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Abstract

Background
Diabetes prevalence is associated with low socio-economic status (SES), but less is known about the relationship between SES and diabetes incidence.

Data and methods
Data from eight cycles of the National Population Health Survey (1994/1995 through 2008/2009) are used. A sample of 5,547 women and 6,786 men aged 18 or older who did not have diabetes in 1994/1995 was followed to determine if household income and educational attainment were associated with increased risk of diagnosis of or death from diabetes by 2008/2009. Three proportional hazards models were applied for income and for education—for men, for women and for both sexes combined. Independent variables were measured at baseline (1994/1995). Diabetes diagnosis was assessed by self-report of diagnosis by a health professional. Diabetes death was based on ICD-10 codes E10-E14.

Results
Among people aged 18 or older in 1994/1995 who were free of diabetes, 7.2% of men and 6.3% of women had developed or died from the disease by 2008/2009. Lower-income women were more likely to develop type 2 diabetes than were those in high-income households. This association was attenuated, but not eliminated, by ethno-cultural background and obesity/overweight. Associations with lower educational attainment in unadjusted models were almost completely mediated by demographic and behavioural variables.

Interpretation
Social gradients in diabetes incidence cannot be explained entirely by demographic and behavioural variables.

Keywords
education, incidence, income, longitudinal studies, proportional hazards analysis, socio-economic status

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The global prevalence of type 2 diabetes (T2D), estimated at 6.4% in 2010,[1] is expected to be close to 8% by 2030. The increase in prevalence is thought to be due largely to population aging and rising rates of overweight, obesity and physical inactivity.[2,3] The prevalence of T2D has also been shown to be strongly patterned by socio-economic status (SES), particularly among women.[4-8] American data also suggest that the SES gap in diabetes prevalence has widened over time.[9]

Less is known about the role of SES in the incidence of T2D—the onset of new cases. Low SES, as measured by income or education, may influence T2D risk either through higher levels of obesity and physical inactivity or independent of these factors. Associations between SES and incident diabetes were assessed with and without adjustment for obesity and physical activity to clarify this issue. An advantage of studying associations of SES with incident rather than prevalent diabetes is that it clarifies the temporal sequence of any association (that is, low income leading to diabetes versus diabetes reducing labour force participation[10]).

This article reports the results of a 14-year longitudinal analysis of the relationship between T2D incidence and household income and individual educational attainment. It also examines demographic and behavioural factors that may mediate this relationship.

Data and methods

Data source

The data for this analysis are from the first eight cycles (1994/1995 through 2008/2009) of the biennial National Population Health Survey (NPHS). The household component of the survey covers the population living in private dwellings in the 10 provinces in 1994/1995. It excludes people on Indian reserves, in the territories, on Canadian Forces bases, and in some remote areas.

Of 20,095 individuals selected for the longitudinal panel in 1994/1995, 17,276 agreed to participate—a response rate of 83.6%. Based on these 17,276

