The Link Between Poverty and Type 2 Diabetes in Rhode Island

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Type 2 diabetes is a major public health concern. Adults with type 2 diabetes are up to five times more likely to develop heart disease or have a stroke. Because of this, the risk of death among people with type 2 diabetes is about twice that of people of similar age but without diabetes, regardless of sex, age, or other factors.[1]

As of 2012, over 9.8% of Rhode Island's adult population, or 81,000 Rhode Islanders aged 18 and older, had been diagnosed with diabetes, a percentage similar to the estimated 9.7% of U.S. adults with diagnosed diabetes.[2] The percentage of adults with diagnosed diabetes is projected to rise, as rates of type 2 diabetes track closely with obesity and population aging patterns. By 2050, it is projected that as many as one in three U.S. adults could have diabetes,[3] 42% of U.S. adults will be obese,[4] and 20% of the population will be older than age 65, up from 13% in 2010.[5]

More worrisome is the striking gap between the high prevalence of diabetes among the low-income population compared with the average prevalence in the general population. Chaufan and colleagues call this public health problem the twin epidemics of poverty and diabetes to explain the higher rates of type 2 diabetes in low-income populations.[6] Low-income people also have higher rates of uncontrolled diabetes and complications. Data on the relationship between poverty and hospital discharges show that hospitalized patients from the poorest U.S. communities (median household income ≤ $38,000) were 77 percent more likely to be admitted for diabetes with complications compared to people residing in all other communities.[7] While these data provide valuable insight for addressing disparities with respect to diabetes, they do not fully capture health disparities at the state level.

We designed an analysis of diabetes that also accounts for the social determinants of health based on place of residence. In this article we examine the association between neighborhood-level poverty and hospital admission rates for type 2 diabetes in Rhode Island and outline potential policy options.

METHODS

We extracted records of hospital admissions for diabetes (2007-2011) from the Rhode Island Department of Health's Hospital Discharge Data. In Rhode Island all acute-care general hospitals are required to report discharge data to the state health department. Rhode Island's Hospital Discharge Data are event-level files that include demographic information, patient residence at the time of admission coded at the census tract level, clinical data coded to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) and summaries of hospital utilization and charges.[8]

Criteria for inclusion in our study were a primary diagnosis of type 2 diabetes (ICD-9-CM 250.x0, 250.x2) for patients aged 18 and older with a valid census tract. Census tracts are small, relatively homogeneous statistical subdivisions of a county, which usually have between 1,200 and 8,000 people, with an optimal size of 4,000 people.[9] The majority of cities and towns in Rhode Island have more than one census tract.

Five-year poverty rate estimates came from the 2007–2011 American Community Survey (ACS). The U.S. Census Bureau conducts the ACS by sampling a percentage of the U.S. population every year.[10] The Census Bureau defines a poverty area as a census tract where 20% or more of the residents live at or below the federal poverty level.[11] Census tracts with poverty rates of 40% or more are extreme poverty areas.[12] We matched 85.7% of the ACS census tracts to census tracts in the hospital discharge files.

Adult diabetes hospital admission rates were age-adjusted to the 2010 U.S. adult population, using 3 age groups (i.e., 18-44, 45-64, and ≥65.) We calculated a five-year average (2007–2011) for both poverty percentage and diabetes age-adjusted admission rate.

We estimated a correlation coefficient (denoted by r) with a range of between "-1" and "1" to measure the strength of the linear relationship between neighborhood-level poverty status and diabetes inpatient admissions. An r of 0 indicates no linear relationship, and 1 indicates a perfect positive linear relationship. A relationship is considered weak if values are between $0 \le r < 0.3$; moderate, if $0.3 \le r < 0.7$; and strong, if $0.7 \le r \le 1$.[13] The squared correlation coefficient (r^2), also known as the coefficient of determination, is one of the best means for evaluating the strength of a relationship. This is the proportion of variance in diabetes inpatient admission rates that can be accounted for by knowing census tract poverty levels. Conversely, it is the proportion of variance in census tract poverty levels that can be accounted for by knowing diabetes hospital admission rates.[13] SAS version 9.1 (SAS Institute, Inc, Cary, North Carolina) was used for all analyses.

