

## Prevalence of diabetic and atherosclerotic complications among Mohawk Indians of Kahnawake, PQ

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We surveyed adults with diabetes mellitus and adults without diabetes living in the Mohawk community of Kahnawake, PQ, for clinical characteristics related to vascular disease. People with diabetes were selected from a clinical register; nondiabetic subjects were randomly selected from a community register, with matching for age and sex. The response rates among the two groups were 62% and 39% respectively; groups of 82 and 94 people were obtained. Data were collected by chart review, interview and body measurement. The prevalence rate of ischemic heart disease was 48% for the subjects with diabetes and 22% for those without diabetes. The adjusted odds ratio for development of ischemic heart disease in a person with diabetes was 3.56, for development of cerebrovascular disease 4.57 and for development of peripheral vascular disease 5.51. Logistic regression for macrovascular disease showed that age, sex, smoking, hypertension and obesity could not explain the high rates of complications in the subjects with diabetes. The prevalence rates of ischemic heart disease in adults with and without diabetes are the highest reported in a North American Indian population.

**Chez des adultes atteints de diabète sucré et des témoins non diabétiques parmi les Agniers de Kahnawaké (PQ) nous avons recherché les caractères cliniques reliés aux maladies cardiovascu-**

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lares. On choisit les sujets diabétiques (au nombre de 82) à partir d'un registre clinique et les 94 témoins, appariés quant à l'âge et au sexe, à même un registre de la population. Le taux de réponse est de 62% chez les premiers et de 39% chez les seconds. On réunit les données provenant de revue de dossiers, d'entrevues et de mensurations corporelles. Il existe une cardiopathie ischémique chez 48% des diabétiques et 22% des témoins. Pour les premiers on calcule des rapports corrigés de probabilité de 3,56 pour la survenue de cardiopathie ischémique, 4,57 pour les troubles cérébrovasculaires et 5,51 pour les troubles vasculaires périphériques. La régression logistique ne permet de retenir ni l'âge, ni le sexe, ni l'habitude de fumer, ni l'hypertension artérielle, ni l'obésité pour expliquer le taux élevé de maladies macrovasculaires chez les diabétiques. Les taux de cardiopathie ischémique chez nos adultes, tant diabétiques que non diabétiques, sont les plus hauts qu'on ait relevés jusqu'ici dans une population amérindienne.

**D**iabetes mellitus is a chronic disease that before 1940 was virtually unknown in aboriginal North Americans. It now occurs at high prevalence rates in many aboriginal communities in North America.<sup>1-3</sup> In the Mohawk community of Kahnawake, PQ, the prevalence rate of non-insulin-dependent diabetes for those aged 45 to 64 years is 12%,<sup>4</sup> more than double the rate for a similar white US population.<sup>5</sup>

Previous studies in aboriginal North Americans have shown low rates of ischemic heart disease, even in those with diabetes.<sup>1,6-10</sup> Diabetic retinopathy occurs with similar frequency in all races studied, including aboriginal North Americans.<sup>11</sup> Our study was prompted by clinical impressions of physicians within Kahnawake that not only were there large numbers of people with diabetes but also there were high rates of complications in the diabetic population. We confined the

investigation to complications of non-insulin-dependent diabetes because at the time of the study there had not been any cases of insulin-dependent-diabetes documented in Kahnawake.

## Methods

Kahnawake (Mohawk for "On-the-Rapids") is located on the south shore of the St. Lawrence River 19 km from downtown Montreal and has a population of 5409 (1985). The health centre on the territory, the Kateri Memorial Hospital Centre, serves 92% of the residents of Kahnawake.<sup>4</sup> We had access to hospital records dating from 1970, when well-organized patient care became regularly available.

The data for our study were collected as part of an anthropologic study of body fat patterns in people with and without diabetes.<sup>12</sup> All participants in the anthropologic study had to be at least 35 years of age, live on the territory, use the Kateri Memorial Hospital Centre and have two parents, or one parent and three grandparents, of Mohawk descent. In June 1985, 132 of the 141 people known to have diabetes in the community met these criteria. After radio publicity, direct mailing and telephone calls, 82 (62%) agreed to participate. The diagnosis of diabetes was based on numerous determinations of the blood glucose level, interpreted with the criteria of the National Diabetes Data Group as guidelines.<sup>13</sup> Diabetes was diagnosed if the venous blood glucose level was above 140 mg/dl (7.8 mmol/L) on more than one occasion before eating or was greater than 200 mg/dl (11.1 mmol/L) 2 hours after eating.

