The Occurrence of Small for Gestational Age Infants and Perinatal and Maternal Outcomes in Normal and Poor Maternal Weight Gain Singleton Pregnancies

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Objective: *To assess the occurrence of small for gestational age (SGA) infants and perinatal and maternal outcomes in singleton pregnancies with normal and poor maternal weight gain.*

Material and Method: *Pregnant women with normal pre-pregnancy body mass index (BMI) and attending the antenatal clinic at King Chulalongkorn Memorial Hospital (KCMH) between 2006 and 2010 were eligible for the present study. The Thai population guidelines recommend a total weight gain of 10 to16 kg or ≥0.27 kg/week during pregnancy. In contrast, in 2009 the Institute of Medicine (IOM) guidelines recommended a total weight gain of 11.5 to16 kg or ≥0.31 kg/week. Our patients were analyzed using both sets of guidelines based on a normal pre-pregnancy BMI (18.5-24.9 kg/m^2). SGA infants, perinatal outcomes, and maternal outcomes were compared between women whose weight gain met or exceeded the recommendations (normal weight gain) and women who did not meet these recommendations (poor weight gain).*

Results: *A case-control of 1,152 singleton pregnancies was used for the analyses. Women with poor weight gain by the recommendation of the Thai population guidelines were significantly associated with SGA infants (1% in normal weight gain group and 2.6% in poor weight gain group adjusted odd ratio (aOR) 2.77, 95% confidence interval (CI) 1.06 to 7.28), preterm births (aOR 2.20, 95% CI 1.43 to 3.38), and low birth weight (LBW) infants (aOR 2.57, 95% CI 1.60 to 4.13). Women with poor weight gain by the recommendation in the 2009 IOM guidelines were significantly associated with preterm births (aOR 2.04, 95% CI 1.31 to 3.17), LBW infants (aOR 2.75, 95% CI 1.66 to 4.55), but not SGA infants (aOR1.97, 95% CI 0.74 to 5.20). Maternal weight gain <0.27 kg/week (Thai guidelines) was more likely to associate with SGA infants than maternal weight gain <0.31 kg/week (2009 IOM guidelines). Women with normal weight gain by both recommendations were more likely to have pregnancy-induced hypertension and less likely to have gestational diabetes compared with women with poor weight gain.*

Conclusion: *Poor maternal weight gain during pregnancy was associated with SGA infants, preterm births, and LBW infants. The Thai guidelines were a better predictor of SGA infants. The 2009 IOM guidelines should be used with caution in Thai patients.*

Keywords: *Maternal weight gain, Small for gestational age (SGA), Poor weight gain*

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Small for gestational age (SGA) infants, which is defined as infants whose birth weights are less than the tenth percentile for their gestational ages, have major maternal and child health problems that need to be solved in Thailand. Complications found in SGA infants are asphyxia, meconium aspiration, hypothermia, hypoglycemia, infections, and polycythemia. Incidence of SGA infants are 8.9% at King Chulalongkorn Memorial Hospital (KCMH)[1], and four to 10% in the USA[2].

The etiologies of SGA infants are unknown. However, many epidemiological studies demonstrate that various factors during pregnancy are associated with SGA infants including malnutrition, low socio-economic status, chronic medical diseases, drug abuse, smoking, and alcohol, etc.[2,3]. However, one of the main associated factors found in several studies is poor maternal weight gain[4-7]. Therefore, the authors are interested in this factor. The general recommendation of maternal weight gain in normal pregnancy in Thai population is 10 to 16 kg[4,8-10]. In 2009, the Institute of Medicine (IOM) revised the guidelines for weight

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gain in singleton pregnancy based on body mass index (BMI)-specific weight gains[11]. The IOM has recommended new maternal weight gain during pregnancy that has never been tested in a Thai population. The primary objective of the present study was to compare SGA infants, perinatal and maternal outcomes between maternal normal weight gain and poor weight gain in singleton pregnancy with normal pre-pregnancy BMI. The secondary objective was to compare SGA infants between maternal normal weight gain and poor weight gain following the recommendations for singleton pregnancies in the 2009 IOM guidelines.

