Influence of Maternal Height, Weight and Body Mass Index on Birthweight in an Asian Population

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Citation

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Abstract

Objective: Birthweight is an important parameter to both obstetricians and neonatologists. Gestational age-specific birthweight gives useful information on the possibility of intra-uterine growth restriction or overgrowth. The aim of this study is to construct reference gestation age-specific birthweight percentile charts for Asian babies with particular reference to maternal height, weight and body mass index (BMI).Method: Birthweights of 25,141 babies born in KK Hospital, Singapore in 1994 and 1995 were analysed. Results: The median (10^{th} - 90^{th} percentiles) maternal height was 155 cm (148 cm - 163 cm), corrected mid-trimester maternal weight was 59.9 kg (48.4 kg - 75.6 kg) and BMI was 24.8 kg/m^2 (20.6 kg/m^2 - 31.2 kg/m^2). All 3 parameters were positively associated with larger birthweights. The mean birthweights for tall and short mothers were 3219g versus 3014g ($p < 0.001$), heavy and light mothers 3337g versus 2845g ($p<0.001$) and, overweight and underweight mothers 3276g versus 2909g ($p<0.001$) respectively. Besides race, parity and gestational differences, anthropometric differences in maternal height, weight, body mass index are important factors that affect birthweight.Conclusion: The availability of local gestation age-specific birthweight centile charts are essential for obstetricians & neonatologists in their perinatal practice. Gestational age-specific birthweight charts need to take into account maternal height, weight and BMI of the local population in order to be useful to practicing clinicians. These charts also allows comparison of changes in local birthweights over the decades and for different generations.

INTRODUCTION

Birthweight is an important parameter to both obstetricians and neonatologists. In relation to the gestation, it gives extremely useful information with regards to possibility of intra-uterine growth restriction or hypergrowth. It is also a powerful predictor of obstetric performance, infant morbidity & survival, childhood growth and adult height. [123] Birthweight is influenced by many factors including race, parity, maternal stature and weight, infant sex and gestation. Gestational birthweight distribution has been studied in detail for different combinations of race, infant sex and parity. [4567891011] Although there are few studies which investigated the influence of maternal height , weight and body mass index (BMI) on birthweight. [11121314] , there are no local study thus far. The availability of local gestation age-specific birthweight centile charts with reference to various maternal epidemiological, obstetric and anthropometric characteristics would be useful for obstetricians & neonatologists in their perinatal practice in Singapore & Malaysia. This aim of this study is to construct reference gestational age-specific birthweight centile charts for Asian babies with particular reference to maternal height, weight and BMI.

METHODS

Data collected from the Obstetric Information System (OIS) of Labour Wards of Kandang Kerbau Hospital (KKH) were used. The OIS was a Clipper-5 based computer database program installed in the labour wards of KKH to capture all clinical and obstetric information of patients delivering in KKH. The data were collected and entered into the computer network by houseofficers, midwives and labour ward clinical assistants at the time of delivery. A random audit of 3% of the data (verifying computer data with case records) had been instituted weekly to ensure the validity and accuracy of the data collected.

The database relating to all deliveries for 1994 and 1995 were extracted from OIS. The birthweights of 29,704 babies delivered in the hospital from January 1994 to December 1995 were analysed with respect to the gestation, parity, maternal weight, maternal height, race and infant sex. Missing data on gestational age, maternal height and weight

were also excluded from analysis accordingly. Multiple pregnancies and stillbirths were excluded. A total of 25 141 birthweights of babies were used for the derivation of the gestation age-specific birthweight centile charts after exclusion of multiple pregnancy, stillbirths, uncertain dates and missing data.

The median, mode and the percentile distribution (3 rd , 5 th , 10 th , 50 th , 90 th , 95 th , 97 th percentiles) of maternal age, height, weight and BMI for the maternal population were calculated. Maternal weight at the first and last visits were obtained from the database. The mid-trimester maternal weight was derived from a standardisation formula based on the first and last maternal weight and corrected to the 25th week of gestation. The BMI was based on the corrected mid-trimester maternal weight at 25 th week of gestation. Mean birthweight, term (37-42 weeks) birthweight, mean term firstborn birthweight, parity, gestation, maternal height, weight, overall BMI and primiparous BMI of the three races (Chinese, Malay & Indians) were also derived using the statistical program SPSS (Version 6).

