DOI: http://doi.org/10.4038/sljog.v38i3.7798
www.slcog.lk/sljog

Small for Gestational Age: Towards standards of our own

Dias T[a]

BACKGROUND

Perinatal mortality is accepted as an important performance indicator of the obstetric provision. Stillbirth is a major contributor for the perinatal mortality and is estimate to occur at a rate of 18.9 per 1000 births[1]. In year 2009, approximately 2.64 million stillbirths occurred globally, of which 76.2% of stillbirths were in Sub-Saharan Africa and south Asia[1].

Stillbirth Collaborative Research Network Writing Group in the United States recognizes stillbirths as one of the most common adverse pregnancy outcomes in the United States where it affects 1 in 160 pregnancies[2, 3]. The published perinatal mortality rates in European countries ranged from 5.4 per 1000 total births in Sweden and Finland to 9.7 in Greece and Northern Ireland[4]. However, a majority of stillbirths occur in developing countries where the estimated rates of stillbirth are 10-fold or more greater than in developed countries[5].

Since the stillbirths are often under-reported, accurate national perinatal mortality rates are not available in Sri Lanka[6]. Therefore, the true magnitude of the problem is not clear for policy planning. It should be noted that a substantial amount of the health budget of the country is spent on improving neonatal care, especially of the premature births, in order to reduce the perinatal death rate whereas proper and close monitoring of the pregnancy at and near term can also reduce the perinatal mortality by reducing stillbirths which is another major contributor of perinatal death [7].

[a]*Senior Lecturer and Consultant Obstetrician and Gynaecologist, Department of Obstetrics and Gynaecology*

Faculty of Medicine, University of Kelaniya, Sri Lanka.

Correspondence: Tiran Dias

E mail - thiran_dias@yahoo.com

Competing interests: The authors report no conflict of interest

The rise in risk of stillbirth with advancing gestational age towards and beyond estimated date of delivery is important since it allows the proper timing of interventions. This can vary in different populations since it is depended on multiple factors. In a retrospective study on risk of stillbirth at term and timing of delivery carried out at General Hospital, Ampara, utilizing data gathered from 12595 maternities reports prospective risk of stillbirths, we were able to demonstrate the actual risk of in utero-death per 1000 ongoing pregnancies remains constant up to 38 weeks' gestation and rises steeply thereafter[7]. The prospective risk of stillbirth was 1.43 per 1000 at 38^{+0} to 39^{+6} weeks and rose to 2.57 per 1000 at 40^{+0} to 41^{+6} weeks [7]. Accordingly, induction of labour between 38 and 41 weeks has the potential to reduce the perinatal mortality and this warrants close monitoring and appropriate assessment of fetal wellbeing around term in order to prevent stillbirths and carryout timely delivery[7].

FETAL GROWTH RESTRICTION AS A CAUSE OF STILLBIRTH

A significant portion of stillbirths remain unexplained despite a thorough evaluation. A population based study done in the United States involving post-mortem examinations of 512 neonates demonstrated that obstetric complications were the most common category for cause of death (150 cases/ 29.3%)[2]. Moreover, uteroplacental insufficiency and maternal vascular disorders were found as the cause for stillbirth in 121 cases (23.6%)[2]. Fetal genetic/structural abnormalities, infection, umbilical cord abnormalities, hypertensive disorders, and maternal medical complications have been attributed as other causes[2]. A systematic review and meta-analysis carried out on major risk factors for stillbirth in high-income countries depicts small size for gestational age and placental abruption as having the highest population-attributable risk (23% and 15% respectively), out of the pregnancy disorders[9].

SCREENING FOR SGA

Identification of fetuses who are small for gestational age remains an important aspect of recognizing fetal growth restriction. The Royal College of Obstetricians and Gynaecologists (RCOG) recommends screening for small for gestational age (SGA) using a series of parameters which includes history, biochemical markers, uterine artery Doppler and clinical examination[10]. It is further recommended to assess all women at booking visit for risk factors for SGA to identify those who require increased surveillance[10]. Women who have major risk factors should be referred for serial ultrasound measurement of fetal size and assessment of wellbeing with umbilical artery Doppler from 26–28 weeks gestation[10]. Routine measurement of symphysio fundal height (SFH) is recommended in low risk women. Since serial measurement of SFH improves prediction of a SGA neonate, it is recommended to measure SFH at each antenatal appointment from 24 weeks of pregnancy. RCOG advocates plotting SFH on a customized chart rather than a population–based chart because it may improve prediction of SGA. Women should be referred for ultrasound measurement of fetal size on detection of a single SFH value below the 10th centile or serial measurements which demonstrate slow or static growth by crossing of centiles.[10] Serial assessment of fetal size using ultrasound is also recommended in women in whom measurement of SFH is difficult (BMI > 35, large fibroids, polyhydramnios etc..) [10]. In a retrospective study conducted at the North Colombo Teaching Hospital which included a total of 3962 women (737, 2265 and 960 with low, normal and high BMI respectively) we showed that SFH measurement tends to be systematically smaller among women with a low BMI while it tends to be larger among women with a high BMI, compared to those with a normal BMI (Table 1) [11].

