Eye care utilization and its determinants in Canada

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ABSTRACT ●

Objective: To provide the frequency and potential determinants of eye care utilization over the last 12 months among Canadians between the ages of 45 and 85 years old.

Design: Cross-sectional population-based study.

Participants: 30,097 people in the Comprehensive Cohort of the Canadian Longitudinal Study on Aging.

Methods: Inclusion criteria included being between the ages of 45 and 85 years old, community-dwelling and living near one of the 11 data collection sites across 7 Canadian provinces. Eye care utilization was defined as the self-report of a visit to an optometrist or ophthalmologist in the past 12 months.

Results: In the last year, 57% of 28 728 adults visited an eye care provider although there was heterogeneity between provinces. The highest eye care utilization was found in Ontario at 62%, whereas the lowest was in Newfoundland and Labrador at 50%. Of concern, 25.3% of people with diabetes above the age of 60 years had not seen an eye care provider in the last year. Our novel finding was that current smokers were less likely to use eye care compared to never smokers (odds ratio [OR] = 0.76, 95% confidence interval [CI] 0.67–0.87). Confirming previous research, men compared to women (OR = 0.67, 95% CI 0.62–0.71), people with less than a bachelor's degree compared to more than a bachelor's degree (OR = 0.87, 95% CI 0.79–0.95), and people making less income (linear trend $p < 0.05$) were less likely to use eye care.

Conclusions: Disparities exist in eye care utilization in Canada. Efforts should be made to reduce these disparities to reduce avoidable vision loss.

Visual impairment is a substantial economic burden in Canada costing approximately $15.8 billion per year.[1] The prevalence of visual impairment increases dramatically with age such that approximately 1 in 10 adults above the age of 60 years is affected.[2] The majority of visual impairment is due to uncorrected refractive error.[2] Routine eye examinations are important for the timely detection of refractive error and the early identification and management of eye disease.[3]

The most recent study to examine rates and determinants of eye care utilization in Canada used data that are now more than 10 years old.[4] Jin and Trope used the 2005 Canadian Community Health Survey to examine eye care utilization in individuals aged 12 and older and found that 40% of Canadians in this age group utilized eye care services from an optometrist or an ophthalmologist in a 12-month period.[4] Being male, younger, having lower socioeconomic status, and living in Newfoundland and Labrador were factors associated with less utilization ($p < 0.05$).

The Canadian Longitudinal Study on Aging (CLSA) Comprehensive Cohort, a large, national, population-based epidemiological study of over 30 000 middle-aged and older adults across 7 provinces of Canada, allows us to address the following goals: (*i*) to provide up-to-date estimates of eye care utilization, and (*ii*) to identify novel and confirm previously identified determinants of eye care utilization.[5] Knowing the current patterns and frequency of eye care utilization would help to identify eye care access disparities, which would allow policymakers, researchers, and health care providers to devise ways to close the gaps and improve Canada's vision and eye health.

METHODS

Setting

The CLSA is a national prospective cohort study of adult development and aging. A detailed description of the CLSA methodology is reported elsewhere.[5] This analysis used baseline data from the 30 097 participants in the Comprehensive Cohort of the CLSA collected between 2012 and 2015. Participants were community-dwelling adults aged between 45 and 85 years living near one of 11 data collection sites (Victoria, Vancouver, Surrey, Calgary, Winnipeg, Hamilton, Ottawa, Montreal, Sherbrooke, Halifax, and St. John's) across 7 Canadian provinces. People were not eligible if they lived in an institution, were on a First Nations reserve or settlement, were full-time members of the Canadian Armed Forces, did not speak French or English, or had overt cognitive difficulties. Written informed consent was obtained and the project was approved by research ethics boards in 7 different provinces.