Gestational age-specific birthweight centile charts (from 32 weeks to 42 weeks) were derived and plotted using standard computer database, spreadsheets and a locally written database program. The 3 rd , 5 th , 10 th , 50 th , 90 th , 95 th , 97 th birthweight percentiles for each of the gestation were obtained for the general population. The 10 th , 50 th and 90 th birthweight percentiles were obtained for each gestation comparing male and female infants, the 3 main races and firstborn and subsequent-born infants. The 10 th , 50 th and 90 th birthweight percentiles were also obtained for each gestation comparing tall (≥ 163 cm) and short (≤ 148 cm) mothers, heavy (≥ 75.6 kg)and light (≤ 48.4 kg) mothers and overweight (≥ 31.2 kg/m ^{2}) and underweight (≤ 20.6 kg/ m ^{2})mothers. These anthropometric criteria corresponded to the 10 th and the 90 th percentiles relating to the maternal characteristics of this antenatal population. Statistical significance tests using t-test program in SPSS (Version 6) were applied when appropriate.

RESULTS

The study population of 25,141 patients comprised 12611 Chinese (50.2%), 8643 Malays (35.4%), 2497 Indians (9.9%) and 1390 (5.5%)of other races. The mean parity was 2.0 (sd 1.1). Primiparity constituted 38.3%, and multiparity 61.7%. The mean gestational age was 39.2 weeks (sd 2.1 weeks) with a range from 23 weeks to 43 weeks. The median (10 th - 90 th percentiles) maternal height was 155 cm (148 cm - 163 cm), corrected mid-trimester maternal weight was 59.9 kg (48.4 kg - 75.6 kg) and BMI was 24.8 kg/m ^{2} (20.6 kg/m ^{2} - 31.2 kg/m ^{2}). All 3 parameters were positively associated with larger birthweights. The maternal age, height, weight and BMI percentile distributions are in TABLE I.

The mean birthweights of Malay, Chinese and Indian babies were 3140, 3125g & 3067g respectively. Malay mothers had the highest parity and BMI compared to the other 2 races while Chinese mothers had the lowest parity and BMI (TABLE II). The BMI of Malay, Indian and Chinese primiparous mothers were 25.9 kg/m ^{2} (sd 5.0 kg/m ^{2}), 25.3 kg/m ^{2} (sd 4.5 kg/m ^{2}) and 24.2 kg/m ^{2} (sd 3.6 kg/m ^{2}) respectively. This corresponded to the order of overall BMI of the 3 races.

The gestational age-specific birthweight percentile chart for the general population is in Fig 3. The gestational age-specific birthweight percentile charts comparing male and female infants, the 3 main races, first and subsequent born infants are in Figs 1 - 4 respectively. The mean birthweights for tall and short mothers were 3219g versus 3014g ($p < 0.001$), heavy and light mothers 3337g versus 2845g ($p<0.001$) and overweight and underweight mothers 3276g versus 2909g ($p<0.001$) respectively. The gestational age-specific birthweight percentile charts for tall versus short mothers, heavy versus light mothers and overweight versus underweight mothers are in Figs 5 - 7 respectively.

