PRAMSGRAM
OKLAHOMA PREGNANCY RISK ASSESSMENT MONITORING SYSTEM · VOL 6 NO 1

Prenatal Weight Gain and Birth Weight Among Oklahoma Mothers

Background

Research over the last 30 years has indicated that, accounting for gestational age, pre-pregnancy weight and prenatal weight gain are the primary predictors of infant birth weight.[1]

A study by Dawes[2] found a positive correlation between maternal weight gain and birth weight beginning at 28 weeks gestation. Bruce[3] saw an increase in birth weight among low pre-pregnancy weight women who experienced appropriate prenatal weight gain. Studies based on the Collaborative Perinatal Project (1959-1966), demonstrated that a progressive increase in both pre-pregnancy weight and prenatal weight gain paralleled an increase in birth weight.[1]

Although pre-pregnancy weight and weight gain act independently of each other in their impact on birth weight, together they become additive in their effects.[1,4,5] Data from the 1980 National Natality Survey indicated the percentage of low birth weight is highest among women with the lowest pre-pregnancy weights and lowest prenatal weight gains.[4] This study also found that, within categories of gestational weight gain, mean birth weights increased with increased body mass index (BMI). There were consistent differences between smokers and non-smokers.[4]

In 1990, the National Academy of Sciences (NAS) recommended a prenatal weight gain range based on pre-pregnancy BMI.[6] Following these recommendations should help achieve the *Healthy People 2000* objective to increase to at least 85% the proportion of mothers who achieve the minimum recommended weight gain during pregnancy.

Methods

Data from the Oklahoma Pregnancy Risk Assessment Monitoring System (PRAMS) were used to examine pre-pregnancy weight, prenatal weight gain and their relationship to low (< 2,500 grams) birth weight. In the PRAMS survey, women are asked three questions related to their pre-pregnancy weight and prenatal weight gain: *1) How much did you weigh during the three months before you became pregnant; 2) How tall are you without shoes;* and *3) How much weight did you gain during your pregnancy.* A woman's pre-pregnancy body mass index (BMI) was calculated by dividing her weight in kilograms by her height in meters squared; it was categorized into low BMI, normal BMI and high BMI. A woman's prenatal weight gain was calculated using the National Academy of Sciences (NAS) standard prenatal weight gain ranges adjusted for pre-pregnancy BMI (Table 1)[6] and classified as less than recommended, within recommended, and more than recommended weight gain. As the NAS recommendations apply only to women whose gestational age is 40 weeks or greater, the ranges of prenatal weight gain for women with less than 40 weeks gestation were estimated.

In Oklahoma

- Approximately one-fourth (23.8%) of women are underweight (low BMI*) when they become pregnant and 20.6% are overweight (high BMI).
- Close to one-in-five women (19.3%) gain less than the recommended amount of weight during pregnancy and two-in-five (39.4%) gain more than the recommended amount.
- Women who gain less than the recommended amount of weight during pregnancy, regardless of their pre-pregnancy weight, are at greater risk for low birth weight.
- Underweight (low BMI) women gaining less than the recommended amount of weight experience the highest percentage of low birth weight infants (10.2%) compared to all other women.
- Smokers who are underweight when pregnancy begins and who gain less than the recommended amount of weight are 2.6 times as likely to deliver a low birth weight infant as underweight smokers who gain more than the recommended amount of weight (16.9% vs. 6.5%).

* Body Mass Index (BMI) is defined as weight (kilograms)/height (meters) squared.

Table 1 **Recommended total weight gain ranges for pregnant women by pre-pregnancy BMI**

Pre-pregnancy weight-for-height		Recommended total gain in pounds (lbs)
Low BMI	(BMI < 19.8)	28-40 lbs
Normal BMI	(BMI of 19.8 to 26.0)	25-35 lbs
High BMI	(BMI > 26.0 to 29.0)	15-25 lbs
Obese BMI	(BMI > 29.0)	at least 15 lbs

For this study, PRAMS data from April 1988-March 1995 were used to examine pre-pregnancy BMI [low, normal, and high (including obese)] and prenatal weight gain (less than, within, and more than recommended). Only data from singleton births are used. Frequency distributions and 95% confidence intervals (95% CI) are presented. In addition to overall prevalence and demographic characteristics associated with various levels of prenatal weight gain, the relationship of these variables to low birth weight is also examined, including the potential impact of smoking during the prenatal period.