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Design

The participants in the CLSA Comprehensive Cohort were sampled using both provincial health registries (14%) and random digit dialling (86%). For those recruited using provincial health registries, a letter was sent to the randomly chosen, age-eligible person introducing the study and providing a consent form to be returned to the CLSA. For those recruited through random digit dialling, a random sample of landline telephone numbers was selected for a given geographic area. Stratified sampling was used to ensure adequate representation of various demographic groups. Strata within a province were defined by age group, sex, and distance from the data collection sites.

Sources of Data

All CLSA personnel underwent detailed training in all aspects of data collection. The training was standardized across all data collection sites. The following data were collected as part of a face-to-face, interviewer-administered questionnaire given either in the home or at a data collection site, unless otherwise specified.

Sociodemographic. Data on demographic variables such as age, sex, race/cultural group, highest level of education, and urban versus rural residence were obtained. Household income was assessed by asking, "What is your best estimate of the total household income received by all household members, from all sources, before taxes and deductions, in the past 12 months?" Respondents chose from 5 categories of household income: < $20 000; $20 000–$50 000; $50 000–$100 000; $100 000–$150 000; and $150 000 or more.

Lifestyle and Health. Participants were asked about former and current smoking. Depression was ascertained through the Center for Epidemiologic Studies Depression Scale Revised (CESD-R-10) questionnaire.[6] Participants who scored ≥10 points were classified as having depression. Memory problems were determined using the following questionnaire item: "Has a doctor ever told you that you have a memory problem?" Participants were classified as having diabetes if they answered "yes" to "Has a doctor ever told you that you have diabetes, borderline diabetes or that your blood sugar is high?" Those who said "yes" were then asked whether they had type 1 or type 2 diabetes.

Eye Disease, Corrective Lenses, Visual Impairment, and Eye Care Utilization. Information on eye disease was obtained by asking, "Has a doctor ever told you that you have [glaucoma, cataract, macular degeneration]?" People who said that they had been told that they had cataract were then asked if they currently had a cataract. Those who said no were assumed to have had it removed. Participants were asked if they wore contact lenses or glasses. Participants were also asked to rate their visual health using a 5-item Likert scale ranging from "Excellent," "Very good," "Good," "Fair," to "Poor or Nonexistent." Visual acuity was assessed with both eyes open using the Early Treatment Diabetic Retinopathy Study (ETDRS) letter chart at a 2 m distance, while participants wore their currently prescribed glasses or contact lenses for distance correction.[7] Participants who had a visual acuity of ≤20/40 were classified as visually impaired, as is standard in North America.[8] Information on eye care utilization was ascertained over the telephone with the question: "During the past 12 months, have you had contact with an ophthalmologist or optometrist about your health?" Previous research indicates that the self-report of eye care use in the previous year has good agreement with eye care use as confirmed in medical records (kappa = 0.64).[9]

Number of Ophthalmologists and Optometrists by Province. Data on the number of optometrists per 100 000 people by province were obtained from the Canadian Institute for Health Information.[10] Data on the number of ophthalmologists per province were obtained from the Canadian Medical Association,[11] and data on the number of people per province were taken from Statistics Canada.[12] All data are from the year 2013.

Statistical Analysis

The proportion who used eye care by province was plotted on a map using Stata/IC Version 14.2.[13] χ^2 tests of independence were used to determine the relationship between categorical variables and use of eye care. Variables that had a p value of 0.1 or lower from the χ^2 tests were retained for regression analysis to try to ensure that no important variables were missed. Logistic regression was then used for adjustment for the following: age, sex, ethnicity, education, marital status, income, rural residence, province, smoking, diabetes, self-reported eye disease, and visual impairment.[14–16] Only those variables that reached the Bonferroni-adjusted p value of 0.0014 for the 35 tests in the logistic regression model were considered statistically significant. The complex survey design was accounted for in all analyses by using the primary sampling unit, sample weight, and strata variables within the SVY commands in STATA Version 14.2 (College Station, Tex.). Age standardization of the primary outcome was done by direct age adjustment in which age-stratified rates were applied to a standard population (Alberta).

