# Weight Gain in Twin Pregnancies and Adverse Outcomes

## *Examining the 2009 Institute of Medicine Guidelines*

*Nathan S. Fox, MD, Andrei Rebarber, MD, Ashley S. Roman, MD, MPH, Chad K. Klauser, MD, Danielle Peress, MA, and Daniel H. Saltzman, MD*

**OBJECTIVE:** To estimate whether the weight gain recommendations for twin pregnancies in the 2009 Institute of Medicine (IOM) guidelines are associated with improved perinatal outcomes.

**METHODS:** A cohort of 297 twin pregnancies was identified from a single practice with measured prepregnancy body mass index (BMI) and weight gain during pregnancy. Recommended IOM guidelines were applied to our cohort based on prepregnancy BMI categories (normal weight, overweight, obese). Pregnancy outcomes were compared between patients whose weight gain met or exceeded the IOM recommendations and patients who did not meet these recommendations.

**RESULTS:** Patients with normal prepregnancy BMIs whose weight gain met the IOM recommendations had significantly improved outcomes compared with patients who did not meet the IOM recommendations. They were less likely to have preterm birth before 32 weeks (5.0% compared with 13.8%) and spontaneous preterm birth before 32 weeks (3.4% compared with 11.5%). They also delivered significantly larger neontates (larger twin birth weight 2,582.1±493.4 g compared with 2,370.3±586.0 g; smaller twin birth weight 2,277.0±512.1 g compared with 2,109.3±560.9 g) and were significantly more likely to have both neonates weigh more than 2,500 g (38.8% compared with 22.5%) and more than 1,000 g (97.5% compared with 91.2%) and were less likely to deliver any twin with a birth weight lower than the fifth percentile for gestational age (21.5% compared with 35.0%).

**CONCLUSION:** In women with twin pregnancies and normal starting BMIs, weight gain during pregnancy is significantly associated with improved outcomes, including a decreased risk of prematurity and larger birth weights.

*(Obstet Gynecol 2010;116:100–6)*

**LEVEL OF EVIDENCE:** II

*From Maternal–Fetal Medicine Associates, PLLC, and the Department of Obstetrics, Gynecology, and Reproductive Science, Mount Sinai School of Medicine, New York, New York.*

*Corresponding author: Nathan S. Fox, MD, Maternal–Fetal Medicine Associates, PLLC, 70 East 90th Street, New York, NY 10128; e-mail: nfox@mfmnyc.com.*

***Financial Disclosure***
*The authors did not report any potential conflicts of interest.*



ISSN: 0029-7844/10

Although twins account for 3% of all live births in the United States,[1] they account for a greater proportion of neonatal morbidity and mortality. Nearly 60% of twins deliver preterm, and approximately one in four very low birth weight (less than 1,500 g) neonates and one in six neonates who die in the first month of life are from twin pregnancies.[2–4]

In 1990, the Institute of Medicine (IOM) defined optimal weight gain in twin pregnancies to be 35–45 pounds in a term twin pregnancy.[5] Subsequent to these recommendations, a number of studies demonstrated that, similar to singleton pregnancies, gestational weight gain in twin pregnancies is positively associated with birth weight.[6–9] Further studies also demonstrated that, similar to singleton pregnancies, normal weight gain in twin pregnancies is influenced by prepregnancy maternal body mass index (BMI).[10] Optimal weight gain in twin pregnancy differs between women with different body BMIs, with women with lower BMIs requiring more weight gain than women with higher BMIs.[10,11] However, the 1990 IOM recommendations did not take into account maternal BMI. Without taking into account maternal BMI, only 25% of women with twin pregnancies gain the 35–45 pounds, which was recommended by the IOM in 1990.[10]

