

Incidence and outcomes of diabetes mellitus in elderly people: report from the Canadian Study of Health and Aging

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Abstract

Background: The epidemiology of diabetes in elderly people is not well understood. The purpose of this study was to estimate the incidence of diabetes mellitus among elderly people in Canada and the relative risks of death and admission to an institution among elderly diabetic patients.

Methods: The study was a secondary analysis of data for a community-dwelling sample from the Canadian Study of Health and Aging, a nationwide representative cohort study of 9008 elderly people (65 years of age or older at baseline) in Canada. Diabetes was identified primarily by self-reporting, and a clinician's diagnosis and the presence of treatments for diabetes were used to identify diabetic patients who did not report that they had the condition.

Results: The reliability of self-reported diabetes (the kappa statistic) was 0.85. The estimated annual incidence of diabetes was 8.6 cases per thousand for elderly Canadians. Incidence decreased with age, from 9.5 for subjects 65–74 years of age, to 7.9 for those 75–84 years of age and then to 3.1 for those 85 years of age and older. Diabetes was associated with death (relative risk 1.87, 95% confidence interval 1.59–2.19) and admission to an institution (relative risk 1.58, 95% confidence interval 1.28–1.94).

Interpretation: Diabetes mellitus is common among elderly people, but the incidence declines among the very old.

Diabetes mellitus is a common condition associated with greater risks of illness and death. It is more common with age, although prevalence estimates for elderly people (those 65 years of age and older) vary widely, from 8.9% to 16.6%.^{1,2} Estimates of annual incidence are similarly variable,^{3,4} although an estimate of about 10 per thousand seems reasonable.^{3–10} Interestingly, although some studies have reported that incidence rises throughout late life,^{3–6} others have found fewer new cases among the very old.^{7–11} It is not clear whether this variation in results reflects differences in methods or the disease itself, but the method used to identify diabetic subjects is key: up to half of all late-onset cases go undiagnosed,^{12–13} so self-reporting methods may underestimate true incidence.

In the first phase of the Canadian Study of Health and Aging (CSHA-1)¹⁴ the prevalence of diabetes mellitus was 12.1%.¹⁵ We now report the incidence of this condition during the second phase of the study (CSHA-2) and the associated risks of death and admission to an institution.

Methods

The CSHA investigates the epidemiology of dementia and health problems in elderly people; the methods are detailed elsewhere.^{14,16–18} CSHA-1, conducted in 1991–1992, was based on a representative sample of 9008 community-dwelling people. To provide more precise estimates for elderly adults, we oversampled those 75 years of age and older. In addition to stratifying by age, we sampled areas close to the 18 study sites to reduce costs. The effects of both of these strategies were accounted for by weighting age stratification and regional

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clustering to reflect their true distribution in the population, so the estimates we report should be representative of the elderly Canadian population. Self-reported and test data were collected, by screening interview, on cognition, function and medical problems, including diabetes. Subjects who screened positive for cognitive impairment with the Modified Mini-Mental State Examination,¹⁹ as well as a random sample of those who screened negative for cognitive impairment, were invited to undergo a comprehensive clinical assessment. People in institutions (1255 subjects, sampled separately from the community-dwelling subjects) and 59 of the community-dwelling subjects who could not complete the screening interview because of vision or hearing impairment also underwent the clinical assessment.

Phase 2 of the study was conducted in 1996–1997; the same community-dwelling subjects were screened, and comprehensive assessments were conducted as in CSHA-1. The study was approved by each study site’s research and ethics committee.

Table 1: Comparison of the community-dwelling cohort at baseline and at follow-up in the Canadian Study of Health and Aging (unweighted data)

Characteristic	Date; proportion of study population, %	
	1991–1992 (n = 8949)	1996–1997 (n = 5101)
Age, yr		
65–74	44.0	56.1
75–84	41.4	37.9
≥ 85	14.6	6.1
Sex, % female	59.5	60.2
Marital status, % widowed	37.8	33.1
Living alone	36.0	33.9
Cognitive impairment (3MS score < 78)	18.0	6.9

Note: 3MS = Modified Mini-Mental State examination.¹⁹

Diabetes was diagnosed primarily by self-reporting. Self-reported data from the screening interview were supplemented by a clinical examination in 1667 subjects. An assessment by a clinical investigator that the subject had diabetes, the presence of treatment for diabetes or evidence of regular monitoring of blood glucose levels was used to identify anyone with diabetes who did not report having the condition.

The prevalence of diabetes in CSHA-1 was established by means of sample weights that accounted for age stratification, clustering and regional variation in response bias.¹⁴ In CSHA-2 nonsurvival was potentially an additional confounder; therefore, CSHA-1 weights were recalculated to account for deaths occurring between baseline and follow-up.

Results

Table 1 presents demographic data at baseline and follow-up. Of the community-dwelling subjects, 2074 died before CSHA-2, and vital status was unknown for 252. Of the 6623 known to be alive at CSHA-2, 587 refused to participate, 189 could not be screened because of hearing or vision impairment, and 145 could not be recontacted, so 5702 subjects completed the CSHA-2 screening interview. Self-reported information was complete for 5101 subjects, 643 (12.6%) of whom reported diabetes. Comparison with the baseline self-reported data yielded an overall weighted estimate of 39 new cases per thousand. Given a median of 4.9 years between baseline and follow-up, the annualized incidence of self-reported diabetes mellitus was 8.3 per thousand subjects.