Figure 1

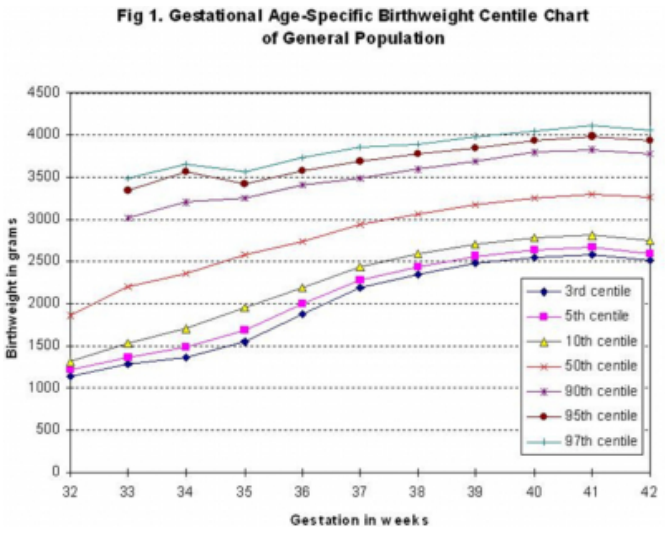


Figure 2

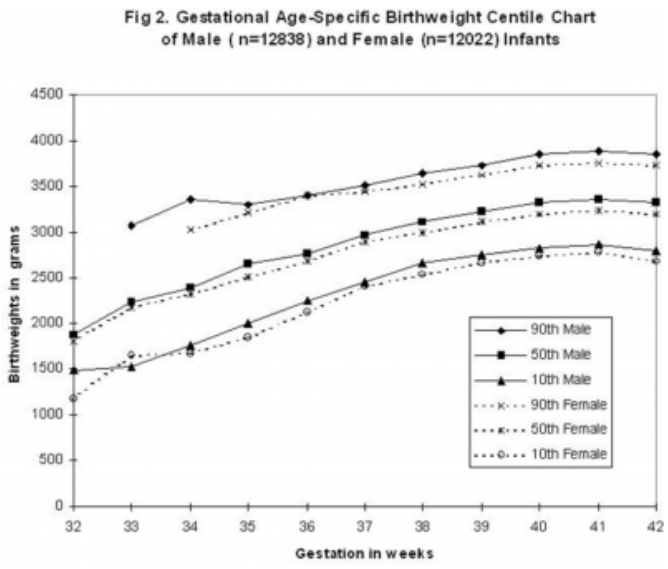


Figure 3

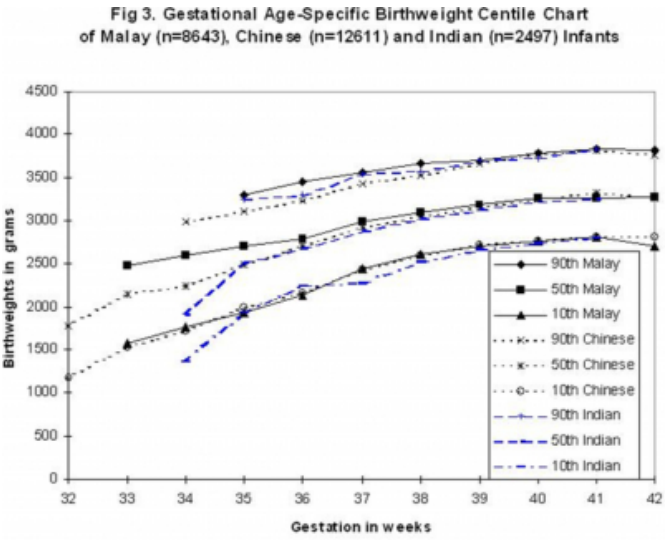


Figure 4

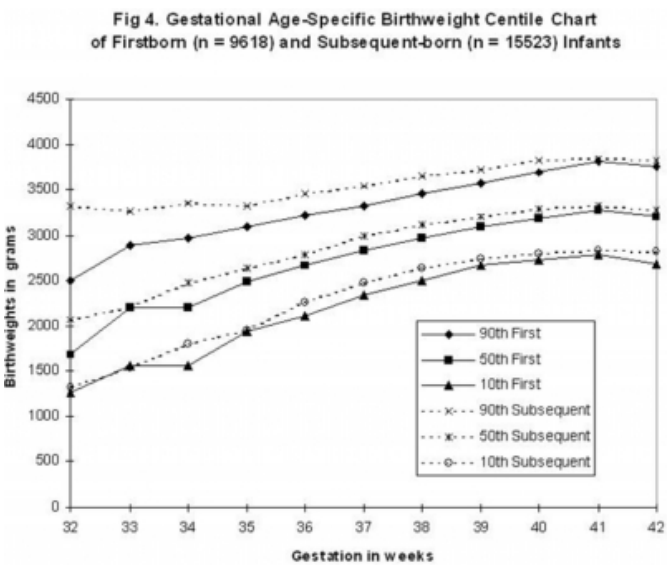
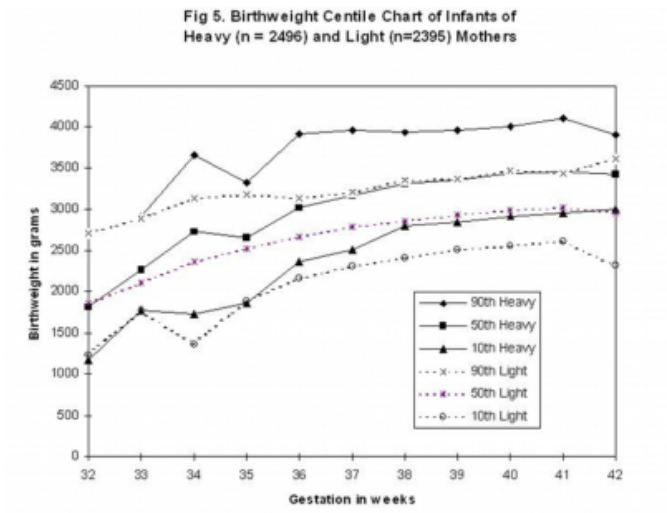
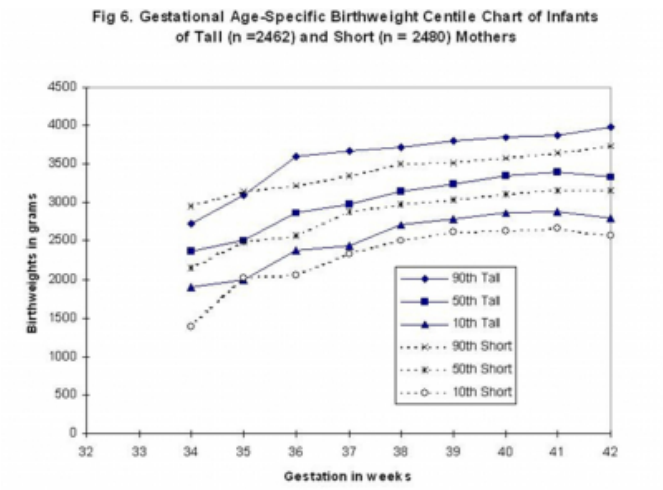


