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Trends in gestational weight gain: the Pregnancy Risk Assessment Monitoring System, 2000-2009

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OBSTETRICS

Trends in gestational weight gain: the Pregnancy Risk Assessment Monitoring System, 2000–2009

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OBJECTIVE: Achieving adequate gestational weight gain (GWG) is important for optimal health of the infant and mother. We estimate current population-based trends of GWG.

STUDY DESIGN: We analyzed data from the Pregnancy Risk Assessment Monitoring System for 124,348 women who delivered live infants in 14 states during 2000 through 2009. We examined prevalence and trends in GWG in pounds as a continuous variable, and within 1990 Institute of Medicine (IOM) recommendations (yes/no) as a dichotomous variable. We examined adjusted trends in mean GWG using multivariable linear regression and GWG within recommendations using multivariable multinomial logistic regression.

RESULTS: During 2000 through 2009, 35.8% of women gained within IOM GWG recommendations, 44.4% gained above, and 19.8% gained below. From 2000 through 2009, there was a biennial 1.0 percentage point decrease in women gaining within IOM GWG recommendations (P trend $< .01$) and a biennial 0.8 percentage point increase in women gaining above IOM recommendations (P trend $< .01$). The percentage of women gaining weight below IOM recommendations remained relatively constant from 2000 through 2009 (P trend $= .14$). The adjusted odds of gaining within IOM recommendations were lower in 2006 through 2007 (adjusted odds ratio, 0.90; 95% confidence interval, 0.85–0.96) and 2008 through 2009 (adjusted odds ratio, 0.90; 95% confidence interval, 0.85–0.96) relative to 2000 through 2001.

CONCLUSION: Overall, from 2000 through 2009 the percentage of women gaining within IOM recommendations slightly decreased while mean GWG slightly increased. Efforts are needed to develop and implement strategies to ensure that women achieve GWG within recommendations.

Key words: gestational weight gain, Institute of Medicine gestational weight gain recommendations, Pregnancy Risk Assessment Monitoring System, prepregnancy body mass index, trend

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Gestational weight gain (GWG), defined as maternal weight gain during pregnancy, may affect the health and well-being of infants and mothers.[1,2] Women who gain below Institute of Medicine (IOM) recommendations are more likely to experience preterm birth[3,4] and have infants with poor fetal growth and/or low birthweight.[3,5] Women who gain above recommendations may experience pregnancy complications such as preeclampsia and gestational diabetes, and complications of labor and delivery such as cesarean.[3,4,6] Additionally, pregnancies among women who gain above recommendations are associated with fetal complications such as macrosomia and large for gestational age.[3-5,7,8] Long-term outcomes of excessive GWG include increased risk of overweight or obesity for the child[4,6,9] and weight retention for the mother leading to overweight and obesity beyond pregnancy.[4,10,11]

To help clinicians monitor appropriate GWG, the IOM established recommendations in 1990[12] and updated those recommendations in 2009.[1] IOM recommendations for GWG are based on a woman's prepregnancy body mass index (BMI) (Metropolitan Life Insurance BMI cut points in 1990; World Health Organization [WHO] BMI cut points in 2009).[13] A 2009 IOM report using population-based data from the Pregnancy Risk Assessment Monitoring System (PRAMS) examined trends in

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GWG from 1993 through 2003 among women with singleton, term infants in 8 states.[1] Findings from the 10-year period showed increases in the proportion of women gaining above 1990 IOM GWG recommendations among normal-weight, overweight, and obese women. By 2002 through 2003, 63% of overweight and 46% of obese women had GWG above 1990 IOM recommendations. However, more recent population-based estimates of trends in GWG have not been reported.

Trends in GWG are particularly of interest since prepregnancy BMI has increased over time in the United States.[14-16] It is unclear whether US trends in GWG paralleled the increasing trend in prepregnancy BMI. This analysis estimates current trends in GWG by prepregnancy BMI among women who delivered singleton infants during 2000 through 2009, when 1990 IOM recommendations were in effect.

