

Weight Gain: A Modifiable Risk Factor for Primary Cesarean Delivery

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Abstract

Objective: To evaluate the relationship between weight gain and primary cesarean delivery. **Methods:** This was a retrospective cohort study of women 5442 who delivered a singleton from 2009-2013. Women were classified as normal weight [pre-pregnancy body mass index (BMI) 18.5 - 24.9 kg/m²], overweight (pre-pregnancy BMI 25.0 - 29.9 kg/m²), obese (pre-pregnancy BMI 30.0 - 39.9 kg/m²), and extremely obese (pre-pregnancy BMI ≥ 40.0 kg/m²). Each BMI group was subdivided by weight gain—low, recommended, or excessive, as defined by the 2009 Institute of Medicine guidelines—and rates of primary cesarean delivery were compared. **Results:** The overall primary cesarean delivery rate was 27.3%, but this varied based on pre-pregnancy BMI. The primary cesarean delivery rate among women of normal weight was 22.3%, overweight women 27.5%, obese women 35.3%, and extremely obese women 45.7%. Among normal-weight, obese, and extremely obese women, the risk of primary cesarean delivery increased with excessive weight gain [normal weight odds ratio (OR) 1.63, (95% confidence interval 1.32 - 2.01); obese OR 1.55 (1.12 - 2.15); extremely obese OR 2.19 (1.18 - 4.08)] compared to recommended weight gain. More than half of women (53.2%) had excessive weight gain. **Conclusion:** Adherence to guidelines may decrease a woman's risk of primary cesarean delivery.

Keywords

Primary Cesarean, Weight Gain, Pre-Pregnancy BMI, Obese, Obesity

1. Introduction

Cesarean delivery is among the most common major surgical procedure performed worldwide, with an estimated 18.5 million performed yearly [1]. The to-

tal cesarean delivery rate has risen dramatically over the last two decades, especially in high- and middle-income countries [2]. As early as 1985, a panel of international experts at a meeting organized by the World Health Organization (WHO) stated “there is no justification for any region to have a rate higher than 10% - 15%,” a sentiment echoed in their 2015 statement [2]. Yet, in 2010, 69 of 137 countries studied had a cesarean delivery rate greater than 15% [1]. The most recent cesarean delivery rate in the United States was 32.7 [3], while in England it was 26.2% [4]. Mirroring the rise in the total cesarean delivery rate, the primary cesarean delivery rate has also increased. Avoiding primary cesarean deliveries could decrease total cesarean delivery rate both directly (in the index pregnancy) and indirectly (by avoiding repeat cesarean deliveries).

While many factors have been cited for the rise in cesarean deliveries, pre-pregnancy weight and weight gain during pregnancy are among the few factors that are potentially within a woman’s control. Both obesity and excessive weight gain have been linked to an increased risk of cesarean delivery; however, much of the data include women with a history of prior cesarean delivery [5] [6].

The objective of this study was to evaluate the relationship between pre-pregnancy body mass index (BMI), weight gain during pregnancy, and the risk of primary cesarean delivery. Our hypothesis was that excessive weight gain during pregnancy would be associated with an increased risk of primary cesarean delivery, regardless of pre-pregnancy BMI. The primary outcome was cesarean delivery rate among women with a normal pre-pregnancy BMI (18.5 - 24.9 kg/m²) who gained more weight than recommended by the Institute of Medicine as compared to weight gain within guidelines.

2. Methods

We conducted a retrospective cohort study of women who delivered from 2009 to 2012 at a single tertiary care center with active physician and midwife practices. The institution does approximately 3500 deliveries per year and has approximately 20 attending physicians and 7 midwives on staff. Women were included if they delivered a singleton pregnancy at 23 weeks’ gestation or above and had in the records a measured or self-reported height, pre-pregnancy weight, and weight at time of admission to labor and delivery. Women were excluded if they had a prior cesarean delivery. Only 4 patients were underweight prior to conception; they were excluded from the analysis as their numbers were too few to allow for a valid analysis. Labor and delivery records were abstracted by one of two trained research nurses who were blinded to the study’s objective and hypothesis. The local institutional review board (IRB) approved this study (IRB #2012-259).

Women were classified as normal weight [pre-pregnancy body mass index (BMI) 18.5 - 24.9 kg/m²], overweight (pre-pregnancy BMI 25.0 - 29.9 kg/m²), obese (pre-pregnancy BMI 30.0 - 39.9 kg/m²), or morbidly obese (pre-pregnancy BMI \geq 40.0 kg/m²). Each BMI group was subdivided by weight gain: low, recommended, or excessive weight as defined by the 2009 Institute of Medicine

guidelines [7]. Weight gain was measured by subtracting pre-pregnancy weight from current weight. Most often these were the weights at the first and last prenatal visits. Women who gained the recommended amount of weight based on their pre-pregnancy BMI (25 - 35 pounds for those of normal weight, 15 - 25 pounds for those who were overweight, and 11 - 20 pounds for those who were obese or extremely obese) served as controls. Missing data was excluded from analysis.

