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Abstract

Background
Using a health outcome research framework, the hospitalization risk for a type 2 diabetes (T2DM) cohort is evaluated. Diabetes is "ambulatory care sensitive"— a condition largely manageable with appropriate care in the community. Thus, hospitalization may represent a negative care outcome.

Data and methods
Analyses were conducted by linking data from the Canadian Community Health Survey (CCHS) cycle 1.1 to the Canadian Hospital Morbidity Database for respondents identified as having T2DM. Logistic regression was used to examine the association between the likelihood of all-cause hospitalization within two years of the survey date and patients' characteristics, care path, and health system characteristics.

Results
When the effects of demographic, socio-economic and health status characteristics were taken into account, physical inactivity and former or current smoking were significantly associated with an increased likelihood of hospitalization for those with type 2 diabetes. Specialist visits were positively related to hospitalization (OR=1.4), whereas the relationship with general practitioner visits was negative (OR=0.7). Regional hospital use patterns were significantly associated with hospitalization (OR=2.6).

Interpretation
Regional patterns of hospital use are important for hospitalization: T2DM residents of health regions with generally higher hospitalization rates were more likely to be hospitalized than were those living elsewhere. In terms of care path, GP consultations were associated with a lower risk of hospitalization. Specialist consultations, likely a marker of disease severity, had the reverse effect.

Keywords
databases, health services research, health surveys, hospital records, inpatient, outcome assessment, probabilistic linkage

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In recent years, diabetes-related mortality has increased, an increase that has been linked to an upturn in the prevalence of obesity.[1,2] Diabetes is currently the sixth leading cause of death in Canada.[3] In 2005, approximately 1.3 million Canadians aged 12 or older (5% of the population in that age range) reported that they had been diagnosed with the disease.[4] The complications of diabetes can attack every major organ. Because of its wide-ranging impact on the health of individuals and the economic burden it places on the health care system,[5,6] diabetes is recognized as a major public health problem.

Yet, to some extent, diabetes is also "ambulatory care sensitive." That is, it can be managed with appropriate care in the community.[7] But if not well controlled, diabetes can result in multiple co-morbidities that may require extensive care,[8] including hospitalization.[8-10]

With the rise of health expenditures,[11] emphasis is being placed on the effectiveness of services. A conceptual framework, developed jointly by Statistics Canada and the Canadian Institute for Health Information,[12,13] highlights the relationship between patient outcomes and three sets of possible determinants—health care system, care path and patient characteristics—in the context of place and environment. Through a linkage of survey and hospitalization data, the current study applies this framework to diabetes.

Specifically, this analysis examines risk factors for acute care hospitalization in a cohort with type 2 diabetes (T2DM), the predominant form of the disease, accounting for 95% of cases. Acute care hospitalization (for any reason) is used as a proxy for negative outcome. Associations between hospitalization and patients' characteristics, care path factors, and health system characteristics are analysed.

With regard to care path, relatively little is known about the roles of general practitioners (GPs) and specialists in the risk of hospitalization of people with

diabetes. Previous research suggests that the more aggressive care offered by specialists[14-18] may simply reflect more advanced disease.

With regard to characteristics of the health care system, the use of services has been shown to vary by region.[19-22] It is possible, then, that the likelihood of hospital admission may, in part, reflect where an individual lives; all else being equal, residents of "high-use" areas may be more likely to be hospitalized.

Of course, the role of risk factors like smoking, drinking, physical activity and diet must also be taken into account.[23,24]

This article assesses a range of factors associated with hospitalization of individuals with type 2 diabetes, using linked survey and administrative data.

Methods

The dataset used in this analysis links the 2000/2001 Canadian Community Health Survey (CCHS) to the Hospital Morbidity Data Base (HMDB). The CCHS collects information about the health and well-being of the household population. For cycle 1.1 (2000/2001), about 130,000 Canadians aged 12 or older were interviewed.[25] In addition to questions about socio-demographic characteristics, risk factors, and health care services use, they were asked about diabetes and related treatment. The HMDB is a national administrative database of acute inpatient hospital stays from 1992/1993 to 2003/2004. It can be used to analyse trends in causes of hospitalization,[26-28] but it lacks detailed patient information such as socio-economic background and risk factors. However, linkage of the CCHS and the HMDB yields a dataset with information about hospital patients' socio-economic status and risk factors.[29]

The linked dataset used in this analysis consisted of a preliminary cohort of 6,361 CCHS 1.1 respondents who self-reported diabetes. Of these, 1,003 Quebec residents were excluded because Statistics Canada did not have health insurance numbers with which to link them to the HMDB. An additional 467 non-Quebec respondents who refused permission to link their survey results to health services administrative data were excluded, along with 37 who reported only gestational diabetes. An algorithm[30] was used to exclude another 243 respondents identified as having type 1 diabetes.[31] The final T2DM cohort consisted of 4,611 CCHS respondents. Statistics Canada's Policy Committee approved the data linkage .

