Regional Variation in Preterm Birth and Associated Risk Factors in Texas (2008-2011)

A County Level Analysis Using Geographic Information Systems
Conflict of Interest Disclosure

The following individuals have reported NO financial relationships with commercial interests (drug/device companies):

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Public Health Significance

Preterm birth (PTB) is:

- a leading cause of infant mortality and infant and child morbidity
- a factor in driving disparities in infant mortality
- costly to families, the health care system and society, ~ $54,150/PTB*

*March of Dimes, Premature birth: The financial impact on business 12/13
Public Health Significance

- Infant born too early are at increased risk for:
  - Respiratory problems including asthma
  - Neuro-developmental disabilities
  - Necrotizing enterocolitis
  - Infections
  - Cardiovascular disorders

Preterm Birth in Texas

PTB: all births less than 37 weeks gestation
Low Birth Weight and Premature Births (all births): Harris County, 2005-2013

Data Source Texas Department of State Health Services Center for Health Statistics. * 2013 Preliminary Data
Harris County 2011 Preterm Births

% Preterm Births 2011

- 0.0 or no data
- 0.1 - 11.4 Healthy People 2020 goal
- 11.5 - 11.6 U.S. rate
- 11.7 - 17.1
- 17.2 - 22.8
- 22.9 - 23.2
- Highways

Percentage of births in Harris County, with infants delivered before 37 weeks. Healthy People 2020 goal is 11.4% of births will be preterm. U.S. rate for 2011 is 11.55%. Location is based on mother’s residence zip code.

Data Source: Texas Department of State Health Services Center for Health Statistics, October 2013
Objectives

- Describe key risk factors for PTB.
- Identify areas of Harris County Texas disproportionately affected by PTB using Geographic Information System (GIS).
- Describe contribution of maternal risk factors across different rate categories of PTB in the county.
Methods

- **Study design**: retrospective cross-sectional analysis
- **Time frame**: PTBs that occurred in Texas between 2008 and 2011 to characterize burden of PTB and its associated risk factors.
- **Data source**: Vital statistics data was obtained from the Texas Department of State Health Services for the years 2008 through 2011.
- **Additional data**: Socio-demographic and behavioral risk factor data were obtained from birth certificates and census track data from the American Community Survey.
Methods Continued

- **Characterization PTB prevalence**: GIS to locate areas most affected by PTB using latitude and longitude coordinates to do spatial analysis statistics.

- **Analytic Sample**: Singleton births for 379,141 women

- **PTB classification**: births <37 weeks gestational age.

- **Statistical analysis**: Multivariable logistic regression models were used to determine county-level, and low, medium and high risk areas within the county for contribution of maternal risk factors with PTB.

- We also looked at risk factors for the area of county with the highest numbers of PTB, which is different from the area with the highest rates.
Birth Data

- Essentially complete, all births, data for an eight-county region – Harris County and the seven contiguous counties
- Four years of data, 2008 to 2011.
- 379,141 total number of cases for all four years
- 366,095 singleton cases for all four years
- Aged 13 – 47 years
- Cases were geocoded, using the mother’s residential address, by the Texas Department of State Health Services, Center for Health Statistics, to an unmasked longitude (x) and latitude (y) - point level of geography
Geocoding Accuracy

• Overall geocoding accuracy, by geographic level:
  – Street – 97.1% (368,058)
  – ZIP + 4 – 1.2% (4,570)
  – Not Geocoded – 1.7% (6,513)

• For singleton births:
  – Street – 97.1% (355,404)
  – ZIP + 4 – 1.2% (4,402)
  – Not Geocoded – 1.7% (6,289)

• All geocoded cases were used
Spatial Analysis

• Used dual kernel density estimation (KDE) – ratio of densities
  – The program used for this presentation is CrimeStat 4.01 (freeware available from the Department of Justice, Ned Levine PhD, author)
  – Dual kernel density estimates were designed to give a ratio of densities
    • Primary file (numerator) has all geocoded singleton PTBs
    • Secondary file (denominator) has all geocoded singleton births
  – We assumed a normal distribution

• Cell size and bandwidth were optimized for Harris County/City of Houston area size and population density and to reduce or eliminate “false hotspots” – Type 1, false positive results
  – Kernel cell size is approximately 600 x 600 meters
  – Fixed bandwidth of 1500 meters was chosen for the search radius

• Spatial autocorrelation (Geary’s C) did not test to be significant
Kernel: approximately 600 meters square

Search radius or bandwidth: 1500 meters

KDE Singleton PTB

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\begin{array}{ccc}
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KDE Singleton Births

\[
\begin{array}{ccc}
Z & Z & Z \\
Z & Z & Z \\
Z & Z & Z \\
\end{array}
\]

Ratio of Densities

\[
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Rz & Rz & Rz \\
Rz & Rz & Rz \\
\end{array}
\]

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\end{array}
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\end{array}
\]
Births in Areas with PTB Greater than 14.4 %

- Area 1 – 7732 total births; 7526 singleton births
- Area 2 – 1867 total births; 1833 singleton births
- Area 3 – 326 total births; 317 singleton births
- Area A – Too few births
- Area B – Too few births within Harris County
PTB by Race/Ethnic Singleton Births
Harris County (2008-2011)