Materials and Methods

We used data from the PRAMS, an ongoing, state-representative, population-based surveillance system of the Centers for Disease Control and Prevention (CDC) and state health departments. PRAMS collects information in participating states about maternal behaviors and experiences before, during, and after pregnancies resulting in live infants. In each participating site, PRAMS uses birth certificates to draw a stratified sample of live births, and oversamples certain high-risk populations. Self-administered questionnaires are mailed to the mothers' homes, with telephone follow-up for nonresponders. Data from maternal questionnaires are linked to the data from the child's birth certificate. Data are weighted to account for sample design, nonresponse, and noncoverage. More detail on PRAMS methodology is available at http://www.cdc.gov/prams/methodology.htm.

We used 2000 through 2009 data from states that met the established PRAMS response rate threshold of ≥70% from 2000 through 2006, or ≥65% from 2007 through 2009. Year of infant birth, 2000 through 2009, was categorized into 2-year increments for this analysis (eg, 2000 through 2001, 2002 through 2003) to maximize the number of states eligible for inclusion in this analysis. Fourteen states met the response rate threshold criteria for at least 1 year in each 2-year increment from 2000 through 2009 (Alaska, Arkansas, Colorado, Hawaii, Maine, Maryland, Michigan, Nebraska, New York, Ohio, Oklahoma, Utah, Washington, and West Virginia). We included women who had a singleton live birth and were ≥18 years of age. We limited the analysis to women with full-term infants (37-41 weeks and 6 days' gestation) (n = 147,706) and conducted sensitivity analyses among women delivering infants at 39-40 weeks to limit confounding associated with pregnancy duration. Respondents were excluded if they had missing data on weight gain (5.9%) or prepregnancy BMI (4.8%), extreme values for BMI (<12 or >75 kg/m^2) (n = 48) or missing data on ≥1 covariates (9.4%). In total, 15.8% of respondents (n = 23,358) were excluded, resulting in a final sample size of 124,348 women. Mean infant age at time of PRAMS survey completion for women in this analysis was 112.6 days (SE 0.21). Compared to women included in the full analytic sample, women excluded due to missing data or extreme values were younger, less educated, less likely to gain above IOM GWG recommendations, less likely to smoke during pregnancy, less likely to report nausea during pregnancy, more likely to be a racial and ethnic minority, more likely to be Medicaid insured at delivery, more likely to have ≥1 previous births, and more likely to have gestational or preexisting diabetes (χ^2 $P < .05$ for all).

We used birth certificate data to categorize maternal race-ethnicity as: non-Hispanic white, non-Hispanic black, Hispanic, Alaska Native, American Indian, Asian/Pacific Islander, and other (women reporting mixed race or any race-ethnicity other than those described above). Using birth certificate data, we categorized self-reported age (18-19; 20-24; 25-29; 30-34; ≥35 years), education (less than high school; high school; greater than high school), parity (no previous birth; ≥1 previous births), gestational or preexisting hypertension (yes/no), and gestational or preexisting diabetes (yes/no). PRAMS questionnaires provided self-reported data on Medicaid coverage at delivery (yes/no), prenatal smoking (smoker throughout pregnancy; quit smoking before third trimester; nonsmoker), and nausea during pregnancy (yes/no).

The outcome for this analysis, self-reported GWG, was obtained from the birth certificate and modeled 2 ways: continuous GWG in pounds and as a categorical variable according to 1990 IOM GWG recommendations based on the woman's prepregnancy BMI. Prepregnancy BMI was calculated as (weight in kilograms)/(height in meters)^2, using self-reported height and weight from PRAMS questionnaires, and categorized according to the current WHO guidelines.[17] A woman was classified as gaining below, within, or above 1990 IOM recommendations based on her prepregnancy BMI. Weight gain within recommendations was defined as: 28-40 lb for underweight women (BMI <18.5 kg/m^2); 25-35 lb for women with a normal BMI (18.5 ≤ BMI <25 kg/m^2); 15-25 lb for overweight women (25 ≤ BMI <30 kg/m^2); and 15-25 lb for obese women (BMI ≥30 kg/m^2). For obese women, we used the maximum GWG of 25 lb recommended for overweight women because no maximum weight gain allowance was established for obese women in the 1990 IOM recommendations.

