Neighborhood characteristics associated with hospital readmissions for pediatric asthma in Rhode Island, 2001-2005

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Purpose of study

- To assess the association between neighborhood characteristics and time to hospital readmissions for pediatric asthma, controlling for sociodemographic factors

Background

- Asthma is one of the most frequent causes of hospital admissions among children and one of the most preventable (Mannino, Homa, Akinbami et al., 2002)
- A small proportion of asthma patients account for a disproportionate amount of healthcare visits (Adam et al 2000)
- Black children more likely than white children to be hospitalized for asthma (Akinbami & Schoendorf, 2002)
- Highest pediatric asthma hospitalization rates are clustered in low-income areas (Corburn, Osleeb, Porter, 2006; Kreiger & Higgins, 2002; Mott, 1995, Saxena 2006)

Research hypotheses

- Time to readmission for pediatric asthma will be associated with markers for economic disadvantage
  - Public insurance
  - Living in neighborhoods with high poverty
  - Living in neighborhoods with crowded housing conditions

Methods

- Linked data files from:
  - 2000 US Census
  - 2001-2005 Rhode Island Hospital Discharge Data

- Eligibility criteria:
  - Age 18 or younger
  - At least one hospital admission for asthma (ICD code 493) in 2001 – 2005
  - No prior hospital admissions for asthma during the three years before 2001
  - Reported accurate census tract
  - N=3,981 children

Measures – Asthma Hospitalization

- Defined as an admission with a diagnosis for asthma (ICD code 493) in the primary diagnosis or in any of the 10 additional diagnosis for this claim

Measures - Outcome

- Repeat pediatric asthma hospitalization
  - Right-censored:
    - Child never experienced another asthma hospitalization during time period
    - Turned 19 before having another asthma hospitalization in Rhode Island
    - Turned 19 before the end of study period

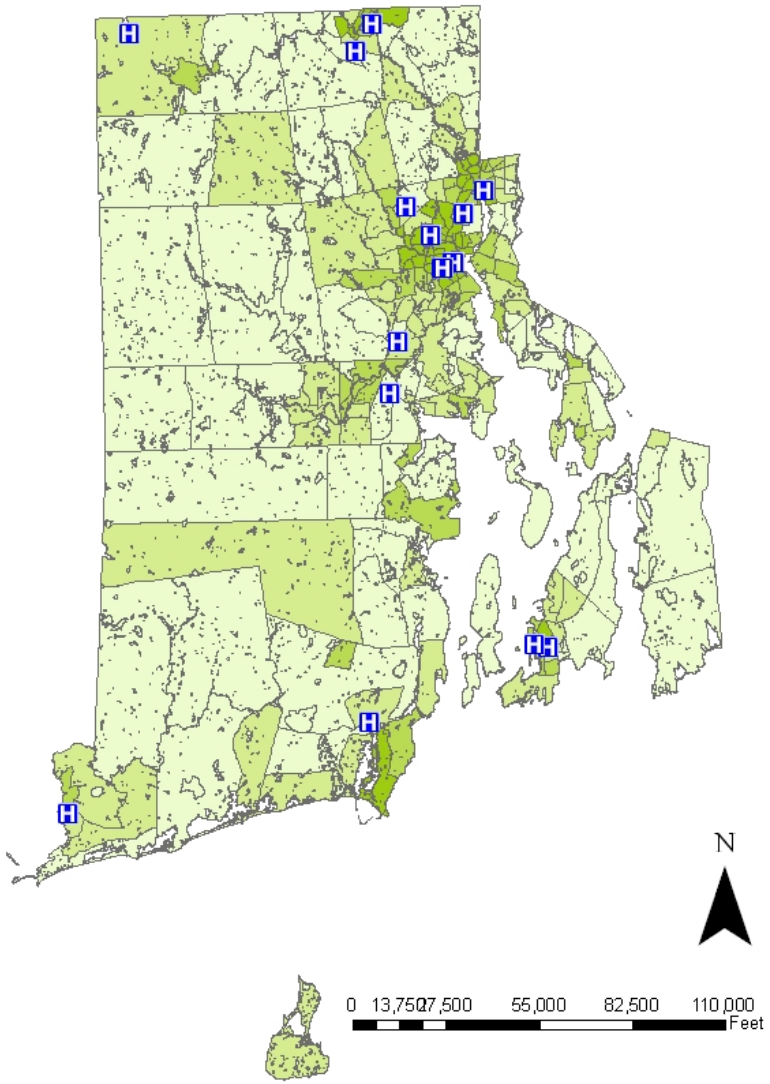
Measures - Covariates

- Individual-level characteristics:
  - Year of first hospital admission for asthma
  - Age (0-4, 5-10, 11-18)
  - Gender (Male/ Female)
  - Race/ethnicity (White, Black, Other)
  - Insurance type (Private, Public, Other)
  - Share zip code with medical facility (Yes/ No)

Measures – Census Tract

- Census-tract level characteristics:
  - Percent of the population in the census tract living in poverty (1 - 4.9%, 5 – 9.9%, 10 – 19.9%, 20% or more)
  - Proportion of population living in crowded conditions (<5%, 5% or more)

