Gestational Weight Gain in Adolescent Pregnancy: A Study among Sisters

Jeanene Johnson

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University of Washington School of Public Health
Department of Epidemiology
Maternal & Child Public Health Leadership Training Program
Background

- Adolescent girls continue to grow for up to 5 years after menarche

- Adolescent pregnancy complicates growth process
  - Reduced potential skeletal growth in mothers and reduced infant birth weight

- Clinical research indicates that fetus and adolescent mother compete for nutrients

- Possible that larger weight gains than those recommended for adults may be appropriate for adolescents in order to permit simultaneous growth of the mother and fetus
Background

- Some studies do not support the hypothesis of fetal-maternal growth competition
- Much recent research focuses on excessive gestational weight gain in adolescents
  - Concerns about high postpartum weight retention and long-term consequences of overweight and obesity
- Issue of appropriate gestational weight gain in adolescent pregnancy remains controversial
Background

Gestational weight gain guidelines (IOM)

- **1990**: Adolescents should gain in the upper end of the recommended range
- **2009**: Adolescents should gain in the same ranges as adults until further research is available

<table>
<thead>
<tr>
<th>Pre-pregnancy BMI</th>
<th>Recommended Total Weight Gain Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>28-40 lbs</td>
</tr>
<tr>
<td>Normal</td>
<td>25-35 lbs</td>
</tr>
<tr>
<td>Overweight</td>
<td>15-25 lbs</td>
</tr>
<tr>
<td>Obese (all classes)</td>
<td>11-20 lbs</td>
</tr>
</tbody>
</table>
Study objective

To evaluate the difference in association between gestational weight gain and infant birth weight in adolescent and adult primiparas
Study design

**Design:** Population based, retrospective cohort

**Data source:**
- ‘Sisters’ dataset (UW)
- Births in Washington state 1987-2008
- ~43,000 sister pairs
- Maternally linked birth certificate and hospital discharge (CHARS) data
Study design

Inclusion criteria:

- Full biological sister pairs
- One sister age ≤18 at delivery
- Other sister age 22-34 at delivery
- First pregnancy
- Full-term (37-42 weeks gestation), singleton infant
- Excluded if infant had any type of malformation
- Excluded if BW or GWG was missing for either sister
Exposure:  Gestational weight gain (GWG), (kg)
Outcome:  Birth weight (BW), (g)
Model:  BW as a function of GWG, maternal age group (adolescent vs. adult), and other potential confounding factors
Methods

Covariates assessed for inclusion in the model:

- Prepregnancy weight (PPW)
- Medicaid payer status
- Maternal smoking
- Adequacy of prenatal care, Kotelchuck Index
- Marital status
- Gestational diabetes
- Preeclampsia
Methods

Multilevel mixed-effects linear regression

- Standard regression model assumes that observations are independent
- This method accounts for both age group and sister pair associations to make more precise comparisons
## Results

### Cohort characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Adolescents (n=1,283)</th>
<th>Adults (n=1,283)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, years</td>
<td>17.2 (0.0)</td>
<td>24.7 (0.1)</td>
</tr>
<tr>
<td>Gestational age at delivery, weeks</td>
<td>39.6 (0.0)</td>
<td>39.4 (0.0)</td>
</tr>
<tr>
<td>Mean prepregnancy weight (kg)</td>
<td>61.3 (0.4)</td>
<td>72.8 (0.6)</td>
</tr>
<tr>
<td>Mean gestational weight gain (kg)</td>
<td>16.7 (0.2)</td>
<td>15.8 (0.2)</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>3435 (12)</td>
<td>3456 (13)</td>
</tr>
</tbody>
</table>
Cohort characteristics (continued):

- Majority were White (85%)
- Adolescents:
  - More likely to smoke (27% vs. 21%)
  - Less likely to receive adequate PNC (62% vs. 71%)
  - Less likely to be married (17% vs. 56%)
  - More likely to have Medicaid payer (49% vs. 37%)
- Adults more likely to experience GDM (4% vs. 1%) and preeclampsia (7% vs. 10%)
## Results