Diagnosis of a SGA fetus is made by ultrasound detection of fetal size,that

This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Table 1: Estimated mean difference between symphysis fundal height (SFH) measurements in BMI groups and their standard errors of mean compared for each gestational age between 24 and 40 weeks.

Week	Normal BMI versus High BMI		Normal BMI vs Low BMI	
	Estimated mean difference	95% CI	Estimated mean difference	95% CI
24	-0.45	-0.68 to -0.22	0.35	0.10 to 0.60
26	-0.49	-0.84 to -0.14	0.20	-0.11 to 0.51
28	0.28	-0.07 to 0.63	0.57	0.21 to 0.93
30	-0.35	-0.55 to -0.15	0.59	0.37 to 0.81
32	-0.23	-0.55 to 0.09	0.33	0.03 to 0.63
34	-0.47	-0.79 to -0.15	0.22	0.07 to 0.51
36	-0.66	-0.84 to -0.48	0.59	0.39 to 0.79
38	-0.87	-1.24 to -0.50	0.44	0.99 to 0.79
40	-1.07	-1.39 to -0.75	0.76	0.39 to 1.13

is fetal abdominal circumference (AC) or estimated fetal weight (EFW) being lower than the 10th centile. Customized fetal biometry/weight reference has been suggested to improve the predictive ability of SGA and adverse perinatal outcome. Serial measurements of AC or EFW can be used to determine growth velocity that is then used for the diagnosis of FGR. However, to minimize false-positive rates of FGR diagnosis, it is advocated to take fetal measurements at least 2 weeks apart. Women should be offered serial assessment of fetal size and umbilical artery Doppler if the fetal AC or EFW is found to be <10th centile or there is evidence of reduced growth velocity[10].

THE SRI LANKAN PRACTICE

Sri Lanka is regarded as having a well-organized antenatal care service with the lowest maternal mortality ratio in South Asian region. The maternal care package designed by the Family Health Bureau illustrates practices that should be followed in providing obstetric care. It is recommended to refer for specialized care if fetal growth restriction (FGR) is suspected. The attending health care workers are expected to measure the SFH and plot on the chart against the relevant period of amenorrhoea (POA) during each antenatal clinic visit in the antenatal record[12]. However, this system is not without any deficiencies and limitations. Few of these and the action taken so far in improving the service are mentioned below.

LIMITATIONS IN GESTATIONAL AGE ASSESSMENT

The accurate gestational age assessment during early pregnancy is crucial as it gives a reference point to interpret fetal growth in later pregnancy. Inaccuracy in dating could have implications for management and outcomes of the pregnancy. Significant over estimation of gestational age can lead to an iatrogenic prematurity whereas a significant underestimation may lead to a delay in intervention and post maturity. In a retrospective study of 675 patients we looked at the agreement of the date of delivery with the expected date of delivery (EDD) determined by the LMP and ultrasound (USS) dating. This study demonstrated that delivery within 14 days of the EDD was observed in 93.7% when USS EDD was considered and it was only in 86.2% with the LMP EDD (OR 2.40, 95% CI 1.64-3.52) indicating USS EDD is more in agreement with the date of spontaneous delivery than the EDD estimated from LMP[13]. However, there is no uniform policy of timing of ultrasound dating in Sri Lanka. In a retrospective observational study carried out at the De Soysa and Castle Street Hospitals for Women between 2009 and 2011 we described the mean gestational age at first scan was 19 weeks (SD 7.3) [14].

