The Association of Socioeconomic Status and Late Stage Breast Cancer in Florida: 

* A Spatial Analysis using Area-Based Socioeconomic Measures

Jill Amlong MacKinnon, PhD
Florida Cancer Data System
University of Miami Miller School of Medicine
Co-Authors

- Dr. Robert Duncan, UMMSM
- Dr. Youjie Huang, Florida DOH
- Dr. David Lee, UMMSM
- Dr. Lora Fleming, UMMSM
- Dr. Lydia Voti, UMMSM
- Mr. Mark Rudolph, UMMSM
- Dr. Jay Wilkinson, UMMSM

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Outline

- Background and Significance
- Methods
  - SatScan
  - Area-Based Measures
- Results
- Conclusions
- Future Research
Axiom of Public Health

“Social Status is one of the Strongest Determinants of Health”
Goal of Research

- Develop a new methodology to assist with the identification of populations that are at high risk of being diagnosed with late stage breast cancer.
- Assess what effect Socioeconomic Status (SES) has on the incidence of late stage breast cancer in Florida.
- Assist Cancer Surveillance and Control professionals to design specific and targeted interventions for these high risk populations.
Background and Significance
Breast Cancer

- Breast cancer is the most common cancer in women in the US and Florida
  - Second leading cancer-related death in women
Breast Cancer in Florida 1998-2002

- **Incidence**
  - N ~ 64,000 (AAR 125.4/100,000)
  - **Late Stage** (regional and distant)
    - N ~ 19,000 (AAR 39.3/100,000)

- **Mortality**
  - N ~ 13,000 (AAR 23.8/100,000)
Socioeconomic Status (SES)

- SES appears to be related to breast cancer incidence, mortality and survival (Baquet, Commiskey)

- Lack of SES data in surveillance data limiting research
  - Overcome this limitation with use of area-based socioeconomic measures
Area-Based Socioeconomic Measures

- Census-derived
- Possible because of geocoding
- Meaningful indicators
  - Analyzed together with individual data
- Information on
  - Area residents
  - Area characteristics
Area-Based SES Measures (con’t)

- **Strengths**
  - Appended to any database with addresses
  - Provides contextual and compositional data
  - Applied equally to all persons

- **Weaknesses**
  - Not individual data
  - SES at time of case ascertainment
  - Can be outdated - decennial Census
Methods Overview

- **Study design**
  - Cross sectional

- **Dependent variable**
  - Incidence of late stage breast cancer

- **Independent variables**
  - Race/ethnicity, SES, insurance, urban/rural, mammography use

- **Unit of analysis**
  - Block Group
Disparate Block Group SES within Census tracts
Study Setting and Population

- State of Florida
  - Cancer data obtained from Florida Cancer Data System
  - Population and area-based measures obtained from the 2000 US Census
Sampling Frame

- **Inclusion Criteria**
  - Female, Florida resident
  - Diagnosis date between 1998 and 2002
  - Regional or distant (late stage) breast cancer

- **Cases in study n = 18,683**
  - Valid race (excluded n=31)
  - Valid address geocode (excluded n= 309)

- **Block groups in study n = 6,361 (of 9,112 in Florida ~ 70%)**
Patient Level and Area-Based Measures

- **Patient Level**
  - Primary site/stage of disease
  - Race
  - Insurance status

- **Area-Based**
  - Socioeconomic Status
  - Urban/Rural designation
  - Mammography usage
Insurance Status

- **Patient level**
  - Uninsured
  - Private
  - Medicare
  - Medicaid

* FCDS data - 92 cases ‘unknown’ insurance status randomly assigned to other 4 categories based on distribution

Recoded from 15 different categories
Socioeconomic Status

“Ratio of Income to Poverty” (9 categories)

<table>
<thead>
<tr>
<th>Recoded Groups (Krieger, et al)</th>
<th>Actual Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Poverty</td>
<td>79%</td>
</tr>
<tr>
<td>Near Poverty</td>
<td>17%</td>
</tr>
<tr>
<td>Non-Poverty</td>
<td>4%</td>
</tr>
</tbody>
</table>

- Dade County, Block Group Number 15012 (n=2,474)
Urban/ Rural Designation

- Beale Codes - 10 urban-rural county continuum codes
  - Describe counties by their population size, degree of urbanization and nearness to a large metropolitan area
    - Urban – 3 codes
    - Rural – 7 codes
- Dichotomized into urban or rural
Mammography Usage

- Florida Behavioral Risk Factor Survey
  - County level (67 counties)
    - County quartiles
      - Highest to lowest usage
Spatial Analysis - SaTScan

- Developed under the joint auspices of Dr. Martin Kulldorff, the National Cancer Institute and Dr. Farzad Mostashari at the New York City Department of Health and Mental Hygiene.

