



Relationship between GP visits and time spent in-hospital among insulin-dependent Canadians with type 2 diabetes

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Abstract

Objective To determine whether higher frequency of GP visits among insulin-dependent patients with type 2 diabetes is associated with reduced hospitalizations.

Design Nationally representative study using data from the 2013-2014 cycle of the Canadian Community Health Survey.

Setting Canada.

Participants A study sample comprising 2203 insulin-dependent Canadians with type 2 diabetes.

Main outcome measures The relationship between GP visits (no visits, 1-5 visits, ≥ 6 visits) in the past year and the number of nights spent in-hospital. Zero-inflated negative binomial Poisson regression models were used to account for overdispersion and excess zeros.

Results Higher numbers of GP visits were associated with spending fewer nights in-hospital. Patients with 1 to 5 GP visits had a significantly lower number of nights spent in-hospital (rate ratio of 0.38, 95% CI 0.25 to 0.56), as did those with 6 or more GP visits (rate ratio of 0.57, 95% CI 0.38 to 0.84) despite having reduced odds of not being hospitalized (odds ratio of 0.62, 95% CI 0.39 to 0.95), compared with those who did not see a GP in the past year, after adjusting for confounders.

Conclusion We found that insulin-dependent patients with diabetes who saw GPs more frequently were hospitalized less commonly compared with those who did not see a GP in the past year. Further research is needed to examine relationships with other types of follow-up, ideally using a longitudinal design.

Editor's key points

► Insulin, the primary treatment for diabetes, is a high-risk medication that can result in serious adverse events requiring hospitalization, including permanent neurological injury and death. More frequent monitoring of people who live with diabetes to ensure treatment stability and encourage self-management might prevent hospitalizations. While most diabetes care is conducted in primary care, it is unknown whether a higher frequency of GP visits is associated with reduced hospitalizations.

► The results of this nationally representative study of 2203 Canadians managing type 2 diabetes with insulin indicate that more frequent visits to a GP lead to reduced hospitalization, when compared with those who did not attend primary care clinics. This study suggests that diabetes management in primary care might be protective against acute hospitalizations and that it is an appropriate primary management setting for people who are taking insulin to manage type 2 diabetes.



Points de repère du rédacteur

► L'insuline, qui est le principal traitement pour le diabète, est un médicament à risque élevé qui peut causer des événements indésirables sérieux nécessitant une hospitalisation, notamment des lésions neurologiques permanentes et le décès. Une surveillance plus fréquente des personnes qui vivent avec le diabète pour assurer la stabilité thérapeutique et encourager l'autogestion des soins pourrait prévenir les hospitalisations. La plupart des soins pour le diabète sont fournis en première ligne, mais nous ne savons pas si des visites plus fréquentes auprès d'un généraliste sont associées à une réduction des hospitalisations.

► Les résultats de cette étude nationalement représentative auprès de 2203 Canadiens prenant en charge leur diabète de type 2 avec de l'insuline indiquent que des visites plus fréquentes auprès d'un généraliste entraînent une réduction des hospitalisations par rapport à l'omission de fréquenter des cliniques de soins primaires. Cette étude fait valoir que la prise en charge du diabète en soins primaires pourrait prévenir les admissions à l'hôpital pour soins actifs, et que les soins de première ligne sont un milieu approprié de prise en charge primaire pour les personnes qui prennent de l'insuline pour gérer le diabète de type 2.

Relation entre les visites chez le généraliste et le temps passé à l'hôpital par les Canadiens insulino dépendants ayant un diabète de type 2

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Résumé

Objectif Déterminer si des visites plus fréquentes auprès d'un généraliste par des patients insulino dépendants ayant un diabète de type 2 sont associées à une réduction des hospitalisations.

Type d'étude Étude représentative sur le plan national à l'aide de données tirées du cycle 2013-2014 de l'Enquête sur la santé dans les collectivités canadiennes.

Contexte Canada.

