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Weight Gain During Pregnancy: Trends and Outcomes

During the 20th century, recommendations for appropriate weight gain in pregnancy changed dramatically, ranging from rigid restriction in the first half of the century to substantial gain in the 1970s and 1980s[1]. In 1990, the Institute of Medicine (IOM) recommended weight gain ranges with the primary goal of improving infant birth weight. Based on pre-pregnancy body mass index (BMI) categorizations, the recommended weight gain ranges were: 28-40 pounds for underweight women, 25-35 pounds for normal weight women, 15-25 pounds for overweight women and at least 15 pounds for obese women. The recommendation for obese women was modified in 2009 to 11-20 pounds. In addition, the BMI ranges were slightly changed in 2009 to conform to those used by the World Health Organization rather than those developed from the Metropolitan Life Insurance tables.

This report examines the trends in weight gain during pregnancy among Missouri women from 1989 to 2008 as well as the pregnancy outcomes by weight gain among Missouri women for the five year period 2004-2008. The 2009 IOM ranges of recommended weight gain were used as one set of categories for measuring adequacy of weight gain. Low was defined as less than the lower limit of the recommended range for each pre-pregnancy BMI group. Normal was defined as within the recommended range, while high was above the highest limit of the range. In addition, the data are also presented using the simpler categorization of less than 15 pounds, 15-44 pounds and 45 or more pounds gain. These categories have been used in numerous previous annual vital statistics and website reports by the Missouri Department of Health and Senior Services. Because multiple births and gestational age are strongly linked to weight gain, only singleton full-term (at least 37 weeks gestation) births were included in the analysis.

As Table 1 shows, weight gain has been edging upwards among Missouri mothers over the last nearly 20 years. The average weight gain in 1989 was 31.6 pounds compared to 32.5 pounds in 2008. Those gaining 45 or more pounds increased from 14.2 percent of births in 1989 to 18.8 percent in 2008. The weight gain increase would have been greater if not for the increase in the proportion of women in higher BMI categories. The number and percent of obese women more than doubled from 1989 to 2008. Generally, and as the IOM recommends, heavier women do not gain as much weight as normal weight women. In 2008, obese mothers gained about 10 pounds less during pregnancy than normal weight and underweight mothers.

According to the 2009 IOM guidelines, less than one-third of Missouri mothers in 2008 gained the recommended amount of weight during pregnancy. About 52 percent gained too much weight and 15 percent gained too little weight. The comparable percents in 1989 were about 40 percent normal weight gain, 40 percent high and 20 percent low. These percentages varied tremendously by pre-pregnancy BMI category. In 2008 the proportion with high weight gain ranged from 26.8 percent for underweight women to 68.1 percent for overweight women. Comparable percentages for normal weight women and obese women were 43.2 and 58.1 percent, respectively. Overweight women gained an average of 2 pounds less than underweight and normal weight women, but the IOM recommends they gain at least 10 pounds less based on a comparison of the recommended ranges.

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Table 1
Trends in Percent Distributions of Weight Gain During Pregnancy by Pre-pregnancy BMI Category: Missouri Resident Singleton Full-term Births 1989, 1993, 1998, 2003, and 2008