Pre-pregnancy Weight and Weight Gain

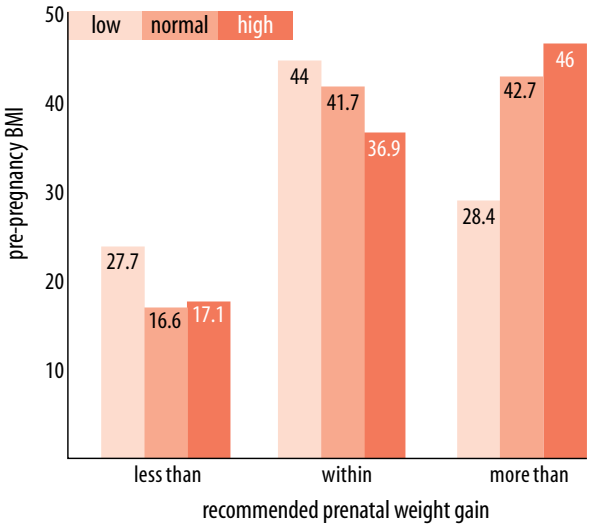
Pre-pregnancy body mass index (BMI) and prenatal weight gain among Oklahoma mothers is presented in Table 2.

Table 2 **Pre-pregnancy BMI and prenatal weight gain**

	%	95% CI
Pre-pregnancy BMI		
low	23.8	22.4-25.2
normal	55.6	54.0-57.2
high	20.6	19.3-21.8
Prenatal Weight Gain		
less than recommended	19.3	17.9-20.7
within recommended	41.3	39.7-42.9
more than recommended	39.4	37.8-40.9

As pre-pregnancy weight and prenatal weight gain have both independent and cumulative effects on infant birth weight,[1] it is important to examine them in relation to each other. Figure 1 presents those women gaining less than, within, and more than the recommended amount of weight by pre-pregnancy BMI. Women with low BMI were most likely to gain less than the recommended prenatal weight gain (27.7%) while women with high BMI were most likely to gain more than the recommended amount of weight (46.0%). Studies have found that the women at "extremes" of BMI and prenatal weight gain (i.e., low BMI/less than recommended and high BMI/more than recommended) are at increased risk for poor birth weight outcome.[1,2,4]

Figure 1 **Prenatal weight gain by pre-pregnancy BMI**



In order to more fully describe those women more likely to be in either of these higher risk groups, Table 3 presents sociodemographic characteristics of women by pre-pregnancy BMI and weight gain. Among women with low BMI and less than recommended weight gain, 21.2% were under age 20 compared to 12.5% of those with high BMI/more than recommended weight gain and 10.9% of those with normal BMI/within recommended weight gain. These women (low BMI/less than recommended weight gain) were also more likely to have less than 12 years of education, not be married, have inadequate prenatal care, and smoke during pregnancy than either of the other two BMI/weight gain groups. Women with high BMI/more than recommended weight gain were more likely to be African-American or Native American, to receive public assistance, to use WIC during their pregnancy, and to use Medicaid funding for prenatal care and/or delivery services.

Low Birth Weight

Women who gain less than the recommended amount of weight, regardless of pre-pregnancy BMI status, are at increased risk for LBW outcome compared to women gaining within or more than the recommended amount of weight (Figure 2). Women with low pre-pregnancy BMI who gained less than the recommended amount of weight experienced

PRAMS is a population-based survey of Oklahoma women with a recent delivery. A stratified systematic sampling approach is used to select approximately 200 new mothers each month from the state's live birth registry. Up to three mailed questionnaires are used to solicit a response. Telephone interviews are attempted for non-respondents. Data for this report reflect live births occurring between April 1988 and March 1995. The overall response rate was 71%. All data represent state estimates.

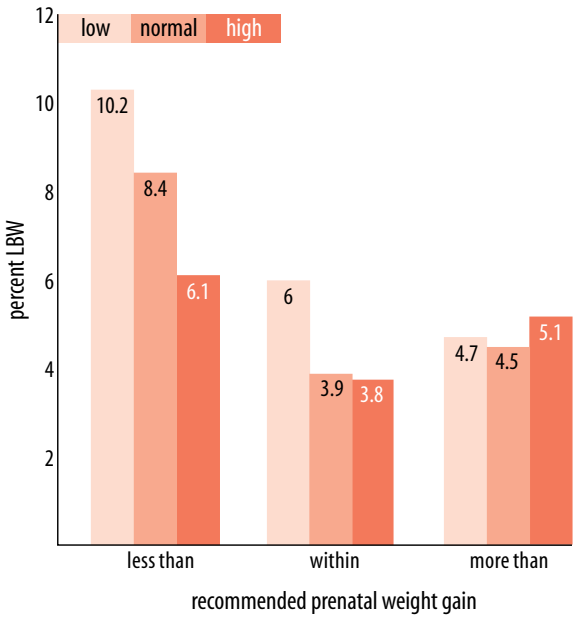
the highest percentage of LBW infants (10.2%). LBW declined to 6% in women with low BMI who gained within the recommended amount of weight and to 4.7% in women with low BMI who gained more than the recommended amount of weight, thus reducing the risk for LBW by 2.2 times. Among women with low BMI, the direct relationship between low birth weight and increasing prenatal weight gain has also been found in other studies.[1] Unlike women with low BMI, there is not a direct relationship between prenatal weight gain and risk for LBW among women with normal or high BMI. For these women, gaining less or more than the recommended amount of weight places them at increased risk for delivering a LBW infant.