Results

Of the 30 097 CLSA Comprehensive Cohort participants, a total of 28 728 participants completed the eye care utilization question (95%). The mean age of those who did and did not answer the question was the same at 60 years, and there was no difference by sex ($p > 0.05$). However, those with missing data on eye care utilization were more likely to have lower household incomes, were

Table 1—Crude and age-standardized proportions of people who utilized eye care in the last year by province

Province	Crude Eye Care Utilization % (95% CI)	Age-Standardized Eye Care Utilization, %
Alberta (n = 2860)	60.2 (57.9–62.5)	61.6
British Columbia (n = 5971)	56.1 (54.6–57.5)	55.7
Manitoba (n = 2968)	54.7 (52.6–56.7)	54.1
Newfoundland & Labrador (n = 2047)	50.4 (47.9–52.8)	50.2
Nova Scotia (n = 2909)	56.3 (54.2–58.3)	56.2
Ontario (n = 6122)	62.3 (60.9–63.7)	61.6
Quebec (n = 5851)	54.4 (52.9–55.8)	53.8
Canada (n = 28 728)	56.9 (56.3–57.6)	57.2

$p < 0.001$ for inter-provincial differences

more likely to currently smoke, and were more likely to have visual impairment ($p < 0.001$). The annual frequency of eye care utilization among adults aged 45 to 85 years was 56.9% (95% confidence interval [CI] 56.3–57.6).

The frequency of eye care utilization during a 12-month period significantly varied by province ($p < 0.001$) as shown in Table 1 and Figure 1. The lowest frequency of eye care utilization was seen in the province of Newfoundland and Labrador at 50.4%, whereas the highest was in Ontario at 62.3%. There was almost no difference between the crude and age-standardized rates of eye care utilization (Table 1).

Sociodemographic factors and their relationship with the frequency of eye care utilization are shown in Table 2. Utilization increased with age, ranging from 50.3% in those aged 45–54 years to 73.3% in those aged 75–85 years. The frequency of eye care utilization was higher in women than in men ($p < 0.05$). Marital status, race/cultural group, education, household income, and urban residence were associated with eye care utilization in the unadjusted analyses ($p < 0.05$).

In Table 3, lifestyle, health, and ocular factors and their relationship to eye care utilization are shown. Individuals who were current smokers; had self-reported type 1 or type 2 diabetes, cataracts, glaucoma, and macular degeneration; those who wore glasses or contacts; and those with visual impairment were more likely to utilize eye care in a 12-month period in comparison to their counterparts ($p < 0.001$).

In Figure 2, the frequency of eye care utilization is plotted by the optometrist rate per 100 000 people (Fig. 2A) and the ophthalmologist rate per 100 000 people (Fig. 2B) for each province. There is a positive linear relationship between the frequency of eye care utilization and the optometrist rate per 100 000 people in all the provinces, with the exception of Quebec. There was no relationship between the frequency of eye care utilization and the ophthalmologist rate per 100 000 people as the fitted line was flat.

Figure 3 shows the frequency of eye care utilization by age in the overall group and also in high-risk groups (diabetes and glaucoma). There is a positive linear trend