We calculated the mean and SE for GWG and the weighted prevalence and SE for 1990 IOM recommended GWG groups (below, within, and above) and for maternal and pregnancy characteristics. All estimates were calculated overall (2000 through 2009 combined) and by 2-year increments from 2000 through 2009. We used linear regression (for mean) and logistic regression (for categorical variables) models to examine trends in weight gain and in maternal and pregnancy characteristics. We conducted similar analyses on mean GWG and the prevalence of GWG below, within, and above IOM recommendations stratified by prepregnancy BMI. To estimate the magnitude of change in the prevalence estimates for statistically significant

TABLE 1
Sample characteristics by year among singleton full-term infants, PRAMS

Characteristic	Overall 2000 through 2009 n = 124,348 % (SE)[b]	Year categories: 2000 through 2001 n = 24,118	2002 through 2003 n = 25,726	2004 through 2005 n = 24,346	2006 through 2007 n = 25,254	2008 through 2009 n = 24,904	Trend 2000 through 2009 *P* value[a]
Mean gestational weight gain, lb[c]	31.3 (0.06)	31.2 (0.14)	31.4 (0.13)	31.2 (0.14)	31.3 (0.14)	31.4 (0.14)	.46
IOM[d]							
Below recommended guidelines	19.8 (0.18)	20.0 (0.42)	19.3 (0.38)	19.3 (0.39)	20.3 (0.39)	20.3 (0.38)	.14
Within recommended guidelines	35.8 (0.21)	37.5 (0.52)	37.0 (0.47)	36.2 (0.48)	34.3 (0.46)	34.2 (0.45)	< .01
Above recommended guidelines	44.4 (0.22)	42.5 (0.53)	43.7 (0.48)	44.5 (0.50)	45.4 (0.49)	45.5 (0.48)	< .01
Prepregnancy body mass index							
Underweight (<18.5 kg/m^2)	4.7 (0.09)	5.8 (0.25)	5.3 (0.22)	4.3 (0.20)	4.2 (0.19)	3.9 (0.18)	< .01
Normal (18.5–24.9 kg/m^2)	53.4 (0.22)	55.6 (0.53)	54.4 (0.48)	53.3 (0.50)	52.1 (0.49)	51.8 (0.48)	< .01
Overweight (25.0–29.9 kg/m^2)	23.3 (0.19)	21.7 (0.44)	22.7 (0.40)	22.9 (0.42)	24.7 (0.43)	24.3 (0.42)	< .01
Class I obesity (30.0–34.9 kg/m^2)	10.8 (0.14)	9.8 (0.32)	10.7 (0.31)	11.3 (0.32)	10.9 (0.30)	11.2 (0.30)	< .01
Class II obesity (35.0–39.9 kg/m^2)	4.8 (0.10)	4.4 (0.23)	4.3 (0.20)	5.0 (0.23)	4.8 (0.21)	5.2 (0.22)	< .01
Class III obesity (≥40 kg/m^2)	3.1 (0.08)	2.8 (0.18)	2.6 (0.15)	3.2 (0.19)	3.3 (0.18)	3.5 (0.18)	< .01
Age, y							
18-19	6.7 (0.12)	7.2 (0.28)	6.5 (0.25)	6.2 (0.26)	7.1 (0.27)	6.6 (0.25)	.51
20-24	24.7 (0.19)	24.9 (0.46)	25.3 (0.42)	24.9 (0.43)	24.7 (0.42)	24.0 (0.41)	.07
25-29	29.9 (0.20)	29.2 (0.48)	28.4 (0.44)	29.5 (0.46)	30.6 (0.45)	31.6 (0.45)	< .01
30-34	24.5 (0.19)	25.2 (0.47)	25.6 (0.42)	24.2 (0.43)	23.7 (0.41)	24.1 (0.41)	< .01
≥35	14.2 (0.15)	13.5 (0.36)	14.3 (0.33)	15.1 (0.35)	14.0 (0.32)	13.8 (0.31)	.93
Race/ethnicity							
White, non-Hispanic	74.3 (0.17)	77.5 (0.38)	76.0 (0.36)	74.3 (0.42)	73.3 (0.37)	71.2 (0.37)	< .01
Black, non-Hispanic	9.6 (0.12)	8.4 (0.24)	10.1 (0.26)	9.2 (0.31)	9.7 (0.24)	10.6 (0.24)	< .01
Hispanic	9.2 (0.12)	8.2 (0.27)	8.2 (0.23)	9.7 (0.28)	9.8 (0.27)	9.8 (0.25)	< .01
American Indian/ Alaska Native	1.5 (0.04)	1.5 (0.10)	1.3 (0.07)	1.5 (0.09)	1.6 (0.09)	1.6 (0.08)	.19
Asian/Pacific Islander	4.5 (0.07)	4.2 (0.16)	4.3 (0.16)	4.4 (0.15)	4.7 (0.16)	4.8 (0.15)	< .01
Other	0.9 (0.05)	0.2 (0.05)	0.2 (0.04)	1.1 (0.12)	1.0 (0.10)	2.0 (0.14)	< .01