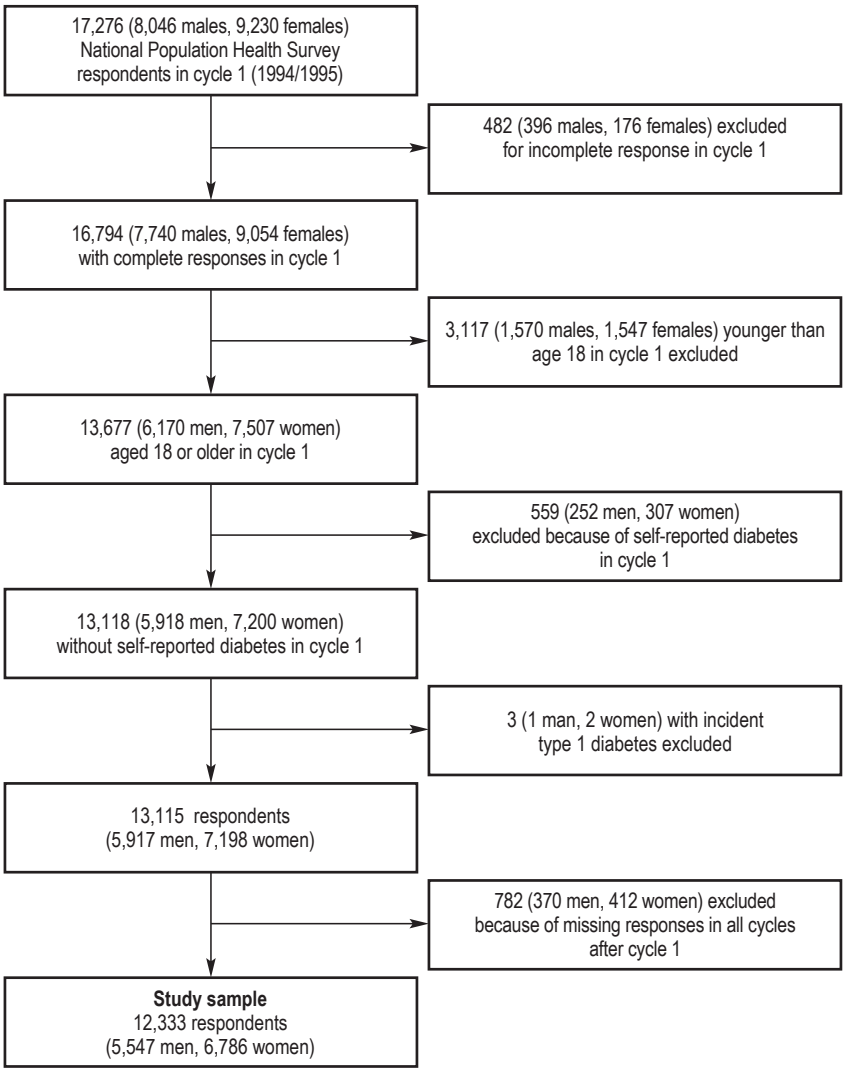
participants, the response rates for subsequent cycles were: 92.8% in 1996/1997; 88.2% in 1998/1999; 84.9% in 2000/2001; 80.8% in 2002/2003; 77.6% 2004/2005; 77.2% in 2006/2007; and 70.7% in 2008/2009.

This analysis uses the cycle 8 (2008/2009) longitudinal "square" file, which contains records for all members of the original panel, regardless of whether information about them was obtained in every subsequent cycle. More detailed descriptions of the design, sample and interview procedures can be found in published reports.[11,12]

Study sample

Of the 17,276 NPHS participants in 1994/1995, 482 who did not have a complete questionnaire response that year, 3,117 who were younger than age 18, and 559 who reported a diagnosis of diabetes were excluded from the study sample (Figure 1). Another 782 were excluded because of missing responses in all cycles after cycle 1. Incident T2D occurring between 1994/1995 and 2000/2001 (identified based on responses to the 2000/2001 interview and application of an algorithm[13]) resulted in the exclusion of three respondents younger than age 30 who reported starting insulin within six months of diagnosis. Four respondents who reported first being diagnosed with diabetes while they were pregnant, but who also reported being diagnosed with diabetes at some other time, were included. The final study sample numbered 12,333 (6,786 women and 5,547 men).

Figure 1
Definition of study sample



Definitions

Diabetes

In the NPHS, the prevalence of chronic conditions, including diabetes, was based on self-reports of diagnosed illness. Respondents were asked about any "long-term health conditions that have lasted or are expected to last six months or more and that have been diagnosed by a health professional." The NPHS used a checklist of conditions, one of which was diabetes. Death from diabetes was based on ICD-10 codes E10 to E14.