Total						Weight Gain Based on IOM* Guidelines		
	Births	Avg.(lbs)	< 15 lbs	15-44 lbs	45+ lbs	Low	Normal	High
1989	65,118	31.6	5.9	79.9	14.2	20.1	40.2	39.7
1993	62,556	32.0	7.1	77.0	16.0	18.2	37.3	44.5
1998	62,197	32.5	7.8	74.6	17.6	16.0	35.0	48.8
2003	62,282	33.0	8.3	72.0	19.7	14.7	33.1	52.2
2008	64,728	32.5	9.1	72.1	18.8	15.4	32.6	52.0
Underweight								
	Births	Avg.(lbs)	< 15 lbs	15-44 lbs	45+ lbs	Low	Normal	High
1989	5,831	32.5	2.1	84.3	13.6	34.8	45.7	19.5
1993	4,552	33.3	2.2	82.6	15.1	32.3	46.0	21.6
1998	3,747	35.2	2.2	77.2	20.6	25.7	46.9	27.4
2003	3,231	36.4	1.4	75.9	22.7	22.2	47.1	30.6
2008	3,001	35.3	1.9	78.9	19.2	25.9	47.4	26.8
Normal								
	Births	Avg.(lbs)	< 15 lbs	15-44 lbs	45+ lbs	Low	Normal	High
1989	41,892	32.7	2.8	82.8	14.5	21.5	44.7	33.8
1993	37,175	33.7	2.9	80.4	16.7	19.7	42.4	37.9
1998	33,549	34.7	2.6	78.2	19.2	17.5	41.5	41.0
2003	31,340	35.7	2.4	75.7	21.9	15.8	40.1	44.1
2008	31,078	35.3	2.7	76.4	20.9	16.9	39.9	43.2
Overweight								
	Births	Avg.(lbs)	< 15 lbs	15-44 lbs	45+ lbs	Low	Normal	High
1989	10,564	31.0	8.4	76.4	15.3	8.4	29.3	62.3
1993	11,936	31.4	8.4	74.7	16.8	8.4	27.6	64.0
1998	13,478	32.0	8.4	74.0	17.6	8.4	25.7	65.9
2003	14,342	33.1	7.5	72.0	20.5	7.5	24.2	68.4
2008	15,439	33.0	7.7	72.4	19.9	7.7	24.2	68.1
Obese								
	Births	Avg.(lbs)	< 15 lbs	15-44 lbs	45+ lbs	Low	Normal	High
1989	6,562	24.7	24.4	66.4	9.3	16.6	26.1	57.3
1993	8,517	24.8	25.0	64.7	10.4	17.5	25.4	57.1
1998	11,031	25.1	24.1	65.2	10.7	17.3	24.5	58.2
2003	13,012	25.5	24.8	63.5	11.7	18.1	23.3	58.6
2008	14,735	25.6	24.6	63.3	12.1	17.7	24.2	58.1

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As Table 2 shows, African-American mothers tended to gain excess weight and too little weight more than white women, although the differences were not substantial. Younger mothers tended to gain more weight during pregnancy than their older counterparts, even after adjusting for BMI. Similarly, unmarried mothers and women having their first birth also had higher rates of excess weight gain during pregnancy. Among those with higher rates of gaining less weight than the IOM guidelines were women of other races (neither white nor black), women aged 35 or more, women having higher order births, underweight women, smokers, and those having inadequate prenatal care.

Table 2
Percent Distribution of Weight Gain During Pregnancy by Selected Variables: Missouri 2004-2008 Resident Singleton Full-term Births

	Number of Births	Percent Gain		Weight Gain Based on IOM* Guidelines		
		<15 lbs	45+ lbs	Low	Normal	High
Race of Mother						
White	266,212	8.8	19.7	15.0	32.6	52.5
Black	43,272	10.7	21.0	16.8	28.3	54.9
Other	10,964	7.6	14.6	20.8	38.0	41.0
Age of Mother						
<20	35,737	5.5	27.6	14.8	29.2	56.0
20-24	92,344	8.6	22.5	15.3	30.1	54.7
25-29	95,629	9.6	18.6	15.1	32.3	52.6
30-34	64,773	9.5	15.9	15.6	34.6	49.8
35+	32,891	11.0	13.9	17.3	36.3	46.4
Education of Mother						
<12	55,797	9.5	22.8	17.8	30.4	51.8
12	97,358	10.2	21.4	16.0	29.8	54.2
13-15	75,140	10.2	19.7	15.1	31.0	53.9
16+	90,511	6.3	16.0	13.5	36.8	49.6
Married	200,413	9.2	16.8	15.4	34.3	50.3
Unmarried	120,945	8.7	24.5	15.5	28.8	55.8
Birth Order						
1st	132,402	5.9	25.5	12.2	29.4	58.4
2nd	102,895	10.0	15.9	16.7	34.4	49.0
3rd	54,026	11.7	15.6	18.2	34.1	47.7
4th	20,150	13.9	14.8	20.2	33.2	46.6
5th or more	11,907	13.9	14.6	20.2	34.1	45.7
Birth Spacing						
<18 months	20,710	11.8	11.7	20.9	34.9	44.2
18 or more months	162,261	11.0	16.0	17.3	34.1	48.6
Pre-pregnancy BMI						
Underweight	15,227	1.9	21.8	25.3	46.1	28.6
normal	157,031	2.9	21.8	16.9	39.2	43.9
overweight	75,416	8.0	20.5	8.0	23.9	68.1
obese	71,458	24.4	12.5	17.7	23.4	58.9
Prenatal Care						
Adequate	279,205	8.8	19.6	14.9	32.3	52.9
Inadequate	31,082	10.7	19.3	20.2	31.9	47.9
Smoker	56,835	11.0	22.2	18.1	30.1	51.8
Non-smoker	264,545	8.6	19.1	14.9	32.6	52.5
Program participation						
Medicaid	146,577	10.0	22.5	16.4	29.5	54.1
WIC	133,091	10.4	22.3	16.4	29.2	54.5
Food Stamps	74,362	11.2	22.6	17.1	28.8	54.1
Total	321,380	9.0	19.7	15.4	32.2	52.4