RESULTS

Between 2007 and 2011, 8,312 hospital discharges occurred in Rhode Island where type 1 and type 2 diabetes were listed as the principal diagnosis, representing 1.17% of all admissions to acute-care hospitals (data not shown). Of these discharges, 5,742 hospital admissions met our study inclusion criteria.

Fifty-five census tracts qualified as poverty areas and nine as extreme poverty areas. Census tract 7 (Upper South Providence) had the highest poverty, with 66% of the residents living at or below the federal poverty level and an age-adjusted diabetes hospital admission rate of 8.04 per 1,000 residents (Table 1). Of the eight additional extreme poverty areas shown in Table 1, four had correspondingly high age-adjusted diabetes admission rates ranging from 7.76 per 1,000 residents to 11.23 per 1,000 residents. These were census tracts 5 (Lower South Providence), 8 (Downtown Providence), 27 (Providence) and 152 (Pawtucket). The remaining four extreme poverty neighborhoods had age-adjusted diabetes admission rates ranging from 1.90 per 1,000 residents to 6.6 per 1,000 residents (data not shown). These were census tracts 12 (Providence: 6.61/1,000 residents), 4 (Providence: 6.08/1,000 residents), 9 (Providence: 2.45/1,000 residents), and 183 (Woonsocket: 1.90/1,000 residents). The age-adjusted diabetes admissions rates in these extreme poverty neighborhoods were considerably higher than the rates shown in Table 2 for Rhode Island's census tracts with the lowest percentage of residents living in poverty.

Two exceptions to the relationship between neighborhood poverty and diabetes admission rates were census tracts 36.02 (College Hill, Providence) and 132.01 (Scituate). Census tract 36.02, with a high proportion of university students, had a low diabetes admission rate (0.68/1,000 residents), but a high percentage of residents in poverty (37.9%). Census tract 132.01 had a high age-adjusted diabetes admission rate (9.04/1.000 residents) but a low percentage of residents in poverty (5.8%).

The neighborhood with the lowest poverty percentage in Rhode Island was census tract 114.02 (Cumberland; Table 2). This census tract had a very low diabetes age-adjusted admission rate of 1.40 per 1,000 residents (data not shown). Of the 19 census tracts with less than three percent of residents living in poverty, five had correspondingly low diabetes age-adjusted admission rates of 1.08 per 1,000 residents or lower. These were census tracts 133 (Foster), 143 (Cranston), 216 (Warwick), 302 (Barrington), and 504.02 (North Kingstown). No low-poverty census tracts were in Providence (Table 2). Providence had only one census tract with a very low diabetes age-adjusted admission rate. In census tract 35, 12.4% of the residents live at or below the federal poverty level.

The correlation analysis between admission rates for diabetes and census tract-level poverty provided a correlation coefficient of 0.5561, indicating a moderate positive linear relationship. The squared correlation coefficient (r^2) was 0.3092. Thus, 30.92% of Rhode Island census tracts with high diabetes hospital admission rates were high-poverty neighborhoods, and conversely, 30.92% of high-poverty census tracts had high hospital admission rates for diabetes (Figure 1).

Table 1. Neighborhoods with the 20 highest poverty percentage and diabetes age-adjusted admission rate in Rhode Island, 2007-2011[1,2]

Rank	Poverty Status			Diabetes age-adjusted admission rate per 1,000 residents		
	Census Tract	Town/City	% in poverty	Census Tract	Town/City	Rate per 1,000
226	7	Providence	66.11	25	Providence	28.53
225	5	Providence	57.18	161	Pawtucket	17.09
224	27	Providence	50.54	2	Providence	13.32
223	12	Providence	50.53	178	Woonsocket	12.88
222	152	Pawtucket	48.24	5	Providence	11.23
221	4	Providence	48.16	1.02	Providence	10.31
220	183	Woonsocket	42.97	8	Providence	9.75
219	9	Providence	41.27	132.01	Scituate	9.04
218	8	Providence	40.36	111	Central Falls	8.92
217	2	Providence	39.40	27	Providence	8.66
216	31	Providence	38.93	6	Providence	8.48
215	151	Pawtucket	38.32	31	Providence	8.16
214	36.02	Providence	37.95	184	Woonsocket	8.14
213	180	Woonsocket	37.93	7	Providence	8.04
212	161	Pawtucket	37.90	152	Pawtucket	7.76
211	174	Woonsocket	37.40	104	East Providence	7.35
210	111	Central Falls	37.23	151	Pawtucket	7.24
209	166	Pawtucket	35.59	1.01	Providence	7.22
208	14	Providence	34.74	13	Providence	7.20
207	22	Providence	34.50	3	Providence	6.96