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trends in GWG groups (below, within, above recommendations), the biennial percentage point change was estimated from the beta coefficient of the infant's birth year. Lastly, we examined the adjusted trend from 2000 through 2009 in mean GWG using linear regression, with year of infant birth as the independent variable and adjusted for all

TABLE 1
Sample characteristics by year among singleton full-term infants, PRAMS *(continued)*

Characteristic	Year categories: Overall 2000 through 2009 n = 124,348 % (SE)[b]	2000 through 2001 n = 24,118	2002 through 2003 n = 25,726	2004 through 2005 n = 24,346	2006 through 2007 n = 25,254	2008 through 2009 n = 24,904	Trend 2000 through 2009 *P* value[a]
Education, y							
<12	12.0 (0.15)	11.7 (0.36)	12.5 (0.34)	11.9 (0.35)	12.3 (0.35)	11.6 (0.32)	.56
12	30.3 (0.20)	33.2 (0.51)	31.9 (0.45)	30.6 (0.46)	28.9 (0.44)	27.3 (0.43)	< .01
>12	57.7 (0.22)	55.1 (0.53)	55.6 (0.48)	57.5 (0.49)	58.8 (0.48)	61.2 (0.47)	< .01
Parity							
0	39.2 (0.22)	38.9 (0.52)	39.0 (0.47)	38.7 (0.49)	39.9 (0.48)	39.3 (0.47)	.30
≥1	60.8 (0.22)	61.1 (0.52)	61.0 (0.47)	61.3 (0.49)	60.1 (0.48)	60.7 (0.47)	.30
Insurance coverage at delivery							
Medicaid	35.5 (0.21)	28.4 (0.47)	32.2 (0.45)	37.2 (0.49)	38.1 (0.47)	40.5 (0.47)	< .01
Other insurance/ uninsured	64.5 (0.21)	71.6 (0.47)	67.8 (0.45)	62.8 (0.49)	61.9 (0.47)	59.5 (0.47)	< .01
Prenatal smoking							
Smoker throughout pregnancy	14.2 (0.16)	14.7 (0.40)	14.1 (0.35)	14.6 (0.37)	13.7 (0.35)	13.9 (0.35)	.08
Quit smoking before third trimester of pregnancy	11.2 (0.14)	10.6 (0.34)	11.1 (0.31)	10.8 (0.32)	11.5 (0.32)	11.8 (0.32)	< .01
Nonsmoker	74.7 (0.20)	74.7 (0.48)	74.9 (0.43)	74.6 (0.45)	74.8 (0.43)	74.3 (0.43)	.54
Gestational or preexisting hypertension	4.6 (0.09)	4.3 (0.20)	4.7 (0.20)	4.8 (0.21)	4.5 (0.19)	4.6 (0.20)	.61
Gestational or preexisting diabetes	3.7 (0.08)	3.3 (0.19)	3.5 (0.18)	3.4 (0.18)	4.3 (0.20)	4.1 (0.19)	< .01
Nausea during pregnancy	73.1 (0.20)	75.0 (0.47)	75.1 (0.42)	71.2 (0.46)	72.1 (0.44)	72.5 (0.43)	< .01

BMI, body mass index; *IOM*, Institute of Medicine; *PRAMS*, Pregnancy Risk Assessment Monitoring System.

[a] *P* values for trend generated from unadjusted regression models; [b] Weighted data; [c] Mean gestational weight gain trend indicated by pounds (SE); [d] Gaining within IOM guidelines: 28–40 lb for underweight women (BMI <18.5 kg/m^2); 25–35 lb for normal-weight women (18.5 ≤ BMI <25 kg/m^2); 15–25 lb for overweight women (25 ≤ BMI <30 kg/m^2); and 15–25 lb for obese women (BMI ≥30 kg/m^2).