Based on the increasing knowledge that maternal BMI influences the optimal weight gain in twin pregnancies, the IOM recently revised their recommendations for optimal weight gain in twin pregnan-





cies.[12] The 2009 IOM guidelines for weight gain in twin pregnancy recommend BMI-specific weight gains: for normal-weight women (BMI 18.5–24.9 kg/m$^2$), 17–25 kg (37–54 lbs), overweight women (BMI 25–29.9) 14–23 kg (31–50 lbs), and obese women (BMI 30 or greater) 11–19 kg (25–42 lbs). They concluded that there was insufficient evidence to make recommendation for underweight women (BMI less than 18.5). These recommendations were made assuming a term (37–42-week) delivery. Although the IOM referred to these recommendations as "provisional," these recommendations were recommended in a recent comprehensive review of nutrition in twin pregnancies.[13]

The objective of this study was to estimate whether the weight gain recommendations for twin pregnancies in the revised IOM guidelines are associated with improved perinatal outcomes.

## MATERIALS AND METHODS

A historical cohort of patients with twin pregnancies was obtained from patients in our private Maternal–Fetal Medicine practice between 2005 and 2009. Institutional Review Board approval was obtained from the Biomedical Research Alliance of New York before conducting the study. Baseline characteristics and pregnancy outcomes were obtained from our computerized medical records. At the initial prenatal visit, all of our patients are asked to provide their prepregnancy weight. Maternal height is measured by a registered nurse or certified medical assistant. The prepregnancy BMI was calculated using these two values in kilograms per square meter. At each prenatal visit, the maternal weight is measured on a scale by a registered nurse or certified medical assistant. The prepregnancy weight was subtracted from the final weight measured in our office to calculate weight gain during pregnancy. Gestational age was confirmed by first-trimester ultrasonography in all patients. If the pregnancy was known to be the result of in vitro fertilization, gestational age was determined from the in vitro fertilization date.

Patients were included if they had a recorded prepregnancy weight, maternal height, and maternal weight measurements during pregnancy. All patients received prenatal care in our practice; patients who transferred to our practice after 20 weeks of gestation were excluded from analysis. Monoamniotic twins and pregnancies with major fetal anomalies were excluded as well.

Patients were divided into four groups based on their prepregnancy BMI: underweight (BMI less than 18.5), normal weight (BMI 18.5–24.9), overweight (BMI 25–29.9), and obese (BMI 30 or greater). Because the IOM weight gain recommendations are for women who deliver at 37 weeks or greater (the minority of twin pregnancies), 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, we divided the total weight gain by the gestational age in weeks at the last weight measurement to obtain the weight gain per week.

We then divided the IOM lower limit of normal weight gain at 37–42 weeks by 37 to determine the IOM recommended weight gain per week. For normal-weight women, this was 1.0 lb per week (37 lbs over 37 weeks); for overweight women, this was 0.84 lb per week (31 lbs over 37 weeks); for obese women, this was 0.68 lb per week (25 lbs over 37 weeks). We compared pregnancy outcomes for women whose weight gain per week equaled or exceeded the new IOM recommendations (normal weight gain group) to women whose weight gain per week was less than the IOM recommendations (low weight gain group). Because the IOM did not make recommendations for underweight women, these patients were excluded from this analysis. We compared outcomes in three subgroups: women with a normal prepregnancy BMI, women with an overweight prepregnancy BMI, and women with an obese prepregnancy BMI.

In our practice, we typically deliver uncomplicated twin pregnancies at 38–39 weeks. The diagnosis of gestational hypertension or preeclampsia was made using standard criteria.[14] We used published tables to determine birth weight percentiles.[15] Aside from looking at mean gestational age at delivery, we looked at preterm birth at prespecified gestational ages from all causes as well as from preterm labor or preterm premature rupture of membranes specifically (spontaneous preterm birth). Pearson correlation, Student *t* test and chi square were used when appropriate (SPSS for Windows 16.0, Chicago, IL). A $P$ value of $<.05$ was considered significant.

## RESULTS

A total of 297 patients met the inclusion criteria. All patients had private medical insurance. Using the prepregnancy BMI, 16 (5.4%) women were underweight, 201 (67.7%) women were normal weight, 51 (17.2%) women were overweight, and 29 (9.8%) women were obese. The mean weight gain per week was $1.09 \pm 0.40$ lbs. In the entire cohort, the weight gain per week was significantly positively associated with the gestational age at delivery (Pearson correlation 0.152, $P=.009$) and birth weight of the larger

(Pearson correlation 0.239, $P<.001$) and smaller twin (Pearson correlation 0.187, $P=.001$).