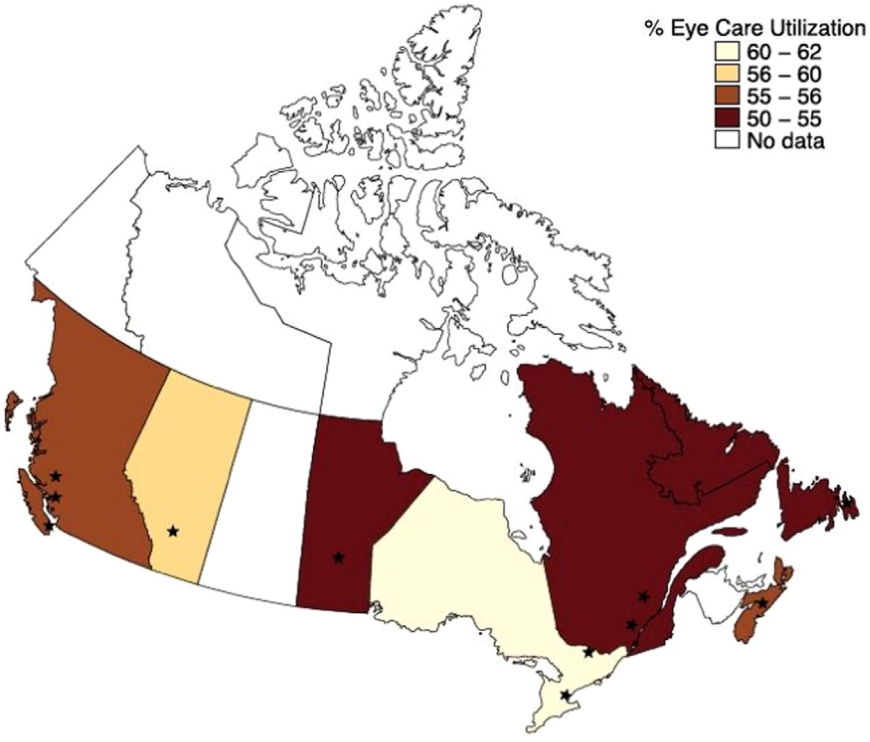

Fig. 1—Map of Canada showing frequency (%) of yearly eye care utilization. The use of eye care in the last year varied by province. The stars indicate the locations of the 11 data collection sites. The frequencies of eye care utilization may be generalizable only to the areas 25–50 km from each data collection site.

Table 2—Demographic characteristics of participants by eye care utilization

	Eye Care Utilization (%), n = 28 728	χ^2 *p*-Value
Age group, years		<0.001
45–54 (n = 7214)	50.3	
55–64 (n = 9476)	54.3	
65–74 (n = 7084)	67.2	
75–85 (n = 4954)	73.3	
Sex		<0.001
Female (n = 14 617)	61.1	
Male (n = 14 111)	52.6	
Marital status*		<0.001
Married (n = 19 860)	56.8	
Single (n = 2512)	51.4	
Divorced/separated (n = 3722)	55.7	
Widowed (n = 2626)	68.1	
Race/cultural group		0.019
White (n= 27 126)	57.1	
Black (n = 238)	52	
Asian (East, South, SE) (n = 629)	58.9	
Arab and West Asian (n = 133)	42.3	
Latin American (n = 114)	54.4	
Aboriginal (n = 335)	52.5	
Other (n = 153)	54.6	
Education*		<0.001
More than bachelor's (n = 6282)	59.5	
Bachelor's degree (n = 6842)	58.7	
Less than bachelor's (n = 15 553)	55.3	
Household income per year		0.028
≥ $100 000 (n = 9986)	56.9	
$50 000–$100 000 (n = 9538)	57.4	
$20 000–$50 000 (n = 5974)	55.7	
<$20 000 (n = 1401)	54.1	
Refused/don't know (n = 1829)	59.9	
Language spoken at home*		0.274
English or French (n = 27 024)	57	
Other (n = 1675)	55.5	
Residence*		0.008
Urban, semi-urban (n = 26 055)	57.2	
Rural (n = 2316)	54	

*n missing: marital status (n = 8), education (n = 51), language (n = 29), residence (n = 357).