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maternal and pregnancy characteristics. Similarly, we used multivariable logistic regression to generate adjusted odds ratios (aOR) and 95% confidence intervals (CI) for gaining within (yes/no) IOM recommendations for GWG for each 2-year increment (2002 through 2003, 2004 through 2005, 2006 through 2007, and 2008 through 2009), compared with the reference group, 2000 through 2001. For all analyses we considered a $P < .05$ as statistically significant. All analyses were conducted with SAS 9.2 (SAS Institute, Cary, NC) and SUDAAN 10.0.1 (RTI International, Research Triangle Park, NC) to account for the PRAMS complex survey design and weighted to reflect population estimates. The CDC Institutional Review Board approved the PRAMS protocol, and all participating states approved the analysis plan for the study.

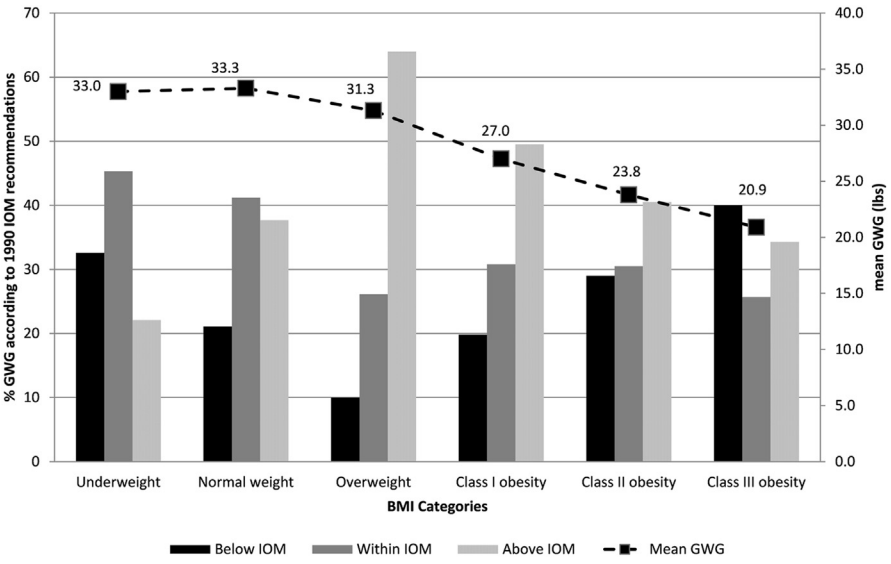
Results

Women in the sample had an overall mean GWG of 31.3 lb. Approximately 35.8% of women had GWG within IOM recommendations, 44.4% gained above recommendations, and 19.8% gained below recommendations (Table 1). Of the 124,348 women in the final sample, the majority had a normal prepregnancy BMI (53.4%), were <30 years of age (61.3%), were non-Hispanic white (74.3%), had a post-high school education (57.7%), were multiparous (60.8%), were not enrolled in Medicaid at delivery (64.5%), were nonsmokers before pregnancy (74.7%), did not report preexisting or gestational diabetes (96.3%) or hypertension (95.4%), and reported nausea during pregnancy (73.1%).

Among women in this sample, unadjusted mean GWG remained relatively constant from 2000 through 2001 (31.2 lb) to 2008 through 2009 (31.4 lb) (P trend = .46) (Table 1). There was a statistically significant 1.0 biennial percentage point decrease from 2000 through 2001 (37.5%) to 2008 through 2009 (34.2%) in the percentage of women who gained weight within IOM recommendations (P trend < .01) (Table 1). In addition, there was a significant 0.8 biennial percentage point increase from 2000 through 2001 (42.5%) to 2008 through 2009 (45.5%) in the percentage of women who gained weight above IOM recommendations (P trend < .01) (Table 1). The percentage of women who gained weight below IOM recommendations remained relatively constant from 2000 through 2001 (20.0%) to 2008 through 2009 (20.3%) (P trend = .14). There was a statistically significant decrease from 2000 through 2009 in the percentage of women who were underweight (P trend < .01) or had a normal prepregnancy BMI (P trend < .01). Additionally, there were significant increases from 2000 through 2009 in the percentages of women who were overweight (P trend < .01) or class I, II, and III obese (P trend < .01 for all) before pregnancy (Table 1). From 2000 through 2009, there were also statistically significant changes in all other variables examined, except parity and hypertension (P trend < .05).

