

The impact of maternal height and ethnicity on birthweight of low-risk term pregnancies delivered vaginally - a 7-year Malaysian experience

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Introduction

Birth weight reflects intrauterine fetal growth and is an important predictor of the newborns short and long-term health.¹ Maternal factors including ethnicity, height, nutrition, parity, body mass index (BMI) and presence of medical conditions during pregnancy impacts fetal birth weight.^{2,3} At present, the standard estimated fetal weight charts used in Malaysia was designed using data derived primarily from the Western populations, and it may not be the best approach for the shorter Asian population.

In Malaysia, the rate of shoulder dystocia in 2017 in non-diabetic mothers, was 75% amongst neonates who were appropriate for gestational age (AGA), based on current percentile charts with the risk of being delivered at health care facilities not adequately equipped to manage shoulder dystocia and neonatal resuscitation.⁴

It is imperative to accurately identify small or large for gestational age (SGA or LGA) to avoid unnecessary interventions for healthy fetuses and overlooking "macrosomic" ones.

Objectives

The aim of this study is to analyse the association between maternal height and the average birth weight of full-term uncomplicated pregnancies delivered vaginally, in relation to ethnicity and gestational age. The results of the analysis will be used to aid counselling and management options of the term fetus based on estimated fetal weight and maternal height amongst our multi-ethnic population in Malaysia.

Methodology

The National Obstetric Registry (NOR), is a clinical database launched in 2009 by the Obstetrics & Gynaecology fraternity in Malaysia and receives obstetrics data from 15 tertiary maternity hospitals across East and West Malaysia to allow for healthcare planning, implementation and evaluation of the population.⁵

Data of all low-risk, term (37 to 40 weeks) singleton pregnancies delivered vaginally from 2010 to 2017 were extracted and stratified according to maternal characteristics (ethnicity, age, height, BMI and parity) and neonatal characteristics (gender, gestational age and birth weight). Subsequently, birth weight percentiles (10th and 90th) were calculated by categories of maternal height (<145 cm, 145-149 cm, 150-154 cm, 155-159 cm, 160-164 cm, 165-169 cm and ≥170 cm), baby's gender (male and female) and gestational age (37 weeks, 38 weeks, 39 weeks and 40 weeks).

Statistical analyses were conducted using Stata/MP, version 17.0 (Stata Corp LLC).

This study was registered with the National Medical Research Register (NMRR ID: NMRR-21-889-59660) and Monash University Human Research Ethics Committee (MUHREC Project ID: 30354)

Results

A total of **354,488** mothers and neonates were included in this study.

The median maternal age is 28.3 and the median maternal height is 155.5cm.

80% of mothers are of Malay ethnicity (n=282,803; 79.7%), followed by Chinese (n=19,790; 5.6%) and Indians (n=14,440; 4.1%). Other ethnic groups included are Bumiputera (n=31,039; 8.8%), Orang Asli (n=2,218; 0.6%), and others (n=3,098, 0.9%).

The median maternal body height differs between ethnic groups. In this study, the Chinese have the highest median maternal height of 158.0cm, while the Orang Asli have the lowest, of 150.6cm. The characteristics were further analysed using multiple linear regression (Table) using 2 different models which effectively demonstrates the greater effect of height as compared to ethnicity on birth weight.