Socio-economic status (SES)

SES was proxied by two measures: household income and individual educational attainment. Each measure was assessed separately, given that the potential for reverse causality is higher for income than for education (that is, because of diabetes onset, income is reduced). As well, although these variables are correlated, their relationship to T2D is likely to differ. Household income may influence risk through its capacity to affect access to material resources for improved health, while education may influence health-related knowledge and behaviour.

Household income was based on total self-reported household income from all sources in the previous 12 months. The ratio between total household income and the low-income cut-off corresponding to the number of people in the household and community size was calculated. The ratios were then divided by the highest ratio for all NPHS respondents.

These adjusted ratios were grouped into deciles, which were collapsed into five categories: low (deciles 1 and 2); low-to-middle (deciles 3 and 4); middle (deciles 5 and 6); high-to-middle (deciles 7 and 8); and high (deciles 9 and 10). More information about the income variable can be found in the NPHS derived variable documentation at www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3225&lang=en&db=imdb&adm=8&dis=2#4.

Education refers to the highest level acquired by the respondent throughout the entire study period: postsecondary graduation; some postsecondary; secondary graduation; or less than secondary graduation.

Covariates

Age in 1994/1995 was measured as a continuous variable and contained values of 18 years or more.

Ethno-cultural background was based on the question, "How would you best describe your race or colour?" Respondents were grouped into three categories: White, Aboriginal or South/Southeast Asian, and other (includes multiple-race category).

Body mass index (BMI) in 1994/1995 was calculated by dividing self-reported weight in kilograms by the square of self-reported height in metres. The BMI groups were: underweight/acceptable (BMI less than 25.0 kg/m^2) and overweight/obese (25.0 kg/m^2 or more).

The number of *secondary behavioural risk factors* in 1994/1995 was based on whether respondents reported heavy drinking (15 or more drinks in the past week for men; 10 or more for women); were current daily smokers; or were physically inactive during leisure time (based on average daily energy expenditure from leisure activities in the three months before the interview).

Statistical analysis

Cox proportional hazards modeling was used to identify variables associated with an increased or decreased risk of being diagnosed with or dying from diabetes during follow-up. This technique allows for the study of relationships between individual characteristics and an outcome when that outcome can take place over a period of time. The method accounts for the possibility that respondents do not develop or die from diabetes during the study period, and minimizes the bias associated with attrition.

The analysis was restricted to respondents aged 18 or older at cycle 1 (1994/1995). Since the prevalence of and characteristics associated with diabetes can differ between men and women,[4,5,8,14-18] combined and sex-specific analyses were conducted.

If a respondent reported a diagnosis of diabetes or died of diabetes after 1994/1995, this was considered an event. Given that the development of diabetes, which is a continuous process, was measured only at discrete two-year intervals, many transitions to a diabetes event were recorded at the same time—after 2, 4, 6, 8, 10, 12 or 14 years—even though they could have occurred at any time between the interviews. Thus, the complementary log-log model was used.[19]

If self-reported diabetes information was missing for one or more survey cycles, but values for subsequent cycles were available, the cases were retained. This creates intervals of varying lengths between observations. To control for the fact that the longer the interval, the more likely a respondent was to develop diabetes, values for interval length and interval length squared were entered as independent variables in the model.

An imputed value of "No" to the diabetes question was used if a missing response was bounded by "No's" in the previous and subsequent cycles. Of the 12,333 respondents, 1,928 (15.6%) contain imputed "No" response(s) in one or more cycles.

For both sexes combined, for men and for women, three models were applied separately for household income and for education. The first model was adjusted for income or education and the varying lengths of time between observations. The second adjusted for these variables and age. The final model adjusted for these variables and for ethno-cultural background, BMI, and the number of secondary behavioural risk factors.

All the analyses were weighted using the longitudinal weights constructed to represent the total population in 1994. The bootstrap method was used to account for the complex survey design in the calculation of confidence intervals and in the assessment of statistical significance.[20-22] The significance level was set at $p<0.05$.

