Development of birth weight for gestational age charts in a Sri Lankan setting - methodological issues

T. Ruwanpathirana, Dulitha N. Fernando¹, Hemanta Senanayake²

ABSTRACT

Background: This study was taken up to identify the main types of low birth weight (LBW) for the development of weight for gestational age charts relevant to the country/regional level for the formulation of preventive strategies.

Materials and Methods: A sample of mothers registered by Public Health Midwives (PHMs) from two Medical Officers of Health (MOH) areas in Colombo district were followed up until delivery in five selected hospitals. Period of gestation (POG) was assessed between 10 and 12 weeks using ultrasonography. Records of 474 mother/newborn pairs were used for development of gestational age-related birth weight charts for each sex and POG. Mothers with one or more risk factors for LBW were excluded. Mothers with POG less than 38 weeks and more than 40 weeks were limited. Information on all possible risk factors contributing to LBW were assessed.

Results: Incidence of small for gestational age (SGA) assessed using the 10th centile value for each POG, was 19.0% for males and 18.0% for females. Percentages of symmetrical and asymmetrical SGA newborns were 72.1% and 27.9%, respectively.

Conclusion: The charts were developed paying attention to all methodological aspects that highlighted the key issues relevant to development of weight for gestational age charts in a developing country setting. As action was taken to minimize the biases introduced by such issues, the charts developed could be used for assessment of incidence and risk factors for SGA until charts based on national level data are available.

Key words: Assessment of gestational age-related birth weight, incidence of small for gestational age newborns, low birth weight

INTRODUCTION

The prevalence of low birth weight (LBW) has not shown much improvement over the past two decades in Sri Lanka. Studies that provide data on the two categories of LBW as pre-term and small for gestational age (SGA) newborns are limited. Some used clinical methods in making the assessment,¹,² while another³ used customized computer generated software programmes. It is suggested that the best clinical methods available have approximately 50% accuracy when compared with assessments based on ultrasonography (USG) performed at 10-12 weeks of pregnancy.⁴ Development of country-specific reference curves for weight, height and head circumference for gestational age are needed to enable identification of the two main groups of LBW babies, SGA and pre-term that will provide basic data on incidence and risk factors of SGA, based on which...
preventive strategies to further reduce LBW levels could be developed. More recent trends are to develop customized growth charts for each pregnancy for each mother.\[^{[5]}\]

The key variables required to develop such curves are accurate assessment of the gestational age and birth weight. It is also necessary to identify all mothers who have any risk factor for LBW so that they could be excluded.

This report describes the first attempt made to develop weight for gestational age charts undertaken in Sri Lanka with the focus on the methodological issues experienced in undertaking such a task.

**MATERIALS AND METHODS**

The study was performed in two Medical Officer of Health (MOH) areas\[^{1}\], Kaduwela and Homagama in the Colombo district. A total of 1200 pregnant mothers registered by the field level health staff (Public Health Midwives [PHMs])\[^{2}\] within the first 8 weeks of amenorrhea during the first 6 month’s commencing from January 2010 comprised the study population. Those who were not permanent residents of the areas, those who planned to deliver in a hospital other than the five hospitals identified, those having mental disabilities and those who live in institutions were excluded.

**Sampling**

Using available data\[^{3}\] the sample size was calculated as 1114 mothers who fulfilled the eligibility criteria. However, all 1200 mothers registered were included.

**Study instruments**

To develop weight for gestational age charts, pregnant women were followed up from 14 weeks of gestation until delivery and obtained accurate information on the period of gestation (POG) and the weight of the newborn at the time of delivery. All mothers were recruited prior to period of amenorrhoea (POA) of 8 weeks and the POG assessed by measuring the crown rump length by using trans-abdominal USG between 10 and 14 weeks. We used a CHISON 600M ultrasound scanner with a curvilinear probe of 3.5 MHz. Their follow up included identification of all possible factors that are likely to influence birth weight.

Thus, data collection required obtaining a wide range of information from the dating USG to details regarding delivery and accurate assessment of the birth weight, as well as identifying other factors that are likely to have a negative effect on birth weight. Hence, a total of seven questionnaires were used. A brief description is given as follows.

Questionnaire 1 was administered at the first visit by a pre-intern Medical Officer and included basic socio demographic information, current and past obstetric history, present and past medical and surgical histories and other possible risk factors for SGA. Findings of the clinical examination, urine full report and haemoglobin level were also recorded.

Questionnaire 2 was administered by the area PHM during the second trimester to collect information for development of wealth index\[^{6}\], assessment of home risk factors and family history of disabled and LBW children.

A self administered Questionnaire 3A, was used to assess the psychological stress level of the pregnant mothers as this was considered an important risk factor for LBW\[^{7}\]. The instrument used was the translated GHQ 30, which had been validated and used in Sri Lanka\[^{8,9}\].