Participants Un échantillon de sujets à l'étude comptant 2203 Canadiens insulino dépendants ayant un diabète de type 2.

Principaux paramètres à l'étude La relation entre les visites auprès d'un généraliste (aucune visite, de 1 à 5 visites, ≥ 6 visites) durant l'année précédente et le nombre de nuits passées à l'hôpital. Des modèles de régression de Poisson et binomial négatif à inflation de zéro ont servi pour tenir compte de la surdispersion et de la surabondance de réponses nulles.

Résultats Des visites plus nombreuses auprès d'un généraliste étaient associées à un nombre moins élevé de nuits passées à l'hôpital. Les patients qui comptaient de 1 à 5 visites à un généraliste avaient passé un nombre significativement moins élevé de nuits à l'hôpital (ratio des taux de 0,38, IC à 95 % de 0,25 à 0,56), tout comme ceux qui avaient vu un généraliste 6 fois ou plus (rapport de cotes de 0,57, IC à 95 % de 0,38 à 0,84) malgré qu'ils eurent une probabilité moins grande de ne pas être hospitalisés (rapport de cotes de 0,62, IC à 95 % de 0,39 à 0,95), par comparaison avec ceux qui n'avaient pas vu de généraliste durant l'année précédente, après rajustement pour les facteurs de confusion.

Conclusion Nous avons constaté que les patients diabétiques insulino dépendants qui avaient vu un généraliste plus fréquemment étaient hospitalisés moins souvent par rapport à ceux qui n'en avaient pas consulté durant l'année précédente. D'autres recherches sont nécessaires pour examiner les relations avec d'autres types de suivi, idéalement selon une conception longitudinale.

Diabetes is a leading cause of morbidity and mortality in Canada. Between 1998 and 2009, the prevalence of diabetes increased by 70%, with 2.4 million Canadians affected in 2009.¹ Its prevalence is projected to increase by an additional 45% by 2025,² and its associated costs by \$4.3 billion by 2020. In 2010, Canada spent an average of \$6741 per person living with diabetes,³ a cost which could be mitigated with improved management, as 80% of diabetes-associated costs arise from mismanagement and disease-related complications.³⁻⁵

Insulin, the primary treatment for type 1 diabetes and a frequent adjunct therapy for type 2 diabetes, is a high-risk medication that requires monitoring to ensure its effectiveness and to avoid drug-related harm.^{6,7} Unfortunately, its narrow therapeutic index often results in dosing issues, which can lead to severe metabolic abnormalities ranging from ketoacidosis and hyperosmolar hyperglycemic nonketotic syndrome if underdosed, to serious adverse effects from high doses causing life-threatening hypoglycemia.^{7,8} This can result in seizures, coma, and even death. Regular monitoring and patient education are crucial to ensuring that diabetes treatments are tailored to optimize sugar control and minimize long-term complications, while avoiding preventable adverse events. To achieve this, clinical practice guidelines recommend a collaborative approach among patients, caregivers, GPs, and specialists.⁶

Adverse drug events (ADEs)—harmful, unintended effects due to medication use⁹—have become a leading cause of hospital visits in North America. Canadian studies have estimated that 12% of emergency department visits are medication related, 35% of which require admission.¹⁰⁻¹³ Insulin is a leading “culprit medication”¹⁴⁻¹⁷ and is more frequently implicated than other high-risk medications. Insulin-related ADEs result almost entirely from high doses causing severe hypoglycemia.^{14,15} One-third of insulin-related emergency department visits require admission, and 60% of patients experience severe neurologic effects,¹⁶ prolonging hospital stays and increasing patient morbidity. Additionally, patients taking insulin frequently experience preventable, repeat ADEs.¹⁸

Given that primary care physicians provide most diabetes care in Canada,¹⁹⁻²¹ and that the continuity of care provided by GPs has been shown to improve outcomes (eg, medication adherence, glycemic control) for those living with diabetes,^{22,23} it is possible that more primary care visits might prevent hospital use. Therefore, our main objective was to examine the association between self-reported primary care and hospital use among Canadians with type 2 diabetes taking insulin.