Results

Characteristics of respondents

A total of 12,333 respondents aged 18 or older were followed from 1994/1995 to 2008/2009. During this period, 877 of them (an estimated 1.2 million) were diagnosed with or died from diabetes (Table 1). The overall 14-year incidence rate of T2D was slightly higher for men (7.2%) than for women (6.3%), a difference that was not statistically meaningful.

Few respondents died from diabetes—23 overall (12 men, 11 women). Half of these 23 respondents reported a diabetes diagnosis before they died, so the incident cases that were deaths were 6 men (1.5% of 407 events) and 6 women (1.3% of 469 events) (data not shown).

The men in the sample were more likely than the women to live in the highest income households and to be postsecondary graduates (Appendix Table A). They were also more likely to be overweight/obese and to report two or three of the secondary behavioural risk factors considered in this study (heavy drinking, smoking, physical inactivity).

Household income

An elevated risk of T2D incidence remained in the models for both sexes combined among people in the lowest income households (proportional hazards ratio 1.6; CI: 1.1 to 2.3), compared with those in the most affluent, and a modest association for those in low-to-middle-income households (proportional hazards ratio 1.4; CI: 1.0 to1.9) (Table 2).

Table 1
New diagnosis of or death from diabetes between 1996/1997 and 2008/2009, by sex, household population aged 18 or older with no diagnosis of diabetes in 1994/1995, Canada excluding territories

	Both sexes			Men			Women		
	Sample size	Estimated population '000	%	Sample size	Estimated population '000	%	Sample size	Estimated population '000	%
Total	**12,333**	**18,385**	**100.0**	**5,547**	**8,917**	**100.0**	**6,786**	**9,468**	**100.0**
No diagnosis of or death from diabetes	11,456	17,151	93.3	5,140	8,277	92.8	6,316	8,874	93.7
Diagnosis of or death from diabetes	877	1,234	6.7	407	640	7.2	470	594	6.3

Note: Deaths attributed to diabetes are based on records for which cause of death was available.
Source: 1994/1995 to 2008/2009 National Population Health Survey, longitudinal square file.

The magnitude of associations changed little with adjustment. Other important associations with diabetes were ethno-cultural background (Aboriginal or South/Southeast Asian), overweight/obesity, and the number of secondary behavioural risk factors (Appendix Table B).

Among men, there were consistent increases in hazards ratios with decreasing household income in all models, and associations between household income and T2D were similar in adjusted and unadjusted models. Other associations with T2D in men included overweight/obesity (proportional hazards ratio 3.2; CI: 2.3 to 4.7) and the number of secondary behavioural factors they reported.

Among women, associations between income and incident diabetes were evident in both unadjusted and adjusted models, but in contrast to men, the unadjusted hazard ratios were not notably larger than the adjusted ones. For example, the unadjusted hazard ratio comparing incident diabetes between the lowest and highest income women was 2.4, falling to 1.9 with age adjustment and to 1.7 with full adjustment.

Individual educational attainment

For both sexes combined, no important association between T2D incidence and level of education persisted when adjusting for demographic and behavioural factors (Table 2). Sex-specific analyses showed that among men, the association between lower educational attainment and incident T2D was entirely accounted for by age, overweight/obesity (proportional hazards ratio 3.2; CI: 2.1 to 4.8) and behavioural factors (proportional hazards ratios of 1.7 and 1.5 for reporting one or two to three secondary behavioural factors, respectively) (Appendix Table C). Among women, a modest association with secondary versus postsecondary graduation persisted, although it was strongly attenuated by Aboriginal or South/Southeast Asian ethno-cultural background (proportional hazards ratio 3.3; CI: 1.8 to 5.9) and overweight/obesity (proportional hazards ratio 4.1; CI: 2.9 to 5.7).

Discussion

Compared with the highest income individuals, overall there was a persistent association between low income and incident diabetes in fully adjusted models. The magnitude of associations between income and incident diabetes was similar for men and women in the fully adjusted models, but greater for women in the unadjusted models, suggesting that age and other variables partly explained associations between incident diabetes and low income in women.

