# Standardising assessment of birthweight in the UK

Jason Gardosi - May 2019



The professions involved in perinatal care use different standards to assess birthweight, and this can lead to misdiagnosis and confusion for clinicians and parents.

Neonatologists tend to use the traditional WHO charts adapted to a UK 1990 reference standard, i.e. soon 30 year old, which is also used in the national 'Red Book' for measurement of the infant [1,2].

A version specifying the 2<sup>nd</sup> centile was used in the more recent BAPM Framework document on hypoglycaemia at term [3] - although the quoted reference in the document (No. 4) refers to another BAPM Framework document (NEWTT) [4], in which the origin of this term birthweight standard is only listed in reference No. 28 as: *'Cole, T. 2014. Personal Communication'*.

We also hear in our regular GAP training workshops that 2.5kg is still used in many neonatal units as the level below which further investigation for hypoglycaemia is considered to be indicated. Less surprisingly, many public health reports also still use a 2.5kg cut off to designate a 'small baby'.

On the obstetric and midwifery side, the concept of weight-for-gestation is well entrenched, together with the awareness that pregnancies need to be well dated for a reliable population based standard [5]. However the applicability of a single standard in the NHS's heterogeneous, multi-ethnic maternity population has been long questioned in the general [5, 6] and obstetric [7] as well as neonatal [8] literature, and a customised standard (GROW - Gestation Related Optimal Weight) for fetal as well as birthweight has been developed which is adjusted according to maternal characteristics including height, weight, parity and ethnic origin [6,7]. GROW is recommended by RCOG guidelines [9] and is now in place or about to be implemented in 83% of all NHS maternity units in the UK [10]. It is a central part of the Growth Assessment Protocol (GAP) which has improved antenatal recognition of babies at risk of FGR and which in turn is responsible for the recent year-on-year reduction in stillbirth rates to their lowest ever levels [11,12]. The customised GROW standard is also used in many research projects as well as reports (e.g. National Pregnancy in Diabetes Audit) and is used as the standard in the currently running, NIHR/HTA funded Big Baby Trial of shoulder dystocia in macrosomic pregnancies.

After delivery, the GROW software derives a customised birthweight centile adjusted for the same maternal characteristics as well as newborn sex. This information is important for immediate postnatal management as well as subsequent pregnancies, as a history of a small for gestational age (SGA) baby is a significant risk factor for SGA or stillbirth in future pregnancies. SGA is also a risk factor for the immediate neonatal period, e.g. for hypoglycaemia, but most neonatologists still use the UK-WHO standard for this assessment. Thus, many mothers and midwives are left with conflicting assessments of their baby's weight which - not surprisingly - leads to confusion and concern.

Comparisons between customised GROW and various uncustomised, population based standards including the more recently introduced Intergrowth 21<sup>st</sup> [13] have shown consistently that SGA based on customised assessment is better associated with perinatal mortality and morbidity, reduces false positives, and identifies a significant number of additional pregnancies or babies at risk [14-19].

Direct comparison with WHO-UK90 has demonstrated that the customised GROW standard identifies a third more cases that are at risk of perinatal mortality [20]. Standardised case reviews of perinatal deaths has furthermore shown that a number of infants with unexplained death in infancy (SIDS) were missed i.e. not recognised as at-risk due to being SGA at birth by the WHO UK90 standard, while SGA

would have been identified by the GROW standard [21]. A direct comparison of standards for screening for hypoglycaemia, presented at BAPM 2017, showed that customised GROW centiles using any cut-off were able to detect more term infants at risk of admission than the conventionally used UK-WHO centiles [22].

Whereas the GROW 10<sup>th</sup> centile is usually used for antenatal / prospective assessment, for newborn screening a 3<sup>rd</sup> centile cut-off may be used, balancing sensitivity of detection with neonatal workload. A group in Liverpool compared GROW and WHO-UK90, and recommended the use of the 3<sup>rd</sup> GROW centile in the assessment of SGA as hypoglycaemia risk [23].

**In conclusion,** accurate assessment of birthweight has important implications for the parents and all professions providing maternity and perinatal care. Birthweight assessment should be standardised along the evidence based, more precise method already adopted in most maternity units in the UK.

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NB the last 4 references (20-23) are peer reviewed abstracts and reproduced in Appendices 1-4.



#### PP.72

### Comparative analysis of SGA defined by customised GROW Charts and the UK-WHO neonatal weight charts to assess association with indicators of adverse pregnancy outcome Francis, A; Gardosi, J

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Introduction Birthweights of babies born in the UK are currently assessed by two methods: the customised standard recommended by the RCOG and used in the national hand held maternity record ('Green Notes'), and the UK-WHO neonatal weight standard recommended by the RCPCH and used in the parent held record ('Red Book'). The two methods often give different results. We set out to examine the association between SGA defined by either method and four indicators of adverse outcome. **Methods** SGA was defined as <10th centile based on (i) the UK-WHO standard for boys and girls (Stat Med. 1998;17:407–29), (ii)

the customised centile calculator using GROW (gestation related optimal weight), adjusted for baby's sex as well as maternal height, weight, parity and ethnic origin (www.gestation.net). The data were derived from a regional database of 143 536 singleton pregnancies.