Figure 5



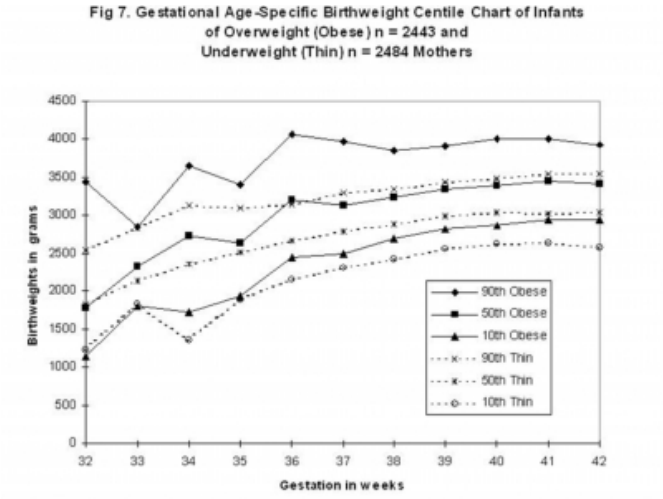
Heavy - Maternal Weight ≥ 90 percentile (75.6 kg), Light - Maternal Weight ≤ 10 percentile (48.4 kg)

Figure 6



Tall - Maternal Height ≥ 90 percentile (163 cm); Short - Maternal Height ≤ 10 percentile (148 cm)

Figure 7



Overweight (Obese)-Maternal BMI ≥ 90 percentile (31.2 kg/m²); Underweight (Thin)-Maternal BMI ≤ 10 percentile (20.6 kg/m²)

DISCUSSION

Birthweight is influenced by many factors including race, parity, maternal stature and weight and infant sex. Maternal height, weight and BMI are positively associated with larger birthweights. Tall mothers, heavy mothers and overweight mothers tend to have larger babies at birth than short, light and underweight mothers as shown in this study. The mean birthweight differences between tall versus short mothers, heavy versus light mothers and overweight versus underweight mothers (all at the 90 th and 10th percentile levels) were statistically significantly different ($p<0.001$) at 205g, 492g and 367g respectively. Maternal weight accounted for a wider variation of birthweights than maternal height comparing at the same percentile levels.

The development and use of a population based standards which take into account factors that significantly affect birthweight distribution, such as in this study, may result in less misclassification of intrauterine growth restriction. Separate standards by maternal height, weight and BMI besides infant sex and parity may lead to more accurate classification of intrauterine growth. Gestational age-specific birthweight charts may therefore need to take into incorporate maternal height, weight and BMI of the local population in order to be useful to practicing clinicians.

