



Original Article

Pregestational body mass index, gestational weight gain, and risks for adverse pregnancy outcomes among Taiwanese women: A retrospective cohort study



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ABSTRACT

Objective: To investigate the associations between maternal pregestational body mass index (BMI), gestational weight gain (GWG), and adverse pregnancy outcomes among Taiwanese women.

Materials and Methods: A retrospective cohort study was conducted among all singletons without fetal anomalies delivered to women at Taipei Chang Gung Memorial Hospital between 2009 and 2015. Two study cohorts were selected for analysis: all deliveries after 24 0/7 weeks of gestation (Cohort 1, $n = 12,064$) and all live births after 37 0/7 weeks of gestation excluding maternal overt diabetes mellitus and chronic hypertension (Cohort 2, $n = 10,973$). The associations between pregestational BMI, GWG outside the 2009 Institute of Medicine (IOM) guidelines, and adverse pregnancy outcomes were assessed using multivariable logistic regression analysis.

Results: In Cohort 1, the prevalence of pregestational underweight, normal weight, overweight, and obesity was 14.0%, 74.8%, 9.0%, and 2.2%, respectively. Compared with the women with normal weight, maternal underweight was associated with increased risk for placental abruption, small-for-gestational age, and low birth weight (<2500 g). In contrast, overweight and obese women were at risk for gestational diabetes mellitus, preeclampsia, dysfunctional labor, cephalopelvic disproportion, large-for-gestational age, and macrosomia (>4000 g). In Cohort 2, GWG below the IOM guidelines were associated with higher rates of gestational diabetes mellitus, small-for-gestational age, and low birth weight, while GWG above the IOM guidelines were with higher rates of primary cesarean delivery, large-for-gestational age, and macrosomia in women with pregestational underweight or normal weight. Normal weight women were more likely to have placental abruption with GWG below the guidelines and to have preeclampsia with GWG above the guidelines. For overweight and obese women, GWG below the guidelines was associated with a higher rate of gestational diabetes mellitus, but GWG above the guidelines was associated with a higher rate of macrosomia.

Conclusions: Women with abnormal pregestational BMI are at risk for adverse maternal and neonatal outcomes. Moreover, GWG has a differential effect on the rates of adverse pregnancy outcomes between women of different pregestational BMI categories.

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Introduction

The continuum of overweight and obesity is a worldwide epidemic; 33% of pregnant women are overweight or obese in the UK [1], 12–38% of pregnant women are overweight and 11–40% are

obese in the US [2–4], and 10–24% of pregnant women are overweight or obese in China [5,6]. At the other end of the spectrum, maternal underweight is also common; 4.3% of pregnant women in the UK [1] and 11–13% of women in China [5,6] are underweight at the first antenatal visit.

Accumulating evidence shows that women with overweight or obesity before pregnancy are at increased risk for adverse maternal and neonatal outcomes compared with normal weight women [7]. These include gestational diabetes mellitus (GDM), gestational hypertensive diseases, preterm birth, large-for-gestational age

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(LGA), macrosomia, stillbirth, and neonatal death [5,6,8–13]. In addition to the increased risk of antenatal complications, there is an increased risk of cesarean delivery and associated morbidities in pregestational overweight or obese women [5,6,10–12]. In contrast, maternal underweight was noted to be associated with suboptimal fetal growth such as small-for-gestational age (SGA) and low birth weight [5,6,10,12,14,15], although the association between maternal underweight and preterm birth is inconsistent [6,10,11,14]. Nevertheless, data on the prevalence of pregestational underweight, overweight, and obesity and whether these women are at risks for similar adverse pregnancy outcomes in Taiwanese women remain scarce [11,16,17]. Furthermore, our recent study shows that women with gestational weight gain (GWG) above or below the 2009 Institute of Medicine (IOM) guidelines are at risk for adverse pregnancy outcomes [18]. It is, however, unclear whether similar associations exist across all women or there is a differential effect of GWG on the rate of adverse pregnancy outcome among women of different pregestational weight categories.

Therefore, the objectives of this study were: (1) to investigate the prevalence of pregestational underweight, normal weight, overweight, and obesity defined by body mass index (BMI) according to the WHO classification; (2) to study the associations between maternal pregestational BMI and adverse maternal and neonatal outcomes; and (3) to evaluate the effect of GWG on the rates of adverse pregnancy outcomes between women of different pregestational BMI categories in a Taiwanese population.

Materials and methods

A retrospective cohort study was conducted among all singleton births to women who delivered at Taipei Chang Gung Memorial Hospital between January 1, 2009 and December 31, 2015. The study data were obtained from a computerized obstetrics database that included demographic characteristics, medical and obstetric histories, and information regarding the course of the index pregnancy and perinatal outcomes. Details of the database have been described previously [18,19]. The study was approved by the Institutional Review Board of Chang Gung Memorial Hospital.