We compared pregnancy outcomes for women whose weight gain per week equaled or exceeded the IOM recommendations (normal weight gain group) with women whose weight gain per week was less than the IOM recommendations (low weight gain group). Because the IOM did not make recommendations for underweight women, these patients were excluded, leaving 281 patients for analysis. One hundred seventy-six women (62.6%) were in the normal weight gain group, and 105 (37.4%) women were in the low weight gain group. Baseline characteristics were similar between the two groups, except that the normal weight gain group was more likely to have in vitro fertilization pregnancies and were more likely to be nulliparous (Table 1).

Table 2 describes pregnancy outcomes between the two groups. In women with a normal prepreg-

**Table 1. Baseline Characteristics in Twin Pregnancies Based on Whether Weight Gain Did or Did Not Meet 2009 Institute of Medicine Guidelines**

| | Low Weight Gain | Normal Weight Gain | *P* |
|---|---|---|---|
| Normal prepregnancy BMI (18.5–24.9) | n=80 | n=121 | |
| Age (y) | 33.92±7.39 | 34.74±6.56 | .411 |
| Starting weight (lbs) | 129.22±15.74 | 127.20±13.77 | .336 |
| Starting BMI (kg/m$^2$) | 21.86±1.73 | 21.42±1.67 | .070 |
| Obstetric history | | | |
| Nulliparous | 51.2 | 66.9 | .026 |
| Prior term birth(s) only | 35.0 | 28.9 | .364 |
| Prior preterm birth(s) only | 7.5 | 3.3 | .181 |
| Prior term and preterm births | 6.2 | 0.8 | .027 |
| White | 93.8 | 89.3 | .275 |
| IVF pregnancy | 57.5 | 74.2 | .014 |
| Multifetal reduction | 10 | 10.7 | .866 |
| Dichorionic | 87.5 | 86 | .752 |
| Cervical length at 20–22 wk (mm) | 38.8±8.2 | 40.0±7.8 | .358 |
| Overweight prepregnancy BMI (25–29.9) | n=17 | n=34 | |
| Age (y) | 32.24±5.21 | 34.75±7.70 | .232 |
| Starting weight (lbs) | 163.59±15.13 | 167.71±17.30 | .408 |
| Starting BMI (kg/m$^2$) | 23.63±1.43 | 27.39±1.51 | .089 |
| Obstetric history | | | |
| Nulliparous | 47.1 | 73.5 | .062 |
| Prior term birth(s) only | 41.2 | 20.6 | .120 |
| Prior preterm birth(s) only | 5.9 | 5.9 | 1.000 |
| Prior term and preterm births | 5.9 | 0 | .153 |
| Caucasian | 87.5 | 88.2 | .941 |
| IVF pregnancy | 52.9 | 61.8 | .546 |
| Multifetal reduction | 11.8 | 8.8 | .739 |
| Dichorionic | 88.2 | 88.2 | 1.000 |
| Cervical length at 20–22 wk (mm) | 40.9±8.3 | 43.6±6.4 | .302 |
| Obese prepregnancy BMI (BMI 30 or greater) | n=8 | n=21 | |
| Age (y) | 29.64±3.81 | 35.25±7.97 | .069 |
| Starting weight (lbs) | 215.38±50.86 | 201.98±27.17 | .364 |
| Starting BMI (kg/m$^2$) | 35.09±4.17 | 34.19±3.87 | .587 |
| Obstetric history | | | |
| Nulliparous | 25.0 | 57.1 | .122 |
| Prior term births only | 62.5 | 33.3 | .154 |
| Prior preterm birth only | 12.5 | 4.8 | .462 |
| Prior term and preterm birth | 0 | 4.8 | .530 |
| Caucasian | 75.0 | 76.2 | .947 |
| IVF pregnancy | 75.0 | 71.4 | .847 |
| Multifetal reduction | 0 | 4.8 | .530 |
| Dichorionic | 87.5 | 100 | .099 |
| Cervical length at 20–22 wk (mm) | 41.3±12.7 | 44.6±5.9 | .639 |

BMI, body mass index; IVF, in vitro fertilization.
Data are mean±standard deviation or % unless otherwise specified.

