Prevalence Estimates of Diabetes and of Other Cardiovascular Risk Factors in the Two Largest Algonquin Communities of Quebec

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OBJECTIVE — To compare the prevalence of non-insulin-dependent diabetes mellitus (NIDDM) in the two largest Algonquin communities of Quebec (Canada) with that of other native groups and to describe the different patterns of NIDDM and other cardiovascular risk markers in these communities (River Desert [RD] and Lac Simon [LS]).

RESEARCH DESIGN AND METHODS — The population-based study targeted all residents aged 15 years and older. In the age-group considered here (30–64 years), there were 480 eligible subjects and 299 participants (50.8% in RD and 86.9% in LS). All except those with confirmed diabetes underwent an oral glucose tolerance test. Serum triglyceride and lipoprotein cholesterol levels, blood pressure, body mass index (BMI), and waist-to-hip ratio (WHR) were measured.

RESULTS — The age-standardized (world population) prevalence of NIDDM in women was twice as high in LS as in RD (48.6% vs. 23.9%). In men, it was 23.9% in LS and 16.3% in RD. Upper-body obesity followed the same pattern. In contrast, high-risk serum low-density lipoprotein (LDL) and high-density lipoprotein (HDL) cholesterol levels were significantly more prevalent in RD than in LS, particularly among men. The rate of high blood pressure was twice as high in men as in women, with little community differences. When we controlled for age, sex, diabetic, and obesity status, mean fasting serum glucose remained significantly higher and triglycerides and LDL cholesterol lower in LS than in RD. There was also an independent community effect on WHR but not on BMI.

CONCLUSIONS — The prevalence of NIDDM in LS women reaches the rate observed in Pima Indian women. The observed differences between two Algonquin communities suggest a highly heterogeneous pattern of NIDDM and cardiovascular disease risk factors in Amerindian populations, even within a given tribe and a limited geographic area.

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BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; IGT, impaired glucose tolerance; LDL, low-density lipoprotein; LS, Lac Simon; NIDDM, non-insulin-dependent diabetes mellitus; OGTT, oral glucose tolerance test; RD, River Desert; WHO, World Health Organization; WHR, waist-to-hip ratio.

Non-insulin-dependent diabetes mellitus (NIDDM) is now seen as an epidemic in Pima Indians and in some unrelated tribes of the U.S. and Canada (1,2). Cardiovascular disease and hypertension have generally been found to be relatively uncommon in American Indians compared with the general U.S. population despite high rates of diabetes and obesity (3,4), but increasing trends are being observed (3,5). In Canada, there is a paucity of population-based information on NIDDM and on cardiovascular disease risks other than obesity among Amerindians (2).

A cross-sectional population-based study on glucose tolerance abnormalities, cardiovascular disease risk markers, and associated family and lifestyle factors was conducted in the two largest Algonquin communities of Quebec (6). The Algonquins belong to the Algonkian linguistic group, in which NIDDM appeared more prevalent than in other Canadian tribes in a national review of diagnosed cases (7). This report compares the prevalence of NIDDM in residents in the 30- to 65-year age range in these communities with other native population groups and describes the different community pattern of NIDDM and other cardiovascular risk markers.

RESEARCH DESIGN AND METHODS

RESEARCH DESIGN AND METHODS — The study sites are located in northwestern Quebec, Canada. River Desert (RD) has a population of 1,200 and is adjacent to an urban center of 20,000 people. Lac Simon (LS) is 250 km further north, its population is 800, and it is 35 km away from a town of similar size. A house-to-house census allowed us to identify as potential participants all community residents aged at least 15 years old. Subjects were recruited through repeated home visits and promotional activities. At each study site, diabetes clinics were held at a central location on average three mornings a week during 3 months and on Saturdays for working people. Informed consent was given by

Table 1—*Community differences in the prevalence (percentage of population) of NIDDM, high-risk lipoprotein cholesterol levels, and upper-body obesity in the age range of 30–64 years*