Questionnaire 3B administered by the PHM during a clinic visit at a POA of approximately 34 weeks, obtained information from the mother and available records on the health conditions developed during the present pregnancy.

Questionnaire 3C: An internationally recognized tool, Pregnancy Physical Activity Questionnaire (PPAQ), a self administered questionnaire was used to assess the workload during pregnancy.\[^{10}\]

Questionnaire 4A collected information related to the birth of the newborn, which was administered by PHM to the mother during the first post partum visit. Information related to childbirth, any complications in the newborn and on any medical conditions that the mother may have developed during the last weeks of pregnancy up to the delivery were collected. Available records were the main sources of information.

Questionnaire 4B aimed to collect information from the mothers who experienced either an abortion or a still birth, by the PHM.

**Training of personnel**

The principal investigator was trained in performing USG by a consultant obstetrician. A pre-intern medical officer was trained as the research assistant and all PHMs of the two study areas were trained in field level data collection. All staff of the labour rooms of the five hospitals where deliveries took place was re-trained in taking the measurements of the newborn.

**Method of data collection**

Informed written consent was obtained from each mother. USG was performed by the same investigator using the same instrument. Data collection took place both at the clinics and at the field level as mentioned earlier. All the steps in the data collection process were supervised. Electronic SECA scales and length measuring boards were provided to all labour rooms. Accuracy of the scales was checked with standard weights once in 3 months.
as instructed by the manufacturers. Birth weights were obtained within one hour of birth using the SECA scales.

Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Colombo. Data entry files were designed using EPI INFO software and analysis was made using IBM SPSS Statistics (Statistical Package for Social Sciences) version 15.

**RESULTS**

Records related to births were available for all 1200 mothers. Of them, only 474 (39%) mothers could be included in this assessment as 726 (61%) of them had one or more risk conditions. The common risk conditions could be broadly grouped as those related to poor nutritional status (anaemia, low body weight index [BMI], etc.) and medical (e.g., hypertension, diabetes) and other pregnancy-related conditions. All mothers were followed up throughout pregnancy and during delivery by the research team and by the field health staff as is the usual practice.

Records of these 474 mother/newborn pairs were grouped according to sex of the newborn and POG at delivery using the USG as the basis of assessment. In each group, the mean birth weight, standard deviation and the centile values were calculated [Table 1a and b]. Number of mothers in the two extreme groups (<38 and >40 weeks) was less than 30 each, hence the centile values were not calculated, as their validity was considered to be low.

Among the male newborns, the mean birth weights at POG 38, 39 and 40 were used to develop the curve [Figure 1]. Similarly, among the female newborns, the mean birth weight values of POG 39 and 40 were used to develop the curve [Figure 2]. The charts were drawn using Microsoft Excel 2007 software. The limited number of newborns in each POG category resulted in a relatively smooth curve, thus not requiring the use of special software.

The incidence of SGA was calculated by assessing the number of newborns with birth weights lower than the 10th centile value for each POG for each sex, as a percentage of the total sample of newborns (938) with POG 38-40 weeks. There were 100 SGA male singleton newborns giving a SGA rate of 19% and with the comparable figure among female singletons being 18%. Among the babies who had birth weights more than 2500 g, 11.6% were classified as SGA [Table 2].

Two main patterns are identified in Intra Uterine Growth Restriction (IUGR), namely, symmetrical and asymmetrical. The pathogenesis and the consequences of the two types are different as described by several authors. This differentiation is made by using the Ponderal Index.

Ponderal Index = Birth weight in grams/(Birth length in cm)^3 × 100

Cut-off value for asymmetrical SGA was 2.4. There were 136 newborns in whom both SGA and length details were available and were identified as SGA, 72.1% were identified as those with asymmetrical SGA and 27.9% as symmetrical.

**DISCUSSION**

Since 1963, when Lubchenco developed the weight for gestational age curves, attempts were made in many countries to develop such curves, for use in assessing gestational age-related birth weight. In most developing countries, SGA contributes to the larger portion of LBW babies. This may be due to inadequate focus on programmes aimed at reducing country-/region-specific risk factors. Thus, development of country-specific gestational age curves and identification of the specific risk factors is of importance.

