# Gestational Weight Gain in Adolescent Compared with Adult Pregnancies: An Age-Specific Body Mass Index Approach

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**Objective** To determine current trends in gestational weight gain (GWG) in adolescents, using adolescent specific body mass index (BMI), in relation to the 2009 Institute of Medicine GWG guidelines.

**Study design** Population-based retrospective cohort using Ohio birth records (2006-2012). Analyses were limited to primiparous women with singleton nonanomalous live births and available data on BMI and GWG. GWG percentiles were stratified by maternal age (less than 15, 15-17, 18-19, and 20-34 years old) and prepregnancy BMI category. Adolescent specific BMI definitions were used for mothers less than 19 years.

**Results** A total of 1 034 552 births occurred during the study period; 326 368 were included for analysis. Less than one-quarter of women gained the recommended amount of weight (20.6%). A large proportion of pregnancies had excessive GWG: 59.8% of mothers less than 15 years of age, compared with older adolescent (59.9%, 62.6%) and adult mothers (64.6%), $P < .001$. Average, median, and IQRs of GWG were similar for all women within the same BMI category, regardless of age. Except in underweight women, the average GWG was at the high end or above the 2009 Institute of Medicine recommendations, for adolescents in all BMI groups, similar to adults, median 35 (IQR 24-47) pounds.

**Conclusions** Current GWG trends indicate that excessive weight gain is nearly as common in adolescents as in adult mothers. *(J Pediatr 2015;167:579-85)*.

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Adolescence is an independent risk factor for adverse pregnancy outcomes for both the mother and the neonate.[1-5] Compared with adult pregnancy, adolescent pregnancy carries higher risk of prematurity,[2] low birth weight (LBW),[3] small for gestational age (SGA),[3] maternal anemia,[6] preeclampsia,[5] eclampsia,[5] and fetal and neonatal mortality.[5] Previous studies have shown excessive gestational weight gain (GWG) in teens to be deleterious[7] but also protective against preterm birth[8] when compared with teens with normal GWG.

The optimal amount of GWG for adolescent pregnancies remains unclear. In 2009, updated Institute of Medicine (IOM) recommendations were published for GWG in adults based on short- and long-term health consequences for the mother and child believed to be related to GWG.[9] These recommendations use World Health Organization (WHO) criteria for adult body mass index (BMI) and attempt to balance the risks of low GWG with the risks of excessive GWG. The IOM recommended GWG is 28-40 pounds in adult underweight women, 25-35 pounds in normal weight women, 15-25 pounds in overweight women, and 11-20 pounds in obese women.[9] The 1990 IOM GWG guidelines recommended that adolescents gain at the upper limit of what was recommended for adults.[9] The 2009 IOM recommendations for GWG, however, drop this guideline because of insufficient evidence supporting a modification of GWG recommendation for adolescents.[9] In addition, the 2009 IOM guidelines proposed that adolescent prepregnancy BMI be categorized by using the WHO cut-off points for adults.[9] The 2009 report acknowledged that adolescents who follow adult BMI cut-off points will likely be categorized into a lighter group and, thus, advised to gain more.[9] The report justifies this BMI categorization by stating that adolescents often need to gain more to improve birth outcomes.[9] However, outside of pregnancy, it is not standard practice to categorize adolescent BMI using adult cut-offs, and rather an age-stratified percentile-based categorization scheme is recommended.[10]

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| BMI | Body mass index |
| CDC | Centers for Disease Control and Prevention |
| GWG | Gestational weight gain |
| IOM | Institute of Medicine |
| LBW | Low birth weight |
| SGA | Small for gestational age |
| WHO | World Health Organization |

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Studies have examined patterns of GWG in adults according to the 1990 IOM GWG guidelines and have shown that most women do not gain within the recommended amount.[11,12] To date, no studies have compared patterns of adolescent GWG based on the new 2009 IOM GWG guidelines to adult patterns of GWG. In adolescents, BMI ranges are specific to age and sex and those ranges differ from those of adults.[13] For example, a BMI of 17.5 is considered underweight in an adult woman but normal weight in a 16-year-old. Thus, when adolescents are categorized using adult BMI cut-offs, they can be put into a lower BMI category and advised to gain more weight. This study aims to elucidate GWG in adolescents compared with adults, using adolescent specific BMI, which differs from BMI categorization in adults.

