Exploring asthma prevalence and sociodemographic factors in an urban community

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Today’s Presentation

• Pediatric Asthma: Brief Description of the Problem
• Spatial Analysis of Pediatric Asthma: Rationale and Data
• Analysis Objective and Goal
• Methods
• Results: Asthma Survey and Census Variables
• Results: Representative Sample
• Limitations
• Conclusions and Future Plans
Pediatric Asthma: Brief Description

- Chronic respiratory disease characterized by inflammation of the airways (NHLBI 1995)

- Most common chronic disease in the United States; affects approximately 7% of all children (Adams et al. 1999; Akinbami and Schoendorf 2003).

- Primary reason for missed school days, non-injury hospitalization and is the single most prevalent cause of childhood disability (Kozak et al. 2005; Newacheck and Taylor 2000; Akinbami et al. 2002)

- Several competing hypotheses with regard to asthma etiology
Research Focus: Asthma Morbidity

• Asthma incidence is a result of the complex interplay between genetics, environment and behavior

• Asthma prevalence data are used to:
  • estimate the burden of disease in a community
  • understand cross-community differences in asthma incidence and prevalence
  • plan for remedial services
  • function as surveillance tools to understand the changing dynamics of the disease
  • identify potential exposures of importance
  • identify groups at risk for increased morbidity
Asthma-related morbidity in urban communities is disproportionately high compared to other types of communities, predominantly among impoverished, non-white children.

$$\text{Asthma-Related Morbidity} = f$$

- Social Environment
- Built Environment
- Economic Environment
- Political Environment
- Natural Environment
Spatial Analysis and Pediatric Asthma

• Geographic analysis offers important insights into the impact of environmental and socioeconomic factors associated with childhood asthma.

• Although there has been extensive exploration of methods to minimize misclassification of asthma-related exposures (i.e. ambient air pollution), accurate classification of asthma and asthma-related morbidity has received little attention in the context of spatial analysis.
# Data for Spatial Analysis

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medical Utilization</strong></td>
<td>• Regional Level</td>
<td>• Hospitalizations/ED Visits are rare events</td>
</tr>
<tr>
<td>(ED Visits/ Hospitalizations)</td>
<td>• Routinely Collected</td>
<td>• Unable to discern between severe cases and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mismanaged cases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Does not represent the full spectrum of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>severity</td>
</tr>
<tr>
<td><strong>National Survey Data</strong></td>
<td>• Cover representative samples of population</td>
<td>• Extensive general health surveys; limited</td>
</tr>
<tr>
<td>(NHIS, NHANES)</td>
<td>• Able to compare prevalence by region</td>
<td>asthma questions</td>
</tr>
<tr>
<td></td>
<td>• Available</td>
<td>• Regional/state scale can’t be linked to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>individual risk factors</td>
</tr>
</tbody>
</table>
Data for Spatial Analysis

<table>
<thead>
<tr>
<th>School-Based Surveillance</th>
<th>Advantages</th>
<th>Drawbacks</th>
</tr>
</thead>
</table>
|                           | • Definable population  
|                           | • Available to conduct extensive survey measurement  
|                           | • Stable population and stable structure  
|                           | • Urban school districts have a disproportionate amount of children in need of services | • Data collection time and labor intensive  
|                           |           | • Need cooperation from school administration  
|                           |           | • Limited age group for information if survey is designed to be self-report |

High resolution data, collected from school-based surveillance programs, may provide a more complete understanding of the burden of asthma in an urban community.
Oakland Unified School District

- Serves over 50,000 students, grades K – 12.
- District Demographics: 42% of students are African American, 34% Latino, 17% Asian/Pacific Islander
- The *Stability Rate* for all OUSD schools is 37%
- One-third of all OUSD middle and high school students are English Learners
- 32% of middle and high school students are from families enrolled in calWORKS, 70% qualified for free or reduced price school lunches

*Source: OUSD District Public Information Data Portal*
A geographic information system (GIS) was utilized to evaluate the relation between the spatial distribution of population-derived pediatric asthma data and census-derived demographic and economic factors in Oakland, CA.

