

HIGH RATES OF THE METABOLIC SYNDROME IN A FIRST NATIONS COMMUNITY IN WESTERN CANADA: PREVALENCE AND DETERMINANTS IN ADULTS AND CHILDREN

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ABSTRACT

Objectives. Increasing type 2 diabetes in Aboriginal communities across North America raises concerns about metabolic syndrome in these populations. Some prevalence information for American Indians exists, but little has been available for Canada's First Nations. **Study Design.** We screened 60 % of the eligible population of a single First Nation in Alberta for diabetes, pre-diabetes, cardiovascular risk, and metabolic syndrome.

Methods. NCEP/ATP III and IDF criteria were used to identify metabolic syndrome in participants aged ≥ 18 ; modified NCEP/ATP III criteria were used for participants aged < 18 . Logistic regression identified factors associated with the metabolic syndrome.

Results. 297 individuals were screened (176 adults, 84 children/adolescents, with complete data). 52.3 % of adults had metabolic syndrome using NCEP/ATP III criteria, and 50 % using IDF criteria. 40.5 % of individuals aged < 18 had the condition. Waist circumference was the most prevalent correlate. Bivariate analysis suggested that age, BMI, weight, A1c, LDL-C, ADA risk score and activity pattern were associated with metabolic syndrome.

Conclusions. Our data represent the first available for Western Cree and are consistent with prevalence reported for Aboriginal populations in Ontario and Manitoba. High rates of obesity, pre-diabetes and metabolic syndrome for participants aged < 18 raise concerns about future prevalence of diabetes and cardiovascular disease.

Keywords: Aboriginal, North America, risk factors, metabolic syndrome X, insulin resistance, cardiovascular diseases, type 2 diabetes mellitus (*Int J Circumpolar Health* 2006;65(5):389-402.)

INTRODUCTION

The metabolic syndrome – a clustering of metabolic abnormalities associated with risk of coronary heart disease, stroke, and cardiovascular mortality greater than that of its individual components (1) – has been shown to predict diabetes and cardiovascular disease. The condition is also known as: Insulin Resistance syndrome, syndrome X, metabolic syndrome X, dysmetabolic syndrome X, and Reaven syndrome (2), since Reaven originally proposed that insulin resistant individuals presented with an increased risk of cardiovascular disease (3).

The National Cholesterol Education Program (NCEP/ATP III) developed criteria for identifying the syndrome in clinical prac-

tice (see Table I). The World Health Organization (WHO), the European Group for the Study of Insulin Resistance (EGIR), and the American Association of Clinical Endocrinologists (AACE) had slightly differing criteria and diagnostic cut-points. Most recently, the International Diabetes Federation (IDF) issued a “consensus worldwide definition”, aimed at ending clinical confusion, and allowing research comparisons between populations (4). The waist criteria proposed by the IDF are more stringent than those of the NCEP/ATP III, reflecting the increasing realization of the role of abdominal obesity as a risk factor for cardiovascular disease (4,5). The American Diabetes Association (ADA) recently issued a statement indicating the need for a critical appraisal of the “syndrome” (6).

Table I. NCEP/ATP III and IDF criteria for the diagnosis of the metabolic syndrome in adults

Variables	Diagnostic values: NCEP/ATP III	Diagnostic values: IDF	
Waist Circumference:	Males: >102cm Females: >88cm	Europid Males: 94cm Females: 80cm	South Asian* Males: 90cm Females: 80cm
Triglycerides	≥1.70mmol/L	≥1.70mmol/L	
HDL Cholesterol	Males: < 1.0mmol/L Females: < 1.3mmol/L	Males: < 0.9mmol/L Females: <1.1mmol/L	
Blood Pressure (higher than or on medications for BP)	≥130/85 mm Hg	≥130/85 mm Hg	
Fasting blood glucose	≥6.1mmol/L		
Fasting blood glucose* new criteria (5)	≥5.6mmol/L	≥5.6mmol/L	
Metabolic Syndrome	Any 3/5 factors	Increased waist circumference plus any 2/4	

*Different cut-off points are suggested for different ethnic groups, with no specific recommendations for North American Aboriginal peoples. The IDF recommends using South Asian cut-off points for South and Central Americans.

Prevalence of the metabolic syndrome has been studied in various populations, most notably amongst adults in the US: NHANES 1999-2000 reported an age-adjusted rate of 27 % given the older National Cholesterol Education Program (NCEP/ATP III) criteria (fasting glucose cut-point of ≥ 6.1 mmol/L) and 32.2 % given the new NCEP/ATP III criteria (Table I) (7,8). Prevalence worldwide varies considerably, with some of the lowest rates being reported in France: 10 % in men and 7 % in women aged 30-64 (9).

The explosion of type 2 diabetes in Aboriginal communities across North America has raised concerns about the prevalence of the metabolic syndrome in these populations (10). In American Indians aged 45-74, prevalence was 35 % using the older NCEP/ATP III criteria (11). In Pima Indians it is believed that the higher prevalence of the metabolic syndrome (estimated at 50 %) is partly explained by genetics, obesity, and lack of physical activity (12,13). One study amongst the Oji-Cree of Sandy Lake First Nation, Ontario, showed a crude prevalence of 29.9 % for adults (≥ 18 years of age) (14,15). Another study amongst Oji-Cree populations in Manitoba and Ontario (including the Sandy Lake data) revealed an age-standardized prevalence of 37.5 % (crude prevalence of 33.3 %) for adults (16).

Objectives

While some prevalence information for American Indians exists, little has been available for Canadian Aboriginals. The data we present is the first available for Western Cree First Nations peoples of the Woodland language group, and we compare this information to studies amongst the Haudeno-

saunee (Iroquois) of the Six Nations Reserve in Ontario, and amongst Oji-Cree populations in Manitoba and Ontario.

