Factors Associated with Missed Eye Examinations in a Cohort with Diabetes

David A.L. Maberley, MD, MSc (Epid)¹

Anita Koushik, MSc²

Alan F. Cruess, MD³

ABSTRACT

Background: The diabetes screening program in Moosonee and Moose Factory, Ontario was evaluated to explore which factors may be associated with individuals who had/had not attended screening examinations for diabetic retinopathy.

Methods: Exposure data were collected from patient charts for basic demographic and medical history data. The main outcome of interest was the absence of a retinal examination in the two years preceding data collection.

Results: There were 248 subjects identified with diabetes who had complete data for the variables of interest. On univariate analysis, younger age and shorter duration of diabetes were significantly associated with not having an eye examination. On multivariate analysis, younger age, residence in Moosonee, and shorter duration of diabetes remained in the final model.

Interpretation: Screening programs for diabetic retinopathy in the James Bay Cree should consider targeting younger individuals with diabetes of less than 5 years duration since this sub-group is not as likely to attend eye examinations.

Over the past half century, diabetes has become a major public health concern worldwide. Tan estimates that 1.5 million Canadians have been diagnosed with diabetes, and that there may be another 750,000 who have yet to be identified.¹ The crude prevalence of diabetes in Canada is between 4% and 6%;² however, the James Bay Cree have an age-standardized prevalence of almost 15%.³

Canadian National Institute for the Blind (CNIB) figures indicate that diabetic retinopathy is the most common cause of blindness in working-aged individuals in Canada.^{4,5} Those with diabetes are 25 times more likely to become blind than persons in the general population.⁶ As with diabetes, the prevalence of diabetic retinopathy appears to be elevated in Aboriginal communities.^{7,8}

The main difficulty in managing diabetic retinopathy is the long, asymptomatic, latent period that precedes vision loss.^{9,10} Fortunately, screening for retinopathy is non-invasive, cost-effective, and highly sensitive and specific.¹¹⁻¹⁶ The benefits of screening and treating diabetic retinopathy have been well documented;^{17,18} however, the logistics of screening numerous geographically remote communities make yearly screening difficult to achieve. As a result, when screening visits to isolated communities are arranged, efforts must be made to ensure that retinal examinations are attended by as large a percentage of the at-risk population as possible. To achieve this goal, programs must work closely with local health care providers, elders, and band-leaders to educate all individuals with diabetes about the importance of timely retinal evaluations. Mechanisms also need to be in place to identify those at risk for retinopathy and non-attendance of retinal evaluations when screening examinations are planned.

The goal of this study was to explore what factors may be associated with non-attendance at ocular screening examinations. By identifying features of this particular segment of a population with diabetes, efforts might be directed at targeting these individuals to ensure a higher rate of clinic attendance.

MATERIALS AND METHODS

The setting for this study was the two largest communities of western James Bay, Moose Factory and Moosonee, which are

La traduction du résumé se trouve à la fin de l'article.

1. Department of Ophthalmology, University of British Columbia, Vancouver, BC

2. McGill University, Department of Epidemiology and Biostatistics, Montreal, QC

3. Department of Ophthalmology, Queen's University, Kingston, ON

Correspondence and reprint requests: Dr. David Maberley, 2550 Willow St., Vancouver, BC V5Z 3N9, Tel: 604-875-4599, Fax: 604-875-4699, E-mail: dmaberle@vanhosp.bc.ca

located at the mouth of the Moose River on the southwest corner of James Bay. Moose Factory is on reserve land on an island in the middle of the Moose River approximately 1.5 miles from Moosonee. Moosonee is located on the Northern shore of the Moose River, has a rail link from Timmins, and is the site of the regional airport. Both towns are mainly populated by the James Bay Cree – one of several Algonkian speaking tribes that comprise the Woodland First Nations of Canada.^{19,20} In the summer, travel between communities is by motorized hunting canoe or small car ferry. In the winter, an ice road permits vehicular travel. In the shoulder seasons, as ice forms and breaks up, travel between communities is very difficult and is primarily by helicopter.