	Men		Women	
	RD	LS	RD	LS
n	68	63	98	70
NIDDM				
Crude rate	17.6	22.2	16.3	44.3
Age-adjusted rate (SR)	16.3	23.9	16.3	48.6*
95% CI for SR	7.9–24.7	12.9–34.9	9.0–23.6	38.4–58.8
High LDL cholesterol				
Crude rate	42.6	22.2	37.8	13.0
Age-adjusted rate (SR)	41.9	21.8*	37.7	14.0*
95% CI for SR	29.7–54.1	11.4–32.2	28.3–47.1	5.6–22.4
Low HDL cholesterol				
Crude rate	33.8	12.7	24.5	20.3
Age-adjusted rate (SR)	32.7	11.9*	24.4	19.8
95% CI for SR	21.5–43.9	3.7–20.1	16.0–32.8	10.2–29.4
Upper-body obesity				
Crude rate	27.3	23.8	29.6	51.4
Age-adjusted rate (SR)	27.2	24.3	29.4	52.2*
95% CI for SR	16.2–38.2	16.3–32.3	20.8–32.0	40.2–64.2

Values were age-standardized to the world population (14). CI, confidence interval; SR, standardized rate.
*Significant difference between communities within sex.

every respondent. All field data were collected by two research assistants after standardization of methods.

As described previously (6), all subjects, except those with previously diagnosed NIDDM as confirmed by the medical chart, underwent an oral glucose tolerance test (OGTT) with 75 g of glucose and two blood samples—one in the fasting state and one 2 h after the glucose load. Serum glucose was measured with the glucose oxidase method. Commercial kits of Technicon RA and enzymatic reagents were used for the determination of fasting levels of serum triglycerides, total cholesterol, and high-density lipoprotein (HDL) cholesterol (after precipitation of non-HDL cholesterol using dextran sulfate and magnesium chloride). The serum low-density lipoprotein (LDL) cholesterol level was calculated from triglyceride, total cholesterol, and HDL cholesterol levels (8). Serum analyses were done by LaboMedic (Montreal, Quebec, Canada).

Two measures of systolic and diastolic blood pressure (9) were taken with subjects in the sitting position before blood sampling. Anthropometric measurements using standard procedures were taken while the subjects wore disposable paper robes. Weight and height were measured using a beam balance with a measuring board. Waist circumference was taken with the measuring tape positioned horizontally at the level of noticeable waist narrowing or, if narrowing could not be determined, midway between the ribs and the hipbone as estimated at lateral level. For hip circumference, the measure was taken horizontally at the level of greatest diameter of the gluteal muscles.

NIDDM and impaired glucose tolerance (IGT) based on the OGTT were defined according to World Health Organization (WHO) criteria (10). High blood pressure (BP) criteria (11) were mean systolic BP $\geq$140, or mean diastolic BP $\geq$90, or medical treatment for hypertension. High-risk lipid profiles were defined as total cholesterol $\geq$5.2 mmol/l, LDL cholesterol $\geq$4.1 mmol/l, HDL cholesterol <0.9 mmol/l, or triglyceride levels >2.3 mmol/l (12). Upper-body obesity criteria were a body mass index (BMI) >30 together with a waist-to-hip ratio (WHR) higher than 1.0 in men and 0.85 in women (13). Prevalence rates were age-adjusted to the standard world population (14). Univariate and multivariate analyses of variance were conducted.

RESULTS — There were 480 eligible subjects in the age range of 30–64 years, and 299 took part in the study (50.8% in RD; 86.9% in LS). Comparisons between participants and nonparticipants revealed a larger proportion of women and a shift of the age distribution toward older age-groups among participants ($P < 0.001$). However, these differences were similar in both communities. The age-standardized prevalence rates of NIDDM, upper-body obesity, high LDL cholesterol, and low HDL cholesterol are given by sex and community in Table 1. NIDDM was significantly more prevalent in LS women than in RD women (48.6 and 16.3%, respectively). The rate of upper-body obesity was also significantly higher in the former (52.2%) than in the latter (29.4%). Among men, there were no community differences in the prevalence of NIDDM or obesity. Standardized rates of IGT (range 5–8%), high triglyceride levels, and high blood pressure within sex were not significantly different in RD and LS (data not shown). However, high triglyceride levels tended to be more prevalent in RD than in LS, both in men and in women. There was no community trend in the rate of high blood pressure, which was much higher in men than in women in RD (36.9 and 20.4%, respectively) as well as in LS (39.4% in men; 24.4% in women).