First step in understanding exposures, factors, and characteristics causally related to asthma morbidity.
Methods

• Symptom and address data were collected from 6th and 9th grade students from 16 OUSD MS and 4 OUSD HS from the years 2003 – 2005.
  • Asthma prevalence calculated as (# students defined as “positive”/# students completed survey) for each census tract

• All legible addresses were coded using the California DHS EHIB Tables Address Geocoder.
  • Valid addresses were considered =>80%
  • Addresses were matched to census tract

• Census level variables were collected from SF3 2000

• Correlations (Pearson R) were calculated between census variables and asthma prevalence
Study Population

8,674 surveys collected, 2003 - 2005

7,613 valid addresses geocoded (87.7%)

Remove non-Oakland addresses (n=38) and duplicates (n=49)

Study Pop: 7,526
Asthma: 16.6% (n=1,251)
No Asthma: 83.4% (n=6,275)
# Results: Classification

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Symptoms</td>
<td>37%</td>
</tr>
<tr>
<td>High Severity</td>
<td>14%</td>
</tr>
<tr>
<td>Low Severity</td>
<td>2%</td>
</tr>
<tr>
<td>Possible Asthma</td>
<td>35%</td>
</tr>
<tr>
<td>Other</td>
<td>12%</td>
</tr>
</tbody>
</table>

Survey Year I
Results: Students with Probable Asthma

Survey Year I

<table>
<thead>
<tr>
<th>Condition</th>
<th>Probable (n=387)</th>
<th>Not Probable (n=1,965)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheeze</td>
<td>80.4</td>
<td>72.7</td>
</tr>
<tr>
<td>Wheeze w/ Exer</td>
<td>61.0</td>
<td>27.1</td>
</tr>
<tr>
<td>Night Sx</td>
<td>55.2</td>
<td>20.1</td>
</tr>
<tr>
<td>Night cough w/o cold</td>
<td>72.7</td>
<td>40.1</td>
</tr>
<tr>
<td>ED visit</td>
<td>33.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Can't Finish Sentence</td>
<td>27.1</td>
<td>8.4</td>
</tr>
</tbody>
</table>
Spatial Analysis: Distribution of Cases

OUSD catchment area, limited access highways and buffer, and identified asthma cases
Number Census Tracts, Oakland: 106

Mean Asthma Prevalence: 17.9% (SD: 8.8)

Median Asthma Prevalence: 16.3%

Asthma Prevalence Range: 0.0 – 50.0%

Interquartile Range: 12.6 – 22.4%
Results: Correlation with Race/Ethnicity

The graph shows the correlation with race/ethnicity, with the Pearson R value ranging from -0.3 to 0.4. The categories include:

- %white
- %black
- %aian
- %asian
- %pac_isl
- %other
- %latino
- %latino_m
- %latino_o
- %latino_ai
- %latino_b
- %multi
- %latino_w
- %latino_pi
- %latino_o

The correlation values for each category are indicated by the length of the bars, with a negative correlation shown in red and a positive correlation shown in blue.
Results: Correlation with Family Structure

- %InFamHHD
- %MarriedChildren<18
- %MHHChildren<18
- %SRMCCH<18
- %SRMHHCH<18
- %SRFHHCH<18
- %FamiliesLE4
- %FamiliesGT4
- %FamHHDLE4
- %FHHChildren<6
- %FHHSchoolChild
- %MarriedChildren<6
- %MarriedSchoolChild
- %Now Married
- %MarriedSpPr
- %MarrSpAbs
- %NeverMarr
- %Divorced
- %Separated
- %Widow