The two communities are considered 'remote' and have a combined population of approximately 5,000. The population of interest is very stable with little in or out migration. One hospital, the Weeneebayko General Hospital in Moose Factory, provides hospital and laboratory services for both communities. There is one outpatient medical clinic in each community, but most physician resources are present in Moose Factory.

A retrospective cohort study design was employed in order to identify factors associated with non-attendance at ocular screening examinations. All individuals known to have diabetes in Moose Factory and Moosonee in January 1998 were identified from hospital and outpatient records and comprised the cohort. Data from the regional diabetic retinopathy screening program were examined to identify individuals who had/had not attended a screening examination within the two-year period from January 1996 to January 1998. For the purpose of this analysis, the primary outcome was non-attendance at a retinal screening evaluation.

The diagnosis of diabetes was determined by fasting blood glucose studies taken during the course of routine medical care. The attending physicians at the clinics used standard criteria to determine a diagnosis of diabetes. In Moose Factory and Moosonee prior to 1997, patients were diagnosed as having diabetes if fasting blood glucose levels were above 7.8 mmol/L, or the 2-hour post-load oral glucose tolerance test level was

TABLE I**Characteristics of Subjects Included and Excluded in the Analyses**

Characteristic	Included (N=248)	Excluded (N=35)
Community = Moose Factory (%)	62.1	57.1
Sex = Female (%)	65.3	71.4
Mean Age (SD)	52.9 (15.1)	54.3 (15.2)

TABLE II**Univariate Odds Ratios Associated with Not Having an Eye Examination**

Characteristic	OR (95% CI)	P-value
Current Age		
<40	1.00 (referent)	<0.01
40-49	0.43 (0.14-1.30)	
50-59	0.26 (0.07-0.88)	
60+	0.09 (0.02-0.41)	
Sex		
Male	1.00 (referent)	0.86
Female	0.92 (0.37-2.29)	
Community of Residence		
Moosonee	1.00 (referent)	0.45
Moose Factory	0.71 (0.29-1.71)	
Duration of Diabetes Mellitus (years)		
<5	1.00 (referent)	<0.01
5-10	0.25 (0.08-0.74)	
10+	0.22 (0.07-0.70)	
Treatment Regime		
Diet	1.00 (referent)	0.06
Oral	0.48 (0.19-1.20)	
Insulin	0.11 (0.01-0.89)	
Hypertension		
No	1.00 (referent)	0.08
Yes	0.46 (0.19-1.11)	
History of Stroke		
No	1.00 (referent)	0.76
Yes	0.72 (0.09-5.76)	
History of Myocardial Infarction		
No	1.00 (referent)	0.82
Yes	0.84 (0.19-3.83)	

TABLE III**Multivariate Determinants of Not Obtaining an Eye Examination**

Characteristic	OR (95% CI)	P-value
Current Age		
<40	1.00 (referent)	0.03
40-49	0.44 (0.14-1.37)	
50-59	0.27 (0.07-0.97)	
60+	0.10 (0.02-0.50)	
Community of Residence		
Moosonee	1.00 (referent)	0.14
Moose Factory	0.48 (0.18-1.27)	
Duration of Diabetes Mellitus (years)		
<5	1.00 (referent)	0.03
5-10	0.24 (0.08-0.76)	
10+	0.33 (0.10-1.14)	

> 11.1 mmol/L.²¹ Individuals with purely gestational diabetes were excluded, as were non-Aboriginals.

Only demographic and medical variables that could be easily identified in an individual – to target them for screening – were evaluated as exposures for the outcome of interest. These included age, sex, community of residence, duration of diabetes, treatment regime, the presence of hypertension, and a history of stroke or myocardial infarction. Outpatient clinic charts as well as inpatient records were reviewed for each individual. Age and duration of diabetes were recorded as of January 1998. Treatment status was the

treatment regimen each subject was on for the majority of 1996 and 1997 and was categorized as diet only, oral hypoglycemic, or insulin. Subjects on both oral hypoglycemics and insulin were categorized as on insulin treatment. Hypertension was considered present if a subject was taking a medication for the control of blood pressure prior to data collection. Macrovascular complications of diabetes were similarly documented as positive in the presence of a history of stroke or myocardial infarction.