Table 3—Health/visual disease characteristics of participants by eye care utilization

	Eye Care Utilization (%), n = 28 728	χ^2 *p*-Value
Smoking*		< 0.001
Never (n = 13 666)	57.7	
Former (n = 12 606)	58.4	
Current (n = 2357)	45.7	
Diabetes*		< 0.001
None (n = 23 618)	55.5	
Type 1 (n = 157)	82.3	
Type 2 (n = 2612)	70.6	
Suspect/neither type (n = 2019)	56.9	
Depression*		0.324
Yes (n = 4375)	56.1	
No (n = 23 966)	57.0	
Memory problems*		0.155
Yes (n = 471)	60.7	
No (n = 28 171)	56.9	
Cataracts*		< 0.001
None (n = 19 957)	52.0	
Past cataract (removed) (n = 1867)	70.5	
Current cataract (n = 1904)	77.1	
Glaucoma*		< 0.001
Yes (n = 1453)	82.4	
No (n = 27 135)	55.9	
Macular degeneration*		< 0.001
Yes (n = 1206)	78.2	
No (n = 16 010)	56.2	
Wears glasses or contacts*		< 0.001
Yes (n = 25 273)	59.5	
No (n = 3453)	41.0	
Visual impairment*		< 0.001
Yes (n = 2037)	66.6	
No (n = 26 300)	56.3	

*n missing: smoking (n = 99), diabetes (n = 322), depression (n = 387), memory problems (n = 86), cataracts (n = 5000), glaucoma (n = 140), macular degeneration (n = 194), wears glasses or contacts (n = 2), visual impairment (n = 391).

between age and the eye care utilization rate in all groups. Eye care utilization in glaucoma participants ranged from 74.9% in the youngest group to 87.4% in the older group; in diabetic participants, it ranged from 64.1% of the youngest group to 76.6% of the oldest group.

In Table 4, sociodemographic, lifestyle, health, and ocular variables are included together in a logistic regression model. After adjusting for one another, being male (odds ratio [OR] = 0.68, 95% CI 0.64–0.73) and having less than a bachelor's degree (OR = 0.85, 95% CI 0.78–0.92) were associated with a lower odds of utilizing eye care, whereas older adults were more likely to use eye care (OR = 1.02, 95% CI 1.01–1.02). Of the lifestyle and health variables, current smokers were less likely to use eye care (OR = 0.75, 95% CI 0.67–0.84). People with both type 1 (OR = 4.25, 95% CI 2.38–7.59) and type 2 diabetes (OR = 1.86, 95% CI 1.64–2.10) were more likely to use eye care. Self-reported eye diseases, such as cataract, glaucoma, and macular degeneration, and wearing glasses or contact lenses were also associated with an increased odds of eye care utilization ($p < 0.0014$), whereas visual impairment was only associated in a borderline fashion, taking into account the multiple comparisons (OR = 1.20, 95% CI 1.04–1.38) ($p = 0.011$).

In a sensitivity analysis, we reran the regression model without cataract given the large number of people with missing data for cataract. The results (n = 27 281) were unchanged except that visual impairment was now statistically significant (OR = 1.26, 95% 1.12–1.43).

Discussion

Our study updates and extends the existing research on eye care utilization patterns in Canada. We found that 57% of Canadians aged 45–85 years utilized an eye care provider in a 12-month period. However, there was large provincial variability with a low of 50% of people in Newfoundland and Labrador and a high of 62% of people in Ontario having seen an eye care provider in the last 12 months. Furthermore, men, people with less education, people with lower household income, and current smokers were less likely to use eye care. Of concern, more than 16% of people aged 60 years and older with glaucoma and 25% of people aged 60 years and older with diabetes had not seen an eye care provider in the last year.

Reasons for the interprovincial variability in eye care utilization are unclear, although differences in provincial coverage of eye examinations and access to optometrists

