Community Conditions and Birth Outcomes: The Issue of Rurality and Economic Status, and the Potential Role of Pregnancy Smoking

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Acknowledgements

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Project Aim

The overall goal of the current investigation was to examine the potential association between community conditions and newborn outcomes in Southern Appalachia, and to determine the degree to which pregnancy smoking may explain such associations.
Despite enhanced research and intervention programs, rates of preterm birth (PTB) and low birth weight (LBW) are increasing in the U.S.

An infant’s gestational age and weight at delivery are the strongest biological predictors of immediate and long-term developmental outcomes.

LBW and PTB are leading causes of neonatal morbidity and mortality in the U.S.

Babies born LBW and/or preterm are at significantly increased risk for health, physical, cognitive and behavioral problems.
# Background

## Cost of Newborn Hospital Care

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Cost</th>
<th>Weight Range</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>$1100</td>
<td>3000gm+</td>
<td>$1000</td>
</tr>
<tr>
<td>36</td>
<td>$2200</td>
<td>2250-2499gm</td>
<td>$4300</td>
</tr>
<tr>
<td>32</td>
<td>$19,000</td>
<td>1750-1999gm</td>
<td>$19,000</td>
</tr>
<tr>
<td>25</td>
<td>$202,000</td>
<td>&lt;1000gm</td>
<td>$100,000+</td>
</tr>
</tbody>
</table>
Background

- Attempts to decrease rates of poor birth outcomes have been largely unsuccessful

- Prevalence of PTB and LBW varies greatly by region
  - Rates below national averages in North, Midwest, and West
  - Rates more than 10% above national averages in the South
  - Rates 20-45% above national averages in Southern states with the highest percentage of residents living in rural areas of Appalachia
Background

- Rurality appears to impact birth outcomes
- Rurality alone, however, does not account for all of the variation in adverse perinatal health
- Complex interplay of mediating individual and community variables may account for elevated rates of LBW and PTB in rural Southern Appalachia in particular
  - Poverty
  - Low educational attainment
  - Inadequate access to medical care
  - Negative health behaviors
Background

Poverty

- Rural regions experience rates of poverty 30% higher than urban areas
- Poverty rates in Southern and Central Appalachia are among the highest in the country
- Poverty, both at the household and regional levels, is significantly associated with LBW and PTB
Contributing to economic hardship experienced by rural women are co-occurring issues of less education, higher rates of unemployment, fewer job opportunities, and lower salaries.

Of these, maternal education is the most consistent determinant of poor health, significantly impacting birth outcomes.

Women without a HS diploma have a more than doubled risk of delivering a preterm or LBW baby.
Background

Access to Medical Care

- 40% of rural families do not have health insurance
- Among those in Southern Appalachia with government subsidized health insurance, rates of prenatal care utilization are as low as for those without insurance
- Obstetricians are leaving rural areas in record numbers – and only 20% of family physicians offer obstetrical care
- Nationally, 17% of women have inadequate prenatal care utilization; in areas of rural Southern Appalachia, rates approach 40%
- Inadequate prenatal care utilization is significantly associated with LBW and PTB
Background

Health Behaviors

- Lack of consistent prenatal care is associated with a lack of adequate information about pregnancy health issues.
- One such health issue is pregnancy smoking, which is linked to increased risk of both LBW and PTB, and is the most modifiable risk factor for poor birth outcomes.
- Cigarette smoking is more prevalent in rural areas.
- Nationally, 12% of pregnant women smoke; in TN the rate is 17%; in rural Appalachian regions of TN rates exceed 40%.
- Women with less education and living in poverty are more likely to smoke, and these conditions are more prevalent in rural areas; thus, smoking may at least partially explain any association between rurality and poor birth outcomes in Southern Appalachia.
Specific Research Questions

1) Are community conditions (rurality, income, poverty, unemployment) associated with newborn outcomes in Southern Appalachia?