**Table 2. Pregnancy Outcomes in Twin Pregnancies Based on Whether Weight Gain Did or Did Not Meet 2009 Institute of Medicine Guidelines**

| | Low Weight Gain | Normal Weight Gain | *P* |
|---|---|---|---|
| Normal prepregnancy BMI (18.5–24.9) | n=80 | n=121 | |
| GA at delivery (wk) | 35.42±3.19 | 36.03±2.23 | .139 |
| Larger twin birth weight (g) | 2,370.3±586.0 | 2,582.1±493.4 | .008 |
| Smaller twin birth weight (g) | 2,109.3±560.9 | 2,277.0±512.1 | .033 |
| Both twins more than 2,500 g | 22.5 | 38.8 | .015 |
| Both twins more than 1,500 g | 87.5 | 92.6 | .230 |
| Both twins more than 1,000 g | 91.2 | 97.5 | .045 |
| Any twin less than 5% birth weight | 35.0 | 21.5 | .034 |
| Gestational hypertension | 13.9 | 19.8 | .282 |
| Gestational diabetes | 6.2 | 4.1 | .499 |
| Indicated preterm birth | 15.0 | 19.0 | .493 |
| Preterm birth less than 37 wk | 62.5 | 57.9 | .511 |
| Preterm birth less than 35 wk | 25.0 | 19.8 | .386 |
| Preterm birth less than 32 wk | 13.8 | 5.0 | .028 |
| Preterm birth less than 28 wk | 6.2 | 1.7 | .082 |
| Spontaneous preterm birth less than 37 wk | 55.2 | 46.9 | .296 |
| Spontaneous preterm birth less than 35 wk | 21.1 | 16.5 | .428 |
| Spontaneous preterm birth less than 32 wk | 11.5 | 3.4 | .025 |
| Spontaneous preterm birth less than 28 wk | 6.2 | 1.7 | .082 |
| Overweight prepregnancy BMI (25–29.9) | n=17 | n=34 | |
| GA at delivery (wk) | 34.44±3.29 | 36.21±1.71 | .014 |
| Larger twin birth weight (g) | 2,274.9±653.4 | 2,664.0±446.7 | .016 |
| Smaller twin birth weight (g) | 2,054.9±640.0 | 2,321.9±507.9 | .111 |
| Both twins more than 2,500 g | 29.4 | 41.2 | .413 |
| Both twins more than 1,500 g | 88.2 | 97.1 | .207 |
| Both twins more than 1,000 g | 94.1 | 100 | .153 |
| Any twin less than 5% birth weight | 17.6 | 23.5 | .630 |
| Gestational hypertension | 11.8 | 21.2 | .410 |
| Gestational diabetes | 11.8 | 8.8 | .739 |
| Indicated preterm birth | 11.8 | 32.4 | .112 |
| Preterm birth less than 37 wk | 64.7 | 50 | .320 |
| Preterm birth less than 35 wk | 52.9 | 20.6 | .019 |
| Preterm birth less than 32 wk | 17.6 | 0 | .012 |
| Preterm birth less than 28 wk | 5.9 | 0 | .153 |
| Spontaneous preterm birth less than 37 wk | 60.5 | 26.1 | .037 |
| Spontaneous preterm birth less than 35 wk | 46.7 | 13.3 | .014 |
| Spontaneous preterm birth less than 32 wk | 17.6 | 0 | .012 |
| Spontaneous preterm birth less than 28 wk | 5.9 | 0 | .153 |
| Obese prepregnancy BMI (30 or greater) | n=8 | n=21 | |
| GA at delivery (wk) | 36.54±1.77 | 36.73±1.42 | .781 |
| Larger twin birth weight (g) | 2,598.1±294.4 | 2,848.3±550.9 | .129 |
| Smaller twin birth weight (g) | 2,404.3±353.7 | 2,512.9±538.7 | .534 |
| Both twins more than 2,500 g | 50 | 47.6 | .909 |
| Both twins more than 1,500 g | 100 | 100 | NA |
| Both twins more than 1,000 g | 100 | 100 | NA |
| Any twin less than 5% birth weight | 25 | 28.6 | .847 |
| Gestational hypertension | 25 | 20 | .771 |
| Gestational diabetes | 0 | 30 | .081 |
| Indicated preterm birth | 12.5 | 14.3 | .901 |
| Preterm birth less than 37 wk | 50 | 47.6 | .909 |
| Preterm birth less than 35 wk | 25 | 9.5 | .280 |
| Preterm birth less than 32 wk | 0 | 4.8 | .530 |
| Preterm birth less than 28 wk | 0 | 0 | NA |
| Spontaneous preterm birth less than 37 wk | 42.9 | 33.3 | .656 |
| Spontaneous preterm birth less than 35 wk | 25 | 9.5 | .280 |
| Spontaneous preterm birth less than 32 wk | 0 | 4.8 | .530 |
| Spontaneous preterm birth less than 28 wk | 0 | 0 | NA |

