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Original Article

Following the 2009 American Institute of Medicine recommendations for normal body mass index and overweight women led to an increased risk of fetal macrosomia among Taiwanese women

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Abstract

Objective: This study aimed to investigate the risk of birth weights over 4000 g (macrosomia) in association with following the 2009 American Institute of Medicine (AIOM) recommendations.
Materials and Methods: Seventy-six nondiabetic women who delivered a singleton, term macrosomic fetus and 82 women who delivered a singleton, term fetus weighing <4000 g were analyzed retrospectively. The relationship between the risk of macrosomia and gestational weight gain in different periods of pregnancy was investigated using logistic regression.
Results: The incidence of macrosomia from January 2008 to December 2009 was 1.8% among the Taiwanese women. The incidences of cesarean delivery (54.5% vs. 18.2%, $p < 0.001$) and blood loss >1000 mL at delivery (35.5% vs. 6.1%, $p < 0.0001$) were associated with macrosomia. The risk of macrosomia among normal weight women with gestational weight gain greater than 13 kg increased four-fold [odds ratio (OR) = 4.88; 95% confidence interval (CI) 1.84–12.90]. For overweight women with total gestational weight gain >11.5 kg, the risk of macrosomia increased nine-fold (OR = 9.63; 95% CI 1.76–52.74).
Conclusion: Macrosomia resulted in more cesarean deliveries and greater maternal blood loss at birth. In Taiwan, to prevent macrosomia, we suggest that the total gestational weight gain should be <11.5 kg among normal weight women and within 10 kg for overweight women.

Keywords: birth weight; body mass index; gestational weight gain; Institute of Medicine; macrosomia

Introduction

Birth weight is a very important factor for neonatal health [1]. Fetuses weighing >4000 g (macrosomia) at birth have been reported to have greater risks of shoulder dystocia, brachial plexus injury, hypoglycemia, hyperbilirubinemia, and still birth, and such births are hazardous to maternal health [2–5]. Avoidance of excessive birth weight is important to enhance obstetric outcomes. Both fetal and maternal nutrition affect birth weight. In a recent meta-analysis, Siega-Riz et al [6] provided strong evidence supporting the associations between excessive weight gain and increased birth weight. They found that women who followed the recommendations of the American Institute of Medicine (AIOM) (1990) [7] were likely to have good birth outcomes and those who gained less than the recommended amount of weight ran the risk of poor fetal growth [6]. However, some authors reported that women with a high body mass index (BMI) or obese women who followed the AIOM recommendations required further evaluation [8,9]. Bracero and Byrne [9] reported that a gain of 31–40 lb for an average BMI woman and 26–30 lb for an overweight or obese woman were associated with optimal obstetrical outcomes, and these suggestions are slightly greater than the AIOM recommendations.

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For a long time, the 1990 AIOM recommendations for gestational weight gain (GWG) have been controversial. In 2009, AIOM set new guidelines for total GWG according to prepregnancy BMI [10]. The recommendations were as follows: (1) 28–40 lb for underweight women with BMI < 18.5 kg/m^2; (2) 25–35 lb for women with normal BMI (18.5–24.9 kg/m^2); (3) 15–25 lb for women with high BMI (25.0–29.9 kg/m^2); and (4) 11–20 lb for obese women (BMI >30.0 kg/m^2). The document's BMI ranges for each weight category differed slightly from the original recommendations [11,12]. In addition to the recommendations for total GWG, average rate of weight gain (RWG) per week were included: 1 lb/wk (range, 1.0–1.3 lb/wk) for underweight women, 1 lb/wk (range, 0.8–1.0 lb/wk) for normal weight women, 0.6 lb/wk (range, 0.5–0.7 lb/wk) for overweight women, and 0.5 lb/wk (range, 0.4–0.6 lb/wk) for obese women. The new recommendations were set for enhancement of maternal and neonatal health.

Parker and Abrams [13] indicated that following the 1990 AIOM recommendations reduced the risk of cesarean delivery and small or large fetus for gestational date. They also suggested examining the AIOM ranges in other populations because ethnicity could affect the birth weight. In a BMI–race–ethnicity study of birth weight, Schieve et al [8] showed questionable benefits to black women who gained weight within the ranges corresponding to the upper half of the 1990 AIOM recommendations. Caulfield and colleagues [14] also showed different birth weight outcomes between black and white women. Thus, we questioned the optimal outcomes for Taiwanese women who followed the 2009 AIOM recommendations.