A nondiabetic comparison group matched for age and sex was randomly selected from the Kahnawake Membership Register (1985), in which people are registered by date of birth. If the person contacted declined to participate, the next person on the register was approached. Of the 261 people contacted, 101 (39%) agreed to participate. All 101 were screened for detectable diabetes by measurement of the total glycosylated hemoglobin level; 7 people (7%) had a level greater than the designated cutoff point of 8.0% of the total hemoglobin<sup>14</sup> and were excluded from the study. (Subsequent investigation proved all seven to be diabetic.) Thus, the final comparison population for statistical analysis numbered 94 people.

The presence of macrovascular disease, microvascular disease, hypertension and hypercholesterolemia in the *eligible* participants (i.e., the 132 patients with diabetes and the 261 subjects in the comparison group) was ascertained by chart review. In addition, the smoking habits of the *actual* participants were determined through an interview, and their height and weight were measured by one observer (N.A.).

Ischemic heart disease was defined as a physician's written chart diagnosis of myocardial infarction or angina or a history of coronary artery

bypass surgery. Cerebral vascular disease was defined as a written diagnosis of stroke, transient ischemic attack or amaurosis fugax. Peripheral vascular disease was defined as a written diagnosis of ischemic foot, amputation or claudication. The diagnosis of diabetic retinopathy was accepted only if made by an ophthalmologist (consultant ophthalmologic services have existed since 1970). Diabetic nephropathy and neuropathy were written chart diagnoses, as was hypertension. Hypercholesterolemia was defined as a blood cholesterol level greater than 280 mg/dl (7.25 mmol/L) within the previous 5 years. Body mass index, an indicator of weight level, was calculated as weight in kilograms divided by height in metres squared.<sup>13</sup>

We used standard methods of statistical analysis. As a first step, two sample *t*-tests and chi-squared tests were used to compare the distribution of the baseline characteristics among the subjects with and without diabetes. Second, to adjust for the effect of unequal baseline differences, multiple logistic regression<sup>15</sup> was used to compare the risk of macrovascular complications in the two groups while the potentially confounding effects of age, sex, smoking, hypertension and body mass index were controlled. The net effect of this adjustment is seen by comparing the crude and adjusted odds-ratio estimates for each macrovascular complication.

## Results

The baseline characteristics of the subjects with and without diabetes are shown in Table I. There was no difference between the two groups in age, sex or smoking status. The mean body mass index was high in both groups; it was significantly higher for the subjects with diabetes than for those without ( $p = 0.003$ ). The rates of hypertension ( $p < 0.001$ ) and hypercholesterolemia ( $p = 0.02$ ) were significantly higher for the subjects with diabetes.

Table II shows that 48% of the subjects with diabetes had ischemic heart disease, 14% had cerebrovascular disease and 12% had peripheral vascular disease; these rates were all significantly higher than the rates for the nondiabetic group ( $p = 0.002, 0.036$  and  $0.038$  respectively). The adjusted odds ratio for development of ischemic heart disease in a person with diabetes was 3.56, for development of cerebrovascular disease 4.57, for development of peripheral vascular disease 5.51 and for development of any one of the three 6.44. Logistic regression showed that these differences could not be explained by differences in age, sex, hypertension or obesity. The logistic regression did not include hypercholesterolemia because for many of the subjects without diabetes there was no cholesterol measurement in the chart.

The prevalence of ischemic heart disease, retinopathy and peripheral vascular disease increased with increasing duration of diabetes. Among the 70 patients who had had the disease

for 10 years or less the overall rates were 44%, 13% and 10% respectively. Among the 12 patients who had had diabetes for more than 10 years the corresponding rates were 75%, 25% and 25%. The prevalence rate of cerebrovascular disease for the group as a whole was 13%, the rate of nephropathy 5% and the rate of neuropathy 6%.

