROWTH charts in March and April 2024. According to the FOI survey, both the original INTERGROWTH fetal weight standard published in 2017¹³ and its 2020 version¹⁸ were in use in NENC.

METHODS

Study design

This was a cohort study of two groups of NHS hospitals compared contemporaneously, and each longitudinally, over a 2 year period (2023 and 2024). All data were completely anonymised and ethical approval was not required.

Participants

Group 1 consisted of pregnant women giving birth in one of the 8 NHS hospitals that make up the North East and North Cumbria region (NENC). Up to February 2024, these hospitals were in the Growth Assessment Protocol (GAP), a programme using customised GROW charts to assess fetal growth, and in March and April 2024, all hospitals switched to INTERGROWTH charts. Group 2 were 8 GAP hospitals that used GROW charts in 2023 and 2024, preselected and matched according to MSMS listed birthrates¹⁶.

Data

A sensitivity analysis was undertaken to examine similarity of characteristics between the groups, based on routinely recorded, anonymised data of pregnancies in 2023, when both groups were in the GAP programme using GROW.

The Maternity Services Monthly Statistics¹⁶ include performance of NHS hospitals on indicators of Element 2 of the Saving Babies Lives (SBL) care bundle, of which version 2 was operational at the time⁶.

The relevant metric monitored was the antenatal identification (screen positive rate) of SGA, defined as <10th centile. The NENC hospitals switched from GROW to INTERGROWTH in March/April 2024, as seen in the sudden reduction and halt of monthly births recorded in the GROW App (Supplementary Figure S1), and as also confirmed by the hospitals' FOI responses ¹⁵. We ascertained antenatal SGA identification rates for three months before (December 2023 to February 2024) and after (May to July 2024) the switch from GROW to INTERGROWTH in 7 of the 8 NENC hospitals, excluding one with missing data. In the group of hospitals continuing with GROW, only two units had submitted complete data to MSMS ¹⁶, therefore screen positive rates were ascertained from GROW App PowerBI data provided for the hospitals' own rolling audit. Such GROW App data was available for 7 of the 8 matched hospitals and were calculated for the same three month periods before and after the March/April 2024 transition period.

Outcome

The primary outcome was stillbirth, defined as a baby born without signs of life from 24 weeks of pregnancy. The ONS maintain the national births dataset with variables including outcome (live/stillbirth) and Middle Layer Super Output Area (MSOA) of maternal residence. By mapping MSOA's to NHS catchment areas¹⁹, number of births and stillbirth for the NENC and matched GROW-continuing hospitals can be reported. An excerpt of such data for 2023 and 2024 with identified hospitals in the two groups was requested from ONS and released in October 2025. ²⁰

Statistical analysis

Stillbirth rates were compared between 2023 & 2024 as well as between NENC and matched GROW-continuing hospitals with two-proportions Z-test. Statistical analysis was performed using Excel (2016; Microsoft, TX, USA)

RESULTS

The constituent hospitals of the NENC and birthrate-matched groups are displayed in Supplementary Table S1. Table 1 lists maternal and pregnancy characteristics according to routinely recorded 2023 GROW data, showing close similarities between the groups.

Figure 1 displays the average antenatal SGA (<10thcentile) identification rates for the 7 NENC and 7 matched hospitals with data, for the 3 month periods before and after the switch to INTERGROWTH. The NENC group had a significant reduction in SGA identification rates from 9.7% to 4.9% - a drop by 49.1% (C.I. 45.0 – 57.5%). In the matched group the SGA identification rate was similar over the two time periods (11.7% and 11.3%).

Table 2 shows two analyses of stillbirth rates (per thousand): First, comparison between NENC and GROW-continuing hospitals showed rates similar in 2023, but a significant increase in 2024 in NENC to 4.16, 34.5% higher than in the GROW-continuing hospitals. Second, comparing before and after the switch in charts, 2024 showed a significant increase in stillbirth rate in NENC by 31.9%, representing 27 additional deaths, while in GROW-continuing hospitals there was a non-significant decrease by 8%.

These changes are illustrated in Fig 2, and include also the stillbirth trend according to ONS' national report ²¹ which, similar to the matched GROW-continuing group, decreased slightly over the two years.

The findings were examined using Bradford-Hill criteria²² which suggested that the observed associations were causal (Supplementary Table S3).

