

ORIGINAL ARTICLE

INCREASING RATES OF DIABETES AND CARDIOVASCULAR RISK IN MÉTIS SETTLEMENTS IN NORTHERN ALBERTA

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ABSTRACT

Objectives. To determine the prevalence of diabetes (using secondary data analysis), as well as undiagnosed diabetes and pre-diabetes (using primary research methods) among adult Métis Settlement dwellers in northern Alberta. We also sought to identify cardiovascular risk factors.

Study design. Quantitative research study utilizing both population census and community-based diabetes screening data.

Methods. Self-reported diabetes was analyzed from the results of the Métis Settlement specific censuses in 1998 and 2006. Mobile clinics travelled into each of the 8 Métis Settlement communities in Alberta recruiting 693 subjects for screening for undiagnosed diabetes, pre-diabetes and metabolic syndrome. Logistic regression analyses (adjusted for age and sex) were used to identify associated factors.

Results. According to the censuses, 4,312 Métis individuals were living on Settlements in 1998 and 5,059 in 2006. Self-reported age-adjusted prevalence of diabetes increased significantly from 5.1% in 1998 to 6.9% in 2006 ($p < 0.01$), with a crude prevalence increase of 66% ($p < 0.01$). In 2006, diabetes prevalence was higher among females than males, 7.8% vs. 6.1% respectively ($p < 0.05$). Of the 266 adults screened in the fasting state, 5.3% had undiagnosed diabetes, whereas 20.3% (Canadian Diabetes Association criteria) and 51.9% (American Diabetes Association criteria) had

pre-diabetes. Rates of obesity and metabolic syndrome were 49.4% (n=693) and 46.4% (n=266), respectively. Hemoglobin A1c>6.1% was strongly associated with diabetes, pre-diabetes and metabolic syndrome.

Conclusions. Our results indicate high rates of diabetes, undiagnosed diabetes, pre-diabetes and metabolic syndrome among adult Alberta Métis Settlement dwellers.

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Keywords: Aboriginal, North American, type 2 diabetes, mass screening, mobile health units, Indigenous health services

INTRODUCTION

Type 2 diabetes is a major health threat to Aboriginal populations in Canada and worldwide (1). About 5% of the adult Canadian population has diagnosed type 2 diabetes, of whom approximately 40% will develop related complications (2). Estimated age-adjusted prevalence rates are 3.6 times higher for First Nations men and 5.3 times higher for First Nations women compared to the general Canadian population (3). In Alberta, the prevalence of type 2 diabetes identified from administrative data was more than twice as high among the First Nations (12%) compared to the non-First Nations population (5%) (4).

Little is known about the prevalence of diabetes among Métis people in Canada, although rates appear to be higher than that of the general population (5,6). In the 2001 Aboriginal Peoples Survey (APS), 6% of the Métis surveyed reported having diabetes (6). The 2003 Canadian Diabetes Association (CDA) Clinical Practice Guidelines recommend community-based screening programs within Aboriginal communities to address the emerging diabetes epidemic (7). Systematic screening undertaken among First Nations in Ontario and Quebec revealed undiagnosed

diabetes prevalence rates of 11% and 3%, respectively (8,9). Such primary screening has not yet been utilized to investigate diabetes epidemiology among the Métis.

Among the adult Métis Settlement dwellers of Alberta, the objectives of this study were to (1) determine diabetes prevalence rates using secondary data analysis, and (2) determine the prevalence of undiagnosed diabetes and pre-diabetes, as well as identify associated cardiovascular risk factors, using primary screening methods.

MATERIAL AND METHODS

Study population

The Métis originated as a result of relationships between Europeans and the Indigenous population prior to and throughout the colonial settlement of Canada (10). The Métis are distinct from First Nations populations in terms of culture, history, sociopolitical and socio-economic factors. Uniquely, there are 8 incorporated Alberta Métis Settlements with distinct terms of governmental jurisdiction and service delivery: Buffalo Lake, East Prairie, Elizabeth, Fishing Lake, Gift Lake, Kikino, Paddle Prairie and Peavine. These Settlements

are similar to First Nations reserves in that they are land-based communities. There are also numerous unincorporated rural Métis communities and communities with a significant Métis population in Alberta. The total population of Métis in Alberta is approximately 70,000 (11), with about 10% living on Settlements (12).

