Thai Journal of Obstetrics and Gynaecology
March 1999, Vol. 11, pp. 11-15

OBSTETRICS

Maternal Factors Associated with Fetal Macrosomia

Adithep Jaovisidha MD,*
Somsak Suthutvoravut MD,*
Surasak Taneepanichskul MD, MPH,**
Yongyoth Herabutya MBBS, MRCOG.*

* *Department of Obstetrics and Gynecology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand*
** *Department of Obstetrics and Gynecology, Faculty of Medicine, Chulalongkorn University, Bangkok 10400, Thailand*

ABSTRACT

Objective To study maternal factors associated with fetal macrosomia.
Design Case – controlled study.
Setting Department of Obstetrics and Gynecology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University.
Subjects One hundred and forty six pregnant women who delivered infants with birth weight more than 4,000 grams and 146 pregnant women who delivered infants with birth weight between 2,500-3,500 grams.
Results Maternal factors associated with fetal macrosomia were age 35 years or more, height more than 160 cms, weight at first antenatal care visit more than 60 kilograms, weight gain more than 20 kilograms, body mass index 24 kg/m^2 or more, previous macrosomia and diabetes mellitus during pregnancy.
Conclusion Total gestational weight gain and gestational diabetes mellitus were the strongest maternal risk factors for fetal macrosomia. Maternal age, height, weight before 20th week gestational, body mass index and previous fetal macrosomia were also important factors.

Key words : maternal factors, macrosomia

Maternal Factors Associated with Fetal Macrosomia

Fetal macrosomia is defined as a birthweight of 4000 gm or more. The largest recorded birthweight was 10,773 gm, for a stillborn infant delivered in 1879 in Ohio.[1] The incidence of fetal macrosomia reported from previous studies has varied from 1.64%[2] to 11%.[3] Although perinatal morbidity and mortality have declined in recent years, macrosomia still predisposes the newborn to birth asphyxia and trauma. The result of such conditions, though seldom lethal, may lead to long term sequelae. Many studies have tried to predict the fetal birthweight. In the past, the Leopold estimation of fetal weight is one of the methods used which is generally unreliable. Symphysis fundus height (SF) measurement has been considered a simple method but found to be of limited value as a screening method to detect abnormal size at birth.[4] Maternal factors have been proposed as a screening method to predict macrosomia.[5] The aim of this study was to

investigate some maternal factors which may be correlated with macrosomia.

Materials & Methods

The cases and controls were selected from the maternal population delivered at the Department of Obstetrics and Gynecology, Ramathibodi hospital, Bangkok. Identification of cases were done by using computer selecting from the data files as well as identification of controls who were mothers delivered just before the studied cases. The cases were mothers delivered of live infants with birth weight of 4,000 gm or more. The controls were mothers delivered of live infants with birth weight between 2,500-3,500 gm. The mothers in both groups started antenatal care before 20 weeks gestation and with at least 4 antenatal visits before delivery.

For the present study, the following variables were extracted from the case records: maternal age at delivery, weight at first visit to the antenatal clinic (before 20 weeks gestation), gestational age at delivery, total gestational weight increase, body mass index, height, parity, manifest or gestational diabetes, previous infant weighing more than 4,000 gm. Total weight gain was calculated as the difference between the weight on admission to labour ward and the weight at the first visit. The body mass index (BMI) was calculated from body weight (kg)/height in meter.[2] For the purpose of analysis, subjects were considered overweight if their BMI was greater than 24[6] Gestational age was confirmed in all cases with ultrasonography screening during 18 to 22 weeks gestation.

The sample size was calculated from

$$N = 2\,pq\,(Z_{\alpha/2} + Z_{\beta})^2 / (P_1 - P_0)^2$$

equal to 146 cases per group which were collected from May 1994 back to June 1993. Statistical methods included X^2 analysis, the student's t test and Fisher's exact test. $P < .05$ was considered statistically significant.

Results

Some maternal characteristics were significantly different in the macrosomia and normal birth weight groups. Higher maternal age and height were significantly more common in macrosomia group. The weights of more than 60 kilograms at first visit to antenatal clinic and maternal total weight increased of more than 20 kilograms were significantly more frequent among macrosomic mothers. Maternal body mass index (BMI) higher than 24 kg/m^2 at first antenatal clinic significantly increased the probability of giving birth to macrosomic infants. The gestational age at delivery and parity were not significantly different in both macrosomic and normal birthweight groups.

Maternal factors which associated with macrosomia is shown in Table 1. Total gestational weight increased and gestational diabetes mellitus were the variables most strongly ($p<0.01$) correlated to a macrosomic infant at delivery. Less significance ($p < 0.05$) were maternal age, height, weight before 20th week gestation , body mass index > 24 kg/m^2 and previous live birth>4,000 g. Parity and gestational age at delivery were shown to have no-significant correlation with macrosomic group.