— Methods —

Study design

This study uses data from the 2013-2014 cycle of the Canadian Community Health Survey (CCHS), a national

cross-sectional survey conducted annually by Statistics Canada among individuals older than 12 years of age living in privately occupied residences across Canada.²⁴ Although the survey does not include those living on reserves or in institutions, or those serving full-time in the Canadian Forces, these exclusions apply to less than 3% of the population. The CCHS collects information on a nationally representative sample of Canadians about health status and determinants, as well as health services use, and employs a multistage clustered design. Detailed data dictionaries, questionnaires, and the interviewing and sampling methodology can be accessed from Statistics Canada.²⁵ The response rate for this cycle of the CCHS was 86.5%.²⁴

The CCHS is conducted under the Statistics Act, requiring that data privacy and confidentiality be maintained. This study falls under the publicly available data clause (item 1.3.1) of “Policy #89: research and other studies involving human subjects,” and therefore did not require project-specific research ethics approval.²⁶

Participants

We included respondents who reported taking insulin to manage diabetes and who indicated on the survey that they had type 2 diabetes. We excluded those who did not report taking insulin, or who were unsure, and participants without valid responses to explanatory or outcome variables, as well as those with missing confounder data.

Study variables

The main outcome was the number of nights spent in-hospital in the past year. This ranged from 1 to 30 nights, with those spending more than 30 nights in-hospital aggregated into a 31-plus category by Statistics Canada.²⁵ The explanatory variable (the number of GP visits in the past 12 months) ranged from 0 to 30, with those reporting 31 or more visits aggregated into a 31-plus category by Statistics Canada.²⁵ We categorized this variable because cell counts for this measure were often small or empty for some counts. While no consensus measure to categorize GP visits exists, we categorized GP visits based on previous health survey research in Canada^{27,28} as follows: no GP visits in the past year; 1 to 5 GP visits in the past year (few-GP-visits group); and 6 or more GP visits in the past year (many-GP-visits group).

We investigated the following confounders: age (19-49, 50-59, 60-69, 70-79, ≥80 years); sex (male vs female); respondents’ highest household education level (less than secondary school to postsecondary graduation); number of chronic conditions reported; and time since the respondent initiated insulin (<1 year to ≥1 year). Reported chronic conditions must have been diagnosed by a health care professional at least 6 months earlier and included asthma, arthritis, hypertension, migraines, chronic obstructive pulmonary disease, heart disease, bowel disorders, ulcers, cancer, scoliosis, effects from stroke, and mood

or anxiety disorders. We summed the number of reported chronic conditions into a count for each respondent. Using these simple disease-count measures has been shown to be equally valid to more complex, widely used comorbidity indices in those with diabetes.²¹

The CCHS cannot be linked to administrative health services use data. Therefore, we used the following self-reported CCHS variables to control for disease severity and duration: frequency of having seen an eye specialist or other medical doctors in the past year and self-reported body mass index (BMI). As those with diabetes have increasing risk of developing retinopathy as the length and severity of the disease increases, or if glycaemic control is not attained,^{29,30} we examined the number of consultations the respondents had with eye specialists in the past year to control for these confounding effects. Finally, we included the number of visits to other doctors, including specialists, in the model to further control for health service use and disease severity.