DISCUSSION

The change to INTERGROWTH charts in the NENC Region resulted in two main findings : 1. a drop in screen positive rates of SGA by nearly a half (49%), from 9.7% to 4.9%, and 2. a significant increase in 2024 stillbirth rates by 32% when compared against the same hospitals' 2023 rates, and an increase also by 35% when compared with the matched group of hospitals that continued with GROW in 2024.

This study is to our knowledge the first to demonstrate an instantly observable effect of introduction of INTERGROWTH charts on stillbirth rates, although the finding is not surprising considering foregoing evidence. The publications of the INTERGROWTH-21st consortium's fetal growth and birthweight standards in 2014 ^{11,12} were welcomed at first, and universal adoption encouraged as 'the best available answer to how unborn babies should be growing' ²³. However questions about suitability for the UK arose already in 2015, when a preliminary analysis of fetal weight SGA limits based on INTERGROWTH's ultrasound parameters ¹² showed that its low screen positive rate would miss 57% of cases with significantly increased stillbirth risk when compared to the GROW standard recommended nationally at the time ²⁴. This was followed by reports of the INTERGROWTH fetal weight and birthweight standards missing at-risk cases in multi-ethnic populations ²⁵, various low, middle and high income country cohorts ²⁶, in the current NHS population ²⁷ and in pregnancies with chronic hypertension ²⁸ and maternal obesity ²⁹. In comparative studies with other population based standards, INTERGROWTH's fetal and neonatal weight charts consistently displayed the lowest SGA rates in cohort studies in Europe ³⁰ and Australia ³¹, and excessively high SGA rates in India³².

The direct effect of reduced screen positive rates on increasing stillbirths is consistent with evidence in reverse, namely that improved detection of SGA is associated with a reduction in stillbirths. This has been shown in an NHS England commissioned longitudinal evaluation of the Saving Babies Lives'

program on fetal growth pre- and post its implementation in 2015³³. It included 19 hospitals, 17 of which were in the GAP programme using GROW charts, and observed significant increases in SGA detection rates and reduction in stillbirth rates³³. Prior to that, introduction of GROW charts in 3 NHS regions with associated training was shown to be responsible for a significant reduction in regional and national stillbirth rates in 2012³⁴, and a ten year longitudinal analysis observed a dose-response relationship between improved antenatal SGA detection in the GAP programme and reduction in ONS reported stillbirth rates.³⁵ Similarly, we are able to show here that in reverse, the association between reduced antenatal identification of SGA and increase in stillbirths is causal (Table S3).

Strengths of the study include the ability to measure a 'hard' but rare outcome like stillbirth by comparing a whole region's stillbirth rate, when all its hospitals changed charts at the same time. The Office for National Statistics is a neutral, high quality source of stillbirth data. As shown in Supplementary Table S2, stillbirths increased in 7 of the 8 NENC hospitals but individually, numbers were too small for the trend to become immediately apparent and statistically significant. This highlights the difficulties in assessing effectiveness of prevention programmes of stillbirths and other serious outcomes at individual hospital level. The designation of calendar year time periods could be considered a limitation, as the 2024 cases included the first two months, January & February, before the switch of charts. However this in fact suggests that the adverse INTERGROWTH effect on stillbirth rate was strong enough to reach significance already before being in use for a complete year. National data for 2025 will be released by ONS in or after May 2026. Another potential limitation is that contributing effects of other factors are not known. Withdrawal from the GAP programme ceased ongoing training, helpdesk support and rolling audit as well as the use of GROW charts. As shown in the DESiGN Trial, use of customised GROW charts can reduce stillbirth rate even when assessed against a fetal weight standard with a similar but uncustomised screen positive rate, by improved recognition of the growth restriction associated risk specific to each individual mother and fetus^{36,37}. However the single largest effect observed here was likely to have been the sudden drop in fetuses being recognised as at risk due to being SGA.

The diminished ability of INTERGROWTH charts to identify SGA in our population can be attributed to two main factors: while proposed as a global 'one size fits all' standard based on a cohort of healthy mothers with low risk pregnancies, the data originates from eight high, middle and low income countries¹¹, and ends up not being suitable for either because of the variation in national averages of term birthweight^{26,38}. The effect of its designated 'universal' tenth centile cut-off, for example, is too high for India, resulting in high SGA rates³², and too low for 15 European countries, thereby missing at-risk cases identified by national charts³⁰. At individual level, it also misses constitutional variation

in maternal characteristics that affect normal fetal growth, which are adjusted for by customised charts and are particularly relevant in heterogeneous, multi-ethnic populations³⁹.

