Customised foetal growth charts have the potential to predict more accurately macrosomia in women with diabetes than standard population charts.

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ABSTRACT

Background: Babies born to women with diabetes have a tendency to be bigger than average (macrosomic). Customised growth charts have been found to identify small for gestational age babies in women with type 2 diabetes, but it is not known whether these charts are useful in identifying macrosomic babies.

Aim: To determine whether customised foetal growth charts better predict macrosomia than the standard population chart in women with diabetes.

Methods: This was a study of pregnancies in women with diabetes (type 1, type 2 and gestational) who delivered at Christchurch Women's Hospital between January 2007 and July 2009. Maternal characteristics were collected and used to construct individual customised growth charts for each baby. Foetal growth and birth weight were plotted on the customised chart and compared with the standard population chart. Babies were classed as macrosomic if they were over the 90th percentile for a given gestational age. Any discrepancies between the charts were noted and further investigated.

Results: Of the 226 pregnancies reviewed, 58 (26%) babies were classed as macrosomic at birth by the standard population growth chart. Ten of the 58 (17%) were reclassified at birth, changing from being classed as macrosomic by the standard chart, to being classed as 'appropriate for gestational age' (AGA) by the customised charts. Of these, two babies were born to Samoan women, two to Maori women and six to Caucasian women. Three babies were classified as macrosomic at birth only by the new customised charts; two were born to Caucasian women and one to an Indian woman. This means that 18% of babies born to Samoan women, 12.5% born to Maori and 4% born to Caucasian women were wrongly classified as macrosomic using the standard chart. In addition, macrosomia was missed in 11% of Indian and 1% of Caucasian babies.

Conclusions: In this study, the customised growth charts diagnosed fewer babies as macrosomic at birth in women with diabetes of Samoan and Maori ethnicity. Therefore there may be a lesser need to induce labour in women before term which decreases the risk of complications at birth to both mother and baby. In addition, the customised charts identified three cases of macrosomia at birth that otherwise would have been missed. A prospective study with a larger cohort of women should be undertaken to confirm these findings.

INTRODUCTION

Women with diabetes in pregnancy whether it be type 1, type 2 or gestational (a form that only occurs or is recognised for the first time in pregnancy) have an increased risk of delivering big babies.[1] This is because more nutrients cross the placenta, affecting foetal growth and metabolism. These babies have an increased risk of morbidity and perinatal mortality[2]. Currently the growth of the baby is plotted on the standard population growth chart, which only takes into account ultrasound scan (USS) measurements. Babies classed as big (macrosomic) on the standard chart, are often delivered several weeks before their due date in order to reduce risks such as shoulder dystocia and still birth.[2] However, early delivery may pose other risks to the baby including respiratory distress secondary to underdeveloped lungs, and may result in the mother having to undergo induction of labour and/or caesarean section.[2] At present, the USS data and findings at delivery often do not match up, meaning that some babies thought to be macrosomic from the USS data are not macrosomic at delivery, and had been unnecessarily delivered early. Others that are macrosomic at birth have been missed according to the USS data, posing risks to the baby before, during and after birth.

Different ethnicities have normal variations in birth weight and a baby classed as macrosomic in one population may not be classed as macrosomic in another. Maori and Polynesian women tend to have larger babies whereas Asian women generally have smaller babies.[3] The standard population charts that are currently used to predict macrosomia (weight over the 90th percentile for a particular gestational age) do not take into account our multi-sized, multi-ethnic population. Customised growth charts are based on maternal characteristics including booking weight, height, ethnicity, age and past obstetric history. The customised growth charts have already been found to identify more babies at risk of complications than the standard growth charts for small for gestational age babies.[3] Therefore there is a need to investigate whether the customised charts are more effective in diagnosing macrosomic babies in women with diabetes.

METHODS

Study Design

This was a retrospective observational study carried out at Christchurch Women's Hospital (CWH). Ethical approval was not required and confimation of this was sought from the Upper South B Regional Ethics Committee. Women with diabetes in pregnancy that reside in the Canterbury region were encouraged to deliver at CWH in case any unforeseen complications arise. Women with diabetes who delivered a baby between the 1st of January 2007 and the 31st of July 2009 were assessed for inclusion in the study.