Analysis

We analyzed the data using SAS, Studio 3.6, University Edition,³¹ and used the sampling weights provided by Statistics Canada to account for varying selection probabilities and improve point estimate precision and variance estimates.²⁴ We produced descriptive statistics to characterize the study sample, as well as the distribution of explanatory and outcome variables. As many patients in our sample were never admitted to hospital during the study period, and would therefore represent an excess of zeros in our count measure, we used a zero-inflated negative binomial Poisson model, allowing us to account for these excess zeros and overdispersion (ie, greater variability in the data than expected for the Poisson distribution) in the data.³² This analytic approach first fits a logistic regression model to estimate the odds of ever having spent the night in-hospital by predicting the excess zero count of days spent in-hospital, and then estimates rate ratios using the count of hospital nights for those who had spent at least 1 night in-hospital (excluding the “true” zero counts) between different GP visit groups using the group with no GP visits as a reference category. Thus, the rate ratio is modeled on those participants who had spent at least 1 night in-hospital so as not to be overdispersed or unduly influenced by those who did not attend an acute care institution within the previous year.

— Results —

Study sample

Among 127 462 CCHS respondents in 2013–2014, 9.0% reported having diabetes, and 2.3% reported taking insulin (**Figure 1**). We excluded 2.8% of respondents owing to missing data. Our final sample comprised 2203 Canadians taking insulin. These individuals comprised

1.7% of the original CCHS sample, and 85.6% of eligible survey respondents.

Baseline characteristics

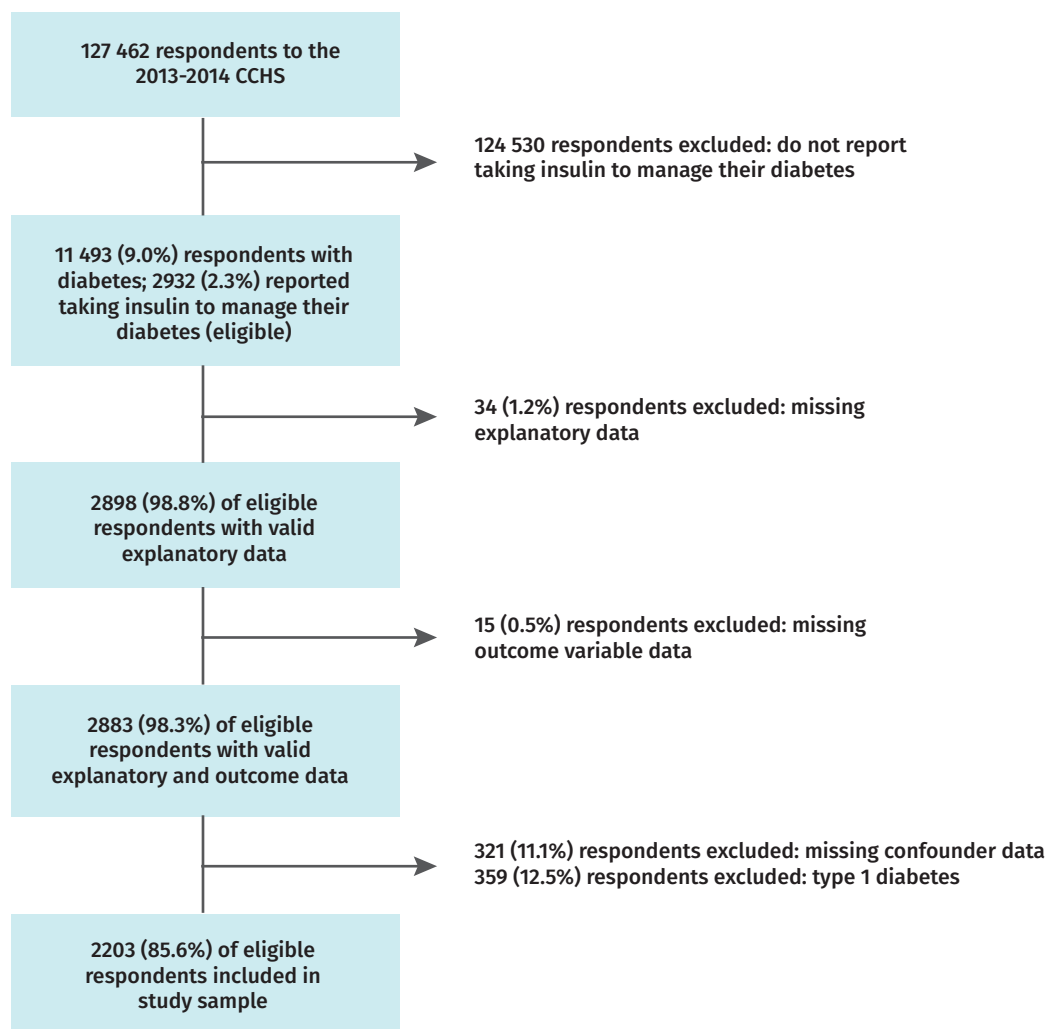
Table 1 presents the patient characteristics of the study sample (N=2203), stratified by GP visit frequency. Means and proportions presented here and in **Table 1** are weighted using the Statistics Canada sampling weights. The sample included more male patients (n=1128, 58.5%) than female patients, and most respondents were between 50 and 69 years of age (59.6%). Most of the sample had a highest household educational level of postsecondary graduation (n=1222, 62.3%) and had been taking insulin for 1 year or more (n=1613, 71.7%). The number of comorbidities differed among the groups, as did the number of respondents reporting visiting other specialists. While the mean (SD) self-reported BMI in the entire sample was 31.1 (7.0) kg/m², corresponding to a BMI indicating obesity,³³ there were no differences in BMI among the groups.