2) Can associations between community conditions and birth outcomes be explained by pregnancy smoking?
Methods

- Study participants were all women who gave birth to live singletons who survived to nursery assignment in Washington County in 2006 and 2007.
- During the study period, 4291 women with eligible deliveries gave birth at JCMC and JCSH.
- Women who did not reside in Appalachia, or for whom data were incomplete were excluded resulting in a final sample of 4144 women and their infants.
- Participants were representative of regional demographics – vast majority Caucasian, approximately half participating in a government insurance program.
Methods

- Data were obtained from electronic delivery logs maintained at the hospitals.
- Data relevant to the current investigation were de-identified and extracted by the MSHA data specialist, with additional cleaning and construction performed by the first author.
- Birth Outcome data of interest included:
  - Birth weight (in gm and LBW classification)
  - Birth length (in inches)
  - Gestational age at delivery (in weeks and PTB classification)
  - Newborn nursery assignment (NICU)
Methods

- County of residence:
  - Half of the women (53%) resided in Washington County
  - The remaining women resided in 44 different Appalachian counties in TN, VA, NC, and KY

- Community conditions for county of residence:
  - Rurality – Rural-Urban Continuum Code (1-6 vs 7-9)
  - Per Capita Income – <$15,000/yr vs rest
  - Poverty Rate - ≥15% vs rest
  - Unemployment Rate – > natl avg vs rest
Methods

Other Variables of Interest:

- Smoking status – self-report at delivery (yes vs no)
- Maternal age
- Maternal weight at delivery
- Gravidity
- Multiple birth and IUFD/NND for exclusionary purposes
Results

- The rate of LBW deliveries was 14.8%, and 16.9% of babies were born preterm.
- One quarter (24.7%) of women self-reported as smokers at delivery.
- County conditions were significantly associated with birth outcomes, with the most dramatic differences seen for rurality of county of residence.
## Results

<table>
<thead>
<tr>
<th>Birth Outcome</th>
<th>Metro/Suburban</th>
<th>Completely Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight (gm)</td>
<td>3241</td>
<td>2535</td>
</tr>
<tr>
<td>LBW (%)</td>
<td>9.8%</td>
<td>45.1%</td>
</tr>
<tr>
<td>Birth Length (in)</td>
<td>19.7</td>
<td>18.2</td>
</tr>
<tr>
<td>Gestational Age (wks)</td>
<td>38.3</td>
<td>35.1</td>
</tr>
<tr>
<td>PTB (%)</td>
<td>11.7%</td>
<td>49.3%</td>
</tr>
<tr>
<td>NICU Admission (%)</td>
<td>8.1%</td>
<td>42.4%</td>
</tr>
</tbody>
</table>

All differences significant at $p<.05$
## Results

<table>
<thead>
<tr>
<th>Birth Outcome</th>
<th>Poverty &lt;15%</th>
<th>Poverty 15%+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight (gm)</td>
<td>3251</td>
<td>3075</td>
</tr>
<tr>
<td>LBW (%)</td>
<td>9.3%</td>
<td>18.1%</td>
</tr>
<tr>
<td>Birth Length (in)</td>
<td>19.7</td>
<td>19.3</td>
</tr>
<tr>
<td>Gestational Age (wks)</td>
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<td>37.7</td>
</tr>
<tr>
<td>PTB (%)</td>
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<td>NICU Admission (%)</td>
<td>8.1%</td>
<td>14.1%</td>
</tr>
</tbody>
</table>

All differences significant at p<.05
Results

County rurality was highly confounded with the other county conditions

<table>
<thead>
<tr>
<th>County Condition</th>
<th>Non-Rural</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment (% &gt; natl avg)</td>
<td>32%</td>
<td>71%</td>
</tr>
<tr>
<td>Poverty (% &gt; 15%)</td>
<td>18%</td>
<td>87%</td>
</tr>
<tr>
<td>Per Capita Income (% &lt; $15K)</td>
<td>17%</td>
<td>84%</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>County Condition</th>
<th>% Smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>34.7%</td>
</tr>
<tr>
<td>Non-Rural</td>
<td>24.4%</td>
</tr>
<tr>
<td>Higher Unemployment</td>
<td>26.6%</td>
</tr>
<tr>
<td>Lower Unemployment</td>
<td>23.8%</td>
</tr>
<tr>
<td>Higher Poverty</td>
<td>28.7%</td>
</tr>
<tr>
<td>Lower Poverty</td>
<td>23.8%</td>
</tr>
<tr>
<td>Lower Income</td>
<td>28.0%</td>
</tr>
<tr>
<td>Higher Income</td>
<td>24.0%</td>
</tr>
</tbody>
</table>
# Results