Overall, mean GWG decreased as prepregnancy BMI increased (Figure 1). Normal-weight women had the greatest mean GWG, 33.3 lb (SE 0.07) and obese, class III women had the lowest mean GWG, 20.9 lb (SE 0.41). Overweight (31.3 lb) and obese, class I (27 lb) women both had a mean GWG >25 lb, the upper limit recommended for GWG for overweight and obese women. Additionally, GWG below recommendations was highest for obese, class III women (40%) followed by women who were underweight (32.6%). Underweight women (45.3%) and normal-weight women (41.2%) had the largest proportion of women gaining within IOM recommended levels. Class III obese women had the smallest proportion gaining within IOM recommended levels (25.7%). Overweight (64%) and class I obese (49.5%) women were the 2 groups with the largest proportions gaining above IOM recommendations (Figure 1).

FIGURE 1
Distribution of GWG by mean and 1990 IOM recommendations, PRAMS



Percentage of women gaining according to 1990 Institute of Medicine (IOM) recommendations by prepregnancy body mass index (BMI) status on left y-axis and distribution of mean gestational weight gain (GWG) by prepregnancy BMI status on right y-axis.

PRAMS, Pregnancy Risk Assessment Monitoring System.

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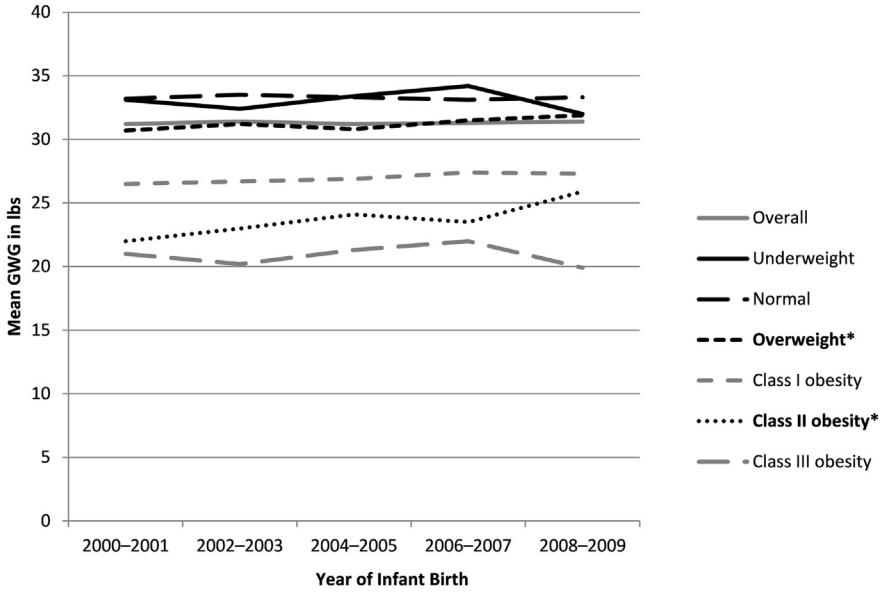
In Figure 2, we present unadjusted trends from 2000 through 2009 in mean GWG overall and stratified by prepregnancy BMI. In the unadjusted model, no statistically significant change was seen in mean GWG from 2000 through 2009 for the entire sample combined. Results were unchanged after adjusting for confounders (data not shown). There were statistically significant increases in mean GWG from 2000 through 2009 among overweight and class II obese women (P trend < .01 for both); results remained after adjusting for confounders (P trend < .01 for both; data not shown).

In Figure 3, we present trends in GWG within 1990 IOM recommendations overall and stratified by prepregnancy BMI. There was a statistically significant decreasing trend from 2000 through 2009 in GWG within IOM recommendations among all women combined (37.5-34.2%), normal-weight women (42.5-39.9%), overweight women (27.4-24.2%), and class III obese women (25.1-22.5%) (P trend < .05 for all); these results remained after adjusting for confounders (P trend < .05 for all, data not shown). When adjusting for maternal and pregnancy characteristics in a logistic regression model among all women combined, the odds of gaining within IOM recommendations were lower in 2006 through 2007 (aOR, 0.90; 95% CI, 0.85−0.96) and 2008 through 2009 (aOR, 0.90; 95% CI, 0.85−0.96) relative to 2000 through 2001 (Table 2).