NHS England's Saving Babies Lives guidelines⁴⁰ currently define <3rd centile as 'FGR' and 3rd<10th centile as 'SGA', without stipulating which standard should be used to calculate the centile for the ultrasound estimated fetal weight. A fetus found to be FGR is to be delivered before 38.0 weeks and if SGA, by 40.0 weeks. There are several problems with such guidance. National monitoring of processes, including recommended interventions, or omissions to intervene, are meaningless if the same standard defining screen positivity is not used throughout. Birthweight also needs to be recorded to ascertain actual antenatal SGA detection rates, and thereby evaluate how many interventions were false negative, i.e. SGAs missed by antenatal surveillance and scan measurement, or undertaken unnecessarily due to false positive antenatal assessment of SGA.

Going forward, it is important that guidelines reflect all up-to-date evidence. An important factor that has been missing in SBL guidelines and NHS England audits is the standardised assessment of fetal growth velocity based on serial scan measurements of fetal size, which can detect many fetuses at-risk due to slow growth without being SGA.⁴¹

Funding: None

Authors' contributions

JG planned the analyses, helped to interpret the data and wrote the first draft. OH helped to plan analyses, undertook them together with AM and both verified the data and results. EB and HE contributed to the planning and helped to interpret data and results. All authors reviewed and helped revise the manuscript and approved the final version.

Declaration of Interest

All authors work for the Perinatal Institute, a not-for-profit social enterprise that has developed and licenses the GROW charts used in this study to NHS hospitals as part of its national GAP programme.

Data sharing

Data from this study, if not already in the public domain, are available from the Perinatal Institute on reasonable request and signed data access agreement.

Acknowledgement

We would like to thank Sherena Corfield and Jack Devlin, parents of stillborn daughter Maia Devlin Corfield, for communicating their sad experience, for their tireless campaign to improve patient safety, and for their advice and encouragement to undertake this study.

REFERENCES

1. Lawn JE, Blencowe H, Pattinson R, Cousens S, Kumar R, Ibiebele I, et al. Stillbirths: Where? When? Why? How to make the data count? *The Lancet*. 2011;377(9775):1448–63. [https://doi.org/10.1016/S0140-6736\(10\)62187-3](https://doi.org/10.1016/S0140-6736(10)62187-3)
2. Gardosi J, Kady SM, McGeown P, Francis A, Tonks A. Classification of stillbirth by relevant condition at death (ReCoDe): population based cohort study. *BMJ*. 2005;331(7525):1113–7. <https://doi.org/10.1136/bmj.38629.587639.7C>
3. Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: population based study. *BMJ*. 2013;346(3). <https://doi.org/10.1136/bmj.f108>
4. Figueras F, Gratacos E. The integrated approach to fetal growth restriction. *Best Practice & Research Clinical Obstetrics & Gynaecology*. 2017;38:48-58 <http://www.sciencedirect.com/science/article/pii/S1521693416301109>
5. Perinatal Institute. Growth Assessment Protocol (GAP), 2009-2025. <http://www.perinatal.org.uk/GAP/Programme>
6. NHS England. Saving Babies' Lives v.2: A care bundle for reducing perinatal mortality. NHS England. 2019. <http://www.england.nhs.uk/publication/saving-babies-lives-version-two-a-care-bundle-for-reducing-perinatal-mortality/>
7. Child and infant mortality in England and Wales - Office for National Statistics. <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/childhoodinfantandperinatalmortalityinenglandandwales/2019>
8. Royal College of Obstetricians and Gynaecologists. The Investigation and Management of the Small for Gestational Age Fetus. Green Top Guideline No 31. 2013; <https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg31/>
9. Gardosi J, Chang A, Kalyan B, Sahota D, Symonds EM. Customised antenatal growth charts. *Lancet*. 1992;339(8788):283–7. [https://doi.org/10.1016/0140-6736\(92\)91342-6](https://doi.org/10.1016/0140-6736(92)91342-6)
10. Gardosi J, Mongelli M, Wilcox M, Chang A. An adjustable fetal weight standard. *Ultrasound in Obstetrics and Gynecology*. 1995;6(3):168–74. <https://doi.org/10.1046/j.1469-0705.1995.06030168.x>
11. Villar J, Papageorghiou AT, Pang R, Ohuma EO, Ismail LC, Barros FC, et al. 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. *The Lancet Diabetes & Endocrinology*. 2014 Oct;2(10):781–92. <http://linkinghub.elsevier.com/retrieve/pii/S2213858714701214>
12. Papageorghiou AT, Ohuma EO, Altman DG, Todros T, Ismail LC, Lambert A, et al. International standards for fetal growth based on serial ultrasound measurements: the Fetal Growth