A hospital episode is defined as any record of acute hospital discharge obtained from the HMDB. Hospital episodes that occurred within one year before and two years after the survey date were included in the analyses. The primary outcome of interest was hospitalization during the two years after the CCHS interview, excluding hospital stays related to pregnancy/birth. All other acute hospitalizations, defined as all-cause hospitalization, were included in the study,

Univariate and bivariate statistics were calculated to describe the data. With bootstrap methods[32,33] and special linked weights, the descriptive statistics were

Table 1
Canadian Community Health Survey (CCHS) and Hospital Morbidity Database (HMDB) variables used in analyses of hospitalization of CCHS respondents with type 2 diabetes

Variable	Source	Explanation
Socio-demographic		
Age group	CCHS	12 to 44, 45 to 64, 65 or older
Sex	CCHS	Male/Female
Household income adjusted for household size	CCHS	Quintiles; missing kept as category
Residence	CCHS	Urban/Rural
Health status		
Health utility index (HUI3)	CCHS	Continuous measure
Other chronic conditions	CCHS	Binary variable; "yes" to at least one of : emphysema/chronic obstructive pulmonary disease, heart disease, asthma, arthritis/rheumatism (excluding fibromyalgia), high blood pressure, cancer, stroke
Prior hospitalization	HMDB	Hospitalization for any reason (except pregnancy/delivery) in year before CCHS interview
Impact of health problems	CCHS	Impact of long-term physical and mental conditions on home, work/school, other activities: often, sometimes, never
Risk factors		
Body mass index (BMI)	CCHS	Underweight, normal, overweight, obese
Physical activity index	CCHS	Active, moderate, inactive
Smoking	CCHS	Current smoker, former smoker, never smoked
Alcohol consumption	CCHS	Regular, occasional, former/never drinker
Daily fruit/vegetable consumption	CCHS	Fewer than than 5 times/5 or more times
Care path		
Current insulin use	CCHS	Yes/No
GP consultation (past 12 months)	CCHS	Yes/No
Specialist consultation (past 12 months)	CCHS	Yes/No
Unmet health care needs	CCHS	Yes/No
System response		
Regional hospitalization patterns	HMDB/CCHS	Likelihood of hospital admission in each health region

adjusted for the complex survey design and to account for non-response when permission to link survey data to hospital records had been denied. Predictors of hospitalization were identified through multivariate logistic regression. Normalized weights were used to ensure proportional representation of the provincial, age and gender distributions in the sample with diabetes, and to report the 95% confidence intervals and significance levels (0.01 and 0.05).

Most variables were derived directly from the CCHS or the HMDB (Table 1). For example, among the CCHS derived variables, "impact of health problem" is a measure of the effect of long-term physical and mental conditions on home, work or school, and other activities: often, sometimes or never. GP and specialist consultations were based on separate questions about the number of contacts with doctors in the past 12 months.

Two additional variables were derived from the linked CCHS/HMDB file. The first attempts to capture regional hospital utilization patterns as an indicator of regional variations in the use of health care services. This variable, based on the full CCHS sample linked to all acute hospitalizations (excluding pregnancy/delivery) in the two years after the survey is the ratio of the observed number of hospitalizations to the expected number in each health region, controlling for characteristics of the region's population that represent need: age, sex, functional health status as measured by the Health Utility Index Mark 3 (HUI3), self-reported health compared with a year earlier, prior hospitalization, co-morbidities, smoking status, alcohol use and physical activity. The second derived variable—prior hospitalization—is a marker for disease severity indicating if the respondent had been admitted to hospital in the year before the CCHS interview.