[1] The majority of cities and towns in Rhode Island have more than one census tract.

[2] Admission rates were restricted to type 2 diabetes and adults 18 years of age and older. Both poverty percentage and diabetes age-adjusted admission rate were five-year averages in Rhode Island, 2007–2011.

Table 2. Neighborhoods with the 20 lowest poverty percentage and diabetes age-adjusted admission rate in Rhode Island, 2007-2011[1,2]

Rank	Poverty Status			Diabetes age-adjusted admission rate per 1,000 residents		
	Census Tract	Town/City	% in poverty	Census Tract	Town/City	Rate per 1,000
1	114.02	Cumberland	0.99	303	Barrington	0.50
2	146	Cranston	1.20	401.01	Portsmouth	0.54
3	513.04	S. Kingstown	1.45	401.02	Portsmouth	0.54
4	127.01	Smithfield	1.84	510	Westerly	0.60
5	219.01	Warwick	1.94	511.02	Charlestown	0.66
6	143	Cranston	1.95	403.02	Middletown	0.70
7	301	Barrington	1.95	143	Cranston	0.73
8	145.01	Cranston	2.00	515.02	Narragansett	0.79
9	504.01	N. Kingstown	2.07	168	Pawtucket	0.84
10	304	Barrington	2.10	515.03	Narragansett	0.85
11	209.04	East Greenwich	2.29	407	Newport	0.88
12	504.02	N. Kingstown	2.38	413	Jamestown	0.93
13	216	Warwick	2.38	35	Providence	0.95
14	302	Barrington	2.46	416.02	Tiverton	0.98
15	507	Hopkinton	2.61	504.02	North Kingstown	0.98
16	113.02	Cumberland	2.62	216	Warwick	0.99
17	126.01	Smithfield	2.62	302	Barrington	1.02
18	133	Foster	2.66	133	Foster	1.08
19	131.02	Glocester	2.73	405	Newport	1.14
20	224	Warwick	2.80	128.01	North Smithfield	1.16

[1] The majority of cities and towns in Rhode Island have more than one census tract.

[2] Admission rates were restricted to type 2 diabetes and adults 18 years of age and older. Rates were not computed for diabetes admission counts containing fewer than 5 cases. Both poverty percentage and diabetes age-adjusted admission rate were five-year averages in Rhode Island, 2007–2011.

DISCUSSION

Type 2 diabetes is a common, growing, and costly disease,[14] with direct medical costs estimated at $176 billion (2012 dollars), of which the largest component is inpatient hospital care.[15] Until recently, poverty was under-recognized as a contributor to type 2 diabetes. The findings presented in this paper underscore the burden of type 2 diabetes among Rhode Islanders living in poverty. Our results showed that 30.9% of census tracts with high admission rates for type 2 diabetes also had high poverty rates. Moreover, we found a positive poverty-place gradient for diabetes hospital admissions. As neighborhood poverty levels increased from less than 3% to over 40%, the corresponding diabetes admission rates went from less than 2 per 1,000 residents to nearly 30 per 1,000 residents.