Census

The Population Research Laboratory (PRL) at the University of Alberta conducted the 1998 and 2006 Métis censuses and maintains the corresponding databases. The censuses contained all Alberta Métis Settlement individuals (including children). All census data were collected in personal interviews by trained Métis interviewers. Responders were asked to report whether any household member had a chronic disability, with diabetes as one of the choices. The PRL was contracted to conduct a secondary data analysis of diabetes prevalence rates among each Alberta Métis Settlement. A database for each census was constructed using SPSS 15.01.

Mobile Diabetes Screening Initiative (MDSi)

The screening portion of the study was considered cross-sectional and was carried out between November 2003 and April 2007. Identical methodology has been reported elsewhere (13). Mobile vans equipped with health professionals and portable diagnostic equipment travelled to each Alberta Métis Settlement providing diabetes screening services. Métis adult subjects (aged ≥ 18) without known diabetes enrolled through self-referral in response to advertising. Measurements included body mass index (BMI), waist circumference (using a standard measuring tape at the iliac crest), blood pressure, blood

glucose, blood lipids (triglycerides and total/fractionated cholesterol) and hemoglobin A1c (A1c). Subjects were dressed in light indoor clothing with no shoes when weighed and rested for 5 minutes prior to a single, seated blood-pressure reading. Blood was collected via a single finger puncture with the Accu-Chek Safe-T-Pro (Roche Diagnostics) lancet after hand washing and finger sanitizing. Once the puncture had been administered, the first blood droplet was discarded using a sterile cotton swab. The subsequent blood was collected and immediately analyzed. Glucose and lipids were analyzed using the Cholestech L.D.X™ (Cholestech Corporation) portable analyzer, and A1c was analyzed using the Bayer DCA2000®+ analyzer (Bayer Diagnostics). The Cholestech L.D.X utilizes both enzymatic methodology and solid-phase technology, where as the Bayer DCA2000+ is an immunoassay. Performance assessments of both analyzers have been provided by the Canadian External Quality Assessment Laboratory (CEQAL) with sample sets covering the clinical range of interest and with accuracy target values assigned by credentialed reference methods. The base of accuracy for A1c was the Diabetes Control and Complications Trial (DCCT) Reference Laboratory at the University of Missouri, whereas CEQAL's Reference Method Laboratory was the base of accuracy for lipid measurements. Day-to-day field monitoring of the analytical performance of both instruments was done by use of an internal quality control program with pre-defined performance limits and accuracy targets assigned by reference methods.

Subjects were also asked about their family history of diabetes, personal history of gestational diabetes (GDM) or babies over 4 kg (9

pounds) and physical activity as per the validated American Diabetes Association (ADA) risk score (whether they engaged in little or no physical activity in most weeks) (14,15). ADA risk scores were calculated based on age, BMI, family history of diabetes, activity pattern and babies over 4 kg (9 pounds) (14).

We defined undiagnosed diabetes as a fasting plasma glucose (FPG) ≥ 7.0 mmol/L and pre-diabetes as a FPG 6.1-6.9 mmol/L according to the cut-offs set by the CDA (7). The most recent ADA criteria for pre-diabetes (FPG 5.6-6.9 mmol/L) was also used for comparison (16). We acknowledge that a single FPG sample does not confirm a diagnosis (7), and suggests only a provisional diagnosis. Most subjects were asked to attend screening in the fasted state, but non-fasted subjects were accepted and tested.

Criteria from the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) (17) were utilized to define overweight (BMI 25-29.9) and obesity (BMI ≥ 30). Since an Aboriginal-specific definition does not exist for the metabolic syndrome, we used the NCEP ATP III definition, where the presence of at least 3 of the following are needed for a diagnosis: increased waist circumference (>102 cm for males; >88 cm for females), elevated triglycerides (≥ 1.69 mmol/L), low HDL (high density lipoprotein) cholesterol (<1.0 mmol/L in males; <1.3 mmol/L in females), diabetes or impaired fasting glucose (IFG) (≥ 6.1 mmol/L) or hypertension ($\geq 130/85$ mmHg) (17). NCEP ATP III-defined metabolic syndrome has been shown to be a useful tool for evaluation of diabetes risk in American Indians (18).