Material and Method

This case-control study was selected from pregnant women and their babies who were delivered at King Chulalongkorn Memorial Hospital (KCMH) between 2006 and 2010. Inclusion criteria were singleton pregnancies, confirmed gestational age (last menstrual period/early ultrasound), and gestational age <14 weeks at first antenatal care (ANC). Underlying medical diseases (e.g., diabetes mellitus, hypertension, anemia, HIV infection, renal disorders, heart disease, and others systemic diseases), abortion, fetal death, congenital abnormalities, and administration of drugs that affect body weight (e.g., diuretics) were excluded.

Sample size was calculated by using the following formula that compared the two proportions of the samples(12):

$$N / group = (Z_{\alpha}\sqrt{2P_cQ_c} + Z_{\beta}\sqrt{P_tQ_t + P_cQ_c})^2 / (P_t - P_c)^2$$

N = sample size; P_t = rate of SGA infants in maternal poor weight gain; P_c = rate of SGA infants in maternal normal weight gain; $\alpha = 0.05$; $\beta = 0.10$; $Z_{\beta} = 1.96$ (two tail), $Z_{\alpha} = 1.28$

According to the present study of De Vader SR et al[5], SGA in maternal poor weight gain was 15% and SGA in maternal normal weight gain was 9.1%, $P_t = 0.15$, $P_c = 0.09$, $Q_t = 1\text{-}P_t = 1\text{-}0.15 = 0.85$, $Q_c = 1\text{-}P_c = 1\text{-}0.09 = 0.91$. Therefore, the number of participants was 576 per group. The present study has been approved by the Institutional Review Board (IRB) of the faculty. Data were collected from the database of KCMH. Because the weight gain recommendations are for women who delivered at 37 weeks or greater, it would not be appropriate to compare total weight gain in women who delivered at earlier gestational ages. Therefore, to control for gestational age at delivery, the authors divided the total weight gain by the gestational age in weeks at the last weight measurement to obtain the weight gain per week. The general recommendation of maternal weight gain in a normal pregnancy in Thai population guidelines was 10 to 16 kg. Therefore, the rate of normal weight gain should be ≥0.27 kg/week, which was calculated from the lower limit of the normal weight gain (10 kg) divided by 37 weeks. The recommendations for weight gain in 2009 IOM guidelines were 11.5 to 16 kg. Therefore, rate of normal weight gain should be ≥0.31 kg/week, which was calculated from the lower limit of normal weight gain (11.5 kg) divided by 37 weeks. The presented patients were analyzed using both sets of guidelines based on a normal pre-pregnancy BMI (18.5-24.9 kg/m^2). SGA infants, perinatal outcomes (preterm birth, low birth weight), and maternal outcomes (pregnancy-induced hypertension (PIH), and gestational diabetes mellitus (GDM)) were compared between women whose weight gain met or exceeded the recommendations (normal weight gain) and women who did not meet these recommendations (poor weight gain).

Results were analyzed with SPSS version 17. Descriptive statistics, Student t-test, and Chi-square were used where appropriate. Univariate analysis was used to define each association factor with poor maternal weight gain by calculating the odds ratio (OR) and 95% confidence interval (CI) of OR. Multivariable analysis was used to define associated factors with poor maternal weight gain after adjusted for confounding factors, by applied multiple logistic regression. A p-value of <0.05 was considered statistically significant.

Operation definition

- Normal body mass index: weight in kilograms divided by height in meters squared is 18.5 to 24.9 kilograms per square meter range[13].

- Small for gestational age (SGA): birth weight below the tenth percentile for their gestational age[2,3].

- Preterm birth: delivery before 37 weeks for gestational age[14].

- Low birth weight (LBW): less than 2,500 grams at birth irrespective of gestational age[14].

- Perinatal outcomes (in the present study): small for gestational age infants, preterm birth, and low birth weight infants.

- Gestational diabetes mellitus (GDM): any degree of glucose intolerance with onset or first recognition during pregnancy[15].

- Pregnancy-induced hypertension (PIH): high blood pressure caused by pregnancy, blood

pressure exceeds 140 mmHg systolic or 90 mmHg diastolic. Korotkoff phase V is used to define diastolic pressure[16].

Results

One thousand one hundred fifty two singleton pregnancies were included into the present study. Using the Thai population guidelines, 576 women were in the normal weight gain group ≥0.27 kg/week) and 576 women were in the poor weight gain group (<0.27 kg/week). Baseline maternal characteristics between the two groups are shown in Table 1. Women in the poor weight gain group had younger age, were shorter, and delivered at earlier gestation than in the normal weight gain group.