Table 1 . Maternal factors associated with macrosomia

	Macrosomia (%)	Normal birth weight (%)	ODDS RATIO (OR)	95% Confidence interval	P – value
Maternal age (year)					
< 35	109 (74.7)	125 (85.6)			
≥ 35	37 (25.3)	21 (14.4)	2.02	1.12 – 3.66	< 0.05
Height (cm)					
≤ 160	113 (77.4)	129 (88.4)			
> 160	33 (22.6)	17 (11.6)	2.21	1.17 – 4.19	< 0.05
Weight (kg) before 20th week					
≤ 60	94 (64.4)	132 (90.4)			
> 60	52 (35.6)	14 (9.6)	5.21	2.73 – 9.96	< 0.05
Total gestational weight increase (kg)					
≤ 20	121 (82.9)	145 (99.3)			
> 20	25 (17.1)	1 (0.7)	29.9	4.23 – 112.71	< 0.01
Body mass index(kg/m^2)					
≤ 24	92 (63.0)	125 (85.6)			
> 24	52 (37.0)	21 (14.4)	3.49	1.97 – 6.19	< 0.05
Gestational age (wk)					
≤ 41	132 (90.4)	136 (93.2)	1.44	0.62 – 3.36	NS
> 41	14 (9.6)	10 (6.8)			
Parity					
0	59 (40.4)	68 (46.6)	1.28	0.81 – 2.04	NS
≥ 1	87 (59.6)	75 (53.4)			
Previous infants > 4000 gm					
0	138 (94.5)	145 (99.3)			< 0.05
1	8 (5.5)	1 (0.7)	8.41	1.04 - 68.1	
Gestational DM					
0	138 (94.5)	146 (100)	-	-	< 0.01
1	8 (5.5)	0 (0)			

Discussion

Numerous studies have reported that fetal macrosomia predisposes to more difficult delivery and increasing rates of neonatal injury. Wikstrom[5] documented an injury rate of 8.0 % in infants weighing > 4500 gm versus 0.6 % in normal weight group. Boyd[3] showed nerve injury up to 4% with birth weight 4000 gm or more. In this study fetal macrosomia was defined as a birth weight of 4000 gm or more. The incidence was between 7%[7] and 11% [3] in the United State. In Thailand, the incidence was between 1.6%[2] and 2.2%[8] from the study in Vajira and Ramathibodi hospital respectively. Our purposes were to find maternal factors that can be used to predict fetal macrosomia and in this study there were many maternal factors associated with fetal macrosomia .

Maternal age of more than 35 years was associated factor in the study which was similar to some studies[5,9] but not the studies of Dougherty[10] and Cnattingius.[11] Although, maternal age was usually correlated with the parity[2,5,12] in many studies, there was no significant difference in parity of the mother of macrosomic and normal birth weight infants in our study .

In this study we found that maternal weight, excessive weight gain and body mass index > 24 kg /m^2 were significantly more common in the study group. The result was similar to other studies.[9,13-16] The differences in each study was the prepregnancy weight. In our study it was found that the prepregnancy weight, defined as the weight before 20th week gestation, of more than 60 kg was 5 times likely to have fetal macrosomia compared to the weight < 60 kg. Wikstrom[5] used maternal weight > 70 kg as a risk group. Houchang[14] found that almost 40% of the mothers, who delivered macrosomic infants, were obese and 15% had a prepregnancy weight of 90 kg or more. Excessive maternal weight gain > 20 kg was the most important factor of having macrosomic infant. The result of this study was similar to the other studies[2,3,13-15]

In the macrosomia group, we found that maternal body mass index 24 kg/m^2 or more was a significant association. According to average standard height of Thai women which are about 1.5 to 1.6 meters, any mothers with prepregnancy weight of 60 kg or more will be classified as obese women.

Gestational diabetes mellitus (GDM) is one of the most important maternal factors associated with fetal macrosomia.[3,9,12,14] In this study, 94.5% of macrosomic infants were born to mother who had no previous history of GDM compared to none in the control group.

History of previous macrosomic infants was one of the significant factor. American College of Obstetricians and Gynecologists[17] summerized that the risk of macrosomia increased 5 – 10 times in mothers who had previous infants weighing 4,500 gm or more. Furthermore, most of the studies[3,5,14] reported that previous macrosomic infants were usually associated with GDM, which were similar to this study. So, previous macrosomia and GDM are strongly recommended for the obstetricians to be aware of the macrosomia in such pregnancy.

Gestational age at delivery has been claimed to be one of the factor of having fetal macrosomia.[3,12] This physiology of pregnancy is clearly understood by obstetricians. Although many studies had reported correlation of gestational age and macrosomia, our study found no significant correlation of gestational age and fetal macrosomia.