Total Preterm Births: N = 43,459

- Non-Hispanic White: 11.6%
- Non-Hispanic Black: 15.5%
- Hispanic: 10.1%
- Other: 10.4%
## Cases of PTB Across GIS Map Rate Areas

<table>
<thead>
<tr>
<th>GIS MAP AREA</th>
<th>TOTAL</th>
<th>Non Hispanic White</th>
<th>Non Hispanic Black</th>
<th>Hispanic</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5%</td>
<td>22</td>
<td>16</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>5.1-9.6%</td>
<td>6,199</td>
<td>3,710</td>
<td>599</td>
<td>1,225</td>
<td>665</td>
</tr>
<tr>
<td>9.7-11.4%</td>
<td>17,358</td>
<td>6,114</td>
<td>2,993</td>
<td>6,910</td>
<td>1,341</td>
</tr>
<tr>
<td>11.5-14.4%</td>
<td>17,589</td>
<td>2,853</td>
<td>5,065</td>
<td>8,932</td>
<td>739</td>
</tr>
<tr>
<td>≥ 14.5</td>
<td>1,557</td>
<td>255</td>
<td>905</td>
<td>369</td>
<td>28</td>
</tr>
<tr>
<td>Unclassified</td>
<td>734</td>
<td>275</td>
<td>149</td>
<td>279</td>
<td>31</td>
</tr>
<tr>
<td>TOTALS</td>
<td>43,459</td>
<td>13,223</td>
<td>9,712</td>
<td>17,720</td>
<td>2,804</td>
</tr>
</tbody>
</table>
Comparison of Mothers Without & With PTB

Mean ± SD

- **Mother's age**
  - Without PTB: 27.9 ± 6.1
  - With PTB: 27.9 ± 6.7

- **Gestational Age**
  - Without PTB: 33.8 ± 3.3
  - With PTB: 38.8 ± 1.1

- **Prenatal Visits**
  - Without PTB: 9.7 ± 3.9
  - With PTB: 8.4 ± 4.7
### Selected Risk Factors for Preterm Births in Harris County, Texas

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥ 35 years</td>
<td>1.3 (1.27-1.36)</td>
</tr>
<tr>
<td>Less than High School Education</td>
<td>0.9 (0.89-0.94)</td>
</tr>
<tr>
<td>Pre-pregnancy Obesity</td>
<td>1.1 (1.02-1.08)</td>
</tr>
<tr>
<td>Previous Preterm Birth</td>
<td>4.1 (3.94-4.58)</td>
</tr>
<tr>
<td>Gestational Diabetes</td>
<td>1.3 (1.13-1.25)</td>
</tr>
<tr>
<td>Chronic Diabetes</td>
<td>2.3 (1.72-2.13)</td>
</tr>
<tr>
<td>Chronic Hypertension</td>
<td>3.2 (2.94-3.45)</td>
</tr>
<tr>
<td>Pregnancy Induced Hypertension</td>
<td>3.8 (3.56-3.86)</td>
</tr>
<tr>
<td>Smoking During Pregnancy</td>
<td>1.3 (1.38-1.77)</td>
</tr>
<tr>
<td>Racial/Ethnic Group (Referent group, Non-Hispanic White)</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>1.4 (1.32-1.41)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.8 (0.85-0.91)</td>
</tr>
<tr>
<td>Other</td>
<td>0.8 (0.83-0.93)</td>
</tr>
</tbody>
</table>
Population Attributable Risk % for Harris County and Seven Contiguous Counties (2008-2011)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Harris County N = 277,946</th>
<th>Non-Harris County N = 101,065</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-pregnancy Obesity</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Previous Preterm Birth</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Gestational Diabetes</td>
<td>1.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Chronic Diabetes</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Chronic Hypertension</td>
<td>1.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Pregnancy Induced Hypertension</td>
<td>8.5</td>
<td>8.8</td>
</tr>
<tr>
<td>Smoking Before Pregnancy</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Smoking During 1st Trimester Pregnancy</td>
<td>0.8</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Prevalence of Preterm Birth Risk Factors Across BMI Categories (%)

* p for trend <0.001
## Comparison between Low and High Rate PTB Areas

<table>
<thead>
<tr>
<th>Variable</th>
<th>GIS Map Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5% Mean, SD</td>
</tr>
<tr>
<td>Mother’s Age</td>
<td>27.6±6.8</td>
</tr>
<tr>
<td># Prenatal Visits</td>
<td>14.4±23.7</td>
</tr>
<tr>
<td>Estimated Gestational Age</td>
<td>34.4±2.6</td>
</tr>
<tr>
<td>Percent Below Poverty</td>
<td>15.6±5.0</td>
</tr>
<tr>
<td># Cigarettes Before pregnancy</td>
<td>2.2±5.5</td>
</tr>
<tr>
<td># Cigarettes 1st trimester</td>
<td>0.7±1.5</td>
</tr>
</tbody>
</table>
Conclusions

• Using GIS spatial analysis techniques enables the identification of a more precise location of the burden of preterm births. Both in number and in rates.

• Analysis of the areas with different rates of PTB, facilitates the identification of specific preventable risk factors to support targeted strategies to prevent PTB.
References


• Institute of Medicine, (2007), Preterm Birth Causes, Consequences and Prevention, National Academies Press, Washington, D.C.
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