While T2D incidence was inversely associated with educational attainment in unadjusted analyses, in multivariate analyses, the relationship was sustained only among women with secondary graduation versus postsecondary graduation. The risk associated with low educational attainment was mediated by overweight/obesity and Aboriginal or South/Southeast Asian ethno-cultural background.

The results of this analysis differ somewhat from comparable American research. In a study of the relationship between SES and the 34-year incidence of T2D among a sample of more than 6,000 residents of Alameda County, California, Maty et al.[23] found that the excess risk associated with income and educational status was largely accounted for by other factors, especially obesity. Robbins et al.[4] looked at the relationship

What is already known on this subject?

- Cross-sectional studies have found an association between socio-economic status (SES) and diabetes prevalence.
- Results of the few longitudinal population-based studies that have examined the association between SES and diabetes incidence have been inconsistent.

What does this study add?

- There is a clear association between low income and incident diabetes.
- Among women, the SES-T2D incidence relationship is partially mediated by overweight/obesity and Aboriginal or South/South East Asian ethno-cultural background.

Table 2
Adjusted proportional hazards ratios relating household income and education in 1994/1995 to diagnosis of or death from diabetes between 1996/1997 and 2008/2009, household population aged 18 or older and free of diabetes in 1994/1995, Canada excluding territories

	Unadjusted	95% confidence interval		Age-adjusted	95% confidence interval		Fully adjusted	95% confidence interval	
		from	to		from	to		from	to
Household income									
Both sexes									
Highest†	1.0	…	…	1.0	…	…	1.0	…	…
Middle-to-high	1.2	0.9	1.6	1.2	0.9	1.6	1.2	0.8	1.7
Middle	1.3	1.0	1.8	1.3	0.9	1.7	1.3	0.8	1.9
Low-to-middle	1.7**	1.3	2.3	1.4*	1.1	1.9	1.4*	1.0	1.9
Lowest	1.7**	1.3	2.3	1.6**	1.2	2.1	1.6**	1.1	2.3
Men									
Highest†	1.0	…	…	1.0	…	…	1.0	…	…
Middle-to-high	1.0	0.7	1.6	1.1	0.7	1.6	1.1	0.7	1.7
Middle	1.3	0.8	1.9	1.2	0.8	1.8	1.3	0.9	2.0
Low-to-middle	1.5	1.0	2.2	1.3	0.9	2.0	1.4	0.9	2.1
Lowest	1.4	0.9	2.1	1.4	0.9	2.2	1.5	1.0	2.4
Women									
Highest†	1.0	…	…	1.0	…	…	1.0	…	…
Middle-to-high	1.4	0.9	2.4	1.4	0.9	2.3	1.3	0.8	2.3
Middle	1.5	0.9	2.5	1.4	0.8	2.4	1.2	0.7	2.2
Low-to-middle	2.2**	1.4	3.4	1.7*	1.1	2.6	1.5	0.9	2.3
Lowest	2.4**	1.5	3.7	1.9**	1.2	3.1	1.7*	1.1	2.8
Education									
Both sexes									
Postsecondary graduation†	1.0	…	…	1.0	…	…	1.0	…	…
Some postsecondary	1.1	0.9	1.4	1.2	0.9	1.5	1.1	0.8	1.6
Secondary graduation	1.3*	1.0	1.8	1.3*	1.0	1.8	1.3	1.0	1.7
Less than secondary graduation	1.9**	1.5	2.4	1.2	1.0	1.6	1.2	0.9	1.5
Men									
Postsecondary graduation†	1.0	…	…	1.0	…	…	1.0	…	…
Some postsecondary	1.2	0.9	1.8	1.4	0.9	2.0	1.4	0.9	2.0
Secondary graduation	1.1	0.8	1.7	1.2	0.8	1.8	1.2	0.8	1.8
Less than secondary graduation	1.5*	1.1	2.2	1.1	0.8	1.6	1.1	0.8	1.6
Women									
Postsecondary graduation†	1.0	…	…	1.0	…	…	1.0	…	…
Some postsecondary	1.0	0.7	1.4	1.0	0.7	1.4	0.9	0.6	1.4
Secondary graduation	1.6*	1.1	2.4	1.5*	1.0	2.3	1.5*	1.0	2.2
Less than secondary graduation	2.4**	1.7	3.3	1.4*	1.0	1.9	1.2	0.9	1.7