**Results** SGA rates were 13.2% (GROW) and 11.5% (UK-WHO). The majority of cases were SGA by both methods, but 30.4% were SGA by GROW only, and 19.9% were SGA by UK-WHO only. The GROW-only SGA group had significant associations with stillbirth (OR 3.6, CI 2.8–4.7), early neonatal death (2.6, 1.6–4.4), Apgar score <7 (1.9, 1.6–2.3) and admission to NICU (2.6, 2.2–3.0). In contrast, the group of babies SGA by UK-WHO only did not have significant associations with either of the four outcome measures.

**Conclusion** GROW improves the identification of SGA babies with an increased risk of adverse perinatal outcome, and reduces the SGA categorisation of babies that have no increased risk.

#### **Poster Presentations**

Pregnancy Outcome (PP)

# Appendix 2

#### PP.1

Neonatal weight standards in the identification of SGA as a risk factor for SIDS

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**Introduction** Fetal growth restriction is a known risk factor for sudden infant death syndrome (SIDS). While most growth restriction is not recognised antenatally, small for gestational age (SGA) birthweight is used as a proxy to alert health professionals if the newborn is at risk.

**Methods** Eight cases of SIDS which occurred at an NHS Trust over a 4-year period were examined using the standardised clinical outcome review tool (SCOR). Birthweights were assessed using two methods: the UK-WHO charts for boys and girls (Stat Med. 1998;17:407–29) and the GROW birthweight centile calculator (www.gestation.net).

**Results** All mothers were British-European and 6 were smokers. Median maternal age was 29, and median BMI was 23.5. Seven babies were born at term and one at 33 weeks 3 days. The median birthweight was 2885 g (range 1640–3275 g). None of the babies were <10 centile according to the UK-WHO neonatal weight charts, and none of the babies were discharged with a record of being SGA. However six of the 8 babies were SGA according to GROW centiles (centile 0, 3, 5, 5, 6, 8).

**Conclusion** The SGA neonate is at increased risk of complications in the perinatal period, infancy and childhood. Current standards used to assess neonatal weight may miss important warning signs.

#### **PP.2**

INTERGROWTH-21 based fetal weight standards versus customised GROW standards and their ability to define SGA babies at increased risk of perinatal death

#### Francis, A; Gardosi, J

Perinatal Institute, Birmingham, UK

**Introduction** INTERGROWTH-21 ultrasound formulae have recently been proposed as an international standard for fetal growth. We wanted to examine how fetal weight curves based on these scan parameters compared with the prevalent, customised fetal growth standard used for defining babies at risk of perinatal mortality due to SGA weight in a UK maternity population.

**Methods** The INTERGROWTH (IG-21) formulae for HC, BPD, AC and FL (Lancet 2014;384:869–879) were transformed into fetal weight curves using the RCOG recommended Hadlock-4 equation (AJOG 1985; 151:333–37). This was compared with the fetal weight standard of the UK version of GROW (gestation related optimal weight), which is adjustable for maternal height, weight, parity and ethnic origin (www.gestation.net). SGA birthweights (<10th centile) defined by the two fetal weight standards were compared in an NHS regional database of 148 276 singleton pregnancies including 798 perinatal deaths.

**Results** 19 990 babies were SGA by GROW centiles (13.5%), of which 11 322 (56.6%) were not small according to IG-21, while 9100 were SGA by IG-21 (6.1%), of which 432 (4.7%) were not SGA according to GROW. Compared to babies not SGA by either standard, the GROW-only SGA group had a significantly increased rate of perinatal death (OR 2.0, CI 1.6–2.5). In contrast, babies SGA by IG-21 only did not have an increased risk (OR 1.3, CI 0.4–4.0). **Conclusion** In a UK population, a fetal weight standard based on Intergrowth-21 fails to identify the majority of SGA babies that are at significantly increased risk of perinatal death.

#### PP.3

Neonatal and maternal outcomes following midtrimester preterm premature rupture of the membranes <u>Linehan, L<sup>1</sup></u>; Walsh, J<sup>1</sup>; Morris, A<sup>1</sup>; Kenny, L<sup>2</sup>; O'Donoghue, K<sup>1</sup>; Russell, N<sup>1</sup>

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**Introduction** Preterm premature rupture of membranes (PPROM) complicates 1% of all pregnancies and occurs in one third of all preterm deliveries. Mid-trimester PPROM is often followed by spontaneous miscarriage and elective termination of ongoing pregnancies is offered in many countries.