In order to detect a 33% increase in primary cesarean delivery rate (assuming a baseline risk of 24%) with a two-sided significance of 95 and a power of 80, we calculated a sample size of 1980 was needed for our primary outcome. All analyses were performed using SAS version 9.1.3 (SAS Institute, Inc., Cary, NC). Chi-square, Kruskal-Wallis, or Student's t-test were used where appropriate, with a p-value of <0.05 considered statistically significant.

3. Results

The study cohort included 5442 women; 0.07% (4) were underweight, 48.5% (2639) were normal weight, 26.7% (1450) were overweight, 20.1% (1095) were obese, and 4.7% (254) were extremely obese prior to pregnancy. The underweight women were not included in this analysis. Women with a higher pre-pregnancy BMI were more likely to be older, African American, and multiparous (Table 1).

Table 1. Demographics and outcomes.

	Normal Weight (BMI 18.5 - 24.9 kg/m ²) n = 2639	Overweight (BMI 25.0 - 29.9 kg/m ²) n = 1450	Obese (BMI 30.0 - 39.9 kg/m ²) n = 1095	Extremely Obese (BMI ≥ 40.0 kg/m ²) n=254	p value
Age, years					
Mean (SD)	24.8 (6.5)	26.4 (6.7)	27.2 (6.6)	27.9 (6.2)	<0.01
Race					
White					
n (%)	230 (8.7%)	171 (11.8%)	72 (6.6%)	5 (1.9%)	
AA					
n (%)	1849 (70.0%)	940 (64.8%)	805 (73.5%)	210 (82.7%)	
Hispanic					
n (%)	259 (9.8%)	158 (10.9%)	107 (9.8%)	19 (7.5%)	
Other					
n (%)	301 (11.4%)	181 (12.5%)	111 (10.1%)	20 (7.9%)	<0.01
Gestational Age, weeks					
Mean (SD)	37.8(4.2)	38.7(3.1)	38.8 (2.9)	38.4 (3.5)	<0.01
Multiparous					
n (%)	1219 (46.2%)	715 (49.3%)	639 (58.4%)	158 (62.2%)	<0.01
1 minute apgar < 7					
n (%)	333 (12.6%)	120 (8.3%)	103 (9.4%)	31 (12.2%)	<0.01
5 minute apgar < 7					
n (%)	129 (4.9%)	32 (2.2%)	31 (2.8%)	6 (2.4%)	<0.01
Birthweight, gm					
Mean (SD)	2834(758)	3115(670)	3215 (691)	3221(778)	<0.01
Weight Gain, lbs					
Mean (SD)	19.2 (38.8)	29.6 (13.3)	32.6 (28.1)	33.0 (24.6)	<0.01

More than half of the women (53.2%) had excessive weight gain based on current Institute of Medicine guidelines. In the normal-weight cohort, 36% (n = 950) gained the recommended amount of weight, while 40% (n = 1056) gained more and 24% (n = 633) gained less weight than recommended. In the overweight cohort, 24% (n = 348) gained the recommended amount, while 65% (n = 943) gained more and 11% (n = 159) gained less weight than recommended. In the obese cohort, 20% (n = 219) gained the recommended amount, while 69% (n = 756) gained more and 11% (n = 120) gained less weight than recommended. In the extremely obese cohort, 23% (n = 59) gained the recommended amount, while 58% (n = 147) gained more and 19% (n = 48) gained less weight than recommended.

Overall, the primary cesarean delivery rate was 27.3%, but this varied based on pre-pregnancy BMI. The primary cesarean delivery rate among women of normal weight was 22.3%, overweight women 27.5%, obese women 35.3%, and extremely obese women 45.7%. The most common indications for cesarean delivery were non-reassuring fetal status, labor arrest, and fetal malpresentation. This was consistent among each cohort.

Among pre-pregnancy normal-weight, obese, and extremely obese women, the risk of primary cesarean delivery increased with excessive weight gain [normal weight odds ratio (OR) 1.63, 95% confidence interval (CI) 1.32 - 2.01, $p < 0.01$; obese OR 1.55, 95% CI 1.12 - 2.15, $p < 0.01$; extremely obese OR 2.19, 95% CI 1.18 - 4.08, $p = 0.01$] compared to recommended weight gain (Figure 1). Among overweight women, low weight gain was associated with a decreased risk of primary cesarean delivery (OR 0.56, 95% CI 0.37 - 0.94, $p = 0.02$) compared to recommended weight gain. While excessive weight gain was associated with an increase in primary cesarean delivery (29.2% vs. 27.3%) among overweight women, this difference was not statistically significant (OR 1.10, 95% CI 0.84 -