Univariate analyses (Table 2) showed that mean age, triglyceride levels, BMI, and WHR of subjects with glucose tolerance abnormalities were in general significantly higher than in subjects with normal glucose tolerance in men and

Table 2—*Serum lipids, BP, and obesity indexes in normal and glucose-intolerant subjects aged 30–64 years*

	Women		Men	
	RD	LS	RD	LS
Age (years)				
Normal	43.9 ± 10.0 (74)†§	38.3 ± 7.0 (34)¶	45.3 ± 8.5 (52)§	41.8 ± 9.7 (45)§
NIDDM + IGT	49.0 ± 10.1 (24)	48.1 ± 8.7 (36)	51.0 ± 8.6 (16)	47.1 ± 8.2 (18)
Triglycerides (mmol/l)				
Normal	1.5 ± 1.1‖	1.3 ± 0.9‖	1.9 ± 1.6†	1.2 ± 0.7¶
NIDDM + IGT	2.3 ± 1.6	2.0 ± 1.0	2.8 ± 1.9	2.3 ± 0.8
LDL cholesterol (mmol/l)				
Normal	3.9 ± 1.6‡	2.8 ± 0.7¶	4.0 ± 1.3†	3.3 ± 0.9§
NIDDM + IGT	3.7 ± 1.0	3.6 ± 0.9	3.8 ± 1.1	3.9 ± 0.9
HDL cholesterol (mmol/l)				
Normal	1.2 ± 0.3	1.1 ± 0.3	1.1 ± 0.5	1.2 ± 0.2‖
NIDDM + IGT	1.0 ± 0.5	1.1 ± 0.3	1.0 ± 0.4	1.0 ± 0.2
Systolic BP (mmHg)				
Normal	117 ± 17	115 ± 12‖	128 ± 17*	122 ± 13¶
NIDDM + IGT	124 ± 14	127 ± 20	135 ± 20	137 ± 18
Diastolic BP (mmHg)				
Normal	77 ± 10	77 ± 8	85 ± 10*	81 ± 9¶
NIDDM + IGT	78 ± 8	80 ± 11	87 ± 10	92 ± 11
BMI				
Normal	27.0 ± 5.5*¶	29.1 ± 4.4‖	27.5 ± 3.7‖	27.1 ± 3.8‖
NIDDM + IGT	31.6 ± 4.2	33.0 ± 6.7	31.8 ± 5.7	30.5 ± 3.6
WHR				
Normal	0.85 ± 0.08‡¶	0.92 ± 0.05	0.99 ± 0.06‖	0.97 ± 0.05¶
NIDDM + IGT	0.92 ± 0.06	0.92 ± 0.06	1.05 ± 0.06	1.03 ± 0.05

Data are means ± SD (*n*). Community difference within sex and diabetic status group: $^*P < 0.05$; $†P < 0.01$; $‡P < 0.001$. Difference according to diabetic status, within sex and community: $§P < 0.05$; $‖P < 0.01$; $¶P < 0.001$.

women of both communities. However, only in LS men and women were glucose tolerance abnormalities associated with significantly higher levels of LDL cholesterol and systolic BP. Furthermore, glucose-intolerant subjects had significantly higher HDL cholesterol levels and diastolic BP only among LS men. Significant community differences were observed among normal subjects. In men, triglyceride and LDL cholesterol levels and systolic and diastolic BP were higher in RD than in LS, although age was not significantly different. In women, mean age and LDL cholesterol levels were higher, while BMI and WHR were lower in RD than in LS.

Multivariate analysis of variance models showed that when we controlled for age, sex, obesity, and diabetic status, fasting serum glucose was significantly lower, while triglyceride and LDL cholesterol levels were significantly higher in RD compared with LS (Table 3). However, the community was not independently associated with HDL cholesterol levels or systolic and diastolic BP (data not shown). WHR, but not BMI, was significantly higher in LS when we controlled for age, sex, and diabetic status.