INADEQUATE USE OF SFH CHARTS

Present SFH chart given in the antenatal data sheet consists of 2 obliquely drawn parallel lines denoting the normal SFH range (the gestational age + 2 to 3 cm) in centimeters for each POA from 16-40 weeks. This chart is designed in a way that it will be most useful in detection of growth abnormalities if serial measurements are plotted. This chart will allow detection of abnormalities in pattern of growth rather than at a single point of time. In the absence of tailor-made charts, adjusted for variables such as parity, maternal height and weight that are becoming more popular among health care workers owing to its higher predictability of unfavorable perinatal outcome, population normograms to plot SFH measurements serially offers the best detection rates[12]. The SFH chart is expected to be filled by the health care professional that attends to a woman at every antenatal visits. SFH should be plotted against the period of amenorrhoea on the chart 4 weekly up to 28 weeks, then 2 weekly up to 36 weeks and weekly thereafter. It is often the responsibility of the community midwife to maintain the chart appropriately, as she manages many of the antenatal visits. A nationwide audit carried out on the appropriate use of symphysio-fundal height chart during antenatal follow up demonstrated the use of the symphysio-fundal height chart at present is unsatisfactory[12]. Of the total study population of 548 approximately 42.7% women had their charts completely marked while it was incompletely marked in 33.2% and not marked in 24.1% of women[12]. Lack of awareness of the importance of this simple intervention is likely to be the reason for not undertaking this practice properly. Moreover, the other possible reasons for non-usage of the charts must be explored and necessary action should be taken to improve its use.[12]

UNAVAILABILITY OF EFW FORMULAE

Estimating the actual fetal weight from ultrasound scan being truly a challenge. It is important to determine the validity of ultrasound EFW formulae for a given population. However, there is paucity of data on accuracy of established ultrasound EFW in predicting actual birth weights in the Sri Lankan population. In spite of this lack of robust evidence on the most suitable EFW formula for Sri Lankan population Hadlock formula 4 is routinely used to estimate fetal weight[15]. It is

apparent that this invariably overestimates SGA rates in Sri Lankan unborn babies and may even deliver inadvertently to overcome potential risks of letting the pregnancy to continue[16].

WORK TOWARDS A VALID TOOL FOR DIAGNOSIS OF SGA IN SRI LANKA

VALIDATION OF EFW FORMULAE

We studied the validity of ultrasound EFW estimation formulae in a Sri Lankan population. "The prospective validation study on the accuracy of ultrasound estimated fetal weight formulae to predict actual birthweight after 34 weeks" is the largest study performed on this discipline in a Sri Lankan population[17]. It demonstrated the overall ability of available EFW formulae including the commonly using Hadlock formula 4 is limited in predicting the actual birthweight. However, wide systematic and random errors prevail with all established EFW formulae which are currently in use, in predicting birthweight in a Sri Lankan population. In other words, all routinely used EFW formulae would either over or under estimate the fetal weight. Therefore, a formula that suits the Sri Lankan population cannot be recommended[17].

VALIDATION OF SRI LANKAN BIRTHWEIGHT REFERENCE

Birthweight centiles for different populations are varied. Generic reference for fetal weight and birthweight that could be adapted to local populations were recently described[18]. A prospective study was performed to validate the fetal/birthweight reference derived from WHO data for birthweights adapted to Sri Lankan population between January 2012 and July 2012 at General Hospital, Ampara. The findings of this study showed that the observed distribution of birthweights matched with the reference range derived from the global reference range adapted to local population based on the WHO survey. The mean birthweight of local population is similar, and the adapted reference range would identify most SGA fetuses including severe SGA fetuses correctly. It would also identify almost all the large for gestational age babies with a birthweight >90th centile[19]. Hence, WHO reference charts can be used effectively in Sri Lankan population[19].

CLINICAL VALIDATION

We carried out a study to compare the ability of commonly used birthweight centile charts in predicting adverse perinatal outcomes. This retrospective analytical study on "Birthweight standards - Ability of birthweight percentiles in predicting abnormal fetal growth and outcome" was carried out between April 2010 and October 2013 at the District General Hospital Ampara, and included 12501 singleton births. We analyzed data by applying three references to the study population, namely, CHDR birthweight reference, Hadlock reference and Sri Lankan birthweight reference (Data from the 2004–08 WHO Global Survey) [18]. The adverse outcomes (perinatal and late neonatal deaths) in small for gestational age, average for gestational age and large for gestational age classified by the three references were compared. We demonstrated that Sri Lankan birthweight reference has an improved ability in identifying abnormal fetal growth associated with an increased risk of neonatal death[16]. Therefore, these birthweight reference charts are clinically effective and can be used in a Sri Lankan population[16].