Location of medical facilites in relation to area level poverty, Rhode Island



Statistical model

- Cox proportional hazards model
  - Individual-level characteristics
  - Individual-level characteristics and neighborhood of living in poverty
  - Individual-level characteristics and neighborhood of living in crowded conditions

$$HR = \frac{h_i(t)}{h_j(t)} = \frac{\lambda_0(t)e^{\beta_1 x_{i1} + \ldots + \beta_k x_{ik}}}{\lambda_0(t)e^{\beta_1 x_{j1} + \ldots + \beta_k x_{jk}}} = e^{\beta_1 (x_{i1} - x_{j1}) + \ldots + \beta_1 (x_{ik} - x_{jk})}$$

Statistical model

- Shared frailty term
  - Frailty term allows for the incorporation of unmeasured random effects
  - Controls for possible correlation between children residing in the same census tract
  - Not significant so our model reduces to a Cox proportional hazard model

Results – Sample characteristics

- Male (55%)
- Between ages 0 to 4 at time of first asthma admission in 2001- 2005 (47%)
- White (61%)
- Hospitalized only once for asthma in 2001-2005 (84%)

Table 1: Cox regression models of time to the next pediatric asthma hospitalization, Rhode Island 2001-2005

	Model 1		Model 2		Model 3	
Variable	***HR***	***95% CI***	***HR***	***95% CI***	***HR***	***95% CI***
Year of first admission						
'2001	Reference		Reference		Reference	
'2002	1.06	(0.84, 1.35)	1.07	(0.84, 1.35)	1.09	(0.86, 1.38)
'2003	1.06	(0.83, 1.35)	1.06	(0.83, 1.35)	1.09	(0.85, 1.38)
'2004	0.92	(0.71, 1.19)	0.92	(0.71, 1.19)	0.95	(0.73, 1.22)
'2005	0.94	(0.69, 1.28)	0.94	(0.69, 1.28)	0.96	(0.70, 1.31)
Gender						
Male	Reference		Reference		Reference	
Female	1.10	(0.94, 1.30)	1.10	(0.94, 1.30)	1.11	(0.94, 1.30)
Age group						
0 - 4 years	1.55	(1.25, 1.94)	1.55	(1.25, 1.94)	1.56	(1.25, 1.94)
5 - 10 years	Reference		Reference		Reference	
10 - 18 years	0.99	(0.76, 1.29)	0.99	(0.76, 1.29)	0.99	(0.76, 1.28)
Race/ ethnicity						
White	Reference		Reference		Reference	
Black	1.00	(0.77, 1.29)	1.00	(0.76, 1.31)	0.92	(0.70, 1.20)
Other	1.01	(0.82, 1.23)	1.01	(0.82, 1.25)	0.93	(0.75, 1.16)
Unknown	1.05	(0.66, 1.66)	1.05	(0.66, 1.67)	0.99	(0.63, 1.57)
Insurance payer						
Private	Reference		Reference		Reference	
Public	1.42	(1.19, 1.70)	1.42	(1.18, 1.71)	1.41	(1.17, 1.69)
Other	1.40	(0.75, 2.60)	1.40	(0.75, 2.60)	1.34	(0.72, 2.49)
Shares zip code with a hospital						
Yes	1.20	(1.02, 1.39)	1.22	(1.04, 1.43)	1.25	(1.05, 1.49)
No	Reference		Reference		Reference	
% of Census Tract Population Living in Poverty						
1 to 4.9%	Reference		Reference		Reference	
5.0 to 19.9%	--	--	1.03	(0.81, 1.31)	--	--
20% or more	--	--	1.01	(0.76, 1.33)	--	--
% of Census tract population living in crowded conditions						
Less than 5%	--	--	Reference		Reference	
5% or more	--	--	--	--	1.51	(1.19, 1.92)

Results

- Individual characteristics positively associated with outcome
  - 0-4 years old compared to 5-10 (adjHR=1.56, 95% CI=1.25-1.94)
  - Public compared to private health insurance (adjHR=1.41, 95% CI=1.17-1.69)

Results

- Neighborhood characteristics positively associated with outcome
  - Shares zip code with a hospital with emergency department services

    (adjHR=1.25, 95% CI=1.05-1.49)

  - Census tract with 5% or more of the population living in crowded conditions

    (adjHR=1.51, 95% CI=1.19-1.92)

Conclusions

- By examining rehospitalizations we focused on the management of asthma rather than on incidence or diagnosis of the disease.

- Our findings suggest that a family's economic well-being (Medicaid insurance, living in crowded housing) may better identify children at risk of repeat hospitalizations for asthma than does race.

Limitations

- **Inconsistencies across providers and across years (e.g. missing or incomplete census tract information from records in the earlier years covered in our study)**
- **Unable to control for behavioral risk factors, such as exposure to environmental tobacco smoke and clinical markers such as adequacy of regular asthma treatment**
- **Data on asthma patients seen in outpatient settings not part of the Hospital Discharge Data**
- **Assume variables are time-invariant**

Directions for Future Research

- Qualitative and population based studies that identify geographical, cost, or other barriers to preventive treatment for asthma

- Exploring implications of modeling repeat hospitalizations for asthma using narrow vs. broad definition

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