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Tables 3 and 4 show the percentages of various medical risk factors and complications of labor by weight gain categories for 2004-2008 Missouri singleton full-term births. Low weight gain was associated with anemia, diabetes, lung disease, and hydramnios/ oligohydramnios. Among labor complications, low weight gain was also associated with precipitous labor and anesthetic complications. High weight gain was associated with hypertension during pregnancy (pre-eclampsia) and previous 4,000+ gram infants. High weight gain was particularly associated with numerous complications of labor. Among these were heavy or moderate meconium, dysfunctional labor, malpresentation, cephalopelvic disproportion and fetal distress. There are a few conditions that are elevated for both high and low weight gain such as lung disease, chronic hypertension, and anesthetic complications. It should also be noted that the cause and effect of these various associations may be complicated. For example, oligohydramnios is a condition that is defined by too little amniotic fluid, which in turn leads to low maternal weight gain. So it may be the condition that causes that the low maternal weight gain rather than the low weight gain causing the condition.

Table 3
Percent of Selected Medical Risk Factors by Weight Gain During Pregnancy Categories: Missouri Resident Singleton Full-term Births

	Weight Gain Based on IOM* Guidelines		
	Low	Normal	High
Anemia	**2.2**	1.8	**1.6**
Cardiac disease	0.59	0.59	**0.53**
Acute or chronic lung dis.	**1.8**	1.4	**1.8**
Diabetes(Insulin dep.)	**1.1**	0.7	**0.9**
Other Diabetes	**5.0**	3.1	**2.8**
Genital Herpes	1.1	1.2	**1.3**
Hydraminios/Oligohydram.	**2.1**	1.7	**1.8**
Hemoglobinopathy	**0.19**	0.13	0.15
Hypertension, chronic	**1.3**	1.0	**1.3**
Pre-eclampsia	**2.8**	3.0	**5.5**
Eclampsia	0.05	0.05	**0.08**
Incompetent cervix	0.2	0.2	0.2
Prev. infant 4000+ g.	**1.0**	1.3	**1.6**
Prev. preterm or SGA	**1.8**	1.3	**1.0**
Renal Disease	0.3	0.2	0.2
RH sensitization	**0.90**	1.01	0.94
Uterine bleeding	0.4	0.4	0.4
Any risk factor	**34.1**	30.0	**32.3**
Total Births	49,629	103,427	168,324

Bold indicates statistically significantly different from "normal".
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Table 4
Percent of Selected Complications of Labor by Weight Gain During Pregnancy Categories: Missouri Resident Singleton Full-term Births