Main results

Most respondents reported visiting a GP 1 to 5 times in the past year (few-GP visits group: n=1402, 64.7%). Overall, 19.7% of respondents had spent at least 1 night in-hospital during the past year. Among those who had spent a night in-hospital, the mean (SD) number of nights during the previous year was 9.2 (9.1). Those in the many-GP-visits group had the highest proportion of respondents having spent at least 1 night in-hospital (36.8%) during the past year, compared with those in the few-GP-visits group (13.5%) and those with no visits (14.1%). There were differences between the groups for the mean number of nights spent in-hospital. Patients reporting many GP visits spent a mean (SD) of 10.1 (9.6) nights in-hospital, compared with those patients reporting few GP visits, who had the lowest mean (SD) number of nights in-hospital (6.9 [7.4]), and those reporting no GP visits, who spent the highest mean (SD) number of nights in-hospital (18.2 [9.9]).

Table 2 presents the unadjusted and adjusted zero-inflated negative binomial Poisson regression model, including the zero-inflation logistic regression estimates. Compared with those in the no-GP-visit group, those in the many-GP-visits group had significantly lower odds of being an “excess” zero and of never being hospitalized in both the unadjusted (odds ratio of 0.44; 95% CI 0.28–0.67) and adjusted (odds ratio of 0.62; 95% CI 0.39–0.95) models. Respondents who had visited a GP in the past year, in both groups, had a higher probability of spending at least 1 night in-hospital compared with those who did not visit primary care.

In the unadjusted models, among patients who experienced at least 1 hospitalization, the number of nights spent in-hospital was lower for both the few-GP-visits (rate ratio [RR] of 0.38, 95% CI 0.25–0.56) and the many-GP-visits

Figure 1. Study sample from the 2013-2014 CCHS examining the relationship between the number of GP consultations in the past 12 months and the odds of hospital admission

CCHS—Canadian Community Health Survey.

(RR=0.57, 95% CI 0.38-0.84) groups, compared with those who had not visited a GP. This trend of lower rates of nights in-hospital remained after adjusting for age, sex, education, time since insulin initiation, comorbidities, self-reported BMI, and number of visits to eye specialists and other physicians. Compared with those reporting no GP visits, those in the few-GP-visits group had an adjusted RR of 0.40 (95% CI 0.26-0.63) and those in the many-GP-visits group had an adjusted RR of 0.62 (95% CI 0.40-0.92) for nights spent in-hospital after adjusting for known confounders, indicating a significant reduction in the number of nights spent in-hospital in the past year for both GP visit groups.