BMI, body mass index; GA, gestational age; NA, not applicable.
Data are mean±standard deviation or % unless otherwise specified.




**Table 3. Pregnancy Outcomes in Twin Pregnancies Based on Whether Weight Gain Did or Did Not Meet 2009 Institute of Medicine Guidelines, Excluding All Patients Who Delivered at Less Than 37 Weeks**

| | Low Weight Gain | Normal Weight Gain | *P* |
|---|---|---|---|
| Normal prepregnancy BMI (18.5–24.9) | n=30 | n=51 | |
| Larger twin birth weight (g) | 2,669.2±286.4 | 2,884.8±294.4 | .002 |
| Smaller twin birth weight (g) | 2,441.7±273.3 | 2,575.2±296.1 | .047 |
| Both twins more than 2,500 g | 36.7 | 62.7 | .023 |
| Any twin less than 5% birth weight | 53.3 | 31.4 | .051 |
| Overweight prepregnancy BMI (25–29.9) | n=6 | n=17 | |
| Larger twin birth weight (g) | 2,887.5±160.8 | 3,021.5±213.8 | .178 |
| Smaller twin birth weight (g) | 2,685.0±161.8 | 2,679.4±344.3 | .970 |
| Both twins more than 2,500 g | 83.3 | 76.5 | .726 |
| Any twin less than 5% birth weight | 16.7 | 23.5 | .726 |
| Obese prepregnancy BMI (BMI 30 or greater) | n=4 | n=11 | |
| Larger twin birth weight (g) | 2,688.8±357.6 | 3,080.9±509.7 | .184 |
| Smaller twin birth weight (g) | 2,586.3±309.9 | 2,808.2±490.3 | .419 |
| Both twins more than 2,500 g | 75.0 | 72.7 | .930 |
| Any twin less than 5% birth weight | 50.0 | 27.3 | .409 |

BMI, body mass index.
Data are mean±standard deviation or % unless otherwise specified.

nancy BMI, which were the largest group, patients whose weight gain met or exceeded the IOM recommendations had significantly improved outcomes, including larger birth weights, higher likelihood of delivering two twins more than 1,000 g and more than 2,500 g, lower likelihood of a birth weight less than 5% for gestational age, and less preterm birth and spontaneous preterm birth less than 32 weeks.

In women with an overweight prepregnancy BMI, despite only having 41 patients, there were multiple statistically significant improved outcomes seen in women whose weight gain met or exceeded the IOM recommendations, including later gestational age at delivery; larger birth weight of the larger twin; less preterm birth less than 35 weeks and less than 32 weeks; and less spontaneous preterm birth less than 37 weeks, less than 35 weeks, and less than 32 weeks.

In women with prepregnancy BMIs that put them in the obese group, which were the smallest subgroup at 29 patients, there were no statistically significant differences noted. Women in the normal weight gain group were not significantly more likely to have gestational diabetes or gestational hypertension. There were no stillbirths in the cohort.