CONCLUSIONS — The study shows that in an Algonquin Indian population of Canada, there is a high prevalence rate of NIDDM, adverse serum lipid profiles, and upper-body obesity in individuals in the 30- to 64-year age range. It also reveals marked differences in the risk profile of two communities, although cautious interpretation is warranted considering the small population size and the much lower response rate in one of the communities.

Self-selection bias may have resulted in inflating the prevalence rates of NIDDM and cardiovascular risk, particularly in the low-response community (RD). However, factors other than self-selection have to be considered, as suggested by the fact that the proportion of previously known and unknown NIDDM cases was similar in both communities, whether in men or women. Out of a total of 73 individuals with NIDDM in the 30- to 64-year age range, 21 new cases were identified through the survey and accounted for 42% of total cases in men and 21% in women. As previously suggested (6), a much higher participation may

Table 3—*ANOVA models for fasting glucose, serum lipids, and obesity indexes: community and biological effects (ages 30–64 years)*

	Fasting glucose		Triglycerides		LDL cholesterol		BMI		WHR	
	β	P	β	P	β	P	β	P	β	P
Independent variables										
Age	0.12	0.028	0.07	0.43	0.27	<0.0001	0.09	0.003	0.13	0.022
Sex	0.00	0.98	0.12	0.025	0.07	0.22	0.08	0.154	0.61	<0.0001
Obesity status	0.01	0.90	0.24	<0.0001	0.12	0.046	—	—	—	—
Diabetic status	0.59	<0.0001	0.21	0.001	0.04	0.51	0.35	<0.0001	0.23	<0.0001
Community	0.13	0.005	0.18	<0.0001	0.21	<0.0001	0.08	0.153	0.11	0.012
Multiple R^2	0.44		0.17		0.14		0.17		0.47	
Adjusted means										
RD community (n = 166)	5.8 mmol/l		2.0 mmol/l		3.9 mmol/l		28.5		0.93	
LS community (n = 133)	6.6 mmol/l		1.5 mmol/l		3.4 mmol/l		29.4		0.95	

Dependent variables: Fasting glucose, Triglycerides, LDL cholesterol, BMI, WHR.

β values are the standardized regression coefficients. Obesity status indicates upper-body obesity versus normal BMI and WHR. Diabetic status indicates NIDDM or IGT versus normal glucose tolerance.

have been achieved in LS because it has been less studied than RD, which is more accessible and therefore a preferred research site. The age-standardized rate of NIDDM (and upper-body obesity) was particularly high among women of the smaller and more remote community of LS. This high prevalence (48.6%), which is similar to that found in large studies among Pima Indian and Nauru (Pacific) women (15), is considered representative because 92% of LS women took part in the study. While lower than in women, the NIDDM rate of 23.9% in LS men (82% response) compares with that observed among Australian aboriginal men (15). In RD, the estimated rate was 16% in both men and women, which is also in the high range according to global estimates (15).

Despite a higher prevalence of NIDDM and upper-body obesity in LS, no clustering of other cardiovascular disease risk factors was observed in this community. Adverse serum lipid profiles, particularly high LDL cholesterol, were indeed more prevalent in RD than in LS. Serum lipoprotein distribution in LS, but not in RD, was somewhat similar to that of Pima Indians (16). The rate of high LDL cholesterol in RD men (42%) was roughly twice as high as reported in Canadian men aged 35–64 years (17). There was a significant and independent community effect on LDL cholesterol and triglyceride levels, fasting serum glucose, and WHR, but the effect was negative for glucose and WHR where the direction of the effect was positive for LDL cholesterol and triglycerides. These findings suggest a high heterogeneity of NIDDM and cardiovascular disease risk factors in the Amerindian population, even within a given tribe and a limited geographic area. Different degrees of acculturation may play an important role. Family inheritance and lifestyle risk factors are being examined to complete the information needed for prevention purposes.

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