In the present study, women who had poor weight gain were less likely to have PIH (OR 0.52, 95% CI 0.27 to 0.95) and more likely to have GDM (OR 1.74, 95% CI 1.06 to 3.10) than women who gained normal weight gain, as shown in Table 2. Immediate postpartum hemorrhage, puerperal infection, and perineal injury showed no significant difference between the two groups.

Table 3 shows neonatal data between the two groups. Neonatal sex showed no significant difference between the two groups. Women in the poor weight gain group had lesser birth weights but more successful vaginal deliveries.

When we compared neonatal outcomes between the two groups before and after adjusting for confounding factors, a significant difference was seen between the two groups with the poor weight gain group having more SGA infants (1% in normal weight gain group and 2.6% in poor weight gain group adjusted odd ratio [aOR] 2.77, 95% CI 1.06 to 7.28), more preterm births (aOR 2.20, 95% CI 1.43 to 3.38), and more infants with lower birth weight (aOR 2.57, 95% CI 1.60 to 4.13) (Table 4).

The authors re-analyzed our data using 2009 IOM guidelines, we found that 508 women were in the normal weight gain group (≥0.31 kg/week) and 644 women were in the poor weight gain group (<0.31 kg/week). Using the 2009 IOM guidelines, we compared neonatal outcomes between the two groups before and after adjusting for confounding factors, a significant difference was found only more

Table 1. The maternal characteristics between normal weight gain (≥0.27 kg/wk) and poor weight gain (<0.27 kg/wk)

	Thai guidelines		
	Normal weight gain (n = 576)	Poor weight gain (n = 576)	p-value
Age (years)	30.92±5.13	28.97±6.66	<0.001
Race			
Thai	574 (99.7%)	566 (98.3%)	0.042
Others	2 (0.3%)	10 (1.7%)	
Nulliparous	283 (49.1%)	203 (35.2%)	<0.001
Multiparous	293 (50.9%)	373 (64.8%)	
Height (cm)	157.8±4.97	156.14±5.46	<0.001
Pre-pregnancy weight (kg)	52.70±5.50	52.83±6.37	0.705
Gestational age			
28-<37 weeks	35 (6.1%)	71 (12.3%)	<0.001
≥37 weeks	541 (93.9%)	505 (87.7%)	

Table 2. Maternal outcomes between normal weight gain (≥0.27 kg/wk) and poor weight gain (<0.27 kg/wk)

Maternal outcomes	Thai guidelines				
	Normal weight gain (n = 576)	Poor weight gain (n = 576)	Odd ratio	95% CI	p-value
PIH	30 (5.2%)	16 (2.8%)	0.52	0.27 to 0.95	0.050
GDM	23 (4.0%)	39 (6.8%)	1.74	1.06 to 3.10	0.050
Immediate postpartum hemorrhage	2 (0.3%)	5 (0.9%)	2.51	0.49 to 13.15	0.448
Puerperal infection	0	2 (0.3%)	-	-	0.479
Perineal injury	27 (4.7%)	28 (4.9%)	1.04	0.59 to 1.77	0.622

Table 3. The neonatal characteristics between normal weight gain (≥0.27 kg/wk) and poor weight gain (<0.27 kg/wk)

	Thai guidelines		
	Normal weight gain (n = 576)	Poor weight gain (n = 576)	p-value
Sex			
Male	295 (51.2%)	272 (47.2%)	0.195
Female	281 (48.8%)	304 (52.8%)	
Birth weight (g)	3,151±417	2,914±400	<0.001
Birth weight (g)			
2,000-<2,500	25 (4.3%)	59 (10.2%)	<0.001
1,500-<2,000	3 (0.5%)	9 (1.6%)	
1,000-<1,500	1 (0.2%)	0	
Route of delivery			
Vaginal delivery	298 (51.7%)	412 (71.5%)	<0.001
Cesarean delivery	278 (48.3%)	164 (28.5%)	

Table 4. Neonatal outcomes between normal weight gain (≥0.27 kg/wk) and poor weight gain (<0.27 kg/wk)