- Spatial scan statistic
  - Cluster detection test
    - Detect location of clusters
    - Evaluate their statistical significance
**SaTScan Process**

- **Block group level**
  - Race and Age covariates

- **Files needed**
  - Cases
  - Population
  - Block group centroid
SaTScan

- **Monte Carlo techniques**
  - Assigns relative risk probabilities to defined block groups
  - Generates a number of random replications of the data set under the null hypothesis
    - Test statistic is calculated for each random replication as well as for the real data set
    - If the real data set is among the 5 percent highest, then the test is significant at the 0.05 level
SaTScan (con’t)

- Poisson probability model
  - 999 Monte Carlo replications
- Expected n of cases
  - Indirect standardization (State)
- Adjusts for covariates and interaction terms (race and age)
- Spatial analysis only
- Identified areas with higher than expected number of cases
Identify Geographic Area with Higher than Expected Late Stage Breast Cancer
**SaTScan Results**

- **Block groups**
  - Higher than expected incidence - n=767
  - Expected incidence - n=5,444
Block Groups with Higher than Expected Late Stage Breast Cancers 1998-2002

Legend
SaTScan Results
Higher than Expected
Aggregate Block Group Age Specific Rate by Incidence

Age Group

Age Spec Rate/100,000

Age Group

Higher
Expected
Evaluate the degree to which SES is associated with late stage breast cancer
Percent Severe Poverty by Rate of Late Stage Breast Cancer (Block Group)

\[ y = 0.4145x + 8.786 \]

\[ R^2 = 0.9097 \]
Block Group Odds Ratios and 95% Confidence Intervals of Higher than Expected Late Stage Breast Cancer Stratified by Ratio of Income to Poverty

- OR = 4.1 (2.3, 7.1)
- OR = 1.7 (1.3, 2.2)
- OR = 1.2 (1.0, 1.5)
- OR = 0.7 (0.6, 0.9)
- OR = 1.0
Final Regression Model
## SES

<table>
<thead>
<tr>
<th>Wealth</th>
<th>1</th>
<th>---</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Poverty</td>
<td>1.6</td>
<td>(1.0, 2.6)</td>
</tr>
<tr>
<td>Severe Poverty</td>
<td>3.0</td>
<td>(2.2, 4.0)</td>
</tr>
</tbody>
</table>

### Insurance Status

<table>
<thead>
<tr>
<th>Uninsured</th>
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<th>---</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>0.9</td>
<td>(0.6, 1.4)</td>
</tr>
<tr>
<td>Medicare</td>
<td>0.6</td>
<td>(0.4, 0.9)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>0.9</td>
<td>(0.5, 1.6)</td>
</tr>
</tbody>
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### Mammography Use

<table>
<thead>
<tr>
<th>Highest Quartile 1</th>
<th>1</th>
<th>---</th>
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</thead>
<tbody>
<tr>
<td>Quartile 2</td>
<td>1.3</td>
<td>(1.1, 1.6)</td>
</tr>
<tr>
<td>Quartile 3</td>
<td>3.6</td>
<td>(3.0, 4.5)</td>
</tr>
<tr>
<td>Lowest Quartile 4</td>
<td>6.5</td>
<td>(5.1, 8.3)</td>
</tr>
</tbody>
</table>

### Urban/Rural

<table>
<thead>
<tr>
<th>Rural</th>
<th>1</th>
<th>---</th>
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</thead>
<tbody>
<tr>
<td>Urban</td>
<td>2.9</td>
<td>(2.0, 4.2)</td>
</tr>
</tbody>
</table>
Figure 1 - Areas of Higher than Expected Late Stage Breast Cancer Overlaid with Urban/Rural Counties and Mammography Prevalence

SaTScan Results
Higher than Expected Incidence

Urban and Rural Counties

Mammography Prevalence
Prevalence Quartiles
- <73.0
- 73.3 - 77.2
- 77.3 - 80.6
- >80.6

SaTScan Results
Higher than Expected Incidence
Conclusions

- **Area-based measures**
  - Robust measures that can augment population-based surveillance systems

- **Effect of SES on late stage breast cancer**
  - Clear gradient
  - Not confounded by other factors
  - 28% of higher than expected incidence can be attributed to SES
Limitations

- Study design
  - Cross sectional
- Population
  - 2000 Population denominator for all years
- Geocoding
  - Precision
  - Excluded cases
- SES indicator
  - Single variable
Future Research

- Apply methodology to other diseases
  - Esophageal
  - Bladder
- Multi-level modeling
- Survey
  - Truth the SES data
  - Obtain additional psycho/social data
    - Barriers to access and/or utilization
Funding Sources

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