The role of risk factors, care path and health system characteristics on all-cause hospitalization of the T2DM cohort was examined while controlling for age, sex and household income.[34,35]

Table 2
Selected characteristics of type 2 diabetes cohort compared with other Canadians, household population aged 12 or older, Canada excluding Quebec and territories, 2000/2001

	Type 2 diabetes cohort				Other			
	Percent (weighted)				Percent (weighted)			
		95% confidence interval		Number (unweighted)		95% confidence interval		Number (unweighted)
	%	from	to		%	from	to	
Total	**100.0**	...	...	**4,611**	**100.0**	...	...	**103,566**
Socio-demographic								
Age group								
12 to 44	10.8	9.5	12.6	433	57.5	57.3	57.7	53,783
45 to 64	43.9	41.8	46.0	1,789	27.0	26.8	27.2	28,233
65 or older	45.3	43.3	47.2	2,389	15.6	15.3	15.8	21,550
Sex								
Male	52.8	50.7	54.9	2,285	49.0	48.8	49.2	47,583
Female	47.2	45.1	49.3	2,326	51.0	50.8	51.3	55,983
Household income quintile								
Lower	4.1	3.4	4.9	261	3.3	3.1	3.6	4,442
Lower-middle	10.4	9.2	11.7	702	6.5	6.3	6.8	9,967
Middle	28.4	26.4	30.5	1,390	19.0	18.5	19.4	23,036
Upper-middle	27.4	25.4	29.5	1,193	30.8	30.3	31.3	32,193
Highest	17.2	15.4	19.2	613	29.0	28.4	29.6	23,935
Missing	12.6	11.0	14.3	452	11.4	11.1	11.8	9,993
Residence								
Urban	79.9	78.3	81.4	3,292	81.4	80.7	82.0	75,055
Rural	20.1	18.6	21.7	1,319	18.6	18.0	19.3	28,511
Health status								
Other chronic conditions								
No	25.9	23.9	28.0	1,043	65.7	65.2	66.2	62,931
Yes	74.1	72.0	76.1	3,568	34.3	33.8	34.8	40,635
Prior hospitalization								
No	86.6	85.2	87.9	3,873	94.7	94.4	94.9	96,627
Yes	13.4	12.1	14.8	738	5.3	5.1	5.6	6,939
Impact of health problems								
Often	29.0	27.0	31.1	1,374	12.1	11.7	12.5	14,663
Sometimes	21.3	19.5	23.2	1,029	13.9	13.6	14.3	15,785
Never	49.6	47.3	51.9	2,196	73.9	73.4	74.4	73,023
Missing	F	...	...	F	0.1	0.1	0.1	95
Risk factors								
Body mass index (BMI)								
Underweight	2.8	2.2	3.7	124	12.0	11.7	12.4	11,495
Normal	23.8	21.9	25.9	1,011	42.0	41.5	42.5	41,667
Overweight	36.3	34.2	38.5	1,709	29.7	29.2	30.2	31,801
Obese	35.0	33.0	37.0	1,637	13.5	13.1	13.8	15,416
Missing	2.1	1.7	2.6	130	2.8	2.7	3.0	3,187
Physical activity index								
Active	13.3	12.0	14.8	638	22.1	21.6	22.5	23,701
Moderate	19.7	18.0	21.5	879	21.3	20.9	21.7	22,818
Inactive	58.4	56.1	60.6	2,826	47.8	47.2	48.3	50,429
Missing	8.7	7.3	10.2	268	8.9	8.5	9.3	6,618
Smoking								
Never	30.9	28.7	33.1	1,243	37.8	37.3	38.3	35,230
Former	50.6	48.4	52.7	2,504	36.8	36.3	37.3	40,067
Current	18.4	16.8	20.1	858	25.2	24.7	25.7	28,054
Missing	F	...	...	F	0.2	0.2	0.3	215
Alcohol consumption								
Regular	35.3	33.2	37.4	1,543	54.8	54.2	55.4	54,569
Occasional	23.3	21.4	25.4	1,099	20.2	19.8	20.7	22,007
Former/Never drank	41.3	39.1	43.5	1,961	24.7	24.2	25.2	26,680
Missing	F	...	...	F	0.3	0.2	0.3	310
Daily fruit/vegetable consumption								
Fewer than 5 times	60.5	58.3	62.6	2,767	63.3	62.8	63.8	66,148
5 or more times	37.8	35.7	40.0	1,757	35.6	35.1	36.1	35,797
Missing	1.7	1.2	2.4	87	1.1	1.0	1.2	1,621
Care path								
Current insulin use								
Yes	21.5	19.5	23.6	964	0	...	...	0
No	78.5	76.4	80.5	3,643	99.9	99.9	100.0	103,510
Missing	F	...	...	F	0.1	0.0	0.1	56
GP consultation (past 12 months)								
Yes	93.2	91.9	94.4	4,320	80.8	80.4	81.2	83,631
No	6.5	5.3	7.8	269	18.9	18.5	19.3	19,601
Missing	F	...	...	22	0.3	0.2	0.3	334
Specialist consultation (past 12 months)								
Yes	42.4	40.4	44.5	1,828	28.3	27.8	28.8	29,286
No	57.4	55.3	59.5	2,773	71.5	71.1	72.0	74,137
Missing	F	...	...	F	0.2	0.1	0.2	143
Unmet health care needs								
Yes	86.7	85.3	88.0	3,946	87.4	87.0	87.7	89,621
No	13.1	11.8	14.6	657	12.6	12.2	12.9	13,874
Missing	F	...	...	F	0.1	0.0	0.1	71