Previous research has found disparities in diabetes prevalence and hospital admissions rates by individual- and neighborhood-level poverty. A study conducted in New York City found that diabetes disproportionately affected adults living in low-income households and neighborhoods. Diabetes hospitalization rates per 100,000 residents were almost three times higher in New York City's low-income neighborhoods than in high-income communities.[16] A recent analysis of the Canadian Community Health Survey and the National Population Health Survey found that living in poverty was a significant predictor of developing type 2 diabetes. Further, the prevalence of type 2 diabetes in the poorest income groups was more than four times higher than that of the wealthiest income group, even when education, body mass index and physical activity levels were taken into account.[17,18] A survey of Latino immigrants living in Northern California found high rates of type 2 diabetes among individuals trapped by poverty.[6] Our analysis extends these results to show strong differences in diabetes hospitalization rates at the census tract level.

Although a combination of physical activity, healthy eating, weight loss, and medication adherence can help prevent diabetes,[19] the environment in which one lives may pose barriers to achieving these measures that are difficult to overcome. Previous health inequities by place are well-documented.[20-22] A study designed to examine the relationship between neighborhood walkability and risk of developing diabetes, for example, found that the risk of developing diabetes was three times higher among adults living in a low-income/low walkability neighborhood than in a high-income/high walkability area.[23] We found the most consistent relationship between neighborhood poverty and high diabetes admission rates in Providence. Providence has one of the highest poverty rates in the nation with 27.7% of the population living below the poverty level, more than twice the national rate of 12.8%.[24] Our study found the largest concentration of poverty in census tracts 5, 7, 12 and 27 (Figure 2), where 50% or more of the residents live below the poverty level and between 40 to 65% of the adult residents are Hispanic.[25] Poverty coupled with discrimination, insufficient employment opportunities, zoning restrictions, and local tax structures can all exacerbate disparities between neighborhoods.[25] Inadequate housing, food insecurity, and

Figure 1. The correlation between poverty level and diabetes admission rate, data from the 2007–2011 American Community Survey and the 2007–2011 Rhode Island Hospital Discharge Data.

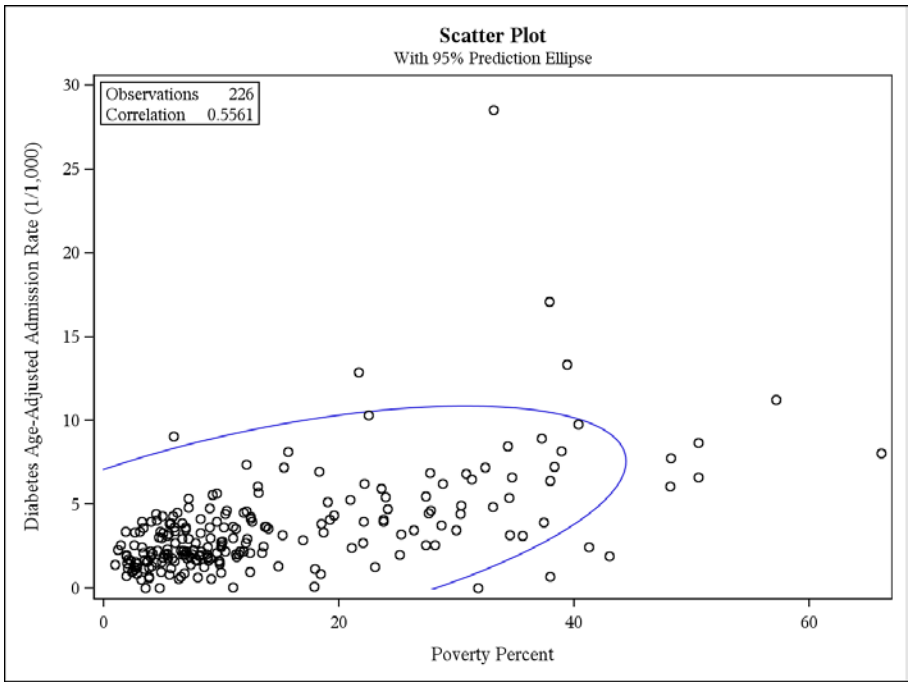
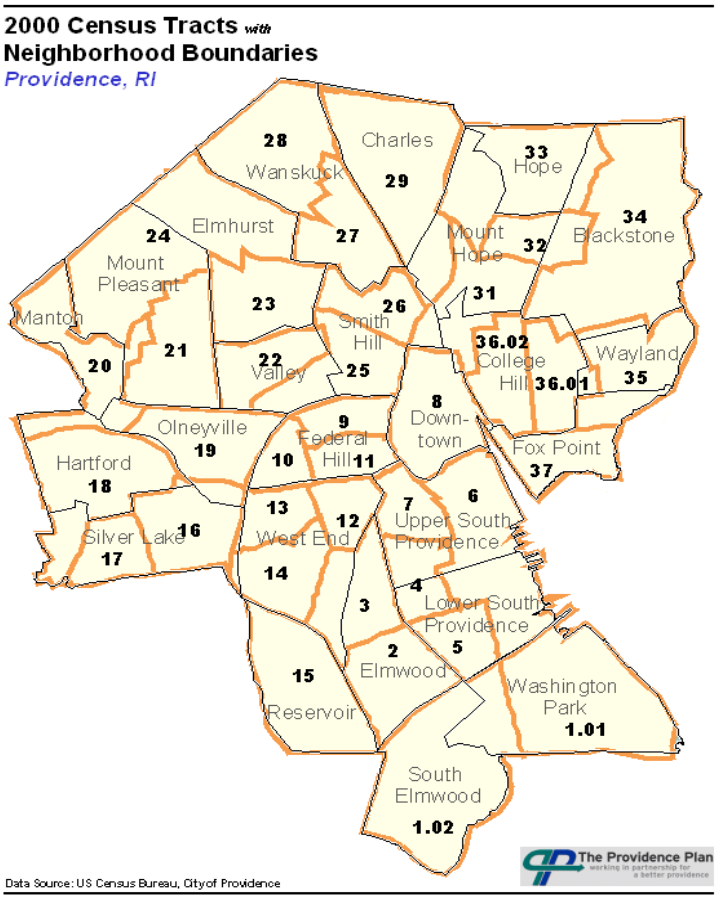