* significantly different from estimate for reference category ($p < 0.05$)
** significantly different from estimate for reference category ($p < 0.01$)
... not applicable
Note: Because of rounding, some hazards ratios with 1.0 as lower confidence limit are statistically significant. A variable was included in all models to control for varying lengths of time between observations, but hazards ratios are not shown. Fully adjusted models also control for age, ethno-cultural background, overweight/obese, and number of secondary behavioural risk factors (heavy drinker, current smoker, inactive). To maximixe sample size, "missing" categories were included for several variables, but hazards ratios are not shown.
Source: 1994/1995 to 2008/2009 National Population Health Survey, longitudinal square file.

between three measures of SES (income, education, occupation) and diabetes risk for more than 11,000 respondents to the NHANES1 National Epidemiologic follow-up study. They found that mediating factors virtually eliminated the risk associated with income and education for women (although a strong risk remained for occupational status), while for men, the risks associated with income and education were not substantially attenuated by mediating factors. In the Whitehall II Study of British civil servants, SES measures were related to T2D incidence only for men. However, the sample contained twice as many men as women, and so was likely under-powered for detecting the relationship between SES and women's T2D risk.[24]

The findings of this study support the conclusion that the inverse association between diabetes *prevalence* and SES, more consistent among women than among men in Canada,[8] is unlikely to be driven by reverse causation (diabetes affecting income through the inability to work) or by longer survival of more affluent or more highly educated diabetes patients.

Limitations

NPHS respondents were asked if they had "diabetes," but no information was collected about the specific type of diabetes. This is not, however, a major limitation, as an estimated 95% of diabetes cases are type 2.[13]

The degree to which self-reported diagnoses of chronic conditions, including diabetes, are inaccurate because of reporting error is unknown. If individuals with lower income or education were less likely to report having been diagnosed with diabetes by a health professional, the strength of the association between these SES variables and T2D incidence is underestimated. However, adjusting the models for "having a regular family doctor" at baseline did not change the relationship (data not shown).

If some respondents who did not report diabetes actually had it, the incidence would be underestimated. The presence of respondents with undiagnosed diabetes in the "no diabetes" reference group would weaken associations in the models between risk factors and incidence. But while undiagnosed diabetes remains an important public health issue in North America,[25,26] it is less common now than it was several decades ago.[9]

Not all factors known to be associated with incident diabetes could be examined in this study. For example, the NPHS does not collect data on diet or biological measures such as blood glucose. Family history of diabetes was not used, because it was collected only in cycle 3 (1998/1999).

BMI was based on self-reported weight and height, which tend to yield lower estimates of obesity than measured data.[27] Thus, this study could underestimate the association between obesity and T2D incidence.

Conclusion

There is a clear association between low income and incident diabetes. Low household income was associated with the onset of T2D in Canadian women, although the relationship was attenuated by overweight/obesity and by Aboriginal or South/South east Asian ethno-cultural background.

The inverse association between educational attainment and T2D incidence in unadjusted analyses was sustained in multivariate analyses only for women. However, again, the relationship was weakened by adjustment for ethno-cultural background and overweight/obesity.