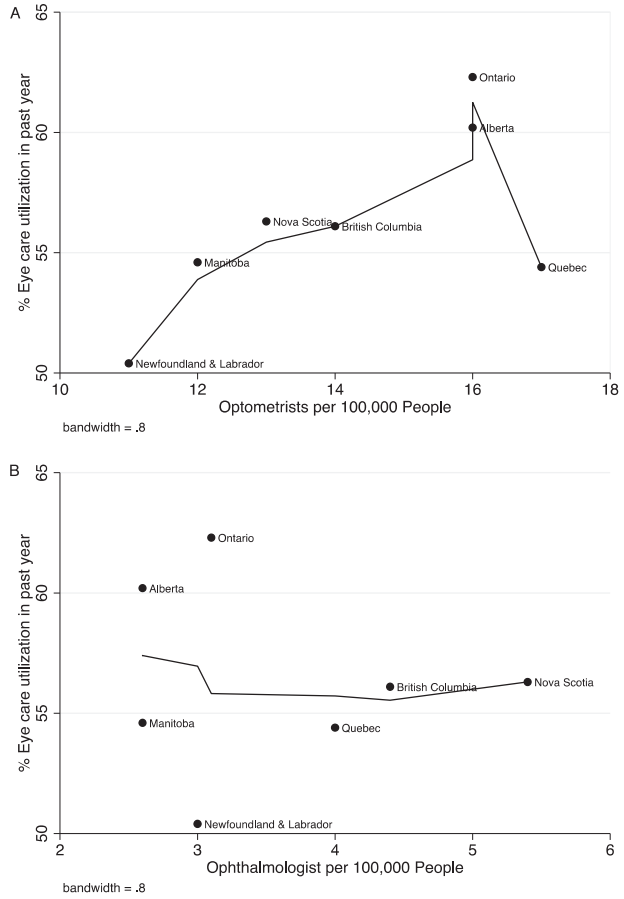

Fig. 2—Lowess smoothed lines showing the provincial frequency of eye care utilization in the past year by (A) optometrists per 100 000 people, and (B) ophthalmologists per 100 000 people.

may explain part of the heterogeneity. Consistent with our results, prior research from 2005 by Jin and Trope[4] also found that Newfoundland and Labrador had the lowest proportion of people using eye care of all of the provinces.[4] Newfoundland and Labrador is one of the few Canadian provinces to not cover the cost of a routine eye examination for adults aged 65 years and older, and so it is possible that this increased cost to the individual may deter some people from accessing eye care. Indeed, prior research found that provinces that did not cover the cost of eye examinations had lower self-reported rates of cataract and glaucoma, whereas they had higher rates of self-reported vision loss.[17] In addition, we found that provinces with a lower rate of optometrists per 100 000 people had less eye care utilization although Quebec did not fit this trend. Instead, Quebec had a high rate of optometrists but a relatively low proportion of people using eye care, which is consistent with prior research by Jin and Trope.[4]

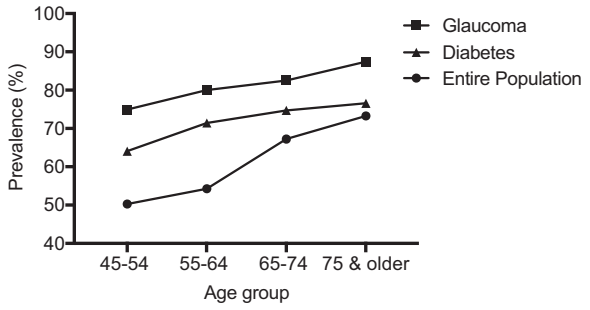

Fig. 3—Frequency of eye care utilization in the past year by age group for the entire population and for the high-risk-status groups of glaucoma and diabetes.

We report a novel association in that current smokers were less likely to access eye care. We are not aware of previous reports of such an association in the general population, although one article has reported that current smokers were less likely to use eye care in a population with diabetes.[18] This association was significant despite adjusting for educational differences between current and never smokers. Current smokers may have a more resistant attitude toward preventive health measures.[19] Current smokers are at a greater risk of eye diseases like cataract and age-related macular degeneration.[20,21] We identified a number of other factors associated with eye care utilization as well. Lower education, male sex, and lower household income were also related to less eye care use. Previous research has also identified these factors.[4,14,15,22–25] Those with lower education may be unaware of the need for routine eye examinations with increasing age. A study done in British Columbia examined public awareness of risk factors for eye disease and found that people had insufficient knowledge about eye disease and its associated risk factors.[26] Researchers in Australia have experimented with a public health campaign to increase awareness and found preliminary evidence that it helped.[27] Furthermore, provincial health care coverage of more eye care costs may lessen the financial burden of receiving routine eye care and may remove the income disparity.

