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Original Research

Association Between Diabetic Ketoacidosis Hospitalizations and Driving Distance to Outpatient Diabetes Centres in Adults with Type 1 Diabetes Mellitus


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ABSTRACT

Objective: The purpose of this study was to assess the relationship between diabetic ketoacidosis (DKA) hospitalization and driving distance from home to outpatient diabetes care in adults with type 1 diabetes mellitus.

Methods: We identified adults with type 1 diabetes using clinical and administrative databases living in Calgary, Alberta. The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, codes were used to identify DKA hospitalizations, and geographic information systems were used to obtain road distance. Multivariate logistic regression was used to assess the association between driving distance (exposure) to diabetes care sites and the outcome of DKA hospitalization.

Results: We identified 1467 patients (151 patients with DKA) with type 1 diabetes. Patients with DKA hospitalizations were younger (35.6 vs. 41.0 years), had shorter duration of diabetes (13.6 vs. 18.7 years) and higher glycated hemoglobin (9.2% vs. 8.4%). Driving distance from home to diabetes centre 1 (adjusted odds ratio 1.02 per 1 km; 95% confidence interval, 0.96 to 1.07), diabetes centre 2 (adjusted odds ratio 1.01; 95% confidence interval, 0.99 to 1.04) or closest general practitioner (adjusted odds ratio 0.9; 95% confidence interval, 0.63 to 1.25) was not associated with DKA hospitalization. Driving distance was also not associated with glycemic control.

Conclusions: Within a large urban city, driving distance to diabetes centres does not appear to be protective of DKA hospitalization. However, this work does not preclude the role of local travel distance and diabetes outcomes. More research is required to explore the role of other individual, neighbourhood and community factors that influence DKA hospitalization.

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R É S U M É

Objectif : Le but de cette étude était d'évaluer la relation entre l'hospitalisation pour une acidocétose diabétique (ACD), et la distance routière entre le domicile et le centre de soins ambulatoires pour les diabétiques chez les adultes souffrant du diabète sucré de type 1.

Méthodes : Nous avons identifié les adultes souffrant du diabète de type 1 et vivant à Calgary, en Alberta à partir des bases de données cliniques et administratives. Les codes de la Classification statistique internationale des maladies et des problèmes de santé connexes, dixième révision, ont été utilisés pour identifier les hospitalisations pour une ACD, et les systèmes d'information géographique ont été utilisés pour obtenir la distance routière. La régression logistique multivariée a été utilisée pour évaluer le lien entre la distance routière (exposition) et les centres de soins aux patients diabétiques, et les résultats de l'hospitalisation pour une ACD.

Résultats : Nous avons identifié 1467 patients (dont 151 patients souffrent d'ACD) souffrant du diabète de type 1. Les patients ayant subi des hospitalisations pour une ACD étaient plus jeunes (35,6 vs 41,0 ans),

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souffraient d'un diabète depuis moins longtemps (13,6 vs 18,7 ans) et avaient une hémoglobine glyquée plus élevée (9,2 % vs 8,4 %). La distance routière du domicile au centre de diabète 1 (ratio d'incidence approché ajusté 1,02 au 1 km; intervalle de confiance à 95 %, 0,96 à 1,07), au centre de diabète 2 (ratio d'incidence approché ajusté 1,01; intervalle de confiance à 95 %, 0,99 à 1,04) ou à l'omnipraticien le plus proche (ratio d'incidence approché ajusté 0,9; intervalle de confiance à 95 %, 0,63 à 1,25) n'a pas été associée à l'hospitalisation pour une ACD. La distance routière n'a également pas été associée à la régulation de la glycémie.

Conclusions : Au sein d'une grande région urbaine, la distance routière vers les centres de diabète ne semble pas faire éviter l'hospitalisation pour une ACD. Cependant, ces travaux n'excluent pas le rôle de la distance de déplacement local et les résultats liés au diabète. Plus de recherches sont nécessaires pour étudier le rôle d'autres facteurs individuels, de proximité et communautaires qui influencent l'hospitalisation pour une ACD.