The attenuation of the association between T2D onset and overweight/obesity and membership in two ethnic groups (Aboriginal and South/Southeast Asian) among women is suggestive of more highly targeted prevention strategies. ■

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Appendix

Table A
Baseline (1994/1995) characteristics of study sample, by sex, Canada excluding territories

	Men			Women		
		Estimated population			Estimated population	
Characteristics	Sample size	'000	%	Sample size	'000	%
Total	**5,547**	**8,917.4**	**100.0**	**6,786**	**9,468.0**	**100.0**
Age group						
18 to 44	3,179	5,447.7	61.1*	3,637	5,419.7	57.2
45 to 64	1,562	2,428.2	27.2	1,811	2,633.3	27.8
65 to 74	523	694.7	7.8*	766	896.1	9.5
75 or older	283	346.9	3.9*	572	519.0	5.5
Household income						
Highest	1,217	2,008.9	22.5*	1,100	1,756.7	18.6
Middle-to-high	1,057	1,772.4	19.9	1,205	1,716.1	18.1
Middle	1,056	1,699.2	19.1	1,166	1,698.1	17.9
Low-to-middle	985	1,455.2	16.3*	1,363	1,827.4	19.3
Lowest	884	1,321.0	14.8*	1,528	1,822.7	19.3
Missing	348	660.8	7.4	424	647.1	6.8
Education						
Postsecondary graduation	1,730	3,057.9	34.3*	2,051	2,940.7	31.1
Some postsecondary	1,373	2,290.4	25.7	1,788	2,547.5	26.9
Secondary graduation	834	1,354.4	15.2*	1,061	1,640.2	17.3
Less than secondary graduation	1,601	2,201.0	24.7	1,880	2,331.9	24.6
Missing	9	F	F	6	F	F
Ethno-cultural background						
White	5,170	8,022.2	90.0	6,360	8,562.2	90.4
South/Southeast Asian or Aboriginal	135	303.8	3.4	175	332.3	3.5
Other	216	530.9	6.0	228	510.1	5.4
Missing	26	60.5E	0.7E	23	63.4E	0.7E
Body mass index						
Underweight/Acceptable (less than 25 kg/m^2)	2,303	3,899.8	43.7*	3,810	5,481.7	57.9
Overweight/Obese (25 kg/m^2 or more)	3,212	4,959.8	55.6*	2,718	3,593.3	38.0
Missing	32	57.8E	0.7E*	258	393.0	4.2
Secondary behavioural risk factors						
0	1,614	2,701.6	30.3*	1,783	2,527.0	26.7
1	2,557	4,185.0	46.9*	3,534	4,952.6	52.3
2 or 3	1,375	2,026.1	22.7*	1,453	1,965.3	20.8
Missing	F	F	F	16	23.0E	0.2E

* significantly different from estimate for women ($p<0.05$)
E use with caution (coefficient of variation 16.6% to 33.3%)
F too unreliable to be published (coefficient of variation greater than 33.3%)
Source: 1994/1995 to 2008/2009 National Population Health Survey, longitudinal square file.

Table B
Adjusted proportional hazards ratios relating household income and selected characteristics to diagnosis of or death from diabetes between 1996/1997 and 2008/2009, by sex, household population aged 18 or older and free of diabetes in 1994/1995, Canada excluding territories

