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To cite this article: Lilly Y. Liu, Kelly B. Zafman & Nathan S. Fox (2019): Weight gain and pregnancy outcomes in underweight women with twin gestations, The Journal of Maternal-Fetal & Neonatal Medicine, DOI: [10.1080/14767058.2018.1562544](https://doi.org/10.1080/14767058.2018.1562544)

To link to this article: <https://doi.org/10.1080/14767058.2018.1562544>



Accepted author version posted online: 20 Dec 2018.  
Published online: 07 Jan 2019.

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## Weight gain and pregnancy outcomes in underweight women with twin gestations

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### ABSTRACT

**Background:** Adherence to minimum weight gain recommendations in twin pregnancies as defined by the Institute of Medicine (IOM) guidelines is associated with improved pregnancy outcomes; however, these recommendations have yet to be made for underweight women (BMI < 18.5 kg/m<sup>2</sup>).

**Objective:** To determine if existing pregnancy weight gain recommendations in twin gestations apply to women with underweight prepregnancy body mass index (BMI), and if these women have similar pregnancy outcomes to women with normal prepregnancy BMI.

**Methods:** This is a retrospective cohort study of women with underweight (BMI < 18.5 kg/m<sup>2</sup>) and normal prepregnancy BMI (18.5–24.9 kg/m<sup>2</sup>) and twin pregnancies delivered > 24 weeks by a single Maternal Fetal Medicine (MFM) practice between 2005–2017. Weight gain patterns and pregnancy outcomes were compared between women with underweight prepregnancy BMI and normal prepregnancy BMI. The primary outcomes of the study were gestational age at delivery and intrauterine growth restriction.

**Results:** A total of 664 women met inclusion criteria during the study period, 55 (8.3%) of whom had an underweight prepregnancy BMI, and 609 (91.7%) of whom had a normal prepregnancy BMI. There were no differences in baseline clinical and demographic characteristics between the groups, nor any differences in overall weight gain or weight gain patterns between the two groups. There were no significant differences between the groups in birthweight of the larger twin (2415 versus 2489 g,  $p = .26$ ) or the smaller twin (2150 versus 2190 g,  $p = .55$ ), gestational age at delivery (35.8 versus 35.8 weeks,  $p = .96$ ), incidence of preterm birth < 34 weeks (16.4 versus 16.3%,  $p = .98$ ), spontaneous preterm birth < 34 weeks (9.1 versus 11.7%,  $p = .57$ ), or the incidence of either twin with a birthweight < 10% for gestational age (60.0 versus 56.0%,  $p = .57$ ) or < 5% for gestational age (36.4 versus 30.9%,  $p = .40$ ).

**Conclusions:** Women with underweight prepregnancy BMI who gain equal weight to women with normal prepregnancy BMI have similar pregnancy outcomes. The recommendations for adequate weight gain in women with underweight prepregnancy BMI should therefore not exceed those for women with normal prepregnancy BMI.

### ARTICLE HISTORY

Received 26 September 2018

Revised 29 November 2018

Accepted 19 December 2018

### KEYWORDS

Neonatal outcomes; prepregnancy BMI; twin weight gain; underweight

### Precis

Women who are underweight with twin pregnancies should have the same weight gain recommendations in pregnancy as women with normal BMIs.

### Introduction

Gestational weight gain in twin pregnancies is associated with significant pregnancy outcomes [1–3]. Recent studies demonstrate that adherence to minimum weight gain recommendations in twin pregnancies is associated with improved pregnancy outcomes

such as decreased likelihood of preterm birth and spontaneous preterm birth, and larger birthweight infants [4–6].

These weight gain recommendations were initially established in 1990 by the Institute of Medicine (IOM), which defined adequate weight gain as 35–45 pounds in a term twin pregnancy [7]. These recommendations were then revised in 2009 to account for differences in prepregnancy maternal body mass index (BMI) when defining optimal pregnancy weight gain [8–10]. For term deliveries between 37 to 42 weeks gestation, the recommended total pregnancy weight gain is 17–25 kg (37–54 pounds) for normal weight women

(BMI 18.5–24.9 kg/m<sup>2</sup>), 14–23 kg (31–50 pounds) for overweight women (BMI 25–29.9 kg/m<sup>2</sup>), and 11–19 kg (25–42 pounds) for obese women (BMI  $\geq$  30 kg/m<sup>2</sup>). However, recommendations were not made for underweight women (BMI < 18.5 kg/m<sup>2</sup>) due to insufficient evidence.