### Unadjusted model

| Variable                  | Regression coefficient (β) | P>|z|  | 95% Confidence Interval |
|---------------------------|----------------------------|------|-------------------------|
| Weight_gain*adolescent    | 7.096                      | 0.004| 2.246-11.946            |
| Weight_gain (kg)          | 9.873                      | 0.000| 6.603-13.142            |
| Adolescent                | -148.231                   | 0.001| -233.422-63.040         |
| _cons                     | 3329.450                   | 0.000| 3243.198-3357.114       |
Results

Adolescent

- All else equal, for each 1kg ↑ in GWG, BW ↑ by an average of 16.97g

Adult

- All else equal, for each 1kg ↑ in GWG, BW ↑ by an average of 9.87g
# Results

## Adjusted model

| Variable                     | Regression coefficient (β) | P>|z| | 95% Confidence Interval |
|------------------------------|-----------------------------|-----|-------------------------|
| Weight_gain*adolescent       | 5.829                       | 0.032 | 0.507                  | 11.152 |
| Weight_gain (kg)             | 14.589                      | 0.000 | 11.161                  | 18.016 |
| Adolescent                   | -80.961                     | 0.103 | -178.298                | 16.377 |
| Prepregnancy weight (kg)     | 5.186                       | 0.000 | 4.017                   | 6.354  |
| Smoked                       | -128.445                    | 0.000 | -171.756                | -85.133 |
| Preeclampsia                 | -141.966                    | 0.000 | -206.582                | -77.349 |
| _cons                        | 2888.089                    | 0.000 | 2773.319                | 3002.859 |
Results

Adolescent

- All else equal, for each 1kg ↑ in GWG, BW ↑ by an average of 20.42g

Adult

- All else equal, for each 1kg ↑ in GWG, BW ↑ by an average of 14.59g
Results

Birth Weight vs. Gestational Weight Gain (Adjusted Model)

![Graph showing the relationship between birth weight and gestational weight gain for adolescents and adults.](image_url)

Birth Weight (g)

Gestational Weight Gain (kg)

- Adolescents
- Adults
Results

- Results indicated a small, statistically significant difference in the BW-GWG relationship for adolescent mothers relative to their adult sisters.
- Suggest that infants born to adolescents may have greater BW potential with increased GWG.
Strengths

- First study to examine the relationship between GWG and BW in a cohort of full biological sisters
- Use of sister pairs allows greater control over genetics, exposures
- Availability of population-based data provides a representative sample and reduces potential selection bias
Limitations

- 15% missing data for PPW
- Birth certificate data typically underestimates:
  - prenatal care visits
  - pregnancy complications
  - tobacco and alcohol use during pregnancy
- Sample not sufficiently diverse to generalize to other populations
Conclusions

- More precise information on appropriate gestational weight gain is needed for adolescents
- Clinical research with monitoring of gestational weight gain throughout pregnancy would be particularly beneficial
Acknowledgements

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Marcia Williams, PhD, MPH, PT (Chair)
Jane Rees, PhD, MS, RD

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Models

Unadjusted

\[ BW = \beta_0 + \beta_1(\text{adol}) + \beta_2(\text{GWG}) + \beta_3(\text{GWG*adol}) \]

Adolescent:  \[ BW = 3151.93 + 16.97(\text{GWG}) \]

Adult:  \[ BW = 3300.16 + 9.87(\text{GWG}) \]

Adjusted

\[ BW = \beta_0 + \beta_1(\text{adol}) + \beta_2(\text{GWG}) + \beta_3(\text{GWG*adol}) + \beta_4(\text{smoked}) + \beta_5(\text{preeclampsia}) + \beta_6(\text{PPW}) \]

Adolescent:  \[ BW = 2807.13 + 20.42(\text{GWG}) - 128.44(\text{smoked}) - 141.97(\text{preclamp}) + 5.19(\text{PPW}) \]

Adult:  \[ BW = 2888.09 + 14.59(\text{GWG}) - 128.44(\text{smoked}) - 141.97(\text{preclamp}) + 5.19(\text{PPW}) \]