	Both sexes			Men			Women		
	Proportional hazards ratio	95% confidence interval		Proportional hazards ratio	95% confidence interval		Proportional hazards ratio	95% confidence interval	
Characteristics		from	to		from	to		from	to
Age (continuous)	1.04**	1.03	1.05	1.04**	1.03	1.04	1.04**	1.03	1.05
Household income									
High†	1.0	…	…	1.0	…	…	1.0	…	…
Middle-to-high	1.2	0.8	1.7	1.1	0.7	1.7	1.3	0.8	2.3
Middle	1.3	0.8	1.9	1.3	0.9	2.0	1.2	0.7	2.2
Low-to-middle	1.4*	1.0	1.9	1.4	0.9	2.1	1.5	0.9	2.3
Low	1.6**	1.1	2.3	1.5	1.0	2.4	1.7*	1.1	2.8
Ethno-cultural background									
White†	1.0	…	…	1.0	…	…	1.0	…	…
South/Southeast Asian or Aboriginal	2.4**	1.4	4.0	1.7	0.7	3.9	3.1**	1.7	5.7
Other	1.2	0.7	2.0	1.4	0.8	2.5	1.0	0.4	2.4
Body mass index									
Underweight/Acceptable (less than 25 kg/m^2)†	1.0	…	…	1.0	…	…	1.0	…	…
Overweight/Obese (25 kg/m^2 or more)	3.8**	2.7	5.3	3.2**	2.3	4.7	4.1**	3.0	5.7
Secondary behavioural risk factors									
0†	1.0	…	…	1.0	…	…	1.0	…	…
1	1.3*	1.1	1.7	1.7**	1.3	2.3	1.0	0.8	1.4
2 or 3	1.2	0.9	1.7	1.5*	1.0	2.2	1.0	0.7	1.5

† reference category
* significantly different from estimate for reference category ($p < 0.05$)
** significantly different from estimate for reference category ($p < 0.01$)
... not applicable
Note: Because of rounding, some hazard ratios with 1.0 as lower confidence limit are statistically significant. To maximize sample size, "missing" categories were included for several variables, but hazards ratios are not shown. A variable was included to control for varying lengths of time between observations, but hazards ratios are not shown.
Source: 1994/1995 to 2008/2009 National Population Health Survey, longitudinal square file.

Table C
Adjusted proportional hazards ratios relating education and selected characteristics to diagnosis of or death from diabetes between 1996/1997 and 2008/2009, by sex, household population aged 18 or older and free of diabetes in 1994/1995, Canada excluding territories

	Both sexes			Men			Women		
	Proportional hazards ratio	95% confidence interval		Proportional hazards ratio	95% confidence interval		Proportional hazards ratio	95% confidence interval	
Characteristics (1994/1995)		from	to		from	to		from	to
Age (continuous)	1.04**	1.03	1.05	1.04**	1.03	1.05	1.04**	1.03	1.05
Household education									
Postsecondary graduation†	1.0	…	…	1.0	…	…	1.0	…	…
Some postsecondary	1.1	0.8	1.6	1.4	0.9	2.0	0.9	0.6	1.4
Secondary graduation	1.3	1.0	1.7	1.2	0.8	1.8	1.5*	1.0	2.2
Less than secondary graduation	1.2	0.9	1.5	1.1	0.8	1.6	1.2	0.9	1.7
Ethno-cultural background									
White†	1.0	…	…	1.0	…	…	1.0	…	…
South/Southeast Asian or Aboriginal	2.5**	1.5	4.1	1.8	0.8	4.1	3.3**	1.8	5.9
Other	1.3	0.8	2.2	1.5	0.8	2.7	1.0	0.4	2.5
Body mass index									
Underweight/Acceptable (less than 25 kg/m^2)†	1.0	…	…	1.0	…	…	1.0	…	…
Overweight/Obese (25 kg/m^2 or more)	3.7**	2.7	5.1	3.2**	2.1	4.8	4.1**	2.9	5.7
Secondary behavioural risk factors									
0†	1.0	…	…	1.0	…	…	1.0	…	…
1	1.3*	1.1	1.7	1.7**	1.2	2.4	1.0	0.8	1.4
2 or 3	1.2	0.9	1.7	1.5*	1.0	2.3	1.0	0.6	1.5

† reference category
* significantly different from estimate for reference category ($p < 0.05$)
** significantly different from estimate for reference category ($p < 0.01$)
... not applicable
Note: Because of rounding, some hazards ratios with 1.0 as the lower confidence limit are statistically significant. To maximize sample size, "missing" categories were included for several variables, but hazards ratios are not shown. A variable was included to control for varying lengths of time between observations, but hazards ratios are not shown.
Source: 1994/1995 to 2008/2009 National Population Health Survey, longitudinal square file.