People with diabetes and glaucoma were more likely to see eye care providers than people without these conditions. However, of great concern is that 1 out of 4 adults with diabetes aged above 60 years did not see an eye care provider in the last year. Annual visits for diabetic patients of this age are recommended every year.[3] Prior research has also reported suboptimal eye care in people with diabetes, and therefore the development of educational programs for this group should be considered.[18,28–30]

A strength of this analysis was the use of a very large, population-based dataset including people from 7 provinces of Canada. A limitation of this analysis is that information on eye care utilization was obtained by self-report, which may have resulted in some misclassification of our primary outcome. Furthermore, 4.5% were missing data on eye care utilization. They were similar in age and sex but were more likely to have lower incomes, to smoke, and to have visual impairment than those who had data on eye care utilization. Another limitation is that these data are cross-sectional, so we cannot establish the temporal relationship of the risk factors and the use of eye care. In

Table 4—Factors associated with eye care utilization in a multiple logistic regression model

	Eye Care Utilization (n = 22 649), Odds Ratio	95% CI
Age, per year	1.02	1.01–1.02
Male sex	0.68	0.64–0.73
Marital status		
Married	1.00	
Single	0.97	0.87–1.09
Divorced/separated	1.01	0.92–1.12
Widowed	1.09	0.95–1.24
Race/cultural group		
White	1.00	
Black	0.87	0.62–1.21
Asian (East, South, SE)	1.01	0.82–1.26
Arab and West Asian	0.74	0.48–1.15
Latin American	1.11	0.69–1.78
Aboriginal	0.88	0.67–1.16
Other	0.77	0.49–1.21
Education		
More than bachelor's	1.00	
Bachelor's degree	1.03	0.94–1.13
Less than bachelor's	0.85	0.78–0.92
Household income per year		
≥$100 000	1.00	
$50 000–$100 000	0.84	0.78–0.91
$20 000–$50 000	0.64	0.57–0.71
<$20 000	0.65	0.54–0.77
Refused/don't know	0.81	0.70–0.93
Rural vs nonrural	0.92	0.82–1.03
Province		
Alberta	1.00	
British Colombia	0.78	0.69–0.89
Manitoba	0.81	0.70–0.93
Newfound & Labrador	0.63	0.54–0.74
Nova Scotia	0.82	0.71–0.94
Ontario	0.99	0.87–1.12
Quebec	0.85	0.75–0.97
Smoking		
Never	1.00	
Former	0.97	0.91–1.04
Current	0.75	0.67–0.84
Diabetes		
None	1.00	
Type 1	4.25	2.38–7.59
Type 2	1.86	1.64–2.10
Suspect/neither type	0.98	0.87–1.10
Glaucoma	2.50	2.03–3.07
Cataract		
None	1.00	
Past cataract (removed)	1.53	1.33–1.75
Current cataract	2.35	2.05–2.70
Macular degeneration	1.60	1.30–1.95
Visual impairment		
No	1.00	
Yes	1.20	1.04–1.38
Glasses or contact lenses	1.81	1.64–1.98

*Adjusted for all variables in table and complex study design.

addition, the CLSA Comprehensive Cohort sample was recruited from within 25–50 km of the 11 urban data collection sites in 7 provinces. Therefore, generalizability of our results to other parts of Canada and to groups other than those studied is unknown.

The results of the current study provide up-to-date information on the frequency and determinants of eye care utilization in Canada and have highlighted the variability of eye care use across the country. Furthermore, our results have also for the first time indicated that current smokers are less likely to obtain eye care. Policy makers should consider ways to make eye care more affordable. Future research should examine the effectiveness of public health campaigns to improve eye care use, particularly in high-risk groups.

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