Disparities of Shigellosis Rates Among California Children by Census Tract Poverty Level and by Race/Ethnicity, 2000-2010

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Introduction

- Widespread agreement about toll of poverty on health

- Absence of socioeconomic data collection in most public health surveillance systems

- Socioeconomic health disparities are invisible without socioeconomic data
  - No ability to assess differences over time, space, group, or across outcomes
Introduction

- Harvard Public Health Disparities Geocoding Project methodology

- Detailed method on Harvard website:
  - Geocode cases
  - Link to census tract data
  - Analyze cases for socioeconomic disparities by demographics

- Method used on some chronic diseases by some states; use on infectious diseases uncommon
Aims of this study

- To use the Harvard Public Health Disparities Geocoding Project methodology to
- Determine whether socioeconomic disparities exist in shigellosis rates among children in California
- Analyze the contribution of socioeconomic inequalities to racial/ethnic disparities in shigellosis
Shigellosis in US

- Common enteric bacterial disease – diarrhea, fever, and stomach cramps
  - Reportable in U.S.
  - Incidence highest among children
  - *Shigella sonnei* ~70%, *Shigella flexneri* ~25%

- In US each year:
  - 14,000 cases reported
  - 131,254 estimated cases; 1,456 hospitalizations; 10 deaths

- Risk groups/settings
  - Children in child care centers
  - International travels
  - MSM
Shigellosis in US

Relative rates of laboratory-confirmed infections with *Shigella*, *Yersinia*, and *Cryptosporidium* compared with 1996–1998 rates, by year, FoodNet 1996–2012*

*The position of each line indicates the relative change in the incidence of that pathogen compared with 1996–1998. The actual incidences of these infections cannot be determined from this graph. Data for 2012 are preliminary.*
Shigellosis in California

Shigellosis in California

Shigellosis in California

Shigellosis cases** California population

- White, non-Hispanic
- Hispanic
- Asian, Pacific Islander
- Black, non-Hispanic
- Native American
- Other or multi-race***

Objectives

- Use reported cases of shigellosis in California
  - 2000-2010 data
  - Children 0-14 years old

- Analyze by
  - Age group
  - Race/ethnicity
  - % population below federal poverty level
Methods

1. Geocode cases to census tract (CT)

2. Download 2010 CT information

3. Merge numerator and denominator data

4. Calculate incidence rates by census tract poverty level
Methods

- Population attributable fraction

\[
P_A F_{agg} = \frac{\sum_i \text{excess number of cases}}{\sum_i \text{number of cases}} = \frac{\sum_i \text{number of cases} \times PAF_i}{\sum_i \text{number of cases}}
\]

- Poisson Regression

\[
\log(\text{cases}) = \text{intercept} + \text{age} + \text{race} + \text{poverty} + \log(\text{population})
\]

0–4 yrs
White
≤5%

5–9
Asian
5–9%

10–14
Black
10–19%

Hispanic
20–29%

30–39%

≥40%
20,949 cases reported to CDPH, 2000-2010

9,740 children under 14

9,178 geocoded

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**Total** | **9,178**
---|---
**Sex** | 
Male | 49% 
**Age Category** | 
Under 5 | 50% 
5 – 9 | 36% 
10 - 14 | 14% 
**Race/Ethnicity** | 
Hispanic | 70% 
Non-Hispanic white | 8% 
Black | 4% 
Asian, Pacific Islander | 3% 
Other | 1% 
Missing | 16% 
**Year of Report** | 
2000 – 2002 | 35% 
2003 – 2005 | 32% 
2006 – 2008 | 23% 
2009 - 2010 | 9%
Results

Shigellosis Incidence (per 100,000 population) in California

- Under 5: 181 cases
- 5 - 9: 132 cases
- 10 - 14: 50 cases

Average incidence rate: 5.5 cases per 100,000 population
Results

Shigellosis Incidence (per 100,000 population) in California

- Asian: 28 cases per 100,000
- White: 35 cases per 100,000
- Black: 79 cases per 100,000
- Hispanic: 163 cases per 100,000
Results

Age-Adjusted Shigellosis Incidence Rates, California, 2000-2010

<table>
<thead>
<tr>
<th>Percent of population below federal poverty level</th>
<th>Cases per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4.9%</td>
<td>4</td>
</tr>
<tr>
<td>5.0%-9.9%</td>
<td>7</td>
</tr>
<tr>
<td>10.0%-19.9%</td>
<td>11</td>
</tr>
<tr>
<td>20.0%-29.9%</td>
<td>17</td>
</tr>
<tr>
<td>30.0%-39.9%</td>
<td>20</td>
</tr>
<tr>
<td>40% or more</td>
<td>22</td>
</tr>
</tbody>
</table>