## Discussion

The prevalence rate of ischemic heart disease among our subjects with diabetes, 48%, is the highest yet reported for any North American aboriginal population. It is substantially higher than the rate reported for Cree and Ojibway subjects with diabetes (17%) in the only other study of aboriginals in Canada.<sup>2</sup> Previous research has always shown low rates of ischemic heart disease among aboriginal groups in the United States, even those with diabetes, although over the last 30 years the rates have slowly but steadily increased.<sup>1,6-10,16</sup> The rates of cerebrovascular disease and peripheral vascular disease in our diabetic subjects were similar to those previously reported for other aboriginal North Americans.<sup>17,18</sup>

In contrast to the higher rates of ischemic heart disease, the prevalence of diabetic retinopathy in our patients was similar to that in aboriginal groups in the United States.<sup>18-20</sup> The rates of nephropathy and neuropathy were low and similar to those reported for Cree and Ojibway subjects<sup>2</sup> but were considerably lower than those reported from US studies.<sup>18,20</sup>

Our finding of a high odds ratio for the development of macrovascular disease in the diabetic subjects independent of the confounding variables of age, sex, smoking, hypertension and obesity duplicates results of the Framingham study that implicated "an elusive unique feature of diabetes that promotes cardiovascular sequelae".<sup>21</sup> We are confident that the rates of disease in the diabetic and nondiabetic subjects in our study are representative of the disease rates in the community. A chart review revealed the same rates of disease for the diabetic subjects who participated as for those who did not. Similarly, a chart review revealed no significant difference in disease rates between the nondiabetic subjects who participated and those who did not. Large end-points of disease were chosen to avoid bias from overreporting of macrovascular disease in the diabetic subjects, and

Table I — Baseline characteristics of adults with and without diabetes in Mohawk Indian community of Kahnawake, PQ

Variable	Subjects with diabetes (n = 82)	Subjects without diabetes (n = 94)	p*
Mean age (and standard deviation [SD]), yr	59 (10.9)	59 (13.0)	NS
Sex, %			
Male	41	39	NS
Female	59	61	
Smoking status, %			
Smoker	29	33	NS
Former smoker	14	23	
Never smoked	57	44	
Mean body mass index (and SD)	32 (7.2)	29 (4.8)	0.003
% with hypertension	71	41	< 0.001
Hypercholesterolemia			
% with	16	12	0.02
% without	80	71	
% unknown	4	17	

\*NS = not significant.

Table II — Prevalence rates of macrovascular disease in the two groups

Variable	% of subjects		Crude odds ratio	Adjusted odds ratio	p	95% confidence limits
	With diabetes	Without diabetes				
Ischemic heart disease (IHD)	48	22	3.27	3.56	0.002	1.54, 8.21
Cerebrovascular disease (CVD)	13	3	4.82	4.57	0.036	1.07, 19.45
Peripheral vascular disease (PVD)	12	2	6.55	5.51	0.038	1.06, 28.64
Any of IHD, CVD and PVD	63	20	5.32	6.44	0.0001	2.73, 15.18

clinicians in Kahnawake are vigilant for atherosclerotic disease whether or not a patient is labelled diabetic.

All our diabetic subjects who had had the disease for more than 15 years had either macrovascular or microvascular disease. This finding confirms our suspicion of serious negative consequences of diabetes in this Mohawk community. The greatest burden of illness is related to damage of macrovascular circulation: 48% of the diabetic group had ischemic heart disease; the rate for those who had had diabetes for more than 10 years was 75%. Even 22% of the nondiabetic group had ischemic heart disease. Why are the rates of ischemic heart disease so high? Kahnawake is an urbanized community where the lifestyle changed rapidly in this century. A sedentary way of life, obesity, stress, smoking, "fast food" and alcohol consumption may all play a role. We did not investigate any of these possible causes. However, half of the total study population smoked or had smoked, 71% of the diabetic group and 41% of the nondiabetic group had hypertension, 16% of the diabetic group and at least 12% of the nondiabetic group had hypercholesterolemia, and both groups had a high mean body mass index. A total of 82% of the diabetic men, 90% of the diabetic women, 70% of the nondiabetic men and 78% of the nondiabetic women were obese (body mass index of 27 or greater for men and 25 or greater for women<sup>13</sup>).

All previous research has documented low rates of macrovascular disease in aboriginal people of North America. More studies are needed in other communities to determine whether our finding of high rates of vascular complications is unique to Kahnawake or whether it represents a general trend among North American aboriginal nations. If these serious medical problems are the consequences of diabetes, more research is needed to investigate the cause and prevention of the disease. More money will be required for more health care workers in the field (dietitians, community health representatives, doctors and nurses) to provide the necessary expertise and educational material. Aboriginal leaders, their communities and all health care workers must be made aware of the serious implications of diabetes so that they can take the lead in promoting healthier and nondiabetogenic lifestyles.<sup>22</sup>

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