F estimate not provided because of small sample size
... not applicable
Source: 2000/2001 Canadian Community Health Survey.

Table 3
Percentage hospitalized within two years of 2000/2001 Canadian Community Health Survey interview, by selected characteristics, household population aged 12 or older with type 2 diabetes, Canada excluding Quebec and territories

		95% confidence interval	
	%	from	to
Total	**24.0**	**22.2**	**25.9**
Socio-demographic			
Age group			
12 to 44	11.7	8.4	16.0
45 to 64	17.1	14.8	19.6
65 or older	33.6	30.6	36.8
Sex			
Male	24.0	21.5	26.6
Female	24.0	21.4	26.8
Household income quintile			
Lower	31.1	23.2	40.4
Lower-middle	33.3	28.0	39.1
Middle	28.3	24.7	32.2
Upper-middle	20.4	17.7	23.5
Highest	16.3	13.1	20.3
Missing	22.5	17.5	28.4
Residence			
Urban	23.7	21.6	26.0
Rural	25.1	21.8	28.6
Health status			
Other chronic conditions			
No	12.5	9.9	15.5
Yes	28.0	25.9	30.2
Prior hospitalization			
No	19.4	17.6	21.3
Yes	53.5	48.2	58.7
Impact of health problems			
Often	37.4	33.5	41.5
Sometimes	28.0	24.2	32.1
Never	14.5	12.5	16.8
Risk factors			
Body mass index (BMI)			
Underweight	28.6[E]	18.8	40.8
Normal	23.7	20.4	27.4
Overweight	24.5	21.3	28.0
Obese	23.1	20.3	26.1
Physical activity index			
Active	16.2	12.5	20.6
Moderate	17.1	14.2	20.6
Inactive	26.9	24.6	29.4
Smoking			
Never	19.3	16.2	22.8
Former	26.5	24.0	29.0
Current	25.3	21.0	30.1
Alcohol consumption			
Regular	18.1	15.7	20.7
Occasional	26.0	22.1	30.4
Former/Never drank	27.9	25.0	31.1
Daily fruit/vegetable consumption			
Fewer than 5 times	24.7	22.3	27.2
5 or more times	22.9	20.2	25.8
Care path			
Current insulin use			
Yes	34.9	30.1	39.9
No	21.0	19.3	22.9
GP consultation (past 12 months)			
Yes	24.0	22.2	25.8
No	24.2	16.6	33.9
Specialist consultation (past 12 months)			
Yes	30.4	27.5	33.6
No	19.2	17.2	21.4
Unmet health care needs			
Yes	28.1	23.1	33.7
No	23.3	21.4	25.3

[E] coefficient of variation between 16.6% and 33.3% (interpret with caution)
Source: 2000/2001 Canadian Community Health Survey.

Results

The characteristics of the T2DM cohort differed substantially from those of other Canadians (Table 2). The T2DM cohort was much older, more likely to be male, and tended to have a lower household income. For instance, almost half (45%) the cohort were aged 65 or older, compared with 16% of the rest of the population. The cohort was more likely to have chronic conditions other than diabetes and to have been hospitalized in the past year. They were more likely than other Canadians to be overweight or obese and physically inactive, but less likely to be current smokers or regular drinkers. Higher percentages of T2DM had consulted a GP or specialist in the year before their CCHS interview.

Given their generally less favourable health status, it is not surprising that in the two years after their CCHS interview, almost a quarter (24%) of the T2DM cohort were admitted to hospital (Table 3). But not all members of the cohort were equally likely to have been hospitalized.