- Longitudinal Study of the INTERGROWTH-21st Project. *The Lancet*. 2014;384(9946):869–79. <https://doi.org/10.1136/bmj.i5662>
13. Stirnemann J, Villar J, Salomon LJ, Ohuma E, Ruyan P, Altman DG, et al. International Estimated Fetal Weight Standards of the INTERGROWTH-21st Project. *Ultrasound in Obstetrics & Gynecology*. 2017;49(4):478–86. <https://doi.org/10.1002/uog.17347>
 14. Morris RK, Johnstone E, Lees C, Morton V, Smith G, the Royal College of Obstetricians and Gynaecologists. Investigation and Care of a Small-for-Gestational-Age Fetus and a Growth Restricted Fetus (Green-top Guideline No. 31). *BJOG: An International Journal of Obstetrics & Gynaecology*. 2024;131(9):e31–80. <https://doi.org/10.1111/1471-0528.17814>
 15. Corfield S, Devlin J. Changes in the Choice of Fetal Growth Charts in England. Rochester, NY: Social Science Research Network; 2025. <https://papers.ssrn.com/abstract=5722522>
 16. NHS Digital. Maternity Services Monthly Statistics. 2024. <https://digital.nhs.uk/data-and-information/publications/statistical/maternity-services-monthly-statistics>
 17. Merricks A, Hugh O, Gardosi J. Effect of INTERGROWTH-21 st Charts on Identification of Small-for-Gestational Age Fetuses. Rochester, NY: Social Science Research Network; 2025. <https://papers.ssrn.com/abstract=5622033>
 18. Stirnemann J, Salomon LJ, Papageorghiou AT. INTERGROWTH-21st standards for Hadlock's estimation of fetal weight. *Ultrasound in Obstetrics & Gynecology*. 2020;56(6):946–8. <https://doi.org/10.1002/uog.22000>
 19. Office for Health & Improvement Disparities. NHS Acute Trust Catchment Boundaries 2022. <https://www.arcgis.com/home/item.html?id=3edbec15dac64c40bb6f62bccd159270>
 20. Live and still births by select NHS Trusts in England, 2023 and 2024 - Office for National Statistics. <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/adhocs/3075liveandstillbirthsbyselectnhstrustsinengland2023and2024>
 21. Office of National Statistics. Births in England and Wales 2024. October 2025. <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/bulletins/birthsummarytablesenglandandwales/2024refreshedpopulations>
 22. Hill AB. The environment and disease: association or causation? *Proc R Soc Med*. 1965;58(5):295–300. <https://www.ncbi.nlm.nih.gov/pubmed/14283879>
 23. McCarthy EA, Walker SP. International fetal growth standards: one size fits all. *The Lancet*. 2014 Sept 6;384(9946):835–6. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(14\)61416-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(14)61416-1/fulltext)
 24. Francis, A, Gardosi, J. INTERGROWTH-21 based fetal weight standards versus customised GROW standards and their ability to define SGA babies at increased risk of perinatal death. British Maternal & Fetal Medicine Society (BMFMS) 17th Annual Conference 2015, London, UK. *BJOG*. 2015;122(S2):101, PP.2. <https://onlinelibrary.wiley.com/doi/abs/10.1111/1471-0528.13390>
 25. Anderson NH, Sadler LC, McKinlay CJD, McCowan LME. INTERGROWTH-21st vs customized birthweight standards for identification of perinatal mortality and morbidity. *Am J Obstet Gynecol*. 2016;214(4):509.e1-509.e7. <https://doi.org/10.1016/j.ajog.2015.10.931>