5.5
## Results

<table>
<thead>
<tr>
<th>Census Tract Poverty</th>
<th>Incidence Rate per 100,000</th>
<th>Incidence Rate Difference</th>
<th>95% confidence interval</th>
<th>Incidence Rate Ratio</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4.9%</td>
<td>4.08</td>
<td>Ref</td>
<td>--</td>
<td>Ref</td>
<td>--</td>
</tr>
<tr>
<td>5.0% - 9.9%</td>
<td>6.97</td>
<td>2.89</td>
<td>2.40 - 3.37</td>
<td>1.71</td>
<td>1.55 - 1.87</td>
</tr>
<tr>
<td>10.0% - 19.9%</td>
<td>11.44</td>
<td>7.35</td>
<td>6.82 - 7.88</td>
<td>2.80</td>
<td>2.57 - 3.05</td>
</tr>
<tr>
<td>20.0% - 29.9%</td>
<td>16.52</td>
<td>12.43</td>
<td>11.68 - 13.18</td>
<td>4.04</td>
<td>3.70 - 4.42</td>
</tr>
<tr>
<td>30.0% - 39.9%</td>
<td>19.70</td>
<td>15.62</td>
<td>14.51 - 16.73</td>
<td>4.82</td>
<td>4.39 - 5.30</td>
</tr>
<tr>
<td>40% or more</td>
<td>22.29</td>
<td>18.21</td>
<td>16.42 - 19.99</td>
<td>5.46</td>
<td>4.89 - 6.10</td>
</tr>
</tbody>
</table>
Results

- \( PAF = \frac{\sum_i \text{excess number of cases}}{\sum_i \text{number of cases}} = 0.62 \)

- Preventable cases = \( 9,178 \times 0.62 = 5,691 \)
## Results

<table>
<thead>
<tr>
<th>Poverty</th>
<th>Unadjusted RR</th>
<th>Poisson RR (95% CL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5% below poverty level</td>
<td>1.0 (ref)</td>
<td>1.0 (ref)</td>
</tr>
<tr>
<td>5% - 9%</td>
<td>1.7</td>
<td>1.6 (1.4, 1.8)</td>
</tr>
<tr>
<td>10% - 19%</td>
<td>2.8</td>
<td>2.2 (2.0, 2.4)</td>
</tr>
<tr>
<td>20% - 29%</td>
<td>4.0</td>
<td>2.9 (2.6, 3.3)</td>
</tr>
<tr>
<td>30% - 39%</td>
<td>4.8</td>
<td>3.3 (3.0, 3.7)</td>
</tr>
<tr>
<td>≥ 40%</td>
<td>5.5</td>
<td>4.0 (3.6, 4.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>Unadjusted RR</th>
<th>Poisson RR (95% CL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>1.0 (ref)</td>
<td>1.0 (ref)</td>
</tr>
<tr>
<td>Asian</td>
<td>0.8</td>
<td>0.8 (0.6, 0.9)</td>
</tr>
<tr>
<td>Black</td>
<td>2.3</td>
<td>1.6 (1.4, 1.9)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4.7</td>
<td>3.3 (3.0, 3.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Unadjusted RR</th>
<th>Poisson RR (95% CL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5 years</td>
<td>3.6</td>
<td>3.5 (3.3, 3.8)</td>
</tr>
<tr>
<td>5% - 9</td>
<td>2.6</td>
<td>2.7 (2.5, 2.9)</td>
</tr>
<tr>
<td>10% - 14</td>
<td>1.0 (ref)</td>
<td>1.0 (ref)</td>
</tr>
</tbody>
</table>
Conclusions

- In California, rates of shigellosis in children increase with CT poverty and were highest for those in the poorest census tracts.

- Rates were higher for Hispanic children in general, but some of the poorest White and Black children still have higher rates than all children in lower poverty categories.

- Differences by CT poverty smaller, but still apparent, after adjusting for race.

- Our analysis shows that socioeconomic disparities strongly affected shigellosis rates among California children across all racial/ethnic groups.
Discussion

- Probably first study in US examining disparities in shigellosis rates in children by race/ethnicity and by poverty level

- High percentage of cases geocoded

- Feasible to geocode addresses of surveillance data as a way to assign socioeconomic status to cases

- Future analysis will examine household crowding

- In California, *Shigella* prevention messages should target all poor families with children and Hispanic families with children
Acknowledgements

California Department of Public Health

- Dan Smith
- Duc Vugia
- Debra Gilliss
- Farzaneh Tabnak

Council of State and Territorial Epidemiologists
Questions?
Methods

- Fay and Feuer γ confidence interval
  - Notation
    \[ \hat{R} = \sum_{i=1}^{m} s_i \left( \frac{d_i}{P_i} \right) = \sum_{i=1}^{m} w_i d_i \]
  - Variance
    \[ v = \sum_{i=1}^{m} d_i \left( \frac{s_i}{P_i} \right)^2 \]
  - Upper and Lower Limit
    \[ \text{Lower Limit} = \frac{v}{2y} \left( \chi^2 \right)^{-1} \left( \frac{\alpha}{2} \right) \]
    \[ \text{Upper Limit} = \frac{v + w_M^2}{2(y + w_M)} \left( \chi^2 \right)^{-1} \left( \frac{1 - \alpha}{2} \right) \]
Results

Disparities in Shigellosis Rates:
Comparing the burden of shigellosis by Census Tract resources and Race

Incidences (per 100,000 population)

Race/Ethnicity

Asian  Black  White  Hispanic

Percent of population below poverty line
- 0-4.9%
- 5-9.9%
- 10-19.9%
- 20-29.9%
- 30-39.9%
- ≥40%