MODIFIED SFH CHARTS ACCORDING TO THE BMI FOR SRI LANKA

SFH size charts based on cross sectional data are considered to be the best when a single measurement is considered at a given time[10]. There is a paucity of evidence of the optimum SFH measurement for each gestational age in low and middle income countries where its use may be most valuable. A cross-sectional study was carried out involving 587 women at Ampara and Gampaha districts between January 2013 and February 2015 in view of constructing symphysis-pubis fundal height (SFH) charts to estimate the fetal size in pregnant women with a normal BMI and also to describe the variation of SFH according to BMI in women within the normal range of BMI. SFH charts to estimate fetal size in pregnant women with a normal BMI, divided into 3 subgroups as low normal (18.5-20.0 kg/m^2), middle normal (20-23 kg/m^2) and high normal (23-25 kg/m^2) were constructed from the SFH measurements using Altman and Chitty's statistical methods. We demonstrated that the use of three separate charts for each subgroup within the normal BMI would be preferable especially in pregnant women whose BMIs are towards the lower limit or upper limit within the normal range of BMI[20].

FETAL BIOMETRY

There is no systematic evaluation of validity of established ultrasound fetal biometric parameters for Sri Lankans. Fetal biometric measurements should be interpreted very accurately as inaccurate interpretation often lead to misguided diagnosis of both small for gestational age and large for gestational age, which then leads to unnecessary intervention. Taking erroneous measurements may even lead to leave growth-restricted fetuses unnoticed, considering them as normal[21].

We carried out a prospective, cross sectional study between January 2013 and February 2014 in the Ampara District with an aim to construct new charts for ultrasound fetal biometry for Sri Lankan population and to compare them with previous references. A total of 714 fetuses had their fetal biometry measured directly. In this carefully designed study, we were successful in creating and validating new centile chart for fetal biometry, in particular fetal bi-parietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length(FL) for the local population. These new reference charts were compared with Chitty charts which were derived from a population consisted of western European (75%) and Afro-Caribbean (25%) population. We recommend using these charts in Sri Lankan pregnant women with normal BMI[22].

THE FUTURE ACTION PLANNED

DEVELOPMENT OF AN EFW FORMULA SUITABLE FOR SRI LANKAN POPULATION.

It was evident from our previous work on validation of ultrasound estimated fetal weight formulae, that almost all the EFW formulae available for current use either over-estimate or under-estimate the predicted values of birth weights

in a Sri Lankan population. Therefore, when making decision on the timing of delivery in low birth weight babies, it must be given thought to the possibility of overestimating the actual birth weights of them when using currently available EFW formulae. We should work towards development of an EFW formula that is best suited to the local population. Until an optimum EFW formula that suits the Sri Lankan population is determined, interpretation of ultrasound EFW should be done cautiously[17].

NATIONAL LEVEL IMPLEMENTATION

Considering deficiencies in current practice and in order to improve the quality of care within the Sri Lankan population it is important to take these new found evidence to the field level. It is a need of the hour to introduce accurate gestational age estimation and apt use of the SFH charts in the day to day clinical practice. In addition, SFH charts designed for normal BMI range can be put in to practice. Using those charts would be preferable especially in pregnant women whose BMI in within the normal level. For the best outcome and the ease of reference during clinical practice, a separate section on screening and diagnosis of SGA babies should be made available along with the "maternal care package". An ultrasound screening criteria for SGA should also be included in a national level guideline. Furthermore, newly created and validated centile chart for fetal biometry, in particular fetal bi-parietal diameter, head circumference, abdominal circumference and femur length for the local population can be made available for clinical practice.