Maternal height and weight are routinely measured in antenatal care in most hospital practice. Short maternal stature has been regarded as a risk factor in obstetric care. The lower limit of 150 cm as a traditional cut off level in risk factor management may not be applicable or realistic in our local Asian population in South East Asia as our population tend to be shorter than those in the West. This cutoff level at 150 cm corresponded to the 12 th percentile of our local antenatal population. A more realistic cutoff point may be at 146 cm or 145 cm which correspond to the 5 th and 3 rd percentiles of the population respectively. This would require further studies on pregnancy outcome to establish the appropriate cutoff point as a risk factor in obstetric care. Besides significantly influencing birthweight, low maternal BMI have been associated with poor infant survival while higher BMI is associated with gestational diabetes. [$_{12}$] BMI is a useful parameter and is worthwhile to measure and consider during the antenatal plan and management.

Racial differences in birthweights are associated with many factors. [$_{4567891011}$] In this study, the mean birthweights of Malay, Chinese and Indian babies were 3140g, 3125g & 3067 g respectively. The larger birthweight of Malay could be accounted for by the higher mean parity and mean BMI compared to the other 2 races. Excluding the influence of parity as in first born babies, Chinese term babies were the heaviest followed by Malay babies and then Indian babies. While Malays have a higher mean maternal weight and BMI than Indians, Chinese have the lowest mean BMI of primiparous mothers and overall BMI and in this study. The higher mean term birthweight of Chinese infants may point to genetic, dietary, anthropometric or behavioural influence. Differences in incidences and severity of medical diseases antenatally and in the maternal and fetal responses between the races may also be factors resulting in birthweight differences. These areas require further investigations.

The Indians in Singapore are also a heterogeneous group

comprising of people originating from the whole Indian subcontinent and Sri Lanka and comprise only 10% of the study population. These account for the wider percentile range of birthweight compared to Chinese and the greater standard deviations in mean birthweights in Indians compared to the other races. Subdivision of the Indian population (eg Northern Indians and Southern Indians) is advised in future similar studies if the study population is large enough.

CONCLUSION

These gestational age-specific charts can serve as a useful reference standard for babies born in Singapore & Malaysia. Birthweight is influenced by many factors including race, parity, infant sex, maternal stature, weight and body mass index. Anthropometric differences in maternal height, weight, body mass index are important factors that affect birthweight. Besides infant sex, race, parity and gestational differences, gestational age-specific birthweight charts need to take into account maternal height, weight and BMI of the local population in order to be useful to practicing clinicians. These charts also serve as comparison of changes in birthweights over the decades. It would be interesting to perform studies comparing changes in birthweights every decade. This study would be a useful start for comparison with new studies in this decade and the next.

Figure 8

TABLE I. Percentile Distribution of Maternal Age, Height, Weight and BMI of the General Population (n = 25141)

Percentile	3rd	5th	10th	50th	90th	95th	97th	Mean	sd
Age (year)	20	21	23	29	36	38	39	29.2	5.4
Height (cm)	145	146	148	155	163	165	166	155.3	5.7
Weight (kg)	47.6	45.1	48.4	59.9	75.6	81.6	85.9	61.1	11.4
BMI (kg/m^2)	18.7	19.5	20.6	24.8	31.2	33.5	35.2	25.4	4.4

Weight is based on corrected weight at 25 week gestation calculated from maternal weight at first and last visit.
BMI based on the standardised and corrected maternal weight at 25 week gestation

Figure 9

TABLE II. Birthweights, Obstetric and Anthropometric Characteristics of Chinese, Malay and Indian Populations

Race	Mean BW (g)	Mean Term BW (g)	Mean Term Firstborn BW (g)	Parity	Gestation (week)	Height (cm)	Weight (kg)	BMI (kg/m2)
Chinese n=12611	3125 (474)	3172 (408)	3127 (397)	1.8 (0.9)	39.3 (1.9)	156.1 (5.6)	59.8 (10.0)	24.5 (3.8)
Malay n=8643	3140* (429)	3185* (426)	3095* (410)	2.4 (1.2)	39.1 (1.9)	154.3 (5.6)	62.5 (13.0)	26.1 (5.1)
Indian n=2497	3067‡ (523)	3136‡ (439)	3063‡ (444)	1.9 (1.0)	39.2 (2.0)	155.6 (5.9)	62.9 (12.1)	25.9 (4.8)
General n=25141	3214 (483)	3174 (420)	3100 (407)	2.0 (1.1)	39.2 (2.1)	155.3 (5.7)	61.1 (11.4)	25.4 (4.4)

BW: Birthweight
Standard deviation in brackets
* p<0.05 compared with Chinese
‡ p<0.001 compared with Chinese
BMI based on standardised and corrected maternal weight at 25 week gestation

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