It is unclear whether women with underweight BMI experience worse outcomes for preterm birth and intrauterine growth restriction (IUGR) in twin pregnancies despite adequate weight gain, as this population has been excluded from prior analyses due to lack of established weight gain recommendations for underweight twin gestations. As optimal weight gain differs for women with different prepregnancy BMI, greater weight gain is recommended for women with lower BMI in comparison to those with higher BMI [8]. The question remains whether women with underweight BMI should gain more weight than women with normal BMI in order to experience obstetric benefits associated with adequate pregnancy weight gain. The objective of this study is to examine pregnancy outcomes in underweight women compared to normal weight women based on adequate pregnancy weight gain as defined by the 2009 IOM recommendations for twin pregnancies, and to determine whether underweight women should consequently be counseled differently on pregnancy weight gain recommendations to optimize clinical outcomes.

## Materials and methods

This is a retrospective cohort study of women with underweight (BMI < 18.5 kg/m<sup>2</sup>) and normal prepregnancy BMI (18.5–24.9 kg/m<sup>2</sup>) and twin pregnancies delivered at 24-week gestation or greater by a single Maternal Fetal Medicine (MFM) practice between 2005–2017. Data on maternal characteristics and pregnancy outcomes were abstracted from the electronic medical record. Gestational age was determined by last menstrual period and confirmed by first trimester ultrasound, or from *in vitro* fertilization (IVF) dating in the setting of pregnancies resulting from IVF. Prepregnancy BMI was calculated from measured heights at the initial prenatal visits and patient-reported prepregnancy weight. Weight gain throughout the pregnancy was measured on a scale and recorded at each prenatal visit. Exclusion criteria included monoamniotic twins, presence of twin–twin transfusion syndrome, intrauterine fetal demise, major fetal anomalies discovered before or after birth, and major maternal uterine anomalies.

Maternal demographic and clinical characteristics were analyzed by prepregnancy BMI. Maternal characteristics included age at delivery, chorionicity, use of IVF, use of multifetal reduction from a higher order pregnancy to a twin pregnancy, race, pregnancy history, maternal use of anticoagulation during pregnancy, presence of fibroids, history of prior cervical excisional biopsy, chronic hypertension, and pregestational diabetes.

Weight gain characteristics were also compared between the two cohorts. These characteristics included maternal height, prepregnancy weight and BMI, adequate average weight gain before and after 24-week gestation, total weight gain over pregnancy, and weight gain between 0 to 16 weeks gestation, 16–24-week gestation, 24–32-week gestation, and 32-week gestation to delivery. Recommended average weight gain per week was calculated by dividing the IOM lower limit of normal weight gain for normal weight women at 37–42 weeks by 37. Consequently, adequate average weight gain was defined as 1 pound or more per week.

Pregnancy outcomes were then analyzed by underweight prepregnancy BMI and normal prepregnancy BMI. The primary outcomes of the study were gestational age at delivery and intrauterine growth restriction (IUGR). These outcomes included gestational age at delivery, birthweight of the larger and smaller twins, any preterm and spontaneous preterm birth less than 37, 34, and 32 weeks, birthweight discordance greater than 20%, any birthweight less than the 10th percentile for gestational age, and any birthweight less than the fifth percentile for gestational age. Three definitions of IUGR were used for twin pregnancies: birthweight of either twin less than the 10th percentile for gestational age, birthweight of either twin less than the fifth percentile for gestational age, and birthweight discordance greater than or equal to 20% [11]. Birthweight percentiles for gestational age were defined using standard tables for singleton pregnancies as these are also used to define IUGR for twin pregnancies in the USA [12–14].

Other outcomes included cesarean delivery, premature rupture of membranes, preeclampsia, gestational diabetes, intrauterine fetal demise of either twin, and maternal blood transfusion. Bivariable analyses were utilized.

This study was approved by the Biomedical Research Alliance of New York. Maternal characteristics and obstetric and neonatal outcomes were compared using the Student *t* test or Mann–Whitney *U* test where applicable for continuous variables, and  $\chi^2$  or

Fisher exact test where applicable for categorical variables. All tests were two-tailed and  $p < 0.05$  denoted significance. All statistical analyses were performed with SPSS Statistical software (version 22; IBM Corp, Armonk, NY, USA).

## Results

A total of 664 women met inclusion criteria during the study period, 55 (8.3%) of whom had an underweight prepregnancy BMI, and 609 (91.7%) of whom had a normal prepregnancy BMI. There were no differences in baseline clinical and demographic characteristics between the two cohorts (Table 1).

The two cohorts were also comparable in their weight gain characteristics (Table 2). There were no differences between the two cohorts in the amount of weight gained in each trimester, or for the total amount of weight gained during the pregnancy. The average total weight gain for the underweight prepregnancy BMI cohort was 39 pounds, and for the normal prepregnancy BMI cohort it was 41 pounds ( $p = .84$ ). The two cohorts were also similar in the percentage of those who had adequate average weight gain in each trimester. The majority of each cohort had adequate average weight gain throughout the pregnancy and especially in the third trimester.