Comment

We examined trends in GWG from 2000 through 2009 in a US state-representative, population-based sample and found that among women with singleton, full-term live birth, there has been a significant decrease in the proportion gaining within IOM recommendations, falling from 37.5% in 2000 through 2001 to 34.2% in 2008 through 2009, while the proportion gaining

FIGURE 2
Trends in mean GWG by prepregnancy BMI, PRAMS



*P-value for trend <.05

Unadjusted trends from 2000 through 2009 in mean gestational weight gain (GWG) overall and stratified by prepregnancy body mass index (BMI).

PRAMS, Pregnancy Risk Assessment Monitoring System.

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above IOM recommendations increased from 42.5-45.5% during the same time period. However, these trends differed by prepregnancy BMI. Specifically, normal-weight and overweight women had significant decreases in GWG within IOM 1990 recommendations from 2000 through 2009. In addition, overweight and class II obese women had significant increases in mean GWG over time.

The decreasing percentage of women gaining within IOM recommendations during our study period may be influenced by increases in mean GWG, as well as increases in prepregnancy BMI during the same time period. Our results show an increasing trend from 2000 through 2009 in the percent of women who were overweight and obese before pregnancy, similar to other studies using PRAMS data.[9,14,15] Class III obese and overweight women had the smallest prevalence of GWG within IOM recommendations (26%) and the prevalence of women who were class III obese and overweight rose from 2.8% and 21.7% in 2000 through 2001 to 3.5% and 24.3% in 2008 through 2009, respectively.

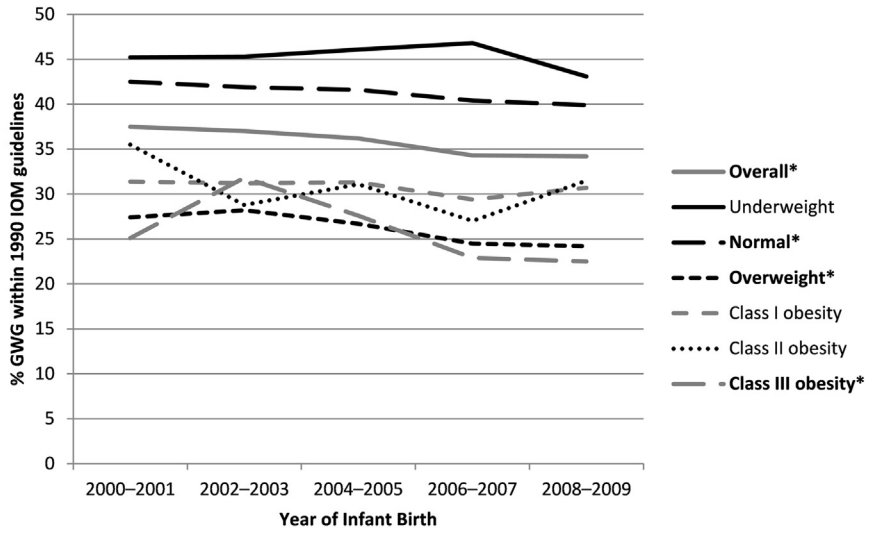
There have been 2 other reports of GWG trends using population-based data. The first assessed unadjusted 10-year trends in GWG according to 1990 IOM recommendations from 1993 through 1994 to 2002 through 2003 using PRAMS data from 8 states.[1] The second included only low-income women attending The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) clinics in 26 states, 5 Tribal Nations, and 1 US Territory from 1997 through 2007.[1] Similar to ours, both prior studies found an increase over time in the proportion of women gaining above 1990 IOM recommendations with less than one third of obese women and less than half of women in any BMI category gaining within IOM GWG recommendations. Our study is the first to report GWG trends by obesity class and to examine trends adjusted for demographic and health characteristics.

Our study has both strengths and limitations. The sample was large, population-based, and used 10 years of data from 14 states in geographically distinct regions of the country for women with term births (37-41 weeks and 6 days' gestation). In the sensitivity analyses examining trends in GWG among women with term infants at 39-40 weeks, trends in GWG within and above IOM recommendations were similar to those reported among all term births at 37-41 weeks and 6 days' gestation. Limitations of this study include use of self-reported weight and height data. Due to possible underestimating of weight data,[18] BMI and GWG may be underestimated.[18-20] Although the IOM recommendations were revised in 2009, almost all respondents in this sample would have been advised according to 1990 IOM recommendations. Finally, the characteristics of women included in our sample differed from those excluded. However, trends in GWG remained when women with missing demographic information were included in unadjusted analyses.