— Discussion —

The results from this nationally representative Canadian study suggest that for those taking insulin to manage diabetes, a higher number of GP visits in the past year was associated with spending fewer nights in-hospital. Over the past decades, the management of diabetes has increasingly moved to the primary care setting,^{19,20} sparking debate about whether diabetes can properly be managed by non-specialized physicians.³⁴ Our results support the notion that more primary care is associated with avoidance of costly downstream health services use, including hospital admissions.

Table 1. Characteristics of the CCHS (2013-2014) study sample

CHARACTERISTICS	STUDY SAMPLE** BY GP VISIT FREQUENCY			OVERALL STUDY SAMPLE (N = 2203)*†
	NO VISITS (N = 171)	1-5 VISITS (N = 1402)	≥ 6 VISITS (N = 630)	
Female sex, n (%)	71 (38.9)	676 (42.2)	328 (40.7)	1075 (41.5)
Age, y, n (%)				
• 19-49	18 (16.3)	111 (12.6)	48 (14.1)	177 (13.3)
• 50-59	40 (33.2)	256 (24.9)	131 (28.3)	427 (27.5)
• 60-69	61 (23.5)	506 (34.4)	225 (29.2)	792 (32.1)
• 70-79	39 (10.8)	387 (20.9)	154 (20.4)	580 (19.9)
• ≥ 80	13 (5.3)	142 (7.2)	72 (8.0)	227 (7.2)
Highest household education, n (%)				
• Less than secondary	42 (10.5)	311 (14.6)	161 (19.2)	514 (15.5)
• Secondary graduation	31 (10.8)	223 (14.8)	131 (20.0)	385 (15.9)
• Some postsecondary	9 (14.8)	57 (5.2)	16 (6.3)	82 (6.3)
• Postsecondary graduation	89 (63.9)	811 (65.4)	322 (54.4)	1222 (62.3)
Insulin initiation				
• < 1 y	54 (43.1)	367 (26.1)	169 (28.6)	590 (28.3)
• ≥ 1 y	117 (56.9)	1035 (73.4)	461 (71.4)	1613 (71.7)
Mean (SD) no. of comorbidities	1.9 (2.0)	2.0 (1.5)	3.4 (2.1)	2.3 (1.9)
Consultations with an eye specialist, n (%)				
• No consultations	77 (45.9)	353 (30.5)	179 (32.4)	609 (32.4)
• 1-3 consultations	85 (50.0)	930 (62.5)	388 (61.4)	1403 (61.1)
• ≥ 4 consultations	9 (4.0)	119 (7.0)	63 (6.2)	191 (6.5)
Consultations with another medical doctor, n (%)				
• No consultations	116 (54.2)	752 (52.8)	214 (32.1)	1082 (47.4)
• 1-5 consultations	45 (42.7)	567 (41.2)	300 (48.0)	912 (43.2)
• ≥ 6 consultations	10 (3.1)	83 (6.0)	116 (19.9)	209 (9.5)
Mean (SD) self-reported BMI, kg/m ²	31.3 (7.8)	30.8 (6.9)	31.8 (6.9)	31.1 (7.0)
Spent ≥ 1 night in-hospital, n (%)	37 (14.1)	217 (13.5)	226 (36.8)	480 (19.7)
Mean (SD) nights in-hospital among patients reporting an admission†	18.2 (9.9)	6.9 (7.4)	10.1 (9.6)	9.2 (9.1)

BMI—body mass index, CCHS—Canadian Community Health Survey.

*Sample proportions and mean values are weighted using the sampling weights provided by Statistics Canada.

†Some percentages do not add to 100 owing to rounding.

‡For respondents who reported ever spending the night in-hospital.