As might be expected, hospitalization rates were higher among those who were older, lived in lower-income households, had co-morbidities, or reported having been hospitalized in the year before the CCHS interview. Around a third (34%) of cohort members aged 65 or older were hospitalized, compared with 12% of those aged 14 to 44. Similarly, about third of the T2DM cohort who lived in lower-income households were hospitalized versus 16% of those in the highest household income quintile. And fully 54% of the T2DM cohort who had been hospitalized in the year before the CCHS interview were admitted to hospital in the two years after the interview, compared with 19% who had no prior hospitalization. T2DM cohort members who never smoked were less likely than former or current smokers (19%, 27% and 25%, respectively) to be hospitalized. Regular drinkers had lower hospitalization rates than did occasional or non-drinkers. In terms of care path, equal percentages of those who did and did not have a recent consultation with GP were hospitalized (24%). However, 30% who had consulted a specialist were hospitalized, compared with 19% who had not done so.

Of course, many characteristics associated with high hospitalization rates are related to each other. For instance, older people with diabetes are more likely than their younger counterparts to have other chronic conditions and to have had a prior hospitalization. Smoking tends to be more prevalent among low- than high-income groups. When the potentially confounding effects of other variables were taken into account, the factors significantly associated with hosptialization among the T2DM cohort were: older age, male, lower reported health utility, presence of other chronic condition(s), impact of health problems, physical inactivity, smoking, alcohol consumption, insulin use, doctor consultations, and system response (high- or low-hospitalization region) (Table 4).

The strongest predictor of hospitalization in the two-year follow-up period was prior hospitalization (OR=3.0, 95% CI: 2.5 to 3.7). T2DM cohort members who had contacted a specialist in the year before their CCHS interview were more likely to be admitted, compared with those who had not (OR=1.4, 95% CI: 1.2 to 1.6). By contrast, those who had contacted a GP were less likely to be admitted to hospital in the next two years (OR=0.7, 95% CI 0.5-0.9). Cohort members who lived in health regions with generally higher hospitalization rates had significantly higher odds of hospitalization in the next two years (OR=2.6, 95% CI: 1.8 to 3.7).

Discussion

Linkage of the CCHS and the HMDB made it possible to identify a number of factors significantly related to all-cause hospitalization of people with type 2 diabetes. Because diabetes is, to a considerable extent, an ambulatory care

Table 4
Adjusted odds ratios relating selected characteristics to hospitalization within two years of 2000/2001 Canadian Community Health Survey, household population aged 12 or older with type 2 diabetes, Canada excluding Quebec and territories

	Adjusted odds ratio	95% confidence interval from	to
Socio-demographic			
Age group			
12 to 44†	1.0	...	...
45 to 64	1.3	0.9	1.8
65 or older	2.9**	2.1	4.1
Sex			
Male†	1.0	...	...
Female	0.8*	0.7	1.0
Household income quintile			
Lower	1.3	0.9	2.0
Lower-middle	1.3	1.0	1.8
Middle	1.1	0.8	1.4
Upper-middle	0.9	0.7	1.2
Highest†	1.0	...	...
Residence			
Urban†	1.0	...	...
Rural	0.9	0.7	1.1
Health status			
Health Utility Index (continuous)	0.5**	0.4	0.7
Other chronic conditions			
No†	1.0	...	...
Yes	1.5**	1.2	1.9
Prior hospitalization			
No†	1.0	...	...
Yes	3.0**	2.5	3.7
Impact of health problems			
Often	1.6**	1.3	2.0
Sometimes	1.6**	1.3	2.0
Never†	1.0	...	...
Risk factors			
Body mass index (BMI)			
Underweight	0.9	0.6	1.4
Normal†	1.0	...	...
Overweight	1.0	0.8	1.2
Obese	0.9	0.7	1.1
Physical activity index			
Active†	1.0	...	...
Moderate	1.0	0.8	1.4
Inactive	1.4*	1.0	1.8
Smoking			
Never†	1.0	...	...
Former	1.4**	1.2	1.7
Current	1.7**	1.4	2.2
Alcohol consumption			
Regular	0.7**	0.6	0.9
Occasional†	1.0	...	...
Former/Never drank	1.0	0.8	1.2
Daily fruit/vegetable consumption			
Fewer than 5 times	1.1	0.9	1.2
5 or more times†	1.0	...	...
Care path			
Current insulin use			
Yes	1.7**	1.4	2.0
No†	1.0	...	...
GP consultation (past 12 months)			
Yes	0.7**	0.5	0.9
No†	1.0	...	...
Specialist consultation (past 12 months)			
Yes	1.4**	1.2	1.6
No†	1.0	...	...
Unmet health care needs			
Yes	0.9	0.7	1.1
No†	1.0	...	...
System response (continuous)	2.6**	1.8	3.7

† reference category
* significantly different from reference category ($p < 0.05$)
* significantly different from reference category ($p < 0.01$)
... not applicable
Source: 2000/2001 Canadian Community Health Survey; Hospital Morbidity Database.

sensitive condition, it was assumed that hospitalization is an indirect indicator of poor outcome.