Pearson R
Results: Correlation with Language

- %ESLEngN
- %SrSpanEngN
- %AdultAsnEngN
- %AdultSpanEngN
- %KidAsnEngN
- %KidSpanEngN
- %EngOnly
- %SrAsnEngG
- %SrSpanEngG
- %AdultAsnEngG
- %AdultSpanEngG
- %EngOnly
- %SrEngOnly
- %EngOnly
- %SrAsnEngG
- %SrSpanEngG
- %AdultAsnEngG
- %AdultSpanEngG
- %EngOnly

Pearson R

-0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5
Results: Place of Birth

%BornCA
%BornUS
%EmigPrevDec
%EmigGT10Y
%SameHome95
%ForeignBorn

Pearson R
Results: Education

- %K-8PubSch
- %K-8PrivSch
- %HS Pub
- %HS Priv
- %HS Ed
- %CollEd

Pearson R

%LT8thGrEd

-0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3
“Representative Sample” was calculated by dividing the number of students in each census tract who completed the survey by the number of school-aged children in each census tract (ages 5 – 17) derived from the census.
### Factors Associated with Representative Sample

<table>
<thead>
<tr>
<th>Positive Correlations (p&lt;0.05)</th>
<th>Negative Correlations (p&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%AIAN 0.21786</td>
<td>0.0294</td>
</tr>
<tr>
<td>%Asian 0.38866</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>%Young Adult 0.41812</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>%Marr Sp Pr 0.33976</td>
<td>0.0005</td>
</tr>
<tr>
<td>%NEVMARR 0.30878</td>
<td>0.0018</td>
</tr>
<tr>
<td>%Kid Asn Eng N 0.21926</td>
<td>0.0284</td>
</tr>
<tr>
<td>% HS Pub 0.30624</td>
<td>0.0019</td>
</tr>
<tr>
<td>% HS 0.42424</td>
<td>0.0001</td>
</tr>
<tr>
<td>% Adult Eng Only -0.26265</td>
<td>0.0083</td>
</tr>
<tr>
<td>%Sr Span Eng G -0.09348</td>
<td>0.0029</td>
</tr>
<tr>
<td>%Sr Asn Eng G -0.22218</td>
<td>0.0263</td>
</tr>
<tr>
<td>%Eng Only -0.29823</td>
<td>0.0026</td>
</tr>
<tr>
<td>%ESL Eng G -0.25119</td>
<td>0.0117</td>
</tr>
<tr>
<td>% Foreign Born -0.23531</td>
<td>0.0184</td>
</tr>
<tr>
<td>%Same Home 95 -0.28374</td>
<td>0.0042</td>
</tr>
<tr>
<td>% College -0.33685</td>
<td>0.0006</td>
</tr>
<tr>
<td>% Grad School -0.33525</td>
<td>0.0007</td>
</tr>
<tr>
<td>% K-8 Private -0.36743</td>
<td>0.0002</td>
</tr>
</tbody>
</table>
### Spatial Analysis: Limitations

- **Census Data**: ecological level data, joint probabilities not available, may not reflect current population demographics.
- **Survey Data**: relies on student’s report of symptoms, frequency, diagnosis; difficult to validate.
- **Address validation**: difficult with self-report student data.
- **Working with a transient population**: who may enter or leave school system at different points during the school year.
Conclusions

• Local surveillance provides high resolution asthma-related morbidity information specific to a community

• Spatial analysis via survey data and analysis of these data in a GIS framework may provide more accurate estimates of asthma-related risk factors compared to health care utilization data

• GIS analysis can inform targeted interventions to address asthma disparities in urban communities

• Survey data obtained from a public school population may not reflect all demographic and economic groups of the school-aged population
Future Plans

• Inclusion of individual level variables collected from surveillance data
• Inclusion of school-level ecological characteristics
• Regression with additional community level variables, including land use and presence of public and assisted housing
• Inclusion of exposure assessment of vehicular pollution: measurement of distance to freeway
Thank You

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