Prior to this study, approval was received from the Weeneebayko General Hospital Board and the local Band Councils. The

protocol was also approved by the Queen's University Health Sciences Human Research Ethics Board in Kingston, Ontario.

Based on the fixed population available for evaluation, the study's power was calculated for a risk factor present in 30% of cases with a proportional difference of 0.25 between cases and controls.²² The power to detect this difference, with an alpha of 0.05, was 85%. This risk difference corresponds to an approximate odds ratio of 1.75 for the same power.

Statistical analyses were conducted using EGRET™ for Windows, version 2.0.3. A logistic regression model was employed to examine variables in both univariate and multivariate contexts. This allowed the determination of odds ratios from the specific variable coefficients.²³ For multivariate analyses, a backwards logistic regression deletion procedure was conducted to identify variables that were significantly associated with no eye examination. The alpha level for exclusion was 0.15. All variables were subsequently re-evaluated in the context of this parsimonious model. For the data presented in this paper, odds ratios greater than one indicated increased risk for an individual not having an eye examination.

RESULTS

Two hundred and eighty-three (283) individuals with diabetes were identified in the two communities. One hundred and seventy-four (174) subjects were from Moose Factory and 109 were from Moosonee. Eighty-five percent (241) of the entire cohort had attended a diabetic retinopathy examination within the preceding 2 years, 42 had not. Of the total cohort of 283, 248 had complete information on all the variables of interest. Twenty-two of the subset of 248 had not had eye examinations.

Characteristics of individuals with/without complete data are compared in Table I. Three comparator variables are presented, as these were the only variables for which complete data were present for all 283 people.

Variables on univariate analysis that were significantly associated with individuals who had not had eye examinations included younger age and shorter duration

of diabetes (< 5 years)(Table II). Dietary treatment regime and the absence of hypertension also showed an association with missed eye examinations, but were not significant at a p-value of 0.05.

Results of the backwards deletion procedure are shown in Table III. Age, community of residence, and duration of diabetes were significantly associated with missing eye examinations when all variables were simultaneously evaluated with a p-value cut-off of 0.15. A re-evaluation of all variables, individually, within this multivariate context did not demonstrate any significant results.

DISCUSSION

This paper presents data on factors that are associated with non-attendance at retinal examinations. The study's goal was to provide information to health care providers that would help them target individuals who are unlikely to attend screening examinations.

Univariate and multivariate analyses identified two factors that were associated with individuals who have not had retinal screening examinations: younger age and shorter duration of diabetes. There are many possible explanations for these findings. First, younger individuals and those with more recently diagnosed diabetes may have had less opportunity to attend screening clinics. Second, these same individuals may be less likely to have been educated about the complications of diabetes and the importance of retinal examinations. Third, medical practitioners may not be as aggressive in encouraging younger individuals and those recently diagnosed with diabetes to attend screening evaluations. This latter possibility would be of concern because individuals with type 2 diabetes should be referred for retinal evaluations close to their time of diagnosis.²⁴

On univariate analysis, dietary treatment regimen and the absence of hypertension showed a trend towards an association. This may suggest that individuals who have more advanced diabetes are more likely to have had eye evaluations. However, individuals with hypertension or insulin therapy are also likely to be older, with a longer duration of diabetes, and a degree of co-linearity between these variables may explain this finding. It is also

possible that individuals who are reluctant to seek medical care will not only miss eye examinations but may also forego medical evaluations that would lead to diabetic or hypertensive treatment regimens.

On multivariate analysis, it was found that individuals from Moosonee were less likely to have attended retinal screening evaluations. This finding may seem intuitive as most of the eye clinics during the two-year assessment period were held in Moose Factory; individuals from Moosonee would have to travel across the Moose River for evaluations. However, there are other factors that could have influenced this relationship. Currently (as well as at the time of this study) physician resources are much less available in Moosonee and, as a result, referral for an ocular evaluation may be less likely. Moreover, reserve-based diabetes education programs – which are not available in Moosonee – may increase awareness of diabetic retinopathy for subjects from Moose Factory, increasing their attendance at eye examinations. These latter two factors are important as both are potentially modifiable.