We aimed to investigate the natural history of these pregnancies in a jurisdiction where termination of pregnancy is not available. **Methods** A retrospective review of 43 cases of PPROM diagnosed between 14 and 23 + 6 weeks of gestation during April 2007 to April 2012, in a tertiary-referral university hospital. Cases where delivery occurred within 24 hours of PPROM were excluded. **Results** The incidence of ongoing pregnancy after mid-trimester PPROM was 0.1% (43/44 667 births). The mean gestation at

# Screening of at-risk infants for hypoglycaemia -Customised (GROW) or Population-based (UK-WHO) centiles?

# Appendix 3

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## Introduction

Infants with intrauterine growth restriction (IUGR) are at an increased risk of hypoglycaemia. Identification of such infants is usually based on an arbitrary weight threshold (e.g. <2.5 kgs), or a specified population centile (e.g. 10<sup>th</sup> or 3<sup>rd</sup> centile). GROW customised charts provide individually optimised growth charts adjusting for maternal weight, height, parity and ethnicity<sup>1</sup>. Customised growth charts have been shown to improve identification of fetuses at risk of stillbirth, neonatal death and low Apgar scores and are recommended by the RCOG for screening for IUGR but their usefulness for detection of infants at risk of hypoglycaemia is not known<sup>2</sup>.

## Aim

To compare the performance of customised (GROW) and populationbased (UK-WHO) centiles for detection of term infants at risk of admission for hypoglycaemia.

#### Methods

#### Study cohort

- All term (gestation ≥37 weeks) infants born in and admitted to the Neonatal units in England from 1 January 2011 to 31 December 2013 with a primary clinical reason for admission codes as Hypoglycaemia.
- We included only the first episode of admission, and excluded babies who never received any intensive, high dependency or special care in a neonatal unit.
- The anonymised patient-level dataset was obtained from the Neonatal Research Database (NNRD).
- Percentile cut-offs from 2nd to 10th were analysed by customised GROW centiles (CC) and population-based UK-WHO (WHO) growth charts to identify those at risk of admission.
- Comparisons were made after equalising numbers below each respective cut-off, and the results extrapolated to a general database of 141,687 term infants born between 2009-2013 to calculate the proportion of infants needed to screen.

### Results



At each percentile cut-off Customised (GROW) centiles identified more admitted babies with hypoglycaemia than the UK-WHO percentiles

Centile cut-off	CC Cases - n (%)	WHO cases - n (%)
2	1745 (21)	1439 (17.3)
3	2014 (24.3)	1754 (21.1)
4	2237 (27)	2005 (24.2)
5	2414 (29.1)	2184 (26.3)
10	2942 (35.5)	2825 (34)



Extrapolated to the general population,			
using GROW instead of UK-WHO standards			
would result in 20.7%, 16.9% and 15.7%			
fewer infants needing to be screened at			
2nd, 3rd and 5 <sup>th</sup> centile cut-offs,			
respectively, to identify the same number			
of infants at risk			

Centile cut-off	Needed to be screened by CC	Needed to be screened by WHO
2	3555	4481
3	5213	6257
4	6939	8303
5	8622	10223
10	17540	18187

#### Differences between numbers screened by CC vs WHO



## Conclusions

Customised centiles detect more term infants at risk of admission for hypoglycaemia compared to the conventionally used UK-WHO centiles.

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# Abstracts

#### PP.62

GROW instead of WHO birthweight charts for neonatal small-for-gestational-age hypoglycaemia management

# <u>Holdsworth, R</u><sup>1</sup>; Rigby, J<sup>2</sup>; Fitzpatrick, C<sup>2</sup>; Dewhurst, C<sup>2</sup>; Yoxall, W<sup>2</sup>; Agarwal, U<sup>2</sup>; Roberts, D<sup>2</sup>; Alfirevic, Z<sup>3</sup>

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Introduction The customised growth chart is gaining impetus as a method for detecting prenatal small-for-gestational-age (SGA) nationally. GROW overestimates SGA when the 10th centile is used as a limit. However, it also identifies a third more cases at significantly increased risk of low Apgar scores and perinatal mortality. Neonatologists have expressed concern that using GROW centiles for neonates will result in more babies requiring SGA hypoglycaemia management because of this overestimation. Currently World Health Organization (WHO) standard charts are used for screening in most Neonatal Units. We set out to determine the potential impact of using GROW for neonatal birthweight on our Neonatology workload.

# Appendix 4

**Methods** A total of 659 GROW birthweight centiles were prospectively compared with the standard UK-WHO charts. **Results** Admission to neonatal intensive care unit for hypoglycemia management-only one infant in the overall cohort by GROW. Less than 10th centile by GROW-1/105; less than 10th centile by WHO-0/65; less than third centile by GROW-1/27; and less than third centile by WHO-0/21. Use of GROW resulted in a tiny increase in the number of neonates requiring screening (1%) but had increased sensitivity for identifying the neonates requiring management for hypoglycaemia.

**Recommendation** Our recommendations are (i) that less than third centile GROW is used for neonatal SGA hypoglycaemia screening and (ii) that units that are already using GROW for antenatal SGA detection can swap over to GROW for neonates without a significant impact on neonatal admissions. We have already done this at the Liverpool Women's NHS Foundation Trust.