We reanalyzed our data excluding all women who delivered preterm (less than 37 weeks). This left 119 patients for analysis (79 in the normal weight gain group and 40 in the low weight gain group). Among women with normal prepregnancy BMIs, a significant difference was seen between the two groups with the normal weight gain group having larger birth weights and fewer neonates with low birth weight and low birth weight percentiles (Table 3). These differences were not seen in women with an overweight or obese prepregnancy BMI, but these groups had very few patients (23 and 15 patients, respectively).

## DISCUSSION

In this study, women with twin pregnancies whose weight gain during pregnancy met or exceeded the revised 2009 IOM guidelines had significantly improved pregnancy outcomes, including longer gestation, less overall preterm birth, less spontaneous preterm birth, and larger neonates. The finding that weight gain in twin pregnancies is associated with birth weight has been shown in previous studies.[6–9] However, the strong association seen in our study between weight gain and rates of preterm birth has not been conclusively demonstrated previously. This is very important because the rate of twin pregnancies has risen between 1990 and 2005 from 2.2% to 3.2% of all births.[1] Additionally, even among twin pregnancies specifically, the rate of preterm birth has risen from 48% to 60% over the same time period.[1] In addition to demonstrating a reduced risk of preterm birth in twin pregnancies with normal weight gain, we were also able to demonstrate that normal weight gain was associated with a reduced rate of spontaneous preterm birth. Therefore, the increased preterm birth rate for women with less weight gain cannot be attributed solely to indicated or iatrogenic preterm births as a result of illness or fetal growth restriction.




Given that our efforts to prevent preterm birth in twin pregnancies have mostly been ineffective, this finding that a focus on nutrition and adequate weight gain may prolong gestation in twin pregnancies is exciting and warrants prospective studies. Perhaps inadequate weight gain could be a correctable cause of prematurity in twins.

Because women who remain pregnant longer are more likely to gain more weight and deliver larger neonates, it is important to analyze the data in a way that can account for these confounders. To account for the expected association between gestational age at delivery and total maternal weight gain, we used the weight gain per week as our measure of weight gain, which controls for gestational age at delivery. Even using this measure of weight gain, women who gained more weight per week delivered at later gestational ages, had less preterm birth, and had neonates with larger birth weights. Another way we controlled for gestational age at delivery was analyzing data for women who delivered more than 37 weeks only. In this cohort, there was still a significant association between increased weight gain and increased birth weights. Therefore, we conclude that maternal weight gain has a positive effect on gestational age at delivery and birth weight above and beyond its association with advancing gestational age. Because our cohort was primarily women with a normal prepregnancy BMI (67.7% of all patients), extrapolating these findings to all patients with twin pregnancies should be done with caution. We did see a similar association between normal weight gain and improved outcomes in women with an overweight prepregnancy BMI, but we had fewer patients in this subgroup. Normal weight gain was not associated with improved outcomes in women with an obese prepregnancy BMI, but we were underpowered for this analysis. Future research is warranted in overweight and obese women with twin pregnancies to determine the optimal weight gain in these cohorts.

Additionally, because 100% of our patients had private health insurance, the applicability of our findings to other populations with different socioeconomic backgrounds is uncertain.

In our cohort, the women who gained more weight were not significantly more likely to develop gestational hypertension or diabetes. We were underpowered to determine whether any weight gain threshold exists above which the risk of these conditions outweighs the benefits, and we were underpowered to determine if women with an overweight or obese prepregnancy BMI who achieve normal weight gain are more susceptible to these conditions. However, for women with twin pregnancies and a normal prepregnancy BMI, they can be reassured that achieving the recommended weight gain will not increase their risk of developing gestational hypertension or diabetes.