MDSi was implemented as a partnership between Alberta Health and Wellness, Alberta's Métis communities, northern Regional Health

Authorities and the University of Alberta. The MDSi project was approved by the Health Research Ethics Board at the University of Alberta, and individuals consented to aggregate analysis of their information.

Statistical analyses

Age adjustments were made to census prevalence rates by the direct method using the 2001 general Alberta census data for each sex separately (19). Chi-square tests and 95% confidence intervals were used to detect significant differences between each census ($p < 0.05$). Logistic regression analyses identified factors associated with the metabolic syndrome, provisional undiagnosed diabetes and pre-diabetes (CDA criteria), after adjusting for age and sex. For the comparisons, the reference groups for undiagnosed diabetes and metabolic syndrome was the rest of the subjects (without the respective condition), whereas the reference group for pre-diabetes was normal glucose tolerance subjects (FPG < 6.1 mmol/L). Associations with A1c $> 6.1\%$, BMI > 30.0 , high waist circumference, high blood pressure, low HDL cholesterol, high triglycerides, elevated low-density lipoprotein cholesterol (LDL), history of GDM or delivering a baby weighing over 4 kg (9 pounds), family history of diabetes, ADA risk score and physical inactivity were sought in individual regression models adjusted for age and sex. Variables included in the NCEP ATP III definition of metabolic syndrome were analyzed as dichotomous (above or below the cut-point). LDL cholesterol and ADA risk score were analyzed as continuous variables. For both the census and screening, subjects were roughly equally distributed between settlements (data not shown). All analyses were undertaken using SPSS version 15.01.

RESULTS

Census

A total of 4,312 Métis individuals in 1998 (2,224 males, 2,088 females) and 5,059 in 2006 (2,591 males, 2,468 females) were living on Alberta Settlements. The crude diabetes prevalence increased significantly ($p < 0.01$) by 66%

between 1998 and 2006, from 2.8% to 4.6% (Table I). The results also indicated an expected trend for a higher prevalence of diabetes in older individuals. Figure 1 shows that the age-adjusted prevalence increased significantly from 5.1% in 1998 to 6.9% in 2006 ($p < 0.01$), and the prevalence for females was higher compared to males, 7.8% and 6.1%, respectively ($p < 0.05$).

Table I. Crude prevalence of diabetes in Alberta Métis Settlements, 1998 and 2006, by age-group and gender, from census self-report. Values are percent (total numerator/total denominator).

Age-group (years)	0-14	15-24	25-44	45-64	65+	Total
Male						
1998	0% (0/835)	0% (0/332)	0.8% (5/647)	8.5% (25/293)	17.9% (21/117)	2.3%[†] (51/2224)
2006	0% (0/834)	0% (0/471)	1.9% (13/680)	13.9% (60/432)	21.8% (38/174)	4.3% (111/2591)
Female						
1998	0.1% (1/838)	0% (0/324)	2.7% (16/593)	12.6% (31/247)	29.4% (20/86)	3.3%[†] (68/2088)
2006	0% (0/828)	0% (0/457)	3.2% (22/688)	16.8% (62/368)	29.1% (37/127)	4.9% (121/2468)
Total						
1998	0.1% (1/1673)	0% (0/656)	1.7% (21/1240)	10.4% (56/540)	20.2% (41/203)	2.8%[†] (119/4312)
2006	0% (0/1662)	0% (0/928)	2.6% (35/1368)	15.3% (122/800)	24.9% (75/301)	4.6% (232/5059)

[†]Significantly different ($P < 0.05$) from 2006 prevalence.