26. Francis A, Hugh O, Gardosi J. Customized vs INTERGROWTH-21 st standards for the assessment of birthweight and stillbirth risk at term. *American Journal of Obstetrics and Gynecology*. 2018;218(2):S692–9. <https://doi.org/10.1016/j.ajog.2017.12.013>
27. Hugh O, Butler E, Ellson H, Mytton J, Gardosi J. Small-for-gestational age according to INTERGROWTH-21st fetal weight standard misses most pregnancies at risk of stillbirth identified by GROW. *Ultrasound Obstet & Gynecol*. 2025;65(6):798–9. <https://doi.org/10.1002/uog.29214>
28. Webster LM, Bramham K, Seed PT, Homsy M, Widdows K, Webb AJ, et al. Impact of ethnicity on adverse perinatal outcome in women with chronic hypertension: a cohort study. *Ultrasound in Obstetrics & Gynecology*. 2019;54(1):72–8. <https://doi.org/10.1002/uog.20132>
29. Gardosi J, Hugh O. Stillbirth risk and smallness for gestational age according to Hadlock, Intergrowth-21st, WHO and GROW fetal weight standards: analysis by maternal ethnicity and body mass index. *American Journal of Obstetrics & Gynecology*. 2023;229(5):p547.e1-547.e13. <https://doi.org/10.1016/j.ajog.2023.05.026>
30. Hocquette A, Durox M, Wood R, Klungsøyr K, Szamotulska K, Berrut S, et al. International versus national growth charts for identifying small and large-for-gestational age newborns: A population-based study in 15 European countries. *The Lancet Regional Health - Europe*. 2021;8:100167. <https://doi.org/10.1016/j.lanepe.2021.100167>
31. Choi SKY, Gordon A, Hilder L, Henry A, Hyett JA, Brew BK, et al. Performance of six birth-weight and estimated-fetal-weight standards for predicting adverse perinatal outcome: a 10-year nationwide population-based study. *Ultrasound in Obstetrics & Gynecology*. 2021;58(2):264–77. <https://doi.org/10.1002/uog.22151>
32. Anand P, Thomas D, Agarwal R, Thukral A, Deorari AK, Paul VK, et al. Comparison of regional versus global growth charts for the classification of small-for-gestational age neonates. *Arch Dis Child Fetal Neonatal Ed*. 2023;108(1):15–9. <https://doi.org/10.1136/archdischild-2021-322457>
33. Widdows K, Reid HE, Roberts SA, Camacho EM, Heazell AEP. Saving babies' lives project impact and results evaluation (SPIRE): a mixed methodology study. *BMC Pregnancy and Childbirth*. 2018 Jan 30;18(1):43. <https://doi.org/10.1186/s12884-018-1672-x>
34. Gardosi J, Giddings S, Clifford S, Wood L, Francis A. Association between reduced stillbirth rates in England and regional uptake of accreditation training in customised fetal growth assessment. *BMJ open*. 2013;3(12):e003942. <https://doi.org/10.1136/bmjopen-2013-003942>
35. Hugh O, Williams M, Turner S, Gardosi J. Reduction of stillbirths in England from 2008 to 2017 according to uptake of the Growth Assessment Protocol: 10-year population-based cohort study. *Ultrasound Obstet Gynecol*. 2021;57(3):401–8. <https://doi.org/10.1002/uog.22187>
36. Vieira MC, Relph S, Muruet-Gutierrez W, Elstad M, Coker B, Moitt N, et al. Evaluation of the Growth Assessment Protocol (GAP) for antenatal detection of small for gestational age: The DESiGN cluster randomised trial. *PLOS Medicine*. 2022 June 21;19(6):e1004004. <https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1004004>
37. McCowan L. Reduction of stillbirths in the DESiGN Trial. *PLOS Medicine*. 2022 June 23;19(6):e1004004. <https://journals.plos.org/plosmedicine/article/comment?id=10.1371/annotation/be476b6e-c1a4-4568-beee-e4923403036b>

38. Mikolajczyk RT, Zhang J, Betran AP, Souza JP, Mori R, Gülmezoglu AM, et al. A global reference for fetal-weight and birthweight percentiles. *The Lancet*. 2011;377(9780):1855–61. <http://www.sciencedirect.com/science/article/pii/S0140673611603644>
39. Gardosi J, Francis A, Turner S, Williams M. Customized growth charts: rationale, validation and clinical benefits. *Am J Obstet Gynecol*. 2018;218(2). <https://doi.org/10.1016/j.ajog.2017.12.011>
40. NHS England. Fetal growth: risk assessment, surveillance and management v 3.2. Saving babies' lives care bundle. 2025. <https://www.england.nhs.uk/long-read/saving-babies-lives-version-3-2/#element-2-fetal-growth-risk-assessment-surveillance-and-management>
41. Hugh O, Gardosi J. Fetal weight projection model to define growth velocity and validation against pregnancy outcome in a cohort of serially scanned pregnancies. *Ultrasound in Obstetrics & Gynecology*. 2022;60(1):86–95. <https://doi.org/10.1002/uog.24860>