Gestational age at delivery[3,12] and parity[18 - 20] have been shown to be important risk factors for excessive fetal growth. Casey[9] reported that women with greater parity were more likely to have gestational diabetes. Although many studies have reported correlation of these two factors with fetal macrosomia, our study found no significant correlation. The explanation for this was that in our hospital, practically, all labors were induced in women with pregnancy beyond 41 week and also 80% of multiparous women had no more than 3 children.

In conclusion, we found that the strongest maternal risk factors for fetal macrosomia to be total gestational weight gain and gestational diabetes mellitus. Maternal age, height, weight before 20th week

gestational, body mass index, and previous fetal macrosomia were also important factors. Gestational age and parity in this study were not related to fetal macrosomia.

References :

1) Belcher DP. A child weighing twenty – five pounds at birth. JAMA 1916 ; 67 : 950.
2) Foongkiat S, Sripramodya M. Fetal macrosomia in Vajira hospital. Vajira Med J 1984; 28: 271 – 94.
3) Boyd ME, Usher RH, McLean FH. Fetal macrosomia : prediction, risks, proposed management. Obstet Gynecol 1983 ; 61: 715 – 22.
4) Persson B, Stangenberg M , Lunell NO, Brodin U, Homberg NG, Vaclavinkova V. Prediction of size of infants at birth by measurement of symphysis fundus height. Br J Obstet Gynecol 1986; 93: 206 – 11.
5) Wikstrom I, Axelsson O, Bergstrom R. Maternal factors associated with high birth weight. Acta Obstet Gynecol Scand 1991 ; 70 : 55 – 61.
6) Speroff L, Glass RH, Kase NG. Clinical gynecologic endocrinology and infertility. 5 th ed. Baltimore : Williams & Wilkins, 1994: 651 – 66.
7) Cunningham FG, MacDonald PC, Gant NF, Deveno KJ, Gilstrap LC III , Hankins CDV, et al. Williams obstetrics. 20 th ed. Connecticut : Appleton & Lange, 1997: 855 – 9.
8) Sirivongs B, Chaturachinada K, Jirachai W. The large fetus. a review on incidence and pregnancy outcome. J Med Assoc Thai 1985 ; 68: 497 – 501.
9) Casey BM, Lucus MJ, McIntire DD, Leveno KJ. Pregnancy outcomes in women with gestational diabetes compared with the general obstetric population. Obstet Gynecol 1997 ; 90 : 869 – 73 .
10) Dougherty CRS, Jones AD. The determinants of birth weight. Am J Obstet Gynecol 1982 ; 144 : 190 – 200.
11) Cnattinggius S, Axelsson O, Eklund G, Lindmark G. Smoking , maternal age, and fetal growth. Obstet Gynecol 1985 ; 66 : 449 – 52.
12) Spellacy WN, Miller S, Winegar A, Peterson PQ. Macrosomia – maternal characteristics and infant complications. Obstet Gynecol 1985 ;66 : 158 – 61.
13) Rydhstrom H, Ingemarsson I. The extremely large fetus antenatal identification, risks, and proposed management. Acta Obstet Gynecol Scand 1989 ; 68: 59 – 63.
14) Modanlou HD, Dorchester WL, Thorosian A, Freeman RK. Macrosomia – Maternal, fetal and neonatal implications. Obstet Gynecol 1980 ; 55 : 420 – 4.
15) Abrams BF, Laros RK, Jr. Prepregnancy weight, weight gain, and birth weight. Am J Obstet Gynecol 1986 ; 154 : 503 – 9.
16) Edwards LE, Hellerstedt WL, Alton IR, Story M , Himes JH. Pregnancy complications and birth outcomes in obese and normal – weight women: effects of gestational weight change. Obstet Gynecol1996; 87 : 389 –97.
17) American College of Obstetricians and Gynecologists: Fetal macrosomia. Technical Bulletin 1991; 159: 1 – 5.
18) Naylor CD, Sermer M, Chen E, Sykora K., Toronto trihospital gestational diabetes investigators. Cesarean delivery in relation to birth weight and gestational glucose tolerance : pathophysiology or practice style ? JAMA 1996;275:1165 – 70.
19) Coustan DR, Nelson C, Carpenter MW, Carr SR, Rotondo L, Wildness JA. Maternal age and screening for gestational diabetes : A population – based study. Obstet Gynecol 1989 ; 73 : 557 – 61.
20) Magee MS, Walden CE, Benedetti TJ, Knopp RH. Influence of diagnostic criteria on the incidence of gestational diabetes and perinatal morbidity. JAMA 1993 ; 269 : 609 – 15.