Study Population

The hospital records of 266 women with diabetes who delivered during the two and a half year study period were obtained and reviewed to determine their eligibility for the study. The inclusion criteria were pregnant women with a diagnosis of either type 1, type 2 or gestational diabetes who delivered at CWH. From the original cohort, 33 were excluded: seven sets of twins, eight miscarriages, one termination, six women who did not have confirmed diabetes, two with missing notes, four with missing maternal characteristics needed to construct the customised growth charts, four who moved cities part way through their pregnancy with no follow up details and one in which no ultrasound data from her pregnancy could be found. In total, 233 women with singleton pregnancies and confirmed diabetes were analysed. In addition to the hospital records of these women, the medical records of their babies were also obtained.

Study Protocol

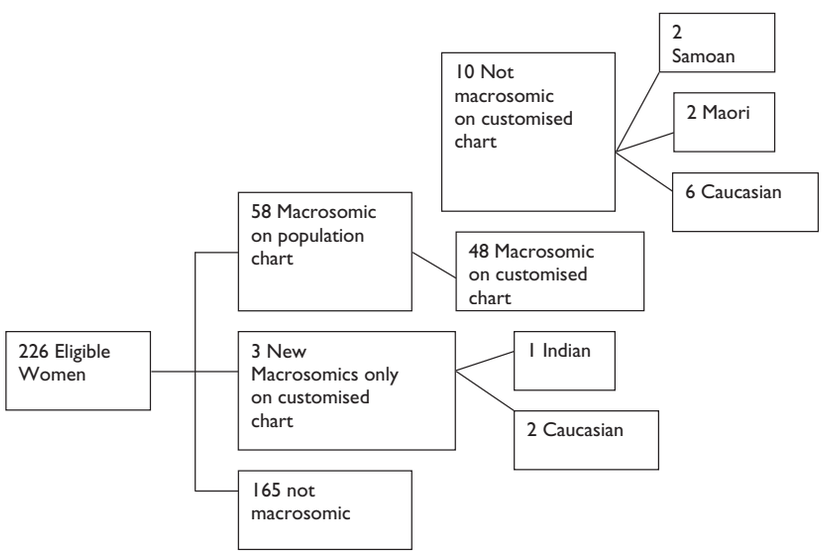
Information was collected from maternal hospital records. This included characteristics needed to construct the customised growth charts such as age, ethnicity, booking weight, height and past obstetric history. For the purpose of this study, women were classed as Chinese if they identified themselves as Chinese, Japanese, Korean, Malaysian or Asian. Ultrasound data for the third trimester was also collected; this included the estimated foetal weight, which was also noted as a percentile. Each baby's medical record was examined for delivery data including delivery method, induction and birth weight.

Customised growth charts were constructed for each woman[4]. Birth weight was plotted on the customised chart and compared with the standard population chart. Population birth weight centiles had been previously calculated using a standard chart constructed by JM Thompson of the Department of Paediatrics, University of Auckland School of Medicine[5]. Babies were classed as macrosomic if they were on or above the 90th percentile for weight on either chart. Any discrepancies between the charts were noted and further investigated.

RESULTS

From the original population of 233 singleton pregnancies, four had no medical record available for the baby and three had no recorded baby birth weight. Both of these measures were needed for the study, therefore these pregnancies were excluded. The final eligible population analysed consisted of 226 women with singleton pregnancies and diabetes.

Figure 1. Flow chart showing cases of macrosomia



Of the 226 pregnancies reviewed, 58 (26%) were classed as macrosomic at birth by the standard population chart. Ten of the 58 (17%) babies were reclassified at birth, changing from being classed as macrosomic by the standard chart to being classed as 'appropriate for gestational age' (AGA) by the customised chart. Of these babies two were born to Samoan women, two to Maori women and six to Caucasian women. This means that 18% of babies born to Samoan women, 12.5% born to Maori and 4% born to Caucasian women were wrongly classified as macrosomic using the standard population charts.

Three babies were classified as macrosomic at birth only by the new customised charts. Two of these babies were born to Caucasian women and one to an Indian woman. This suggests that in Indian women, the customised charts are more sensitive in detecting macrosomia than the standard chart and may pick up an extra 11% of macrosomic babies in this ethnic group.