## Methods

We performed a retrospective population-based cohort study of live births in Ohio occurring between the years 2006 and 2012 using birth certificate data. The exposure variable for this study was maternal age. Pregnancies among women of young maternal age <20 years were compared with births among an adult age reference group, age 20-34 years. The National Center for Health Statistics reports teen pregnancy rates to mothers aged 15-19 years but, by definition, teenage years span from 13-19 years.[14] As we did not want to exclude at-risk young mothers from the exposure group, we defined our primary exposure group of adolescent mothers as age 19 years and younger. We then stratified the analysis into 3 adolescent age groups: <15 years, 15-17 years, and 18-19 years. GWG was also compared between women, both adolescent and adult, in different BMI categories: underweight, normal weight, overweight, and obese. This study was exempt from review by the Institutional Review Board at the University of Cincinnati.

The primary outcome was GWG in adolescents and adults. GWG was defined as the mother's recorded prepregnancy weight subtracted from the mother's weight measured at time of delivery. The 2009 IOM GWG recommendations vary based on the prepregnancy BMI category: underweight (recommended GWG 28-40 pounds), normal weight (recommended GWG 25-35 pounds), overweight (recommended GWG 15-25 pounds), or obese (recommended GWG 11-20 pounds). Categories of GWG were defined as low, appropriate, or excessive based on the mother's prepregnancy BMI and her amount of GWG.

In women 20 years of age and older, BMI categories were defined according to WHO adult BMI guidelines: <18.5 underweight, 18.5-24.9 normal, 25.0-29.9 overweight, and ≥30.0 obese.[15] In women 19 years and younger, BMI categories were defined using WHO age- and sex-specific BMI percentiles that are based on an international population of children, including those from the US, selected to represent optimum growth.[13] In women 19 years and younger, BMI categories were separated by underweight less than 5th percentile for age, normal weight 5th to less than the 85th percentile for age, overweight 85th to less than the 95th percentile for age, and obese equal or greater than the 95th percentile for age as per the Centers for Disease Control and Prevention (CDC) guidelines.[16]

The dataset used for this study included all live births in Ohio from 2006 to 2012, N = 1 034 552. Births missing gestational age data or with gestational age >42 weeks or <20 weeks, births to multiparous mothers (parity >1) or those with missing parity data, missing maternal age, multifetal pregnancy (twins and higher order) or missing plurality data, births complicated by congenital anomalies or genetic abnormalities, and births missing GWG data were not included in this analysis. To account for the effect of gestational age on GWG, the GWG was divided by the gestational age and then multiplied by 40 weeks.[17] Our study was limited to mothers aged 34 and younger, resulting in a total of 326 368 live-born singleton births to primiparous mothers in the final cohort (**Figure 1**; available at www.jpeds.com). There was minimal missing data for other variables of interest: maternal race (1.04%), marital status (0.08%), education (0.39%), type of insurance (3.27%), Special Supplemental Nutrition Program for Women, Infants, and Children use (1.41%), tobacco use (0.49%), number of prenatal care visits (8.90%), prepregnancy hypertension (1.19%), and prepregnancy diabetes (1.19%).

Maternal age, height, prepregnancy weight, and delivery weight were abstracted from the patient's medical record as specified by the US National Vital Statistics System Guide to Completing the Facility Worksheets for the Certificate of Live Birth, and were recorded in the birth certificate.[18] BMI was calculated from the patient's recorded height and prepregnancy weight. Limited prenatal care was defined as ≤5 visits. Other covariates of interest were defined as specified in the US National Vital Statistics guide: race (white, African American, Native American, Chinese, Japanese, Hawaiian, Filipino, Other Asian or Pacific Islander, other nonweight, not classifiable), marital status (ever married or not), education (8th grade or less, 9th through 12th grade, high school graduate or general educational development completed, some college credit, associate degree, bachelor's degree, master's degree, doctorate degree or professional degree, unknown), insurance (private, self-pay, Indian Health Service, other government, other, unknown), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) use (yes, no, unknown), tobacco use (if used during pregnancy or not), prepregnancy hypertension, and prepregnancy diabetes.[18]

### Statistical Analyses

Statistical analyses were performed using Stata Release 12.1 software (StataCorp, College Station, Texas). GWG percentiles were calculated and stratified by maternal age and prepregnancy BMI. Demographic characteristics of the groups were analyzed using ANOVA for continuous variables and $\chi^2$ tests for categorical variables. Multivariate logistic regression estimated the association between age and GWG after