Table 1 – Descriptives of pregnancies recorded within GROW App in 2023

		NENC (N=23,270)*		Matched hospitals (N=28,234)	
		N	(%)	N	(%)
		(unless otherwise stated)		(unless otherwise stated)	
Maternal height	<i>Mean (SD)</i>	164.9	(6.6)	164.9	(6.6)
Maternal weight	<i>Mean (SD)</i>	75.7	(19.0)	74.8	(18.6)
	<i>Median (IQR)</i>	72	(62 - 86)	71	(61 - 85)
Body mass index	<i>Mean (SD)</i>	27.8	(6.5)	27.5	(6.5)
	<i>Median (IQR)</i>	26.5	(22.9 - 31.6)	26.2	(22.7 - 31.1)
	<18.5	611	2.6	712	2.5
	>35	3,348	14.4	3,721	13.2
Ethnicity [♣]					
	British European	19,243	82.7	22,503	79.7
	South Asian	1,023	4.4	1,093	3.9
	East European	522	2.2	1,634	5.8
	Other	2,482	10.7	3,004	10.6
Parity					
	0	10,825	46.5	12,618	44.7
	1	7,529	32.4	9,712	34.4
	2	2,923	12.6	3,501	12.4
	3+	1,993	8.6	2,403	8.5
Neonatal sex					
	Male	11,894	51.1	14,268	50.5
	Female	11,371	48.9	13,956	49.4
Gestational age	<i>Mean (SD)</i>	273.5	(13.1)	274.2	(13.6)
	<i>Median (IQR)</i>	275	(269 - 281)	276	(270 - 282)
	<37 weeks	1,826	7.8	2,138	7.6
Birthweight	<i>Mean (SD)</i>	3302	(563)	3342	(568)

NENC, North East and North Cumbria; * NENC total reduced because data not entered in one hospital;

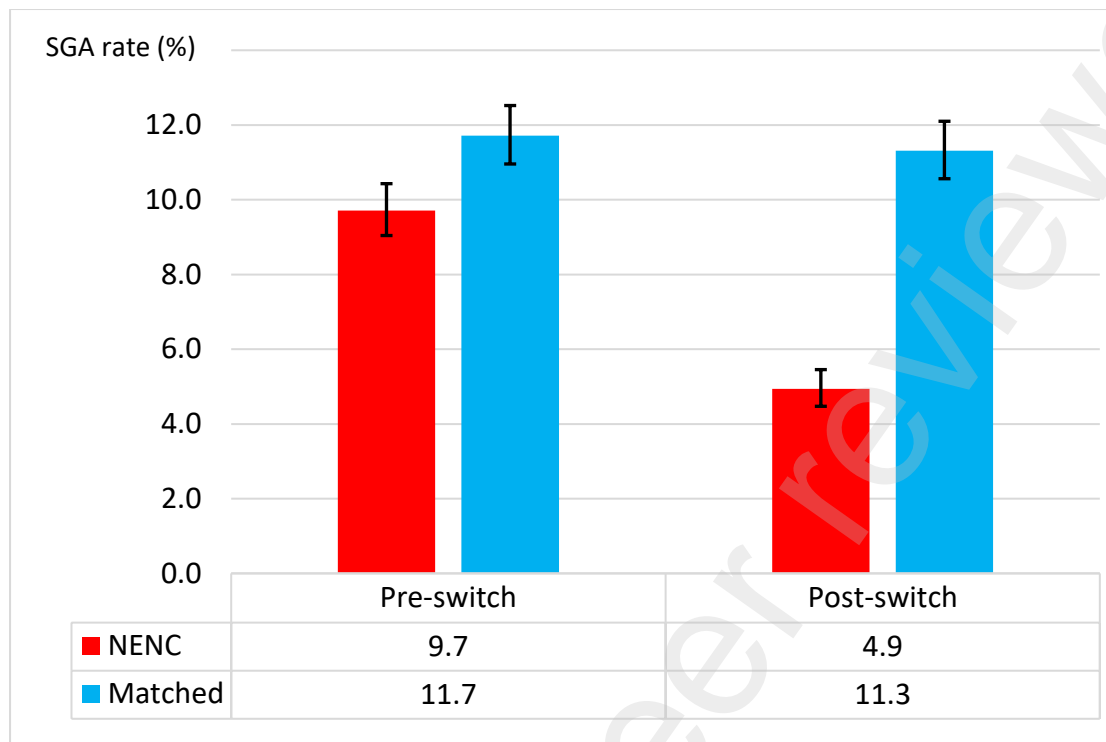
SD, standard deviation; IQR, interquartile range [♣] Ethnicity listed in regional groups recorded in GROW App