There was no difference in pregnancy outcomes between the underweight and normal prepregnancy BMI cohorts (Table 3). Birthweight and incidence of IUGR were similar between both cohorts, as well as gestational age at delivery and incidence of

spontaneous and any preterm birth. Mode of delivery and development of gestational diabetes and preeclampsia were also similar between these two groups.

## Comment

Our study demonstrates that women with underweight and normal prepregnancy BMI with similar weight gain throughout pregnancy have similar pregnancy outcomes. This would support similar recommendations for weight gain in women with underweight prepregnancy BMI as for women with normal prepregnancy BMI [8]. These findings are important because recommendations for adequate weight gain have not yet been established for underweight women. This population was excluded from the 2009 IOM recommendations for adequate pregnancy weight gain in twin gestations, and little evidence exists on pregnancy outcomes in these patients as lack of established weight gain recommendations have excluded them from prior analyses.

Previous studies have demonstrated that normal weight women with adequate pregnancy weight gain in twin gestations experience improved neonatal outcomes, such as decreased preterm birth and IUGR [15–17]. This study shows that underweight women with adequate pregnancy weight gain do not experience worse neonatal outcomes in comparison to their normal weight counterparts. As these two cohorts had similar amounts of weight gain in each trimester and total amounts of weight gain over the course of the pregnancies, women with underweight prepregnancy

**Table 1.** Cohort demographic and clinical characteristics associated with underweight and normal prepregnancy BMI.

	Prepregnancy BMI < 18.5 kg/m <sup>2</sup> (N = 55)	Prepregnancy BMI 18.5–24.9 kg/m <sup>2</sup> (N = 609)	p-value
Maternal Age (years)	33.0 ± 5.68	34.4 ± 6.23	.11
Chorionicity			.51
Monochorionic	7 (12.7%)	98 (16.1%)	
diamniotic			
Dichorionic	48 (87.3%)	511 (83.9%)	
diamnionitic			
<i>in-vitro</i> fertilization pregnancy	33 (60.0%)	360 (59.1%)	.90
Multifetal reduction	4 (7.3%)	37 (6.1%)	.72
White race	45 (81.8%)	527 (86.5%)	.33
Nulliparity	36 (65.5%)	381 (62.6%)	.67
Any prior preterm birth	2 (3.6%)	46 (7.6%)	.28
Any prior vaginal delivery > 20 weeks	18 (32.7%)	177 (29.1%)	.57
Any prior cesarean delivery	3 (5.5%)	62 (10.2%)	.26
Any prior intrauterine fetal demise > 16 weeks	0 (0.0%)	13 (2.1%)	.27
Anticoagulation	3 (5.5%)	24 (3.9%)	.59
Fibroids	1 (1.8%)	41 (6.7%)	.15
Prior cervical excisional procedure	4 (7.3%)	24 (3.9%)	.24
Chronic hypertension	0 (0.0%)	8 (1.3%)	.39
Pregestational diabetes	0 (0.0%)	1 (0.2%)	.76

BMI: body mass index.

Data reported as N(%) or mean ± standard deviation.

**Table 2.** Cohort weight gain characteristics associated with underweight and normal prepregnancy BMI.

	Prepregnancy BMI < 18.5 kg/m <sup>2</sup> (N = 55)	Prepregnancy BMI 18.5–24.9 kg/m <sup>2</sup> (N = 609)	p-value
Maternal height (inches)	66.2 ± 3.3	64.7 ± 2.6	.002
Prepregnancy weight (pounds)	111 ± 11	129 ± 1	< .001
Prepregnancy BMI (kg/m <sup>2</sup> )	17.9 ± 0.6	21.6 ± 1.7	< .001
Weight gain 0–16 weeks (pounds)	11.6 ± 9.3	11.6 ± 7.3	.10
Weight gain 16–24 weeks (pounds)	13.2 ± 4.64	12.9 ± 4.6	.64
Weight gain 24–32 weeks (pounds)	7.1 ± 7.1	7.8 ± 5.5	.48
Weight gain 32 weeks to delivery (pounds)	7.3 ± 5.3	8.7 ± 6.6	.09
Total weight gain over pregnancy (pounds)	39.4 ± 13.3	40.8 ± 13.4	.84
Adequate average weight gain (≥ 1.0 lb/week)	33 (60.0%)	386 (63.4%)	.62
Adequate average weight gain (≥ 1.0 lb/week) before 24 weeks	29 (52.7%)	322 (52.9%)	.98
Adequate average weight gain (≥ 1.0 lb/week) from 24 weeks until delivery	37 (67.3%)	445 (73.1%)	.36

BMI: body mass index.