Neonatal outcomes	Thai guidelines							
	Normal weight gain (n = 576)	Poor weight gain (n = 576)	Odd ratio	95% CI	p-value	Adjusted odd ratio*	95% CI	p-value
SGA	6 (1.0%)	15 (2.6%)	2.54	0.99 to 6.59	0.078	2.77	1.06 to 7.28	0.038
Preterm	35 (6.1%)	71 (12.3%)	2.17	1.42 to 3.32	<0.001	2.20	1.43 to 3.38	<0.001
LBW	29 (5.0%)	68 (11.8%)	2.52	1.61 to 3.96	<0.001	2.57	1.60 to 4.13	<0.001
Nonreassuring FHR	12 (2.1%)	14 (2.4%)	1.17	0.54 to 2.55	0.690	1.18	0.54 to 2.58	0.680
Neonatal jaundice	62 (10.7%)	53 (9.2%)	0.84	0.57 to 1.24	0.380	0.83	0.56 to 1.23	0.360

* Adjusted for GDM, PIH

Table 5. Neonatal and maternal outcomes between normal weight gain (≥0.31 kg/wk) and poor weight gain (<0.31 kg/wk)

	2009 IOM guidelines							
	Normal weight gain (n = 508)	Poor weight gain (n = 644)	Odd ratio	95% CI	p-value	Adjust odd ratio*	95% CI	p-value
SGA	6 (1.2%)	15 (2.3%)	2.00	0.77 to 5.18	0.221	1.97	0.74 to 5.20	0.170
Preterm	31 (6.1%)	75 (11.6%)	2.03	1.31 to 3.14	0.001	2.04	1.31 to 3.17	0.002
LBW	24 (4.7%)	73 (11.3%)	2.61	1.61 to 4.15	<0.001	2.75	1.66 to 4.55	<0.001
PIH	28 (5.5%)	18 (2.8%)	0.49	0.27 to 0.90	0.022	0.48	0.26 to 0.88	0.017
GDM	17 (3.3%)	45 (7.0%)	2.17	1.23 to 3.84	0.008	2.23	1.26 to 3.95	0.006

* Adjusted for GDM, PIH

preterm births (aOR 2.04, 95% CI 1.31 to 3.17), and more infants with lower birth weight (aOR 2.75, 95% CI 1.66 to 4.55) in the poor weight gain group but not SGA infants (aOR 1.97, 95% CI 0.74 to 5.20) (Table 5). Women in the poor weight gain group were less likely to have PIH (OR 0.49, 95% CI 0.27 to 0.90) and more likely to have GDM (OR 2.74, 95% CI 1.23 to 3.84) than women in the normal weight gain group.

Discussion

It has been reported that women with singleton pregnancies whose total weight gain during pregnancy did not meet or was less than the Thai population guidelines or the 2009 IOM guidelines had significantly poor pregnancy outcomes, including more SGA infants, more preterm births and more LBW infants[4,5,8-10,17]. Recommendations of total weight gain are different in each pre-pregnancy BMI (underweight,

normal weight, overweight, and obese). In the present study, we were interested in studying the normal pre-pregnancy BMI group. Recommendation of total weight gain in normal pre-pregnancy BMI woman with singleton pregnancies is 10 to 16 kg in Thai guidelines and 11.5 to 16 kg in the 2009 IOM guidelines that are recommended in term pregnancies. Because women who remain pregnant longer are more likely to gain more weight and deliver larger neonates therefore, it is important to analyze the data in a way that can account for these confounders. To control the gestational age at delivery, the authors used the weight gain per week as our measure of weight gain in the present study. Therefore, the recommendation for normal weight gain per week in singleton pregnancies with normal pre-pregnancy BMI in the Thai guidelines is ≥0.27 kg/week and in the 2009 IOM guidelines is ≥0.31 kg/week. Using this measure of weight gain, women with poor weight gain (<0.27 kg/week) by the recommendation of the Thai population guidelines were significantly associated with SGA infants, preterm births, and LBW infants. Women with poor weight gain by the recommendation in the 2009 IOM guidelines were significantly associated with preterm births, LBW infants, but not SGA infants. Maternal weight gain <0.27 kg/week (Thai guidelines) was more likely to associate with SGA infants than maternal weight gain <0.31 kg/week (2009 IOM guidelines). In the present study, women with normal weight gain by both recommendations were more likely to have pregnancy-induced hypertension and less likely to have gestational diabetes compared with women with poor weight gain. The explanations for these findings may be that PIH patients had edema resulting in rapid increase in body weight and GDM patients had diet control resulting in decrease in body weight.