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**Table 1: Centile values**

<table>
<thead>
<tr>
<th>POG (Weeks)</th>
<th>N</th>
<th>B. Wt (g)</th>
<th>Centile</th>
<th>Mean (g)</th>
<th>SD (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10th</td>
<td>50th</td>
<td>90th</td>
<td></td>
</tr>
<tr>
<td>a) For male singletons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>8</td>
<td>2250</td>
<td>2942</td>
<td>3130</td>
<td>2816</td>
</tr>
<tr>
<td>38</td>
<td>44</td>
<td>2680</td>
<td>2997</td>
<td>3467</td>
<td>3015</td>
</tr>
<tr>
<td>39</td>
<td>58</td>
<td>2650</td>
<td>3060</td>
<td>3535</td>
<td>3074</td>
</tr>
<tr>
<td>40</td>
<td>116</td>
<td>2580</td>
<td>3037</td>
<td>3600</td>
<td>3068</td>
</tr>
<tr>
<td>41</td>
<td>12</td>
<td>3090</td>
<td>3490</td>
<td>3900</td>
<td>3438</td>
</tr>
</tbody>
</table>

**Table 2: Small for gestational age in singleton pregnancies by sex and POG**

<table>
<thead>
<tr>
<th></th>
<th>SGA</th>
<th>%</th>
<th>Non-SGA</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POG 38 weeks</td>
<td>26</td>
<td>24.5</td>
<td>80</td>
<td>75.5</td>
<td>106</td>
<td>100.0</td>
</tr>
<tr>
<td>POG 39 weeks</td>
<td>44</td>
<td>27.5</td>
<td>116</td>
<td>72.5</td>
<td>160</td>
<td>100.0</td>
</tr>
<tr>
<td>POG 40 weeks</td>
<td>30</td>
<td>11.5</td>
<td>230</td>
<td>88.5</td>
<td>260</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>19.0</td>
<td>426</td>
<td>81.0</td>
<td>526</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>SGA</th>
<th>%</th>
<th>Non-SGA</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POG 39 weeks</td>
<td>14</td>
<td>10.9</td>
<td>114</td>
<td>89.1</td>
<td>128</td>
<td>100.0</td>
</tr>
<tr>
<td>POG 40 weeks</td>
<td>60</td>
<td>21.1</td>
<td>224</td>
<td>79.9</td>
<td>284</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>74</td>
<td>18.0</td>
<td>338</td>
<td>82.0</td>
<td>412</td>
<td>100.0</td>
</tr>
<tr>
<td>Grand total</td>
<td>174</td>
<td>18.6</td>
<td>764</td>
<td>81.4</td>
<td>938</td>
<td>100.0</td>
</tr>
</tbody>
</table>

SGA - Small for gestational age, POG - Period of gestation
This study used a longitudinal approach where a sample of mothers was identified early with an accurate assessment of the POG using USG. Assessing POG accurately using USG is not a routine activity in antenatal clinics in many developing countries including Sri Lanka. This poses limitations in using routine data from hospital settings in developing weight for gestational age charts. In this attempt to develop birth weight for gestational age charts, all information on the risk conditions for LBW had to be collected using specially developed study instruments, by trained investigators. They were followed up until delivery at identified hospitals. Use of cross-sectional methods to develop weight for gestational age charts, although more feasible, poses problems related to the ascertainment of the POG and other risk factors.

Obtaining accurate assessment of the birth weight is crucial in this type of study and this was facilitated by training, supervision of staff and provision of SECA digital weighing scale to labour rooms of all relevant hospitals. Such scales have been used in many studies.\[16\]

Among the mothers on whom birth data were available, 61% had factors that could influence birth weight, hence were not included in the development of the curves.

Most studies that have focused on developing such curves have used data from large national level databases or had based them on data from samples of mothers recruited over a period of 5 years or more.\[15,17\] Some have used data collated from a number of small scale studies.\[18\]

In this study that used a longitudinal approach to develop gestational age-related birth weights, USG was performed on all mothers at a POA of 10-12 weeks as specified in the inclusion criteria. Ensuring adequate follow up with minimal ‘drop out’ rates and obtaining accurate measurements on the other key variable, birth weight required a detailed follow up and frequent assessment of the accuracy of the weighing instruments used.

The main limitation of our study was the inability to develop gestational age-related birth weight curves for POG less than 38 and more than 40 weeks. From the experience gained, it is clear that a larger number of mothers had to be enrolled into the study to enable such an assessment, which could not be done. However, since
the vast majority of births occur between 37 and 41 weeks, the chart that has been developed would still be useful as an indicator of the status of growth of these babies. Even with this limitation, the SGA charts developed are useful to be used within a country for categorizing LBW newborn children as belonging to the SGA or non-SGA group, to identify risk factors for developing appropriate interventions to reduce LBW rates. Even though the prevalence of LBW in Sri Lanka has remained at 15-18% over the past decade, non-availability of SGA charts has been a limitation in identifying the prevalence of the two types of LBW to develop appropriate interventions. This study fills this void and hence makes a valuable contribution to the knowledge required for prevention of LBW.

CONCLUSIONS

The charts reported in the study, despite limitations, could be used for assessment of incidence and risk factors for SGA until such time that charts based on national level data are available.

ENDNOTE

1 The field level administrative unit responsible for provision of preventive health services.

2 Previous studies have estimated that the coverage of registration of pregnant women by PHMs is over 95%.

REFERENCES


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