Data reported as N(%) or mean ± standard deviation.

\*p < 0.05 on bivariable analysis.

**Table 3.** Maternal and neonatal outcomes associated with underweight and normal prepregnancy BMI.

	Prepregnancy BMI < 18.5 kg/m <sup>2</sup> (N = 55)	Prepregnancy BMI 18.5–24.9 kg/m <sup>2</sup> (N = 609)	p-value
Gestational age at delivery (weeks)	35.8 ± 1.8	35.8 ± 2.7	.96
Birthweight of larger twin (g)	2415 ± 459	2489 ± 526	.26
Birthweight of smaller twin (g)	2150 ± 467	2190 ± 519	.55
Any preterm birth < 37 weeks	38 (69.1%)	347 (57.0%)	.08
Any preterm birth < 34 weeks	9 (16.4%)	99 (16.3%)	.98
Any preterm birth < 32 weeks	3 (5.5%)	51 (8.4%)	.45
Spontaneous preterm birth < 37 weeks	18 (32.7%)	194 (31.9%)	.89
Spontaneous preterm birth < 34 weeks	5 (9.1%)	71 (11.7%)	.57
Spontaneous preterm birth < 32 weeks	1 (1.8%)	34 (5.6%)	.23
Cesarean delivery	29 (52.7%)	391 (64.2%)	.09
Premature rupture of membranes	4 (7.3%)	94 (15.4%)	.10
Birthweight discordance > 20%	7 (12.7%)	121 (19.9%)	.20
Any birthweight < 10 %ile	33 (60.0%)	341 (56.0%)	.57
Any birthweight < 5 %ile	20 (36.4%)	188 (30.9%)	.40
Preeclampsia	7 (12.7%)	91 (14.9%)	.66
Gestational diabetes	3 (5.5%)	41 (6.7%)	.71
Intrauterine fetal demise of either twin	0 (0.0%)	3 (0.5%)	.60
Maternal blood transfusion	3 (5.5%)	36 (5.9%)	.89

BMI: body mass index.

Data reported as N(%) or mean ± standard deviation.

BMI did not need to gain more weight than women with normal prepregnancy BMI in order to experience similar obstetric benefits associated with adequate pregnancy weight gain. Furthermore, adherence to adequate weight gain recommendations defined by the 2009 IOM guidelines for normal prepregnancy BMI patients did not seem to increase the development of gestational diabetes or gestational hypertension in women with underweight prepregnancy BMI [18].

Our study is unique in that it studies adequate pregnancy weight gain for twin gestations with underweight prepregnancy BMI. Strengths of this study include the large sample of twin gestations studied, with similar baseline characteristics and weight gain patterns in each cohort. Maternal weight gain was also compared across the entire pregnancy as well as throughout each trimester to identify potential differences in pregnancy outcomes based on weight gains

at different periods in pregnancy. Maternal weight gain was uniformly recorded for each patient at each prenatal visit and data extracted from prenatal records, rather than through birth certificate data which can be less accurate. As this study was conducted at a single maternal fetal medicine practice, gestational age was determined reliably for each study participant by first trimester ultrasound, and differentiation between indicated versus spontaneous preterm births was reliably documented. However, one potential limitation of this study is that all patients in this maternal fetal medicine practice had private insurance, which may make these conclusions less generalizable to a wider population of patients from different socioeconomic backgrounds. Another limitation is the relatively small sample size of women with underweight BMI. However, given the lack of data on underweight women with twins to date, as well as the current

obesity epidemic in the USA, it will likely be difficult to identify large numbers of underweight women with twin pregnancies for further research.

Our conclusions have important clinical implications for how underweight women should be counseled on adequate weight gain throughout pregnancy. These women can be counseled that unless other evidence shows otherwise, the recommended amount of weight gain over pregnancy should not differ from those for normal weight women, which is 17–25 kg (37–54 pounds) based on the 2009 IOM guidelines, or 1 pound or more a week on average. Despite underweight pre-pregnancy BMI, these women can expect similar outcomes to normal weight women if they achieve adequate pregnancy weight gain.

### Acknowledgements

Kelly B. ZAFMAN, ba. Department of Obstetrics, gynecology, and Reproductive Science, Icahn School of Medicine at Mount Sinai, New York, NY, USA. KBZ did not receive research funding at the time of the study.

Nathan S. FOX, MD. Department of Obstetrics, gynecology, and Reproductive Science, Icahn School of Medicine at Mount Sinai, New York, NY, USA. Maternal Fetal Medicine Associates, PLLC, New York, NY, USA. NSF did not receive research funding at the time of the study.

### Disclosure statement

No potential conflict of interest was reported by the authors.

### Funding

None.

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