Strengths of our study were large number of patients, confirmed gestational age, and gestational age less than 14 weeks for accuracy of pre-pregnancy weight, no underlying diseases nor taking drugs that may affect maternal body weight. Limitations of the present study were non-standardized measurements of height and weight, unable to differentiate preterm births whether indicated or spontaneous preterm births, weight gain calculated for the entire pregnancy, no documentation of environment, socio-economy, and education of the women, which may affect SGA on infants.

Future studies should be performed to find out the suitable weight gain during pregnancy in a Thai population based on each pre-pregnancy BMI to reduce SGA infants and to reduce significant morbidity and mortality associated with prematurity.

Conclusion

Poor maternal weight gain during pregnancy was associated with SGA infants, preterm births and LBW infants. The Thai guidelines were a better predictor of SGA infants. The 2009 IOM guidelines should be used with caution in Thai pregnant women.

Potential conflicts of interest

None.

References

1. Uerpairojkit B. Intrauterine growth retardation. In: Phaosawat S, Chutiwong S, Reangprayung D, Konkitgowin S, editors. Obstetrics of chulalongkorn University. 2nd ed. Bangkok: OS Printing House; 1995: 344-51.
2. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Fetal growth disorders. Williams obstetrics. 23rd ed. New York: McGraw Hill; 2010: 842-58.
3. Uerpairojkit B. Intrauterine growth retardation. In: Tannirandorn Y, Pupong V, editors. Maternal-fetal medicine. 2nd ed. Bangkok: Pimdee; 2008: 117-31.
4. Weiangkham D, Pichainarong N, Chaveepojnkamjorn W, Kerdmongkol P, Tanawattanacharoen S. Effect of maternal weight gain on small for gestational age (SGA) infants. Chula Med J 2005; 49: 647-55.
5. DeVader SR, Neeley HL, Myles TD, Leet TL. Evaluation of gestational weight gain guidelines for women with normal prepregnancy body mass index. Obstet Gynecol 2007; 110: 745-51.
6. Fox NS, Rebarber A, Roman AS, Klauser CK, Peress D, Saltzman DH. Weight gain in twin pregnancies and adverse outcomes. Obstet Gynecol 2010; 116: 100-6.
7. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Nutrition. Williams obstetrics. 23rd ed. New York: McGraw Hill; 2010: 200-1.
8. Somudorn O. Related factors to low birth weight infants in Ban Mee hospital. J Health Sci 2008; 17: 774-82.
9. Isaranurug S, Mosuwan L, Choprapawon C. A population-based cohort study of effect of maternal risk factors on low birth weight in Thailand. J Med Assoc Thai 2007; 90: 2559-64.

10. Chaveepojnkamjorn W, Pichainarong N. Maternal weight gain and the occurrence of low birth weight. Vajira Med J 2003; 47: 123-31.
11. Institute of Medicine. Weight gain during pregnancy: reexamining the guidelines. Washington, DC: The National Academies Press; 2009.
12. Kamolratanakul P, Chalaprawat M, Tonprayung T. Research methodology to accomplish. 3rd ed. Bangkok: Text and Journal Publication; 2005: 125-7.
13. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Obesity. Williams obstetrics. 23rd ed. New York: McGraw Hill; 2010: 946-57.
14. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Preterm birth. Williams obstetrics. 23rd ed. New York: McGraw Hill; 2010: 804-31.
15. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Diabetes. Williams obstetrics. 23rd ed. New York: McGraw Hill; 2010: 1104-25.
16. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Pregnancy hypertension. Williams obstetrics. 23rd ed. New York: McGraw Hill; 2010: 706-56.
17. Stotland NE, Caughey AB, Lahiff M, Abrams B. Weight gain and spontaneous preterm birth: the role of race or ethnicity and previous preterm birth. Obstet Gynecol 2006; 108: 1448-55.

การเกิดทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์ และผลต่อทารกปริกำเนิดและมารดาในการตั้งครรภ์เดี่ยวที่มารดาน้ำหนักขึ้นตามเกณฑ์และมารดาน้ำหนักขึ้นต่ำกว่าเกณฑ์

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วัตถุประสงค์: *เพื่อศึกษาการเกิดทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์ และผลต่อทารกปริกำเนิดและมารดาในการตั้งครรภ์เดี่ยวที่มารดาน้ำหนักขึ้นตามเกณฑ์และมารดาน้ำหนักขึ้นต่ำกว่าเกณฑ์*

วัสดุและวิธีการ: *เก็บรวบรวมข้อมูลจากเวชระเบียนผู้ป่วยในของมารดาที่มีดัชนีมวลกายก่อนตั้งครรภ์อยู่ในเกณฑ์ปกติ ที่ฝากครรภ์และมาคลอดที่โรงพยาบาลจุฬาลงกรณ์ ในช่วงปี พ.ศ. 2549-2553 โดยคำแนะนำของน้ำหนักที่เพิ่มขึ้นตลอดการตั้งครรภ์ของคนไทย คือ 10-16 กิโลกรัม หรือ มากกว่าเท่ากับ 0.27 กิโลกรัมต่อสัปดาห์ ส่วนคำแนะนำของน้ำหนักที่ขึ้นตลอดการตั้งครรภ์ของ 2009 Institution of Medicine (IOM) คือ 11.5-16 กิโลกรัม หรือ มากกว่าเท่ากับ 0.31 กิโลกรัมต่อสัปดาห์ โดยเก็บข้อมูลมารดาที่มีดัชนีมวลกายก่อนตั้งครรภ์อยู่ในเกณฑ์ปกติ (18.5-24.9 กิโลกรัมต่อตารางเมตร) ศึกษาการเกิดทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์ และผลต่อทารกปริกำเนิดและมารดาในการตั้งครรภ์เดี่ยวระหว่างมารดาที่น้ำหนักขึ้นตามเกณฑ์กับมารดาที่น้ำหนักขึ้นต่ำกว่าเกณฑ์*

ผลการศึกษา: *จากการศึกษาแบบ case-control study ในมารดา 1,152 ราย มารดาที่น้ำหนักขึ้นต่ำกว่าเกณฑ์ของคนไทยมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับภาวะทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์ (adjusted odd ratio (aOR) 2.77, 95% CI 1.06-7.28), ทารกคลอดก่อนกำหนด (aOR 2.20, 95% CI 1.43-3.38), และทารกคลอดน้ำหนักต่ำกว่าเกณฑ์ (aOR 2.57, 95% CI 1.60-4.13) ส่วนมารดาที่น้ำหนักขึ้นต่ำกว่าเกณฑ์ของ 2009 IOM มีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับภาวะทารกคลอดก่อนกำหนด (aOR 2.04, 95% CI 1.31-3.17), ทารกคลอดน้ำหนักต่ำกว่าเกณฑ์ (aOR 2.75, 95% CI 1.66-4.55) แต่ไม่มีนัยสำคัญทางสถิติกับภาวะทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์ (aOR 1.97, 95% CI 0.74-5.20) มารดาที่น้ำหนักขึ้นต่ำกว่าเกณฑ์ของคนไทย (น้อยกว่า 0.27 กิโลกรัมต่อสัปดาห์) มีความสัมพันธ์กับทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์มากกว่ามารดาที่น้ำหนักขึ้นต่ำกว่าเกณฑ์ของ 2009 IOM (น้อยกว่า 0.31 กิโลกรัมต่อสัปดาห์) น้ำหนักที่ขึ้นของมารดาตามเกณฑ์ของทั้งสองคำแนะนำ พบมีภาวะความดันโลหิตสูงระหว่างตั้งครรภ์มากกว่าในมารดาที่น้ำหนักขึ้นตามเกณฑ์ และพบมีภาวะเบาหวานระหว่างตั้งครรภ์มากกว่าในมารดาที่น้ำหนักขึ้นต่ำกว่าเกณฑ์*

สรุป: *มารดาที่น้ำหนักขึ้นต่ำกว่าเกณฑ์มีความสัมพันธ์กับภาวะทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์ ทารกคลอดก่อนกำหนดและทารกคลอดน้ำหนักต่ำกว่าเกณฑ์ คำแนะนำของน้ำหนักที่ขึ้นตลอดการตั้งครรภ์ของคนไทยทำนายการเกิดภาวะทารกน้ำหนักตัวน้อยแบบไม่สมอายุครรภ์ได้ดีกว่า และคำแนะนำของน้ำหนักที่ขึ้นตลอดการตั้งครรภ์ของ IOM 2009 ควรใช้อย่างระมัดระวังในคนไทย*