	Weight Gain Based on IOM Guidelines		
	Low	Normal	High
Febrile	**1.6**	1.9	**2.4**
Meconium mod or heavy	**4.3**	4.6	**5.5**
Prem rupt. Membrane	1.0	1.0	**1.2**
Abruptio placenta	**0.54**	0.46	**0.38**
Placenta previa	**0.21**	0.27	**0.20**
Other excessive bleeding	0.4	0.4	**0.5**
Seizures during labor	0.0	0.0	0.0
Precipitous labor	**3.2**	2.6	**1.9**
Prolonged labor	0.7	0.7	**1.1**
Dysfunctional labor	**3.9**	4.4	**7.2**
Breech	2.3	2.4	**2.5**
Other malpresentation	**1.4**	1.6	**2.2**
Cephalopelvic disproportion	**1.1**	1.6	**2.8**
Cord prolapse	0.1	0.1	0.1
Anesthetic complications	**2.4**	1.0	**1.1**
Fetal distress	6.2	6.3	**7.5**
Any labor complication	33.0	32.6	**37.5**
Total Births	49,629	103,427	168,324

Bold indicates statistically significantly different from "normal".
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Odds ratios of high or low weight gain during pregnancy vs. normal weight gain for selected pregnancy outcomes are presented in Table 5 after adjustment for appropriate confounding variables using multiple logistic regression. Low weight gain pregnancies had an odds ratio of 1.81 for low birth weight(<2,500 grams), meaning that the risk of having a low birth weight baby was approximately 1.81 times greater for babies of mothers with low weight gain compared with babies of mothers experiencing normal weight gain. Conversely, those with high weight gain were much more likely to have large macrosomia infants (>4,499 grams) (odds ratio =2.66). High weight gain was also associated with higher rates of low Apgar score (odds ratio=1.12) and C-Section delivery (odds ratio=1.25).

Table 5
Odds Ratios of Low and High weight gain vs. Normal weight gain (according to IOM Guidelines) on Selected Pregnancy Outcomes: Missouri Resident Singleton full-term Pregnancies 2004-2008

	Low vs. Normal			*High vs. Normal*		
	Odds	*95 percent*		*Odds*	*95 percent*	
Outcome	*Ratio*	*confidence interval*		*Ratio*	*confidence interval*	
Low birth weight (<2500 grams)	**1.81**	**1.71**	**1.91**	**0.56**	**0.53**	**0.60**
Apgar Score at 5 min. < 7	1.02	0.93	1.11	**1.12**	**1.05**	**1.19**
Macrosomia (>4499 grams)	**0.67**	**0.57**	**0.77**	**2.66**	**2.44**	**2.89**
C-Section	**0.94**	**0.92**	**0.97**	**1.25**	**1.23**	**1.28**
Congenital anomalies	1.17	1.09	1.25	0.82	0.79	0.84
Fetal Death	**1.45**	**1.07**	**1.96**	0.91	0.70	1.17
Neonatal (<28 days) death	1.35	0.95	1.92	1.11	0.84	1.47
Post-neonatal (1-11 months) death	1.25	0.99	1.58	0.95	0.79	1.15
Perinatal (fetal or neonatal) death	**1.41**	**1.12**	**1.77**	0.99	0.82	1.20
Infant (<1 year) death	**1.28**	**1.05**	**1.56**	1.00	0.85	1.17
Fetal or infant death	**1.33**	**1.13**	**1.57**	0.97	0.85	1.11

Note: Odds ratios calculated using multivariate logistic regression with the following covariates: Pre-pregnancy BMI weight status, race, education, age, marital status, food stamp, and smoking status of mother and birth order.
Bold font indicates statistically significant difference between designated category and normal reference group.

Low weight gain was associated with increased fetal and infant death rates. There was no significant increase in the various mortality outcomes for those with excess weight gain. The odds ratios of low weight gain vs. normal weight gain were 1.45 for fetal deaths, 1.28 for infant deaths and 1.33 for either fetal or infant death. In Table 6 odds ratios of the extreme categories of less than 15 pounds or more than 44 pounds weight gain were compared with the middle category of 15-44 pounds. The patterns by pregnancy outcome were very similar to the patterns using the IOM categories. The only difference was that the odds ratios for the birth weight categories were slightly more elevated for the extreme categories.