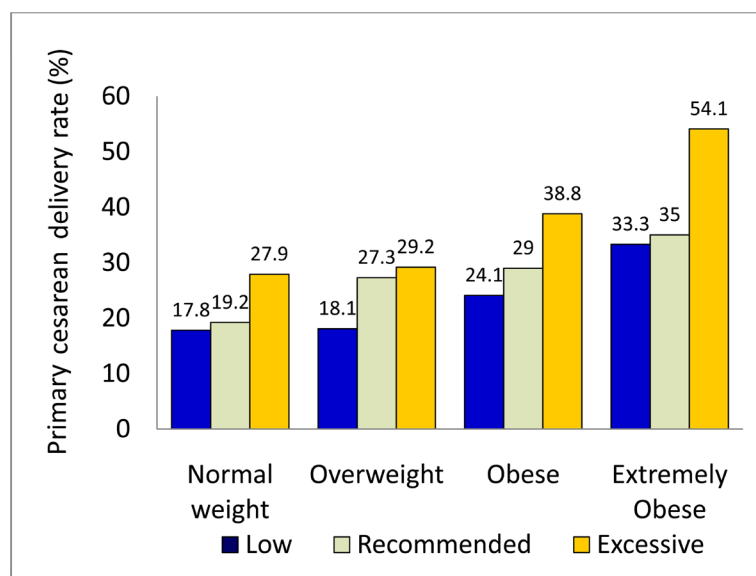


Figure 1. Primary cesarean delivery rate (%) by weight gained and pre-pregnancy body mass index.

1.44, $p = 0.50$).

4. Discussion

Our study showed that pregnancy weight gain above that recommended by the Institute of Medicine increases risk for primary cesarean delivery, and this was statistically significant for normal weight, obese, and extremely obese patients. In this study, both higher pre-pregnancy BMI and excessive weight gain increased the risk of primary cesarean delivery. However, even among the morbidly obese, more than half of women had a successful vaginal delivery. Thus, morbid obesity itself should not be considered an indication for cesarean delivery.

The reason for the increase in cesarean delivery rate is likely multifactorial. Obese women are less likely to enter spontaneous labor [8], and spontaneous labor confers a lower risk of cesarean delivery [9]. The first stage of labor is longer in obese women compared to their non-obese counterparts [8]. Obese women require higher doses of oxytocin during induction [10]. There are also technical limitations practitioners must consider when managing women in labor and delivery who are overweight or obese. For example, maintaining continuous fetal-heart-tone monitoring becomes more difficult with increasing BMI, and the ability to perform a cesarean quickly for fetal benefit is limited by increasing amounts of adipose tissue [11]. Obese women are also at increased risk for anesthetic complications [12]. These technical issues may prompt physicians to have a lower threshold to perform a cesarean.

In our study, increased pregnancy weight gain in the overweight groups was not associated with a statistically significant increase in cesarean delivery. Perhaps this is because the weight gained in the overweight group was only 4.6 pounds over the Institute of Medicine recommendations as compared to 12.6 pounds for obese and 13.0 pounds for extremely obese groups. This may suggest that weight gain less than 5 pounds over the recommendations does not increase cesarean rate, but more research is needed.

In our cohort, more than half of the women entered pregnancy overweight or obese, which is echoed by US national data [13]. Excessive weight gain as defined by Institute of Medicine guidelines was also common [7], affecting more than 50% of the study cohort. Despite lower recommended weight-gain ranges, women with higher pre-pregnancy BMIs gained more weight during pregnancy than those who entered pregnancy at a normal weight (**Table 1**).

Primary cesarean delivery is known to increase a women's risk of complications in both the index pregnancy and subsequent pregnancies [14] [15], and maternal obesity compounds these risks [11]. Previous studies have also linked excessive weight gain in pregnancy to other, non-surgical complications, including hypertensive disorders, gestational diabetes, and fetal macrosomia [11]. Further research is needed into pregnancy weight-management interventions: first, to assess if these are successful, and second, to assess if weight management itself can be translated into reduced rates of cesarean delivery or morbidity. Un-

fortunately, the studies to date have shown a modest, if any, effect [16] [17] [18]. Until appropriately powered studies with meaningful outcomes are completed, obstetric providers are limited in their ability to wisely counsel the pregnant obese population regarding risks and potential outcomes.

Limitations of our study include its observational nature and reliance on patient-reported height, weight, and pregnancy weight gain. While we were able to collect cumulative weight-gain values, we were unable to determine weight-gain patterns throughout the gestational period. However, we believe our study is an accurate reflection of common obstetric recordkeeping. As this study was conducted at a single urban institution in the United States, our data may not be generalizable to other patient populations. A strength of our study is that this was a large, modern cohort encompassing both midwifery and obstetricians' practices, and thus reflects contemporary obstetric practice.

We found that women had higher rates of primary cesarean delivery with excessive weight gain during pregnancy compared to women who adhered to Institute of Medicine guidelines. Ideally, our data could be used to advise women on the importance of weight control during pre-pregnancy counselling. Realistically, our data can be used to counsel women on the importance of modest weight gain regardless of their pre-pregnancy BMI. Adherence to guidelines for weight gain in pregnancy may potentially decrease a women's risk of primary cesarean delivery.

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Declaration of Interest

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