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The local geographic distribution of diabetic complications in New York City: Associated population characteristics and differences by type of complication

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ABSTRACT

Aims: To identify population characteristics associated with local variation in the prevalence of diabetic complications and compare the geographic distribution of different types of complications in New York City.

Methods: Using an all-payer database of emergency visits, we identified the proportion of unique adults with diabetes who also had cardiac, neurologic, renal and lower extremity complications. We performed multivariable regression to identify associations of demographic and socioeconomic factors, and diabetes-specific emergency department use with the prevalence of diabetic complications by Census tract. We also used geospatial analysis to compare local hotspots of diabetic complications.

Results: We identified 4.6 million unique New York City adults, of which 10.5% had diabetes. Adjusting for demographic and socioeconomic factors, diabetes-specific emergency department use was associated with severe microvascular renal and lower extremity complications (p-values < 0.001), but not with severe macrovascular cardiac or neurologic complications (p-values of 0.39 and 0.29). Our hotspot analysis demonstrated significant geographic heterogeneity in the prevalence of diabetic complications depending on the type of complication. Notably, the geographic distribution of hotspots of myocardial infarction were inversely correlated with hotspots of end-stage renal disease and lower extremity amputations (coefficients: −0.28 and −0.28).

Conclusions: We found differences in the local geographic distribution of diabetic complications, which highlight the contrasting risk factors for developing macrovascular versus microvascular diabetic complications. Based on our analysis, we also found that

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high diabetes-specific emergency department use was correlated with poor diabetic outcomes. Emergency department utilization data can help identify the location of specific populations with poor glycemic control.

1. Introduction

Diabetes prevalence in the United States has doubled over two decades, and now nearly 1 in 10 Americans have diabetes [1]. This rapid increase means over 29 million people at greater risk for heart attack, stroke, kidney failure, lower extremity amputation, and other complications [2]. However, this diabetes burden has been unevenly distributed by neighborhood [3]. Some communities have been overwhelmed by diabetes, whereas others have seen modest rises in prevalence [4].

Current diabetes surveillance methods are limited [5]. Traditional surveys have insufficient sample sizes to identify prevalence of diabetes and its complications at a local level [4]. Failure to identify this local variation may mean that certain communities will continue to have poor diabetic outcomes despite advances in diabetes care and management [6]. These high-risk communities may have qualitatively different health needs or may respond better to different types of interventions [7]. Therefore, we must identify the precise geographic regions where diabetic outcomes are especially poor [8].

Globally, researchers have turned to administrative data to track diabetic complications [9]. These studies have suggested declines in complication rates, but give little insight as to whether gains have been evenly distributed. To enhance diabetes surveillance, we have developed novel geographic methods, which take advantage of large data sources and address-level information and enables identification of diabetes burden at a local level [10].

The goal of this study was to use these methods to investigate the prevalence of diabetic complications and identify areas with especially poor diabetic outcomes in New York City. We identify which population characteristics were associated with higher prevalence of diabetic complications. We also used geospatial analysis to compare hotspots for different types of diabetic complications.

2. Materials and methods

2.1. Study design

We identified unique adult emergency department (ED) patients with diabetes who lived in New York City and had diagnosis codes for cardiac, neurologic, renal, and lower extremity conditions associated with diabetes. We compared this calculated prevalence of diabetic complications against New York City estimates from a national survey and registry. Then, we performed multivariable regression to identify associations of population characteristics and diabetes-specific ED utilization with the local prevalence of diabetic complications. Finally, we used geospatial analysis to identify local hotspots and compare the geographic distribution of different types of complications.

2.2. Data sources

2.2.1. New York SPARCS database

The Statewide Planning and Research Cooperative System (SPARCS) is an all-payer claims database that collects patient characteristics, diagnoses, treatment, and services for all inpatient hospitalizations and ED visits in New York State. The database contains unique identifiers for tracking specific individuals and address-level information, which was geocoded to locate the exact residence of patients from 2008 to 2012.

2.2.2. Behavioral Risk Factor Surveillance Survey (BRFSS)

The BRFSS is a national health survey that tracks health behaviors and disease prevalence in the United States and is administered by the Centers for Disease Control and Prevention. It asks respondents whether they have "ever been told by a doctor, nurse, or other health professional" that they have diabetes, coronary artery disease, kidney disease, or have had a heart attack or stroke. It is telephone-based and was redesigned in 2011 to include cell phone only respondents [11]. Therefore, we used 2011–2012 weighted responses for 4432 survey participants and 489 diabetic adults in New York City counties.

2.2.3. United States Renal Data System (USRDS)

The USRDS is a national registry that collects statistics on kidney disease in the United States. For renal failure, it uses Medicare claims and Medical Evidence Report forms mandatory for all renal failure patients, including non-Medicare patients since 1995. It identifies individuals by age, comorbidities including diabetes, and contains zip codes that we used to identify 21,235 New York City adults with renal failure from 2008 to 2012 [12].

2.2.4. American Community Survey (ACS)

To identify population characteristics associated with the prevalence of diabetic complications, we used United States Census data from the 2008 to 2012 ACS. To obtain an adequate sample by Census tract, the ACS pools results from five years to produce estimates of demographic and socioeconomic characteristics. We used ACS data to estimate the number of New York City adults and in combination with BRFSS estimates of diabetes prevalence to estimate the number of diabetic adults in New York City.