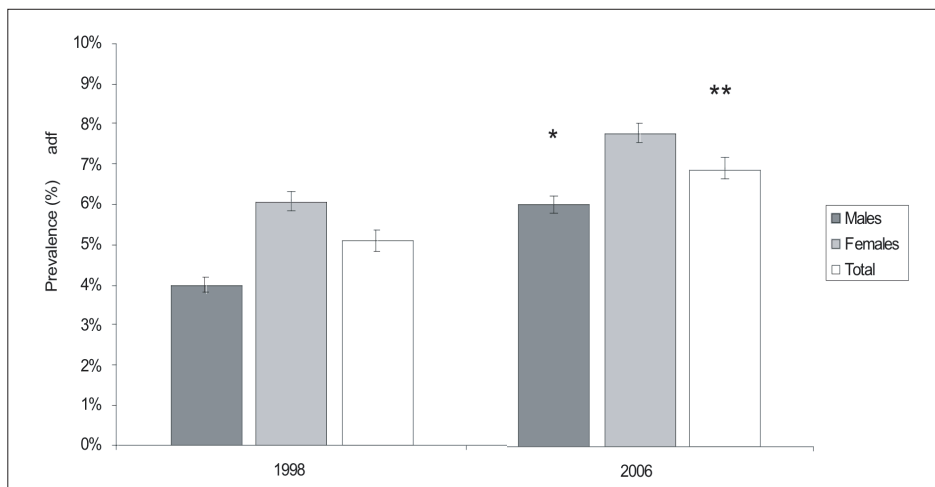


Figure 1. Age-adjusted prevalence of diabetes in Alberta Métis Settlements, 1998 and 2006, by gender, from self-report census.

* Statistically significant ($p < 0.05$) from female 2006 prevalence.

** Statistically significant ($p < 0.01$) from total 1998 prevalence.

MDSi screening

MDSi screened 693 adult subjects from the Alberta Métis Settlements. Approximately 20% of the Alberta Métis Settlements population over the age of 18 was screened by MDSi (11,12,20). The average age of subjects (males 45; females 42) was similar to the average age of the total adult Settlement population (males 42; females 39). However, MDSi participants were predominately female (61%), whereas 48% of the total adult Métis Settlement population was female. Complete data on anthropometrics and family history are shown in Table II. Of the individuals screened, 49.4% were obese, 68.7% had a high waist circumference, 80.1% were physically inactive and 43.4% had a parent with diabetes. A total of 266 MDSi subjects attended fasting, and thus the denominator for ADA risk score, undiagnosed diabetes, pre-diabetes and metabolic syndrome was 266. Although there was no difference in sex distribution between fasted and non-fasted participants, those that fasted were slightly older (44.7 years vs. 42.1 years), had a higher mean BMI (31.1 vs. 29.8) and a higher mean A1c (5.6% vs. 5.4%) (data

not shown). The prevalence of undiagnosed diabetes and pre-diabetes among adults was 5.3%, and 20.3% (CDA criteria), respectively, and 51.9% had pre-diabetes by ADA criteria (Table III). Finally, 46.4% and 67.4% of Métis adults screened had metabolic syndrome and a high ADA risk for diabetes, respectively (Table III).

Logistic regression analyses

Regression analyses suggested that A1c \geq 6.1%, BMI \geq 30, high waist circumference, elevated LDL and triglycerides, history of GDM or baby over 4 kg (9 pounds), sibling with diabetes, and elevated ADA score were associated with increased risk of undiagnosed diabetes (Table IV). With pre-diabetes determined by the CDA criteria, age \geq 40 years, A1c $>$ 6.1%, BMI \geq 30 and high waist circumference were related to an increased risk. Finally, age \geq 40 years, sex, A1c $>$ 6.1% and a high ADA score were associated with increased risk of the metabolic syndrome. An A1c $>$ 6.1% was strongly associated with diabetes, pre-diabetes and the metabolic syndrome (Table IV).

Table II. Anthropometrics and family history of Métis adults (n=693). Values are means \pm SD or percent (95% confidence interval) unless noted otherwise.