To summarize, maternal weight gain during pregnancy has increased slightly (by about one pound on average) in the last 20 years. Only about one-third of Missouri mothers met the IOM guidelines for adequate weight gain during pregnancy in 2008. Low maternal weight gain was associated with anemia, lung disease, diabetes, precipitous labor, anesthetic complications, low birth weight and fetal and infant mortality. High maternal weight gain was associated with hypertension during pregnancy, numerous complications of labor, C-Sections, and macrosomia infants.

These findings are similar to those found in other studies of this kind[1-3]. They clearly suggest that mothers should gain a moderate amount of weight during pregnancy to improve both the outcomes of their pregnancies and their babies' health. Pregnant women

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should be encouraged to maintain a healthy diet, keep activity levels similar to pre-pregnant levels (depending on medical risk factors and the stage of pregnancy) and try to reduce stress levels in order to gain a moderate amount of weight during pregnancy.

Whether the IOM guidelines are the best and only measure of what a moderate amount of weight gain should be is another question and could not really be answered with this limited study. The recommended weight ranges of the guidelines could probably be expanded somewhat without sacrificing bad outcomes. As Abrams observed, the risk of cesarean delivery increases with increasing weight gain, the relationship is continuous and there appears to be no threshold above which the risk of cesarean delivery accelerates[1]. Similarly, the risk of low birth weight increases with decreasing weight gain on a continuous basis. Therefore, any cutoffs or guidelines must be somewhat subjective.

References:

1. Abrams, B, Altman, SB, Pickett, KE. Pregnancy weight gain: still controversial. American Journal of Clinical Nutrition May 2000:71 1223-1241.

2. Crane JM, White J, Murphy P, Burrage L, Hutchens D. The effect of gestational weight gain by body mass index on maternal and neonatal outcomes J Obstet Gynaecol Can. Jan 2009: 31: 28-35

3. Institute of Medicine. Weight Gain During Pregnancy: Reexamining the Guidelines; Committee to Reexamine IOM Pregnancy weight Guidelines; Sponsor Briefing May 27, 2009.

Table 6

Odds Ratios of <15 lbs and 45+ lbs weight gain vs. 15-44 lbs weight gain on Selected Pregnancy Outcomes: Missouri Resident Singleton full-term Pregnancies 2004-2008

	< 15 lbs vs. 15-44 lbs			*45+ lbs vs. 15-44 lbs*		
	Odds	*95 percent*		*Odds*	*95 percent*	
Outcome	*Ratio*	*confidence interval*		*Ratio*	*confidence interval*	
Low birth weight (<2500 grams)	**2.01**	**1.87**	**2.15**	**0.46**	**0.43**	**0.50**
Apgar Score at 5 min. < 7	1.01	0.91	1.11	**1.15**	**1.07**	**1.23**
Macrosomia (>4499 grams)	**0.56**	**0.49**	**0.64**	**3.08**	**2.89**	**3.30**
C-Section	**0.89**	**0.86**	**0.91**	**1.37**	**1.34**	**1.39**
Congenital anomalies	0.94	0.84	1.05	0.94	0.87	1.02
Fetal Death	**1.38**	**1.01**	**1.90**	0.75	0.55	1.01
Neonatal (<28 days) death	1.28	0.87	1.87	1.05	0.78	1.41
Post-neonatal (1-11 months) death	**1.34**	**1.04**	**1.74**	0.96	0.78	1.19
Perinatal (fetal or neonatal) death	**1.34**	**1.05**	**1.71**	0.88	0.71	1.09
Infant (<1 year) death	**1.32**	**1.07**	**1.64**	0.99	0.83	1.17
Fetal or infant death	**1.34**	**1.12**	**1.60**	0.92	0.79	1.06

Note: Odds ratios calculated using multivariate logistic regression with the following covariates: Pre-pregnancy BMI weight status, race, education, age, marital status, food stamp, and smoking status of mother and birth order.
Bold font indicates statistically significant difference between designated category and 15-44 pound weight gain reference group.