Strengths of our study include the uniform and supervised measurements of height and weight as opposed to a reliance on birth certificate data or patient reporting, which can be flawed. We calculated weight gain from actual recorded measurements only. Therefore, our weight gain data should be as accurate as possible. Additionally, because we were able to obtain a first-trimester ultrasonography in all cases, our estimation of gestational age should also be very accurate as compared with birth certificate data as well. Finally, because we cared for all of these patients, we are able to accurately report whether a preterm birth was indicated or spontaneous. Other studies report gestational ages at delivery but are unable to make this differentiation. Our ability to do this uncovered that in addition to weight gain influencing gestational age at delivery and the risk of preterm birth overall, it is also associated with the likelihood of spontaneous preterm birth. These strengths make our data valuable. A limitation to our study is that weight gain was calculated for the entire pregnancy.

It is important that the 2009 IOM revised guidelines be studied in multiple cohorts of twin pregnancies to test their effectiveness. The IOM itself refers to their revised guidelines for twins as "provisional."[12] Therefore, data such as ours are useful. Our data support the revised recommendations of the IOM for women with a normal or overweight prepregnancy BMI and indicate that women with twin pregnancies who meet the IOM guidelines for weight gain have significantly improved outcomes compared with women with twin pregnancies who do not meet those guidelines. Therefore, these guidelines appear effective and should be considered in clinical practice, at least in women with a normal prepregnancy BMI. The association between proper weight gain and a lower incidence of preterm birth and spontaneous preterm warrants prospective studies. The possibility that a focus on maternal nutrition and weight gain could optimize neonatal outcomes and reduce the risk of preterm birth and spontaneous preterm birth deserves significant attention. Future studies could assess nutritional interventions in twin pregnancies and their effect on the rate of preterm birth. This may uncover a simple way to reduce significant morbidity and mortality associated with prematurity.

## REFERENCES


1. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S, et al. Births: final data for 2005. Natl Vital Stat Rep 2007;56:1–103.
2. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S. Births: final data for 2004. Natl Vital Stat Rep 2006;55:1–101.
3. Kogan MD, Alexander GR, Kotelchuck M, MacDorman MF, Buekens P, Martin JA, et al. Trends in twin birth outcomes and prenatal care utilization in the United States, 1981–1997. JAMA 2000;284:335–41.
4. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2003 period linked birth/infant death data set. Natl Vital Stat Rep 2006;54:1–29.
5. Institute of Medicine, National Academy of Sciences. Nutrition during pregnancy: part I: weight gain; part II: nutrient supplements. Washington, DC: National Academies Press; 1990.
6. Luke B, Gillespie B, Min SJ, Avni M, Witter FR, O'Sullivan MJ. Critical periods of maternal weight gain: effect on twin birth weight. Am J Obstet Gynecol 1997;177: 1055–62.
7. Lantz M, Chez RA, Rodriguez A, Porter KB. Maternal weight gain patterns and birth weight outcome in twin gestation. Obstet Gynecol 1996;87:551–6.
8. Luke B, Minogue J, Witter FR, Keith LG, Johnson TR. The ideal twin pregnancy: patterns of weight gain, discordancy, and length of gestation. Am J Obstet Gynecol 1993;169: 588–97.
9. Luke B. The evidence linking maternal nutrition and prematurity. J Perinat Med 2005;33:500–5.
10. Chu SY, D'Angelo DV. Gestational weight gain among US women who deliver twins, 2001–2006. Am J Obstet Gynecol 2009;200:390.e1–6.
11. Luke B, Hediger ML, Nugent C, Newman RB, Mauldin JG, Witter FR, et al. Body mass index-specific weight gains associated with optimal birth weights in twin pregnancies. J Reprod Med 2003;48:217–24.
12. Institute of Medicine. Weight gain during pregnancy: reexamining the guidelines. Washington, DC: The National Academies Press; 2009.
13. Goodnight W, Newman R. Optimal nutrition for improved twin pregnancy outcome. Obstet Gynecol 2009;114: 1121–34.
14. American College of Obstetricians and Gynecologists. Diagnosis and management of preeclampsia. ACOG Practice Bulletin 33. Washington, DC: ACOG; 2002.
15. Oken E, Kleinman KP, Rich-Edwards J, Gillman MW. A nearly continuous measure of birth weight for gestational age using a United States national reference. BMC Pediatr 2003;3:6.