Variables	Females (n=434)	Males (n=259)	Total (n=693)
Mean age (years)	42.3 \pm 14.5	45.0 \pm 14.7	43.1 \pm 14.6
Mean waist circumference (cm)	99.9 \pm 14.60	103.2 \pm 13.30	101.1 \pm 14.20
% Abnormal	77.3% (73.4-81.2)	54.5% (48.4-60.6)	68.7% (65.3-72.2)
Mean BMI (kg/m ²)	30.5 \pm 6.2	29.9 \pm 5.1	30.3 \pm 5.8
% Overweight	31.9% (27-36.3)	36.4% (30.6-42.3)	33.6% (30.1-37.1)
% Obese	50.3% (45.5-54.9)	48.1% (42.0-54.2)	49.4% (45.7-53.1)
Mean A1c	5.4 \pm 0.54	5.6 \pm 0.51	5.5 \pm 0.54
% Physically inactive	81.9% (78.3-85.5)	77.2% (72.0-82.3)	80.1% (77.2-83.1)
% With sibling with diabetes	23.7% (19.8-27.6)	29.7% (24.2-35.2)	26.0% (22.7-29.3)
% With parent with diabetes	43.5% (38.8-48.2)	42.9% (36.8-49.0)	43.4% (39.7-47.1)
% With history of baby over 9 lbs	24.2% (20.1-28.3)	N/A	N/A
% With history of GDM	4.1% (2.1-6.1)	N/A	N/A

Table III. Prevalence of undiagnosed diabetes, pre-diabetes, metabolic syndrome and ADA risk scores in Métis adults (n=266). Values are percent (95% confidence interval).

Clinical variables	Prevalence
Undiagnosed diabetes (FPG \geq 7.0)	5.3% (2.6-7.9)
Pre-diabetes - CDA (FPG 6.1-6.9)	20.3% (15.5-25.1)
Pre-diabetes - ADA (FPG 5.6-6.9)	51.9% (45.6-57.9)
A1c>6.1	8.1% (6.1-10.2)
Metabolic syndrome	46.4% (40.4-52.4)
Low-medium ADA risk (score 3-9)	27.8% (24.5-31.1)
High ADA risk (score \geq 10)	67.4% (63.9-70.9)

Table IV. Factors associated with undiagnosed diabetes, pre-diabetes (CDA criteria) and metabolic syndrome in Métis adults (n=266). Values are odds ratios (95% confidence interval) adjusted for age and sex, unless otherwise specified.

	Undiagnosed diabetes	Pre-diabetes	Metabolic syndrome
Age*	0.44 (0.15–1.30)	2.33 [†] (1.12–4.84)	2.77 [†] (1.62–4.72)
Sex **	1.57 (0.53–4.65)	1.53 (0.81–2.88)	0.44 [†] (0.26–0.74)
A1c>6.1%	61.5 [†] (11.00–343.6)	9.05 [†] (2.82–29.00)	14.21 [†] (3.21–62.86)
BMI \geq 30.0	5.87 [†] (1.26–27.22)	2.63 [†] (1.32–5.25)	NA
High waist circumference	9.2 [†] (1.11 –75.6)	2.28 [†] (1.02–5.07)	NA
Elevated blood pressure	3.24 (0.89–11.72)	1.40 (0.70–2.81)	NA
Elevated LDL [‡]	1.84 [†] (1.02–3.34)	1.00 (0.69–1.44)	1.15 (0.87–1.54)
Low HDL	2.55 (0.73–8.84)	1.21 (0.63–2.35)	NA
High triglycerides	4.15 [†] (1.12–15.35)	1.91 (1.00–3.67)	NA
GDM or baby >9lbs [‡]	9.60 [†] (1.54–59.96)	Insufficient numbers for analysis	0.50 (0.12–2.18)
Sibling with diabetes	3.83 [†] (1.16–12.62)	0.67 (0.32–1.38)	1.15 (0.87–1.54)
Parent with diabetes	2.28 (0.74–7.06)	1.61 (0.85–3.06)	1.41 (0.85–2.35)
Grandparent with diabetes	1.26 (0.15–10.70)	1.23 (0.32–4.73)	1.34 (0.43–4.23)
Elevated ADA score ^{‡‡}	1.54 [†] (1.12–2.11)	1.06 (0.96 – 1.17)	1.21 [†] (1.11–1.31)
Inactive [§]	1.21 (0.25–5.93)	0.46 (0.21–1.02)	0.93 (0.46–1.85)