Insulin is a high-risk medication that follows a complex dosing regimen, and consequently it is associated with hospital admissions in various studies.^{14,15,17} People taking insulin require treatment stability and monitoring to ensure avoidance of long-term disease-related complications while avoiding ADEs. Over time, those living with diabetes generally learn to self-adjust insulin doses.⁶ In primary care clinics, patients develop ongoing relationships with their primary care providers who are able to provide tailored patient education and monitoring. A systematic review on the efficacy of interventions aimed at improving diabetes management in primary care found that supportive interventions and patient education had the greatest effect.³⁵ Clinical care guidelines suggest tailoring insulin regimens to specific patient needs.⁷ Our results support the notion that more frequent contact

with GPs protects against hospital visits. While we were unable to ascertain the causes of hospitalizations, it is possible that this effect was mediated by improving disease-related outcomes and prevention of ADEs, including through counseling, monitoring, and patient education to encourage better insulin self-management.

While our results suggest that having more GP visits is protective against longer lengths of hospital stays, those who had more than 6 visits were at higher odds of having ever spent the night in-hospital. This might reflect how more complex patients tend to also be more frequent users of primary care^{36,37} and by nature of their disease status have higher acute care needs as well. While we attempted to address this possibility by adjusting for comorbidities using proxy measures for baseline disease severity and complexity, respondents in this group still

Table 2. Relationship between GP visits and number of nights spent in-hospital for insulin-dependent patients with type 2 diabetes in the 2013–2014 CCHS: A zero-inflated negative binomial Poisson regression model* was used to estimate RRs.

PATIENT GROUPS	ODDS OF HAVING SPENT ZERO NIGHTS IN-HOSPITAL OVER THE STUDY PERIOD		RR OF THE NO. OF NIGHTS SPENT IN-HOSPITAL AMONG PATIENTS REPORTING ANY HOSPITALIZATION	
	UNADJUSTED OR (95% CI)	ADJUSTED† OR (95% CI)	UNADJUSTED RR (95% CI)	ADJUSTED† RR (95% CI)
GP visit frequency				
• No visits	Reference	Reference	Reference	Reference
• 1–5 visits	1.41 (0.93–2.14)	1.48 (0.95–2.28)	0.38 (0.25–0.56)	0.40 (0.26–0.63)
• ≥ 6 visits	0.44 (0.28–0.67)	0.62 (0.39–0.95)	0.57 (0.38–0.84)	0.62 (0.40–0.92)
Sex				
• Male	Reference	Reference	Reference	Reference
• Female	0.77 (0.62–0.96)	0.85 (0.67–1.09)	0.98 (0.81–1.20)	0.94 (0.76–1.15)
Age (10-y increments†)	0.93 (0.84–1.03)	0.95 (0.84–1.06)	0.99 (0.92–1.09)	1.09 (0.99–1.19)
Education (household)				
• Postsecondary graduation	Reference	Reference	Reference	Reference
• Some postsecondary	0.70 (0.40–1.23)	0.62 (0.35–1.11)	1.13 (0.76–1.69)	1.08 (0.73–1.59)
• Secondary graduation	0.81 (0.60–1.10)	0.90 (0.66–1.24)	1.08 (0.83–1.40)	1.12 (0.87–1.44)
• Less than secondary	0.58 (0.44–0.76)	0.60 (0.44–0.82)	0.92 (0.70–1.19)	0.90 (0.69–1.18)
Insulin initiation				
• ≥ 1 y	Reference	Reference	Reference	Reference
• < 1 y	0.85 (0.67–1.09)	0.84 (0.65–1.10)	1.04 (0.84–1.29)	1.09 (0.88–1.35)
No. of comorbidities	0.79 (0.74–0.84)	0.88 (0.82–0.93)	1.06 (1.01–1.11)	1.03 (0.98–1.08)
No. of consultations with an eye specialist				
• No consultations	Reference	Reference	Reference	Reference
• 1–3 consultations	1.37 (1.07–1.75)	1.37 (1.05–1.78)	0.84 (0.68–1.05)	0.81 (0.66–1.01)
• ≥ 4 consultations	1.01 (0.67–1.52)	1.19 (0.76–1.85)	1.17 (0.82–1.67)	0.99 (0.69–1.42)
No. of consultations with another medical doctor				
• No consultations	Reference	Reference	Reference	Reference
• 1–5 consultations	0.53 (0.41–0.66)	0.58 (0.45–0.75)	0.81 (0.65–1.01)	0.82 (0.65–1.04)
• ≥ 6 consultations	0.25 (0.18–0.36)	0.33 (0.22–0.50)	1.15 (0.87–1.51)	1.06 (0.79–1.42)
Self-reported BMI	1.01 (0.98–1.02)	1.01 (0.99–1.03)	0.99 (0.9–1.00)	0.99 (0.98–1.01)