The aim of the present study was to investigate whether or not the 2009 AIOM recommendations were suitable for Taiwanese women. In this retrospective study, we analyzed the risk of giving birth to a fetus with macrosomia among women who followed 2009 AIOM recommendations and the adverse obstetric outcomes associated with fetal macrosomia.

Materials and methods

Medical records of women who delivered fetuses with birth weights >4000 g after 37 weeks of gestation during January 2008–December 2009 in our hospital were reviewed retrospectively. The pregnant women with matched age, BMI, and delivery in the same week were included as a control group. The study was approved by the institutional review board.

Maternal age (years), gestational age (weeks), parity, maternal body height (cm), initial body weight (kg), maternal weight at each antenatal checkup until birth (kg), GWG (kg), RWG in the 2nd and 3rd trimesters (kg/wk), placental weight (g), maternal blood loss at delivery (mL), adjusted cesarean delivery, infant birth body weight (g), infant birth body length (cm), and Apgar scores at 1 minute and 5 minutes were recorded. The number of newborn infants who were sent to the neonatal intensive care unit due to asphyxia within 7 days of delivery were also recorded. The adjusted cesarean rate was calculated after exclusion of previous cesarean deliveries, previous myomectomy, malpresentation, placenta previa, and women who asked for elective cesarean delivery without a medical indication.

The exclusion criteria were as follows: women referred from other hospitals without antenatal records (7 cases), those with gestational diabetes (5 cases), those who had an abnormal oral glucose tolerance test (50 g of glucose), and those who refused to undergo further investigation (2 cases). Ninety infants were born weighing >4000 g. After exclusion of 14 women, 76 women were included in the study. Similarly, eight women were excluded and 82 women were enrolled as a control group.

The GWG was measured as the maternal weight at delivery minus initial pregnancy (or prepregnancy) weight (kg). The initial maternal body weight was defined as the body weight prior to pregnancy or the weight at the first prenatal visit. BMI was calculated as weight (kg) divided by height (m) squared (kg/m^2). BMI increase was defined as the difference between maternal BMI at delivery and prepregnancy BMI. We defined the 2nd trimester as the 13th–28th gestational weeks and the 3rd trimester as the 29th gestational week to birth. Investigation of 2009 AIOM recommendations was done with the range of target weight gain by different categories of BMI. Because of the limited numbers of underweight and obese women in the study, we evaluated only normal weight and overweight women following the 2009 AIOM guidelines. The reference weight gain was set as RWG $\times$ 16 weeks in the 2nd trimester and RWG $\times$ 12 weeks in the 3rd trimester.

Statistical analysis was performed using SPSS software version 15.0 (SPSS Inc., Chicago, IL, USA). The *t* test was used to compare differences between the two groups for average gestational age, body height, initial body weight, weight at birth, GWG, blood lost during delivery, initial BMI, and BMI at delivery. The Mann–Whitney test was used to compare differences in age between the groups and the Chi-square test for differences in cesarean and neonatal intensive care unit rates. We also used the Chi-square test to analyze the percentages of women who lost more than 1000 mL blood in the two groups and the relationship between blood loss and cesarean delivery.

We used logistic regression to analyze the risk of macrosomia in fetuses according to the different AIOM recommendations for GWG and RWG. Results of the logistic regression were expressed as odds ratios (ORs) with corresponding 95% confidence intervals (CIs). A p value < 0.05 was considered statistically significant. We also stratified the 2nd and 3rd trimesters to investigate the relationship between birth weight and GWG and RWG in the 2nd and 3rd trimesters, which was not mentioned in the AIOM guidelines. All the ORs were adjusted for age.

Results

Clinical characteristics and differences between the two groups

Table 1 shows the clinical characteristics of the two groups, including maternal age, gestational length, body height, initial weight, primiparous rate, and BMI categories. Prepregnancy body weight was not available for 15 women, so initial BMIs