Table 2Stillbirth rates in NENC vs matched GROW-continuing hospitals in 2023 and 2024 ²⁰

Year	NENC			Continuing GROW			NENC vs matched hospitals	
	Births N	Stillbirths n	/1000	Births N	Stillbirths N	/1000	% diff	P value
2023	28250	89	3.15	30629	103	3.36	-6.3	0.65
2024	27914	116	4.16	30750	95	3.09	34.5	<0.05
2024 vs 2023		% diff	P value		% diff	P value		
		31.9	<0.05		-8.1	0.46		

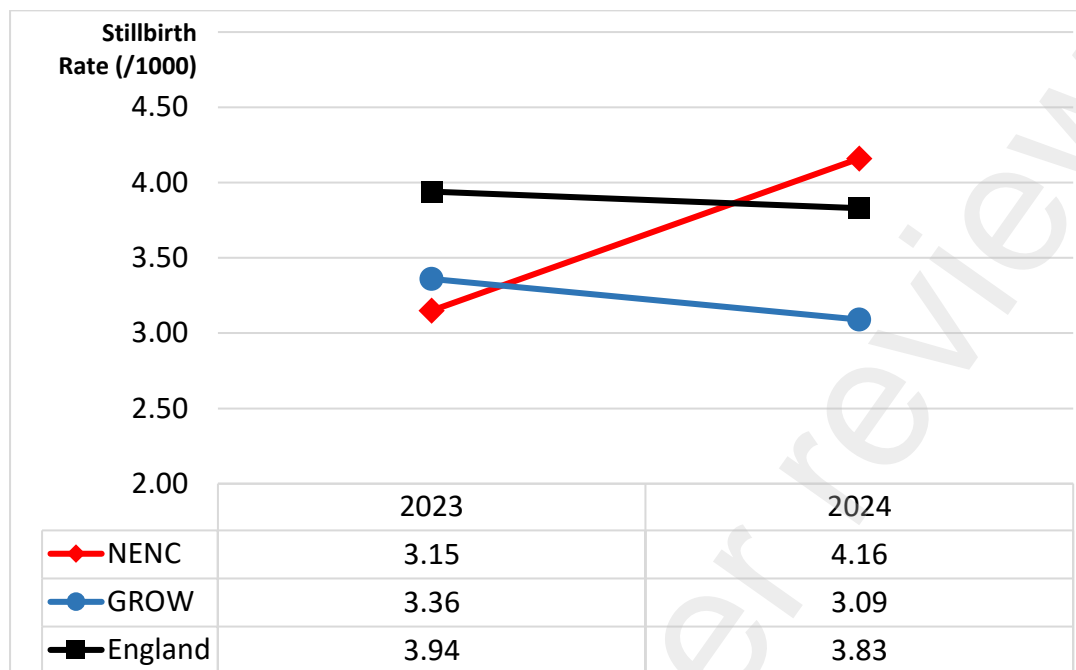
*NENC, North East and North Cumbria.**P values were calculated using two proportions Z tests.*

Figure 1 Three month average SGA (<10th centile) antenatal screen positive rates for NENC and matched hospitals, pre-switch (December 2023 to February 2024) vs post switch (May to July 2024) to INTERGROWTH charts.



One hospital from each of the NENC and matched groups were not included as they were not submitting < 10th centile data.

Figure 2 –Stillbirth rates in North East and North Cumbria, matched GROW- continuing hospitals and national stillbirth rates, 2023 - 2024



NENC, North East and North Cumbria. England represents national stillbirth rates (ONS ²¹)