Table 3 **Characteristics of women by pre-pregnancy BMI and weight gain**

Characteristic	Low BMI/less than recommended wt gain		Normal BMI/ within recommended wt gain		High BMI/over recommended wt gain	
	%	95% CI	%	95% CI	%	95% CI
Age						
<20	21.2	15.5-26.9	10.9	8.5-13.3	12.5	8.7-16.2
20-24	35.5	29.2-41.8	30.0	26.9-33.1	33.9	29.0-38.8
25-29	24.2	18.7-29.7	31.6	28.7-34.5	29.2	24.7-33.7
30-34	15.2	10.9-19.5	19.2	16.7-21.8	17.5	14.0-21.0
35+	3.9	1.7-6.1	8.3	6.5-10.1	6.9	4.6-9.3
Race[1]						
White	84.7	79.9-89.7	85.1	82.5-87.6	75.5	71.0-80.0
African American	9.8	5.5-14.1	5.8	4.0-7.6	11.4	7.7-15.1
Native American	3.9	1.4-6.5	7.5	5.7-9.3	12.6	9.3-15.9
Education						
<12 years	21.7	15.6-27.8	13.2	10.5-15.9	14.8	10.8-18.8
12+ years	78.3	72.2-84.4	86.8	84.1-89.5	85.2	81.2-89.2
Marital Status[2]						
Married	56.6	50.1-63.1	71.6	68.4-74.8	66.2	61.2-71.2
Unmarried	43.4	36.9-49.9	28.4	25.2-31.6	33.8	28.8-38.8
Income Source						
Job/Business	72.9	66.8-79.0	78.7	75.9-81.7	70.1	65.2-71.2
Public Assistance	24.5	18.6-30.4	19.4	16.7-22.3	28.5	23.8-38.8
Other[3]	2.6	0.2-5.1	1.9	0.7-2.9	1.4	0.3-2.5
WIC[4]						
Yes	40.7	34.2-47.2	30.7	27.5-33.9	46.2	41.1-51.3
Kessner						
Adequate	72.2	66.1-78.3	77.6	74.6-80.8	73.9	69.2-78.6
Intermediate	21.3	15.8-26.8	19.1	16.2-22.0	23.2	18.9-27.8
Inadequate	6.5	3.0-10.0	3.3	0.9-4.7	2.9	1.1-4.7
Medicaid[5]						
Yes	35.1	28.8-41.4	27.0	23.8-30.2	39.9	34.8-45.0
Prenatal Smoking[6]						
Yes	26.2	20.5-31.9	19.5	16.8-22.2	21.6	17.2-26.0

[1] "Other" race category not presented due to small cell size
[2] Marital status at conception
[3] Cell size less than 20
[4] On WIC during pregnancy
[5] Use Medicaid to pay for prenatal care and/or delivery
[6] Women who reported smoking in the last three months of pregnancy

Figure 2 **Percent LBW by prenatal weight gain and pre-pregnancy BMI**



PRAMS data on smoking, pre-pregnancy BMI, prenatal weight gain, and low birth weight were also examined. Table 4 presents low birth weight (LBW) by smoking status, pre-pregnancy BMI, and prenatal weight gain. PRAMS data showed smokers with a low pre-pregnancy BMI who gained less than the recommended weight range experienced the highest percentage of LBW at 16.9%, 5.3 times the rate (3.2%) among non-smokers with a normal pre-pregnancy BMI gaining within the recommended weight range. The percentage of low birth weight among smokers with low pre-pregnancy BMI decreased as the amount of weight gain increased; 16.9% for those with low BMI and less than recommended gain, 12.7% within recommended gain, and 6.5% for more than recommended gain.