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Introduction

Geography has influenced health research for many centuries (1). One of the earliest examples dates to the 1800s when Dr. John Snow demonstrated the association between cholera and proximity of residence to the Broad Street pump (1). Since then, location of residence has been shown to be closely connected to health effects, such as outbreaks of infectious diseases, air pollution and respiratory issues, and health outcomes and accessibility to health services (2). Type 1 diabetes mellitus is considered to be an ambulatory care-sensitive condition in that, with adequate ambulatory care, hospitalizations for acute metabolic complications are generally considered to be preventable (3–6). One component of ambulatory care is interdisciplinary diabetes centres. Interdisciplinary diabetes centres provide ambulatory care through diabetes support, education and counselling, and encourage the development of self-management skills to optimize overall diabetes health, including minimizing acute and chronic complications (7). However, barriers, such as travel distance, may exist in accessing outpatient care.

Diabetic ketoacidosis (DKA) is a serious acute complication of type 1 diabetes. It is associated with significant morbidity and is life threatening, with an estimated mortality rate between 4% and 12% (8–10). Common precipitating factors include omission of or inadequate insulin doses, infection, acute illness, trauma and alcohol use (11,12). Although DKA is potentially fatal, it is theoretically preventable with appropriate outpatient diabetes education and support (3,5). In principle, Canada has a universal health system that theoretically fosters universal access to services, such as interdisciplinary diabetes centres. However, the removal of financial barriers to such services does not ensure equal access (13). Other potential barriers exist and factors, such as longer travel distance, may limit access to outpatient diabetes care (14). Differences in quality of care and outcomes between rural and urban patients with diabetes have been established, but whether differences exist among urban dwellers is not known (14–17). Therefore, the objective of this study was to assess the relationship between driving distance to outpatient diabetes care centres and DKA hospitalization for adults with established type 1 diabetes.

Methods

We performed a data linkage study of adults (aged ≥ 18 years old) living in Calgary, Alberta (population, approximately 1 million), with type 1 diabetes, between January 2004 and September 2008 (18). Participants were adults with a valid Personal Health Number (PHN), a valid postal code, who were living within Calgary city limits, who had attended an interdisciplinary diabetes centre and who had received one-on-one diabetes education. From this cohort of patients with diabetes, persons with a DKA hospitalization were identified using International Statistical

Classification of Diseases and Related Health Problems, Tenth Revision, Canada (ICD-10 CA) codes (E10.100, E10.101, E10.120, E10.121, E10.10 and E10.12). Patients were excluded if the duration of their diabetes was < 6 months, to exclude patients with DKA as their initial presentation.

Data sources and linkage

Five clinical and administrative data sources were merged to identify our study population and exposures. Linkages were based on PHN (for clinical data) and postal codes (for census data and general practitioner's office location). The data sources included were as follows.

Alberta Inpatient Discharge Abstract Database

All inpatient separation (by discharge or death) abstracts in Alberta are filed with the Canadian Institute for Health Information. Coders review inpatient charts and extract data including PHN, patient demographics, diagnoses and interventions. All permanent residents are covered by their provincial health insurance plan except for registered First Nations people, the military, the Royal Canadian Mounted Police and prison inmates, who are the responsibility of the federal government. Eligible Alberta residents are assigned a unique lifetime PHN, which is an ideal variable to perform record linkage.

Diabetes, Hypertension and Cholesterol Centre clinical database

In Calgary, publicly funded interdisciplinary diabetes teams for adults are housed at 2 locations that patients visit. Since 2003, each visit has been recorded in the Diabetes, Hypertension and Cholesterol Centre (DHCC) clinical database. Data include patient demographics (sex, birth date, PHN, address with postal code), type of diabetes, date of diagnosis, presence of a diabetes specialist, medical history, blood pressure, anthropometrics, medications, laboratory information and a clinical text note.

General practitioner's office location

The postal codes of general practitioners' offices were obtained from the College of Physicians and Surgeons of Alberta.

Alberta Kidney Disease Network repository of laboratory data

The Alberta Kidney Disease Network is a computerized repository of selected laboratory data for the province of Alberta (19). Inpatient results were excluded, as outpatient results are thought to better reflect stable medical conditions (19).

Statistics Canada 2006 census data

Statistics Canada 2006 census data were used to obtain data on median household income and education per dissemination area. That was done by linking patient postal codes to census dissemination areas using the postal code conversion file maintained by

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