REFERENCES

1. Cousens S, Blencowe H, Stanton C, Chou D, Ahmed S, Steinhardt L, Creanga AA, Tunçalp O, Balsara ZP, Gupta S, Say L, Lawn JE. National, regional, and worldwide estimates of stillbirth rates in 2009 with trends since 1995: a systematic analysis. Lancet. 2011; 377(9774): 1319-30.
2. Stillbirth Collaborative Research Network Writing Group. Causes of death among stillbirths. JAMA, 2011; ***306***(22): 2459.
3. MacDorman MF, Kirmeyer S. Fetal and perinatal mortality, United States, 2005. Natl Vital Stat Rep. 2009; **57**(8):1-19.
4. Graafmans WC, Richardus JH, Macfarlane A, Rebagliato M, Blondel B, Verloove-Vanhorick SP, Mackenbach JP; EuroNatal Working Group. Comparability of published perinatal mortality rates in Western Europe: the quantitative impact of differences in gestational age and birthweight criteria. BJOG. 2001;**108**(12):1237-45.
5. McClure EM, Saleem S, Pasha O, Goldenberg RL. Stillbirth in developing countries: a review of causes, risk factors and prevention strategies. The journal of maternal-fetal & neonatal medicine. 2009; **22**(3): 183-90.
6. Senanayake, H., Goonewardene, M., Ranatunga, A., Hattotuwa, R., Amarasekera, S. and Amarasinghe, I. Achieving Millennium Development Goals 4 and 5 in Sri Lanka. BJOG. 2011; **118**: 78–87.
7. Dias T, Kumarasiri S, Wanigasekara R, Cooper D, Batuwitage C, Jayasinghe L, Padeniya T. Risk of stillbirth at term and optimum timing of delivery in uncomplicated south Asian singleton pregnancies. Ceylon Medical Journal 2014; **59**: 54-58.
8. Varli IH, Petersson K, Bottinga R, et al. The Stockholm classification of stillbirth. Acta Obstet Gynecol Scand. 2008; **87**(11):1202-1212.
9. Flenady, V., Koopmans, L., Middleton, P., Frøen, J.F., Smith, G.C., Gibbons, K., Coory, M., Gordon, A., Ellwood, D., McIntyre, H.D., Fretts, R. Major risk factors for stillbirth in high-income countries: a systematic review and meta-analysis. The Lancet, 2011; ***377***(9774):1331-1340.
10. Royal College of Obstetricians and Gynaecologists. Green–top Guideline No. 31, The Investigation and Management of the Small–for–Gestational–Age Fetus. 2013.
11. Dias T, Kajendran J, Jayawardena GRMUGP, Ranathunga Y, Weeraddana P, Gunathilaka P, Prasanga G. Variation of symphysis-fundal height measurement according to the Body Mass Index. Sri Lanka Journal of Obstetrics & Gynaecology. 2015; **37**(suppl. 1).
12. Palihawadana TS, Wasalthilaka C, Dias T. The apt use of symphysio–fundal height chart during antenatal follow up: A multicenter audit. Sri Lanka Journal of Obstetrics and Gynaecology. 2015; **36**(4).
13. Wasalathilaka C, Kumari SDTL, Palihawadana TS, Herath HMR, Padumadasa S, Pathemeswaran A, Dias TD. Precision of Predicting expected Date of Delivery by ultrasound scan in comparison to Last menstrual Period. Sri Lanka Journal of Obstetrics & Gynaecology 2014; 36 (suppl. 1): 9.
14. T Dias, A Weerasinghe, P Amarathunga, C De Silva, B Thilaganathan. Twin pregnancy chorionicity determination in a tertiary care setting. Ceylon Medical Journal 2013; 58: 170-2.
15. Kumara DMA, Perera H. Evaluation of six commonly used formulae for sonographic estimation of fetal weight in a Sri Lankan population. Sri Lankan Journal of Obstetrics and Gynaecology. 2009; **31**: 20-33.
16. Dias T, Shanmugaraja V, Ganeshamoorthy, Kumarasiri S, Abeykoon S, Padeniya T. Birthweight standards - Ability of birthweight percentiles in predicting abnormal fetal growth and outcome. Sri Lankan Journal of Obstetrics and Gynaecology. 2014; 85-88.
17. Kumarasiri S, Wanigasekara R, Wahalawatta L, Jayasinghe L, Padeniya T, Dias T. Accuracy of ultrasound estimated fetal weight formulae to predict actual birthweight after 34 weeks: prospective validation study. Ceylon Medical Journal. 2013; **58**: 116-121.
18. Mikolajczyk, R.T., Zhang, J., Betran, A.P., Souza, J.P., Mori, R., Gülmezoglu, A.M. and Merialdi, M. A global reference for fetal-weight and birthweight percentiles. The Lancet. 2011; **377**(9780): 1855-1861.
19. Shanmugaraja V, Kumarasiri SG, Wahalawatte SL, Wanigasekara RV, Begam P, Jayasinghe PKCL, Padeniya T, Dias T. Sri Lankan fetal/ birthweight charts: validation of global reference for fetal weight and birthweight percentiles. Ceylon Medical Journal. 2013; **58**: 62-65.

20. Altman DG, Chitty LS. Charts of fetal size: 1. Methodology. BJOG 1994; **101**: 29-34.

21. Sarris I, Ioannou C, Chamberlain P, et al. Intra-and interobserver variability in fetal ultrasound measurements. Ultrasound in Obstetrics & Gynecology. 2012; **39**: 266-273.

22. Dias T, Chandrasiri D, Abeykoon S, Munasinghe R, Gunawardena C, Pragasan G, Padeniya T, Pathmeswaran A. Sri Lankan charts for ultrasound fetal biometry and comparison with commonly using charts. Ceylon Medical Journal 2016 *in press*