<table>
<thead>
<tr>
<th>Birth Outcome</th>
<th>Non-Smokers</th>
<th>Smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight (gm)</td>
<td>3299</td>
<td>2965</td>
</tr>
<tr>
<td>LBW (%)</td>
<td>8.6%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Birth Length (in)</td>
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<td>PTB (%)</td>
<td>11.1%</td>
<td>18.8%</td>
</tr>
<tr>
<td>NICU Admission (%)</td>
<td>7.5%</td>
<td>14.6%</td>
</tr>
</tbody>
</table>

All differences significant at $p<.05$
Results

- Regression analyses were run to test the potentially mediating role of smoking in the associations between county conditions and birth outcomes.
- For all birth outcomes, smoking status accounted for a significant proportion of variance.
- Even after adjustment for smoking status and other maternal characteristics, county conditions still significantly predicted all birth outcomes.
Results

- In all cases, however, the amount of variance in birth outcomes predicted by county conditions was reduced after entry of smoking status into the model.
- Thus, smoking status partially, but not completely, mediated the association between county conditions and birth outcomes.
Rates of LBW, PTB, and pregnancy smoking exceeded national averages in this population.

Babies born to women who smoked during pregnancy were significantly more likely to experience adverse birth outcomes.

These findings are consistent with results from other national studies and those conducted in the South, and point to significant disparities experienced by newborns in Southern Appalachia specifically.
Discussion

- While rates of pregnancy smoking and adverse birth outcomes in this sample are alarming, even more dramatic are findings related to county conditions.
- Babies born to women residing in the most rural areas were at an enormous disadvantage at birth compared with remaining newborns.
- No other published study has reported effects as large as a 700gm decrement in birth weight or a three week reduction in gestation associated with any sociodemographic condition.
Discussion

- Clearly, rurality of county of residence, and to a lesser degree socioeconomic conditions within the residence county, are substantial risk factors for adverse birth outcomes.

- While pregnancy smoking appears to explain some of the effect in a Southern Appalachian sample, other aspects of rurality, or factors associated with rural residence, contributed significantly to these poor birth outcomes.
Discussion

- Efforts to explain and address the association between rurality and poor birth outcomes are clearly worthwhile.
- A cost analysis of the data from the current sample reveals that additional newborn costs in Washington County attributable to LBW over the two year study period exceeded $20 million dollars.
- This figure does not include long term health, educational, and behavioral expenses, and does not consider the 76 newborns that did not survive beyond 24 hours due to PTB and/or LBW that might have been saved.
Discussion

The current study is not without limitations:

- All deliveries occurred in a single county – concept of rurality confounded with distance traveled to delivery
- Confined to Southern Appalachia – unknown if rurality is associated with poor birth outcomes in other regions
- Reliance on data available from medical records – county smallest unit of analysis, smoking status crudely measured
Importance of the current study:

- Magnitude of identified effects demonstrates the enormity of the disparate birth outcomes in rural and socioeconomically disadvantaged areas.
- It is one of the first to examine the effect of rurality on birth outcomes in Southern Appalachia specifically, suggesting that this area of the county may be more disparate than others with respect to birth outcomes.
- While a highly prevalent negative health behavior such as smoking may be partially responsible for the poor birth outcomes in rural Southern Appalachia, pregnancy smoking alone cannot explain the increased risk.
Conclusion

Improving birth outcomes in rural areas of the South will likely require finding ways to increase access to health care services and health information, including offering incentives for health care provider retention, increasing availability of public health services including smoking cessation assistance, increasing awareness and education, and working with communities in the areas of transportation services and employment opportunities.
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