The CSHA-2 self-reported data were supplemented by a clinical examination in 1667 subjects; both sources of data were available for 1487 of these subjects. The kappa statistic for agreement between the clinician’s assessment and self-reporting was 0.85 (for 1487 subjects, $\chi^2 = 913$, $p <$

Table 2: Unweighted and weighted incidence rates of diabetes mellitus over 5 years (as percentage and annualized per thousand population)

Characteristic	Incident cases, %		Weighted annualized incidence, no. cases per thousand (and 95% CI)	
	Unweighted	Weighted		
Diagnosis of diabetes				
Self-reported	4.06	4.07	8.3	(8.3–8.4)
Self-reported estimate adjusted for clinician’s diagnosis	4.15	4.22	8.6	(8.6–8.7)
Age and sex				
65–74 yr	4.78	4.65	9.5	(9.4–9.6)
Men	5.73	5.60	11.4	(11.3–11.5)
Women	4.05	3.87	7.9	(7.8–8.0)
75–84 yr	3.99	3.87	7.9	(7.8–8.0)
Men	3.75	3.05	6.2	(6.1–6.4)
Women	4.12	4.43	9.0	(8.9–9.2)
≥ 85 yr	1.54	1.51	3.1	(3.0–3.2)
Men	3.05	3.01	6.1	(5.9–6.4)
Women	1.10	0.77	1.6	(1.5–1.7)

0.01). Of the 1111 subjects who did not report diabetes and who underwent a clinical assessment, 18 (1.6%) were determined by the clinician to have the condition. Table 2 presents weighted incidence estimates by age and sex for both self-reported and clinical data. The weighted proportion of new cases was 42 per thousand, and the annualized incidence rate was 8.6 per thousand subjects (9.8 for men and 7.5 for women). The incidence of diabetes declined among subjects older than 75 years of age, although the peak incidence occurred later among women.

Of the 930 subjects who had diabetes in 1991, 304 (32.7%) died before follow-up; in contrast, only 1750 (22.6%) of the 7756 nondiabetic subjects died. The relative risk of death, adjusted for age and sex, was 1.87 (95% confidence interval 1.59–2.19). Time to death was shorter for diabetic subjects (mean 55.0 months, standard deviation [SD] 0.68 months) than for nondiabetic subjects (61.5 [SD 0.28] months) (log-rank 49.9, $p < 0.001$). Diabetes was also associated with a higher risk of admission to an institution (relative risk 1.58, 95% confidence interval 1.28–1.94) and a shorter time to entry to an institution (57.7 [SD 0.50] months for diabetic subjects, 66.8 [SD 0.23] months for nondiabetic subjects, log-rank 15.0, $p < 0.001$).

Interpretation

We found that the development of diabetes late in life is common, but that the incidence declines among those who are very old. The method of identifying people with diabetes affected our estimates, which were slightly higher when self-reported data were supplemented with clinical information. The presence of diabetes was associated with higher risks of death and admission to an institution.

Our estimates of incidence fall in the middle of the range of other estimates reported recently.^{3–6,9,10} Manitoba health insurance data for 1991 indicate annual incidence rates of 11.5 per thousand for men and 8.8 per thousand for women 60–69 years of age, 12.1 per thousand for men and 11.3 per thousand for women 70–79 years of age, and 11.5 per thousand for men and 10.0 per thousand for women 80 years of age or older.⁸ A Minnesota study also found that the incidence of diabetes declined in very old age.¹¹ Studies that reported no decline in the incidence of diabetes among the oldest-old either did not subdivide the oldest age categories^{4,6} or involved exclusively Asian populations.^{4,5} It is not clear why the incidence of diabetes should fall in very late life. The most reasonable explanation is that competing risks cause death in those who would otherwise be susceptible to the condition.

Several factors must be considered when interpreting our analysis. Because this investigation was not a primary CSHA objective, the data on diabetes are incomplete. The prevalence of undiagnosed diabetes among elderly people may be high; some report as many unknown as known cases.²⁰ Our estimates would therefore be conservative, although it could be argued that this is balanced by the fact

that we did not adjust for nondiabetic people who reported that they had the condition. On the other hand, undiagnosed diabetes may be less common among older Canadians: a practice-based study found only 1 new case for every 16 known patients.²¹

We do not have interval data on those who died or were admitted to an institution. Because diabetes can increase the risk of both nursing home use^{22,23} and death^{24–26} our estimate again would tend to undercount true incidence. In addition, 587 (8.9%) of the 6623 people known to be alive at the time of the CSHA-2 refused to participate in the screening interview. Most^{27,28} (but not all²⁹) Canadian studies have reported that elderly nonrespondents are less healthy and more disabled than respondents.

The higher relative risk of death is consistent with the results of other population studies.^{24–26} The incidence of admission to an institution was also greater among diabetic patients, which likely reflects the disabling nature of the complications of diabetes. These findings suggest that secondary prevention is an important task for physicians treating elderly diabetic patients.

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