A previous study evaluating risk factors for diabetic retinopathy in the same population, found individuals who were at increased risk for diabetic retinopathy were typically older, on insulin, and had a longer duration of diabetes.²⁵ The present study shows that these are the same factors that are associated with people who have a higher likelihood of attending screening examinations. For this reason, there are grounds to be optimistic that those individuals who are most likely to develop retinopathy are more apt to have had retinal evaluations.

There are limitations to the use of medical record data for the evaluation of risk factors in case-control studies. First, there will invariably be a degree of misclassification bias that affects exposures. This is hard to avoid when different physicians may be involved in the care of a single patient with diabetes. Nonetheless, the variables selected for evaluation in this study are not particularly open to interpretation and are unlikely to be affected by this prejudice. Second, when data are abstracted from medical charts, there is the possibility that the outcome of interest is associated with subjects who have missing

data for the exposures. Third, individuals with undiagnosed diabetes, by definition, are not included in this analysis. Such is the case for any diabetes study that uses registry data; however, since the purpose of this paper is to identify subjects with known diabetes who are less likely to attend retinopathy screening, the findings are still valid. Fourth, the selection of controls is frequently an issue for any case-control study. Using the entire cohort of individuals with diabetes as the control population minimizes this particular concern. Such was the case in this study. This does not invalidate the results, it only means that the results are not necessarily generalizable to the sub-set of subjects with missing exposure information.

In conclusion, for the western James Bay cohort with diabetes, younger individuals and those with a shorter duration of diabetes were less likely to have attended retinal screening evaluations for diabetic retinopathy. These results may aid health care workers in targeting individuals for referral for retinopathy evaluations.

RÉSUMÉ

Contexte : Le programme de dépistage de la rétinopathie diabétique qui a été instauré dans les communautés de Moosonee et de Moose Factory, en Ontario avait comme objectif d'identifier les facteurs qui expliquaient pourquoi les personnes avaient ou n'avaient pas assisté aux séances de dépistage de la rétinopathie diabétique.

Méthodes : Les données relatives à l'exposition ont été cueillies à partir des dossiers de patient contenant les données démographiques et des paramètres médicaux. Le constat le plus important qui en ressort est l'absence de tout examen de la rétine depuis au moins deux ans.

Résultats : On a identifié 248 personnes atteintes de diabète dans ces deux communautés, dont 42 qui n'avaient jamais subi un examen rétinien. Les analyses à une variable révèlent que l'âge plus jeune ainsi que la durée plus courte du diabète sont les facteurs qui sont associés avec les possibilités accrues de ne jamais avoir subi un examen des yeux. Les analyses à variables multiples révèlent que l'âge plus jeune, la durée plus courte du diabète, et le lieu de résidence à Moosonee restaient dans le modèle final.

Interprétation : Les efforts de dépistage devraient viser les jeunes atteints d'un diabète de plus courte durée, étant donné que ce sous-groupe de personnes est susceptible de ne s'être jamais présenté aux cliniques de dépistage.