Table 4 **Low birth weight by smoking status by BMI and prenatal weight gain**

BMI and Weight Gain	Smokers*		Non-smokers	
Low BMI	%	95% CI	%	95% CI
less than recommended	16.9	12.2-21.6	7.7	6.1-9.3
within recommended	12.7	9.4-16.0	4.2	3.4-5.0
more than recommended	6.5	14.3-8.7	3.6	2.8-4.4
Normal BMI				
less than recommended	12.9	9.6-16.2	6.9	5.7-8.1
within recommended	6.9	5.3-8.5	3.2	2.8-3.6
more than recommended	8.9	7.1-10.7	3.3	2.9-3.7
High BMI				
less than recommended	7.7	4.0-11.4	5.4	3.8-7.0
within recommended	4.6	2.6-6.6	3.4	2.6-4.2
more than recommended	7.5	5.2-9.9	4.5	3.7-5.3

*Those women who reported smoking in the last three months of their pregnancy.

Non-smokers in all pre-pregnancy BMI groups had lower percentages of low birth weight than smokers. Non-smoking women who gained at least the recommended amount of weight during pregnancy surpassed the *Healthy People 2000* goal of no more than 5% low birth weight infants.

Conclusions and Discussion

From these data, it appears that women at "extremes" of the pre-pregnancy weight (BMI) and prenatal weight gain (i.e., low BMI/under recommended weight gain and high BMI/more than recommended weight gain) are at higher risk for adverse birth outcome as indicated by birth weight.

The impact of prenatal weight gain on low birth weight among smokers is especially pronounced. Prenatal smokers may need additional nutritional counseling and/or assistance as well as smoking cessation advice.

The higher proportion of "traditional" high risk groups (e.g., less than 12 years of education, unmarried, younger, and other than white) in both the low BMI/less than recommended prenatal weight gain and high BMI/more than recommended prenatal weight gain (compared to normal BMI/within recommended prenatal weight gain) is suggestive of an interrelationship among various sociodemographic characteristics that may influence behaviors and outcomes of women giving birth in Oklahoma. This interrelationship needs to be further explored through additional analyses.

Recommendations

A full-term healthy, normal weight infant is the desired outcome of pregnancy. Nutritional status of women, including pre-pregnancy weight and prenatal weight gain, along with other factors, influence that outcome. The *Healthy People 2000* goal to increase to at least 85% the proportion of mothers who achieve the minimum recommended weight gain during pregnancy will help achieve that outcome. In order to continue progress in this area, the following recommendations are made:

- Continue to disseminate the National Academy of Sciences recommended prenatal weight gain ranges based on pre-pregnancy BMI to health care providers.
- Assess women of child bearing age for BMI, particularly those in family planning clinics, and refer those with low or high BMI to available preconception care programs for assistance in achieving ideal weight before pregnancy.
- Implement preconception care interventions for underweight and overweight women to assist them in achieving ideal weight before pregnancy.
- Take steps to ensure that health care providers recommend that women who smoke, particularly those with low pre-pregnancy BMI, are encouraged to gain at least the recommended amount of weight during pregnancy.
- Develop methods to ensure that health care providers refer the following to a dietitian/nutritionist:
  - any pregnant woman with low or high pre-pregnancy weight,
  - any woman, regardless of pre-pregnancy weight, who fails to gain the recommended amount of weight during pregnancy.
- Train health care providers to assess a pregnant woman's readiness to quit smoking and implement smoking cessation programs specifically designed for them and for women planning to become pregnant.

References

1. Luke, B. Nutritional Influences on Fetal Growth. Clinical Obstetrics and Gynecology. 1994; 37(3): 538-549.
2. Dawes, M.G. Patterns of Maternal Weight in Pregnancy. British Journal of Obstetrics and Gynecology. 1991; 98:195-201.
3. Bruce, L. Nutrition Intervention Program in a Prenatal Clinic. Obstetrics and Gynecology. 1989; 74(3/1):310-312.
4. Luke, B. Maternal-Fetal Nutrition. Clinical Obstetrics and Gynecology. 1994; 37(1):93-109.
5. Eastman, N.J., Jackson, E. Weight Relationships in Pregnancy. I. The Bearing of Maternal Weight Gain and Pre-Pregnancy Weight on Birth Weight in Full Term Pregnancies. Obstetrics & Gynecology. 1968;23:1003-1025.
6. *Nutrition during Pregnancy.* Washington DC: National Academy of Sciences, 1990, p.10,181.

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