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

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