Age was obviously important. As well, females with diabetes had a lower risk of hospitalization than did males. Smoking, whether former and current, was a strong predictor of hospitalization; regular alcohol consumption had a protective effect.[36] As expected, having other chronic disease(s), prior hospitalization, and the impact of long-term physical and mental conditions on daily life were strong predictors of hospitalization.

T2DM cohort members who had consulted a specialist in the 12 months before their CCHS interview had a significantly higher risk of hospitalization over the next two years. Of course, the specialist consultation did not "cause" the hospitalization; rather, consulting a specialist was likely a reflection of disease severity.

At the health care system level, T2DM cohort members in high-hospital-use health regions had signficantly high odds of hospital admission.

Limitations

This analysis has several limitations, foremost among them, in the case of the CCHS, reliance on self-reports. An earlier study found that only about 75% of people with physician-diagnosed diabetes self-reported the condition to the CCHS, and their characteristics differ from those of people who do report diabetes.[37]

The analyses are limited to acute care hospitalizations. Information is not provided about the use of emergency rooms, where diabetes-related events such as hyperglycemia are often treated. As a result, the full extent of diabetes patients' use of hospitals is not represented.

Because the CCHS does not include residents of institutions, the linkage with hospital data is necessarily confined to the household population. An evaluation study of the linked data showed a high undercoverage rate among people aged 75 or older, many of whom live in institutions.[38] Consequently, the data presented here likely underestimate the strength of the relationship between diabetes and hospitalization. As well, Quebec residents were excluded from the analyses.

The analysis would have been stronger had it been possible to include the nature of the care respondents were receiving as a potential factor in their odds of

What is already known on this subject?

- Diabetes is "ambulatory care sensitive"—a condition largely manageable with appropriate community care.
- Well-known risk factors like smoking, drinking, and physical activity are important in managing the disease.
- Much less is known about the roles of GPs and specialists in the risk of hospitalization of people with diabetes.
- Regional variations in the use of health care services suggest that an individual's likelihood of hospitalization may, in part, reflect where he or she lives.

What does this study add?

- Data from the 2000/2001 Canadian Community Health Survey were linked with data from the Hospital Morbidity Database to determine care path and health system factors related to the likelihood that people with type 2 diabetes would be hospitalized over the subsequent two years.
- Among people with type 2 diabetes, consultation with a specialist was associated with a higher risk of hospitalization; this was likely a marker of disease severity.
- Regional hospital utilization patterns were highly significant for all-cause hospitalization.

hospitalization.[39] However, these data were not collected by the 2000/2001 CCHS. Such information (for example, use of haemoglobin A1C testing, foot care, eye exam) was collected in 2005 by the CCHS 3.1, but the data needed to examine subsequent hospital use are not yet available.

Sample size is an issue. Although the CCHS sample was constructed to allow the reporting of various conditions at the health region level, the study pertains to a relatively small group—people with type 2 diabetes—and a low-probability outcome—hospitalization. This combination makes it impossible to conduct analyses even at the provincial level, let alone the health region level. To overcome the problem of small sample size, combining surveys may be an option in the future.

Clinical variables related to hospitalization, such as physiologic characteristics, diagnoses and treatments, could not be considered in this study.

Conclusion

When the effects of demographic, socio-economic and health status characteristics were taken into account, physical inactivity and former or current smoking were significantly associated with an increased likelihood of all-cause hospitalization of people with type 2 diabetes. Specialist visits were positively related to hospitalization, but the relationship with general practitioner visits was negative. However, the fact of having seen a specialist is unlikely to be a risk factor for hospitalization, but rather, a marker for disease severity. Regional hospital use patterns were also significantly associated with all-cause hospitalization. Whether these factors would remain important if the focus was limited to diabetes-specific hospitalization can be a topic for future analyses. ■

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