Table 1. Correlation between ethinicity, macrosomia and maternal BMI

Ethnic Group	Total Number	Macrosomic on either charter	Mean BMI	Standard Diviation
Caucasian	158	50	31.7	7.4
Maori	16	3	40.5	1.7
Samoan	11	4	32.3	2.8
Tongan	6	2	37.8	-
Chinese	20	1	18.4	-
Indian	9	1	22.9	-
African	2	0	-	-
Fijian	4	0	-	-

Table 2. Relationship between ethinicity and BMI is those women who delivered non-macrosomic babies

Ethnic Group	Total Number	No Macrosomic	Mean BMI	Standard Diviation
Caucasian	158	108	29.3	6.9
Maori	16	13	30.6	4.9
Samoan	11	7	37.2	6.7
Tongan	6	4	39.2	4.6
Chinese	20	19	22.6	3.2
Indian	9	8	27.6	5.8
African	2	2	35.5	-
Fijian	4	4	30.5	8.9

When correlating Body Mass Index (BMI) to macrosomia, it was found that Maori women who had macrosomic babies had a mean BMI of 40.5 and Tongan women had a mean BMI of 37.8. The Indian woman that had a macrosomic baby had a BMI of 22.9, and the Chinese woman that had a macrosomic baby had a BMI of 18.4. When comparing these numbers to those in the same ethinic groups that had non-macrosomic babies (Table 2), a relationship between ethnicity, BMI and macrosomic babies born to women with diabetes can be seen.

DISCUSSION

Every year more and more women are diagnosed with diabetes. In particular, there has been an increase in the number of women diagnosed with gestational diabetes.[6] For these women, there is an increased chance that they will give birth to a macrosomic baby; therefore accurate prediction of macrosomia in pregnancy is important. This was the first study done in New Zealand looking at the accuracy of macrosomia detection in diabetic women, comparing detection by the standard population chart to the new customised growth charts.

In the population studied, fewer babies were classified as macrosomic at birth by customised growth charts compared with the standard population chart. Because the customised growth charts take into account various maternal characteristics, they may better predict macrosomia. Those thought to be macrosomic on the USS throughout the pregnancy are more often than not delivered early as there is an increased risk of complications (such as shoulder dystocia) and death in utero.[2] By more accurately predicting macrosomia, customised charts may stop unnecessary preterm delivery of some babies, thus decreasing the risks associated with prematurity such as respiratory distress. Early delivery also increases the risk to the mother, with invasive interventions such as induction of labour and/or caesarean section.

Previous research has suggested that the customised charts better predict small for gestational age babies born to women with type 2 diabetes.[3] This research suggests that they may also better predict macrosomia in New Zealand's multi-ethnic, multi-sized diabetic population. The standard population charts can over-predict macrosomia in babies born to Samoan and Maori women, where in fact these babies are classed as being appropriate for gestational age on the customised growth charts. This suggests that the customised charts maybe useful in determining true macrosomia in these ethnicities. Samoan and Maori women tend to have larger body mass indexes (BMI) and the customised charts take this into account.[7] Conversely, Indian women generally have smaller BMIs[7] and so macrosomia is often missed in these women on the standard population chart. This confirms that maternal BMI and ethnicity play a strong role in the birth weight of the baby, and should be taken into account when predicting babies' growth and birth weight.

It is known that babies born to women who are diabetics are often macrosomic. It is also known that different ethnicities have different thresholds for when a baby is classed as macrosomic. In this study we looked at the relationship between maternal BMI and macrosomia. A woman with a larger BMI is more likely to have a bigger baby, as BMI is itself a risk factor for developing diabetes in the mother (and hence lead to macrosomia). By correcting for BMI on the customised charts we are able to identify those babies that are macrosomic due to the effects of the diabetes, independent of the mothers weight. Therefore there is an interrelationship between ethnicity, BMI, diabetes and macrosomia, and these variables should be taken into account when assessing the mother's risk of delivering a macrosomic baby

Obesity is a growing problem in the western world and the correlations between obesity and diabetes play a role in the increasing number of macrosomic babies.[8] Therefore it is especially important to detect macrosomia early in large ethnic populations to prevent complications and reduce the risk of the baby developing obesity and/or diabetes later in life.

Another potential benefit of the customised charts is to more accurately assess the risk of hypoglycaemia in macrosomic babies. It is already known that babies born to diabetic women have an increased chance of developing hypoglycaemia after birth, especially if those babies are macrosomic.[2] If the customised charts can more accurately predict macrosomia, then the further increased risk of hypoglycaemia in these babies can be more accurately determined.

CONCLUSIONS

The customised growth charts diagnose fewer babies as being macrosomic at birth in women with diabetes. Therefore there may be a lesser need to induce delivery in women before term, decreasing the risks of intervention to the mother and baby. The customised charts also picked up three cases of macrosomia that otherwise would have been missed. The customised growth charts have the potential to prevent over diagnosis of macrosomia in women of Samoan and Maori ethnicity and under diagnosis in Indian women. We would like to undertake a larger prospective study to confirm these findings.

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