REFERENCES

1. Tan MH, MacLean DR. Epidemiology of diabetes mellitus in Canada. *Clin Invest Med* 1995;18(4):240-46.
2. Tan MH, Wornell CM. Diabetes mellitus in Canada. *Diabetes Res Clin Pract* 1991;14:S3-S8.
3. Maberley D, King W, Cruess A. Prevalence of diabetes in the Cree of Western James Bay. *Chronic Diseases in Canada* 2000;21(3):128-33.
4. Klein R, Klein B, Moss S. Epidemiology of proliferative diabetic retinopathy. *Diabetes Care* 1992;15(12):1875-91.
5. Canadian National Institute for the Blind, Client Information 1993. Available on line at: http://www.cnib.ca/pamphlets_publications/bviic/cospubs/diabetes.htm
6. Kahn HA, Hiller R. Blindness caused by diabetic retinopathy. *Am J Ophthalmol* 1974;78:58-67.
7. Brassard P, Robinson E, Dumont C. Descriptive epidemiology of non-insulin-dependent diabetes mellitus in the James Bay Cree population of Quebec, Canada. *Arctic Medical Research* 1993;52:47-54.
8. Montour LT, Macaulay AC, Adelson N. Diabetes mellitus in Mohawks of Kahnawake, PQ: a clinical and epidemiologic description. *CMAJ* 1989;141:549-604.
9. Klein R, Klein BEK, Moss SE, Cruickshanks KJ. The Wisconsin Epidemiologic Study of Diabetic Retinopathy XIV. Ten-year incidence and progression of diabetic retinopathy. *Arch Ophthalmol* 1994;112:1217-28.
10. Klein R, Klein BEK, Moss SE, Cruickshanks KJ. The Wisconsin Epidemiologic Study of Diabetic Retinopathy XV. The long-term incidence of macular edema. *Ophthalmology* 1995;102:7-16.
11. Singer D, Nathan D, Fogel H, Schachat A. Screening for diabetic retinopathy. *Ann Intern Med* 1992;116:660-71.
12. Javitt J, Canner J, Sommer A. Cost effectiveness of current approaches to the control of retinopathy in type 1 diabetics. *Ophthalmology* 1989;96:255-64.
13. Javitt J, Aiello L. Cost-effectiveness of detecting and treating diabetic retinopathy. *Ann Intern Med* 1996;124:164-69.
14. Sussman E, Tsiaras G, Soper K. Diagnosis of diabetic eye disease. *JAMA* 1982;247:3231-34.
15. Kinyoun J, Barton F, Fisher M, Hubbard L, Aiello L, Ferris F. Detection of diabetic macular edema. Ophthalmoscopy versus photography-Early Treatment Diabetic Retinopathy Study Report Number 5. The ETDRS Study Group. *Ophthalmology* 1989;96:647-51.
16. Moss SE, Klein R, Kessler SD, Richie KA. Comparison between ophthalmoscopy and fundus photography in determining severity of diabetic retinopathy. *Ophthalmology* 1985;92:62-67.
17. Diabetic Retinopathy Study Research Group. Photocoagulation of proliferative diabetic retinopathy. DRS Report #8. *Ophthalmology* 1981;88:583-600.
18. Early Treatment Diabetic Retinopathy Study. Photocoagulation for diabetic macular edema. Report #1. *Arch Ophthalmol* 1985;26:983-91.
19. Indian and Northern Affairs Canada. Health Planning Office, Weeneebayko Health Ahtuskaywin.
20. Young TK, Eموke JES, Evers S, Wheatley B. Geographical distribution of diabetes among the native population of Canada: A National Survey. *Soc Sci Med* 1990;31:129-39.
21. National Diabetes Data Group. Classification and diagnosis of diabetes mellitus and other categories of glucose intolerance. *Diabetes* 1979;28:1039-57.
22. Dupont WD, Plummer WD. Power and sample size calculations: A review and computer program. *Control Clin Trials* 1990;11:116-28.
23. Miettinen OS. Theoretical Epidemiology: Principles of occurrence research in medicine. New York: John Wiley and Sons; 1985.
24. Klein R, Klein BEK, Moss SE, et al. The Wisconsin Epidemiologic Study of Diabetic Retinopathy. IX. Four-year incidence and progression of diabetic retinopathy when age at diagnosis is 30 years or more. *Arch Ophthalmol* 1989;107:244-49.
25. Maberley DAL, King W, Cruess AF, Koushik A. Risk factors for diabetic retinopathy in the Cree of James Bay. *Ophthalmic Epidemiology* 2001;8(4).

Received: January 15, 2001

Accepted: December 20, 2001

Erratum

In the paper by Roy É. et al. entitled "Seroprevalence and risk factors for hepatitis A among Montreal street youth" (*Can J Public Health* 2002;93(1):52-53), the prevalence of HAV-antibodies among women was 3.8% and not 8.8% (5.1% among men, p=0.543).