We did not examine how changes in prepregnancy BMI and GWG impacted pregnancy outcomes over the study period. However, our findings that prepregnancy BMI and GWG above IOM recommendations have both increased from 2000 through 2009 may affect the health of mothers and infants.[21] Gaining above IOM GWG recommendations may increase risk of having a large-for-gestational-age infant and cesarean delivery.[1,3] Additionally, GWG within recommendations decreases the probability of women retaining excess weight long-term, reducing their risk of both chronic disease and, possibly, entering a subsequent pregnancy at a higher BMI.

Our results may inform clinical and public health practice as well as policy as we show little evidence that efforts to encourage women to gain within GWG recommendations have worked. The American Congress of Obstetricians and Gynecologists (ACOG) and others currently recommend that women be informed of their BMI and

FIGURE 3
GWG within 1990 IOM recommendations by prepregnancy BMI, PRAMS



*P-value for trend <.05

Trends in gestational weight gain (GWG) within 1990 Institute of Medicine (IOM) recommendations overall and stratified by prepregnancy body mass index (BMI).

PRAMS, Pregnancy Risk Assessment Monitoring System.

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GWG recommendation early in and periodically throughout pregnancy, and that they be counseled about diet and physical activity before and during pregnancy to promote healthy GWG.[13,22-25] ACOG also encourages obstetricians to counsel obese women considering pregnancy on maternal and fetal risk of obesity in pregnancy and emphasize the importance of weight loss before pregnancy.[23] ACOG surveys of obstetrician/gynecologists' practices suggests that the majority report counseling pregnant women on GWG and non-pregnant women on weight control.[25,26] These efforts may not be sufficient. Recent systematic reviews of interventions to prevent excess GWG indicate that diet-focused behavioral interventions, compared to interventions focused on physical activity or mixed approaches, may be effective at reducing GWG.[27,28] Key components of diet-focused interventions include educating on the consequences of the behavior, self-monitoring of behavior, contingency rewards for successful behavior, and motivational interviewing.[27] It remains unclear, however, how the effectiveness of diet-focused interventions to reduce GWG vary by an individual's sociodemographic characteristics.[28] There is also evidence that interventions may be more effective if community-based strategies are incorporated, which encourage change in social and behavioral attitudes and norms towards diet and exercise in pregnancy.[29] Common beliefs about nurturing behaviors during pregnancy often dominate and contradict obstetrician/gynecologist advice to prevent excess weight gain during pregnancy. Cultural and social sensitivity training for health care professionals communicating messages on weight gain during pregnancy and increased public awareness of the consequences of excess weight gain during pregnancy are needed to improve effectiveness of GWG counseling.[29]

In summary, our findings show that from 2000 through 2009, 64.2% of pregnant women did not gain weight within 1990 IOM recommendations and, overall, the percentage of women gaining within IOM recommendations decreased over time. Trends in GWG varied by prepregnancy BMI; however no groups saw improvements over time. Given the more conservative 2009 GWG IOM recommendation for obese women of 11-20 lb, if nothing changes, future data may show a larger percentage of women gaining above recommendations. Therefore, additional efforts are needed to encourage a healthy weight before pregnancy[22] and ensure appropriate weight gain for all pregnant women. Results from this analysis highlight the need for continued clinical and public health efforts toward developing and scaling up effective strategies to ensure women enter pregnancy at a healthy weight and achieve GWG within recommended levels. ■

TABLE 2
Adjusted odds ratios for gaining within 1990 IOM recommendations, PRAMS

	Gaining within IOM recommendations[a]	
Year of infant birth	aOR[b]	95% CI
2000 through 2001	1.00	—
2002 through 2003	0.99	0.93–1.05
2004 through 2005	0.97	0.92–1.03
2006 through 2007	0.90	0.85–0.96
2008 through 2009	0.90	0.85–0.96

aOR, adjusted odds ratio; *CI*, confidence interval; *IOM*, Institute of Medicine; *PRAMS*, Pregnancy Risk Assessment Monitoring System.

[a] n = 124,348; [b] Reference category is gaining below or above IOM recommendations; model adjusted for body mass index, age, maternal race-ethnicity, education, parity, Medicaid insurance coverage at delivery, prenatal smoking, gestational or preexisting hypertension and diabetes, and nausea during pregnancy.

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