	Multiple Linear Regression			
	Model 2a All variables (height as a continuous variable)		Model 2b All variables (height as a categorical variable)	
	Coefficient (95%CI)	p value	Coefficient (95%CI)	p value
Age (years)	4.65 (4.37 – 4.94)	<0.001	4.69 (4.40 – 4.97)	<0.001
Height (cm)	11.76 (11.54 – 11.98)	<0.001	-	-
Height categories (cm)				
<145	-	-	-196.94 (-206.54 – -187.34)	<0.001
145-149	-	-	-122.96 (-127.18 – -118.74)	<0.001
150-154	-	-	-51.84 (-54.83 – -48.86)	<0.001
155-159	-	-	Reference (0)	-
160-164	-	-	55.57 (52.00 – 59.16)	<0.001
165-179	-	-	98.62 (92.91 – 104.34)	<0.001
≥170	-	-	134.38 (122.30 – 146.46)	<0.001
Ethnicity				
Malay	-	-	Reference (0)	-
Chinese	-19.72 (-25.00 – -14.44)	<0.001	-18.22 (-23.50 – -12.94)	<0.001
Indian	-125.58 (-131.67 – -119.49)	<0.001	-123.99 (-130.08 – -117.89)	<0.001
Others	17.78 (4.86 – 30.71)	0.007	17.49 (4.56 – 30.42)	<0.001
Orang Asli	-151.15 (-166.43 – -135.87)	<0.001	-148.88 (-164.19 – -133.57)	<0.001
Other Bumis	-21.76 (-26.07 – -17.46)	<0.001	-23.46 (-27.76 – -19.15)	<0.001
Not available	-29.60 (-50.94 – -8.25)	0.007	-28.93 (-50.29 – -7.57)	<0.001
Parity	37.29 (36.28 – 38.31)	<0.001	37.04 (36.02 – 38.05)	<0.001
Neonatal Gender				
Female	-	-	Reference (0)	-
Male	86.86 (84.46 – 89.25)	<0.001	86.86 (84.46 – 89.26)	<0.001
Gestational age (weeks)				
37	-	-	Reference (0)	-
38	144.73 (141.10 – 148.36)	<0.001	144.72 (141.08 – 148.35)	<0.001
39	260.00 (256.50 – 263.49)	<0.001	260.16 (256.65 – 263.66)	<0.001
40	293.13 (288.20 – 298.05)	<0.001	292.87 (287.94 – 297.79)	<0.001

In model 2a, all characteristics and height were analysed as a continuous variable; while in model 2b, height was a categorical variable. In both models, the overall regression was statistically significant in affecting birth weight when comparing maternal height and ethnicity.

Regression equation based on Model 2a:

$$\hat{Y} \text{ (predicted birth weight)} = 726.19 + 4.65(\text{Age}) + 11.76(\text{Height}) - 19.72 \text{ (Chinese)} - 125.58 \text{ (Indian)} + 17.78 \text{ (Others)} - 151.15(\text{Orang Asli}) - 21.76 \text{ (Other Bumis)} + 37.29 \text{ (parity)} + 144.73 \text{ (38 gestation wks)} + 259.99 \text{ (39 gestation wks)} + 293.13 \text{ (40 gestation wks)} + 86.86 \text{ (Male gender)}$$

Discussion & Conclusion

Our findings show that neonatal birth weight increases with maternal height among Malaysians of all ethnicities. For every 1-cm increase in maternal height, birth weight increases by 11.8 g, which is consistent with earlier researches in other countries.¹ Mothers who are 150 cm tall give birth to infants with a 177 g lower mean birth weight than mothers who are 165 cm.

Upon analysing the ethnic groups individually, the mean fetal birth weight, SGA (10th percentile) and LGA (90th percentile) cut offs vary substantially among each maternal height group. Whereas when one specific maternal height group is analysed, the difference in cut offs are more comparable among each ethnicity. The overall finding is consistent with previous Dutch studies that suggested up to 17.4% of SGA cases and 21.1% of LGA cases would be classified as AGA.¹

The outcomes of this study have great implications on how we may manage future pregnancies, in this region. Fetal growth assessment and monitoring can be modified according to maternal height, especially for exceptionally tall or short mothers. Potentially, a smaller-than-normal fetus may not be pathological and can be managed as a low-risk pregnancy and even be allowed post-term. This approach will eliminate the need for unnecessary fetal surveillance and interventions such as inductions of labour and caesarean sections which are not without risks. Customized growth charts can also be developed for the use in Maternal and Child Health Clinics in the community.

The strengths of our study include a large sample size, recency of data and a variety of Asian ethnic groups, but limited by an unequal distribution and other potential variables which were not included.

References

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