Figure 2. Census tracts in Providence, Rhode Island



intermittent health care coverage, make it extremely difficult for low-income people with diabetes to manage their disease.

There are some limitations to our study. Approximately 30% of census tracts were missing or incorrect in the 2010 Rhode Island Hospital Discharge Data compared to less than 10% in earlier years of hospital data. Many factors are significantly associated with type 2 diabetes, but only census tract poverty was available in the linked files used in this study.

A major strength of our study was that neighborhood-level poverty was assessed by two population-based surveys, not by patients themselves. Promising policy initiatives to improve health in high-poverty neighborhoods include tax incentives and federal funding to build healthier communities that support greater access to healthy foods, a safer environment more conducive to exercise, and the coupling of access to health care with local community-based resources for diabetes self-management. A five-year federal grant awarded to the Rhode Island Department of Health is supporting the establishment of a statewide clinical-community referral network to more efficiently identify and refer people with diabetes and other chronic conditions to evidence-based lifestyle programs. By 2014, the Patient Protection and Affordable Care Act (ACA) of 2010 will likely improve access to services and quality of care, particularly for people who were previously under- and uninsured.

In 2010, Congress passed a federal menu labeling law requiring chain restaurants with 20 or more outlets to list calories and other nutrition information on menus and menu boards.[26] The Food and Drug Administration is implementing the law despite legal challenges in state and local legislative bodies and the courts. Initial evaluations of menu labeling laws have found that they influence some, but not all, consumers to purchase healthier meals.[27] More research in this area is needed, especially with respect to the efficacy of menu labeling laws in high-poverty neighborhoods with a concentration of fast food restaurants.

Data on population- and policy-level approaches to address inequalities in diabetes prevalence and hospital admission rates are limited. The good news is that the Centers for Disease Control and Prevention (CDC) and the National Institute of Diabetes and Digestive and Kidney Diseases are jointly funding a five-year

multicenter research network to examine the effectiveness of large-scale population-level health policies on diabetes prevention, control, and inequalities.[28] As clinicians and public health practitioners, our job is to focus on how we can best address modifiable diabetes risk factors and leverage community partnerships to eliminate health disparities.

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Disclosure

The authors have no financial interests to disclose.

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