* >40 years of age – OR adjusted for sex

** OR adjusted for age

† p<0.05

‡ Females over age 18 only – Unadjusted OR

§ Includes individuals under the age of 65

‡‡ Analyzed as a continuous variable

DISCUSSION

Census results showed a crude increase of 66% in Alberta Métis diabetes prevalence rates over 8 years, and an age-adjusted prevalence of 6.9% in 2006. We also found high rates of undiagnosed diabetes (5.3%), pre-diabetes (20.3% by CDA criteria; 51.9% by ADA criteria) and metabolic syndrome (46.4%) in Métis adults attending screening clinics. An $A1c > 6.1\%$ was positively associated with undiagnosed diabetes, pre-diabetes and metabolic syndrome. High waist circumference, $BMI \geq 30$ and GDM/baby over 4 kg (9 pounds) also emerged as important diabetes predictors in adult Métis individuals.

The observed adult Métis diabetes prevalence of 6.9% in 2006 is higher than that of the general population of Alberta (5%) (4) and parallels data from other Aboriginal communities in Canada showing higher diabetes prevalence rates than the general population (3–6). We show similar reported diabetes rates compared to those determined among the Métis in the APS (6%) (6). Our reported increase in prevalence is similar to that in Alberta First Nations, which increased 41% between 1995 and 2005 (4). This increase could be partly due to more frequent screening and lowered diagnostic thresholds in 2006 compared to 1998 (7). The higher reported female diabetes prevalence compared to males parallels reports in other Canadian Aboriginal populations (4,21,22). Sex trends are contrary to the general Canadian population, where diabetes rates are even among both sexes, or even slightly higher for males (23). Reasons for the higher prevalence in Aboriginal women are not well understood and cannot be determined from this study; however, one possible expla-

nation may be increased identification due to GDM among young women.

The reported rates of undiagnosed diabetes and metabolic syndrome are similar to those shown in a single Alberta First Nations community (4% and 52%, respectively) (24). A report from the Métis National Council in 2006 found that only 28% of Métis communities were within 30 km of a diabetes program, and only 48% were within 100 km of a program (25). This suggests there is a significant barrier to access to health care for Métis individuals in Alberta. One of MDSi's primary roles is to identify individuals with undiagnosed diabetes and then refer to the existing health system for management and follow-up care. $A1c > 6.1\%$ was strongly associated with undiagnosed diabetes, pre-diabetes and metabolic syndrome, supporting a growing body of evidence suggesting the use of A1c in screening for chronic disease (26–28). Since A1c analysis is a relatively simple test and does not require fasting, it has great community-based appeal among many remote Aboriginal populations that have limited access to health care (24,29). Although not a specific aim of the current study, these results provide strong rationale to explore A1c utility as screening tool among Aboriginal individuals.

There are several limitations of the current study. When considering the census data, underreporting is possible if diabetes was not considered a disability, or if its presence was not known to the single respondent per household. MDSi is not a population-based study, and it is likely that participants were those most concerned about their health, as suggested by the higher BMI and A1c among fasted subjects compared to non-fasted subjects. However, population-based studies in Aboriginal popu-

lations present ethical challenges, if they are not linked to providing much needed health services, which MDSi believes it does (30). The prevalence of undiagnosed diabetes, pre-diabetes and metabolic syndrome may be underestimated, as confirmatory testing of glucose results with an oral glucose tolerance test was lacking. Despite these limitations, MDSi has helped gather information needed and requested by Métis Settlement individuals and leadership. MDSi results are specific to Métis people, addressing a gap in knowledge and establishing a unique data source in the inventory of Aboriginal diabetes information.

Our results show an increase in diabetes prevalence among adult Métis Settlement dwellers in Alberta. We also observed a high prevalence of undiagnosed diabetes and pre-diabetes, as well as metabolic syndrome. To our knowledge this is the first study to use primary research methods to examine diabetes risk factors in the Métis. Diabetes awareness and improved healthcare access are hoped to follow to reduce the burden of diabetes among the Métis. Regardless, ideally, to more accurately determine the epidemiology of diabetes in the Métis, population-based studies are needed.

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Conflict of interest statement

This project was funded by Alberta Health and Wellness and the University of Alberta. No possible conflicts of interest are identified.

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