BMI—body mass index, CCHS—Canadian Community Health Centre, OR—odds ratio, RR—rate ratio.

*This model first fits a logistic regression model to determine the odds of being a “true” zero (ie, had a zero hospital-nights count owing to not visiting the hospital), then fits a Poisson regression model to determine the RR of nights spent in-hospital for those who were hospitalized.

†Adjusting for age, sex, highest household educational attainment, time since insulin initiation, and no. of comorbidities.

‡Owing to low cell counts, respondents aged 19–49 y were collapsed into one group.

spent fewer nights in-hospital, consistent with a protective effect associated with primary care use in this group.

Limitations

A main limitation of this study is the cross-sectional design of the survey. It is unclear what the sequence of health services use was within this sample, and it is not possible to know whether the GP visits preceded the hospitalization, nor whether the hospitalization was related to the respondents' diabetes or insulin use, as we were limited to all-cause hospitalization rates; being able to understand the cause of hospitalizations would provide more robust evidence to support our hypothesis. The temporal relationship between the GP visits and the

hospitalization (ie, whether or not the GP visits preceded the hospitalization) would affect the association observed, and future work should examine this relationship prospectively. Another limitation is the self-reported nature of the variables and outcomes, making the data susceptible to recall bias, as respondents might not accurately recall the number of primary care and hospital visits over the past year.^{38,39} While this is possible, a study of self-reported health services use compared to administrative data found that agreement between data sources was highest for primary care, with a κ score of 0.69, indicating good agreement.⁴⁰ As the outcome was examined as a count measure, we believe that this bias was unlikely to have influenced the overall trend of the results.

It is also possible that those patients who visited a GP more regularly were systematically different from those who did not attend primary care. While the many-GP-visits group reported more comorbidities than the other 2 groups, these 2 groups reported a similar level of comorbidities, and therefore the group who did not attend primary care might have different personal attributes that we cannot account for in these results. For example, perhaps those who did not see a GP might have felt capable of handling their own health or ignoring their disease state. Potentially those who saw GPs more frequently were more health conscious and managed their disease more carefully, thereby avoiding hospitalization without requiring GP management, for which we cannot adjust. We have attempted to control for potential differences between patient populations by addressing confounding due to comorbidities, age, BMI, and measures of disease severity. However, we were unable to stratify by urban or rural residence, and therefore these results provide a snapshot of nationally representative findings but cannot detail any differences between rural and urban locations. While we were unable to disaggregate the types of specialists patients visited, and the complexity of the patient might influence the comfort of a GP in providing care for the patient, we were able to control for the aggregate measure of visiting any other physicians, which would include any specialist that patients had seen.

Conclusion

Our results suggest that insulin-dependent Canadians with type 2 diabetes who visit GPs more frequently spend less time in-hospital, after adjusting for potential confounders, than those who do not visit their GPs. Our findings support the notion that more primary care has a protective effect in this population. Future research should examine this phenomenon with greater attention to temporality to ensure that GP visits occurred before hospitalizations, and with attention to the admitting diagnosis in order to understand whether the protective effect is mediated by fewer disease- or treatment-related complications.

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Contributors

Both authors contributed to the concept and design of the study; data gathering, analysis, and interpretation; and preparing the manuscript for submission.

Competing interests

None declared

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