In this hospital, the height of each pregnant woman was measured and her self-reported prepregnancy weight was recorded at the first antenatal visit. Height and the self-reported prepregnancy weight were used to calculate the pregestational BMI [calculated as weight (kg)/height (m)²], which was further categorized into four groups: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obese (30.0 kg/m² or higher). GWG was calculated by subtracting each woman's pregestational weight from her weight at delivery. Women were categorized into three groups based on pregestational BMI and GWG relative to the 2009 IOM recommendations: (1) weight gain below the IOM guidelines; (2) weight gain within the IOM guidelines; and (3) weight gain above the IOM guidelines. The 2009 IOM GWG recommendation is for underweight, normal weight, overweight, and obese women to gain 12.5–18 kg, 11.5–16 kg, 7–11.5 kg, and 5–9 kg, respectively [20].

To study the prevalence of pregestational underweight, normal weight, overweight, and obesity and the associations between maternal pregestational BMI and adverse pregnancy outcomes, we analyzed all deliveries after 24 0/7 weeks of gestation ($n = 12,718$), excluding pregnancies complicated by multiple gestations ($n = 553$) and fetal chromosomal or structural anomalies ($n = 101$). A total of 12,064 deliveries were selected for these purposes and defined as Cohort 1.

To evaluate the effect of GWG on the rates of adverse pregnancy outcomes between women of different pregestational BMI

categories, we analyzed all deliveries after 37 0/7 weeks of gestation ($n = 11,268$), excluding pregnancies complicated by multiple gestations ($n = 169$), fetal chromosomal or structural anomalies ($n = 78$), and fetal demise ($n = 4$). Women with pregestational diabetes mellitus ($n = 28$) and chronic hypertension ($n = 16$) were also excluded. Overall, a total of 10,973 deliveries were selected as Cohort 2 and analyzed for this purpose.

We examined the following maternal and neonatal outcomes: GDM [21], preeclampsia [22], premature rupture of membranes, acute chorioamnionitis [23], placenta previa [24], placental abruption [25], placenta accreta [26], *postpartum* hemorrhage (>500 mL for vaginal delivery and >1000 mL for cesarean delivery), operative vaginal delivery, severe perineal injury (3rd and 4th degree perineal injury), primary cesarean delivery (defined as a cesarean delivery performed for the 1st time on a pregnant woman), indications for primary cesarean delivery including dysfunctional labor, malpresentation, abnormal fetal heart rate pattern, and cephalopelvic disproportion, preterm delivery (<37 weeks of gestation), low birth weight (<2500 g), SGA (defined as birth weight below the 10th percentile of mean weight corrected for fetal sex and gestational age), LGA (defined as birth weight above the 90th percentile of mean weight corrected for fetal sex and gestational age), macrosomia (>4000 g), 1-minute and 5-minute Apgar scores <7, neonatal intensive care unit (NICU) admission, fetal death (>24 weeks of gestation), and neonatal death.

Statistical analyses were performed using SPSS software, version 20.0 (SPSS Inc., Armonk, NY, USA). The categorical variables were calculated as the number and rate (%) and were compared between groups using the χ^2 test. A p value of <0.05 was considered statistically significant. Multivariable logistic regression analysis was used to control for potential confounding when assessing the associations between pregestational BMI and adverse pregnancy outcomes and evaluating the effect of GWG on the rates of adverse pregnancy outcomes among women of different pregestational BMI category. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) were calculated to describe the relative risk.

Results

Maternal characteristics of the women with singletons delivered after 24 weeks of gestation (Cohort 1) are shown in Table 1. Nearly 14% of the women were categorized as underweight. In contrast, the proportion of overweight and obese women was 9.0% and 2.2%, respectively. Compared with women of a normal weight before pregnancy, the rates of teenage pregnancy, primiparity, and having epidural analgesia during labor were higher in underweight women. By contrast, the rates of a prior history of induced abortion and fetal death, overt diabetes mellitus, and chronic hypertension were higher in overweight and obese women. In addition, women with pregestational overweight were more likely to have genetic amniocentesis than normal weight women.

The associations between pregestational BMI and adverse pregnancy outcomes are demonstrated in Table 2. Underweight women were at increased risk for placental abruption (aOR 1.69, 95% CI 1.18–2.41), SGA (aOR 1.85, 95% CI 1.56–2.19), and delivering of neonates with a low birth weight (aOR 1.57, 95% CI 1.30–1.89) compared with the women of normal weight. Both overweight and obese women were more likely to have GDM (aOR 2.15, 95% CI 1.80–2.56; and aOR 3.77, 95% CI 2.81–5.04, respectively), preeclampsia (aOR 3.74, 95% CI 2.75–5.08; and aOR 7.85, 95% CI 5.13–12.00, respectively), dysfunctional labor (aOR 1.47, 95% CI 1.03–2.11; and aOR 3.14, 95% CI 1.55–6.34, respectively), cephalopelvic disproportion (aOR 2.31, 95% CI 1.47–3.09; and aOR 2.67,

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