MATERIAL AND METHODS

Participants

“BRAID” (Believing we can Reduce the Aboriginal Incidence of Diabetes) is an ongoing screening project in a single First Nation community in rural northern Alberta. The project screens for diabetes, pre-diabetes, cardiovascular risk factors, and the metabolic syndrome. BRAID was developed in response to a request from the Community.

From January 2003 to June 2005, the research team screened 297 individuals without known diabetes; complete data was collected for 176 adults and 84 children and adolescents. Using 2001 census data, this amounted to 60 % of the population that did not meet exclusion criteria. Exclusion criteria included known diabetes, an age of less than six years, current pregnancy or less than six weeks post-partum, medications known to interfere with glucose metabolism, acute illness, or a life-expectancy of less than six months.

Approval was obtained from the Health Director and Chief and Council of the First Nation, who have also indicated their approval for this manuscript and collaborated in the authorship. The study (including consent protocols for adult participants, and parental/guardian consent and assent protocols for child participants) was duly approved by the University of Alberta Health Research Ethics Board.

Data Collection and Measures

Individuals were screened in light clothing for anthropometric measurements, blood pressure in the sitting position after five minutes rest (antihypertensive medications were noted), cholesterol (total and fractionated), triglycerides, hemoglobin A1c (A1c), fasting glucose, family history of diabetes, activity pattern, and personal history of gestational diabetes, or babies weighing over nine pounds. A number of factors (age, BMI, family history of diabetes, activity pattern, and babies weighing over nine pounds) were used to determine each participant's American Diabetes Association (ADA) risk score; higher scores indicate higher risk for undiagnosed type 2 diabetes (17). For the purposes of the ADA risk assessment, we used the physical activity standard of 30 minutes a day, five days a week, as recommended by the ADA to define a participant as being 'physically active'.

Waist circumference, in centimeters, was measured at the iliac crest while the individual was standing, using a standard measuring tape (Prym-Dritz Corporation). Height was measured in meters, without shoes, using a standard height scale (Road Rod 214 from Seca). Weights were recorded in kilograms with a standard dial weight scale (Health o meter®).

All data were collected in the field by trained health professionals, and all participants received counseling by a nurse, dietician, or physician regarding their individual results and were offered ongoing follow-up. Portable technology was utilized for measuring lipids and glucose (Cholestech LDX®, Cholestech Corporation), and A1c (DCA 2000® analyzer, Bayer Diagnostics). The Canadian External Quality Assessment Laboratory (CEQAL) provided

performance assessments of the instruments using sample sets covering the clinical range of interest, with accuracy target values assigned by credentialed reference methods. For A1c, the base of accuracy was the DCCT Reference laboratory at the University of Missouri. The base of accuracy for lipid measurements was CEQAL's Reference Method Laboratory, a member of the Cholesterol Reference Method Laboratory Network (CRMLN). Day-to-day analytical performance of the analyzers was monitored in the field through the use of an internal quality control (IQC) program with pre-defined performance limits and accuracy targets assigned by reference methods.

The measurement and diagnostic equipment used were already present in the health center, and were identical to those used in another study (18).

Statistical Analyses

Participants aged 18 or older were identified as having the metabolic syndrome using the NCEP/ATP III (both old and new glucose cut-off points) and International Diabetes Federation (IDF) criteria for metabolic syndrome (Table I). Agreement in the categorization of adult participants as having the metabolic syndrome was determined using the kappa statistic. Level of agreement was categorized as follows: 0 = poor, 0.01-0.20 = slight, 0.21-0.40 = fair, 0.41-.60 = moderate, 0.61-0.80 = substantial, and 0.81-1.00 = almost perfect (19).

For waist circumference, we utilized the IDF percentiles for South Asian individuals (Table I), in the absence of specific percentiles for Native Americans or First Nations individuals. The IDF recommends using South Asian percentiles for Central and South Americans (4); in view of the links between North Amer-

ican and South and Central American peoples and the ancestral peoples of Asia (20), the recommended South Asian criteria may also be the most appropriate substitute for First Nations individuals. Additionally, Anand et al. note that South Asian and First Nations Canadians, compared to European Canadians, share greater abdominal adiposity, which is strongly associated with higher levels of C-reactive protein as well as with insulin resistance, which appears to predict the development of diabetes and, possibly, cardiovascular disease (21).

Participants under the age of 18 were categorized as having metabolic syndrome based on modified NCEP/ATP III criteria (22), with glucose cut-off values lowered from 6.1 mmol/L to 5.6 mmol/L, consistent with recent ADA guidelines for Impaired Fasting Glucose (23). For waist circumference, we utilized age and gender percentiles from Fernandez et al. for Caucasian children (24), as no measures specific for Native American or First Nations children were available.

The directly age-standardized prevalence of the metabolic syndrome was determined using the 1991 Canadian census population as the reference population, and 95 % confidence intervals (CI) were computed based upon the gamma distribution.

Factors associated with the metabolic syndrome in children and adults were identified using bivariate logistic regression analyses. Associations between age (above and below the median of approximately 40 years for adults and of 12 years in children), A1c (above or below the median value of approximately 5.5 %), LDL cholesterol (as a continuous variable), history of gestational diabetes or of a baby weighing over nine

pounds (females over the age of 18 only), family member with diabetes (sibling, parent or grandparent), ADA score (as a continuous variable) and activity pattern (physical activity question: "Less than 65 years old and little or no physical activity in most weeks?") (25) and the metabolic syndrome, were individually assessed. Finally, sensitivity, specificity and diagnostic accuracy were calculated for A1c as a predictor of the metabolic syndrome (26). Data were analyzed using SPSS version 14.0.

RESULTS

Population demographics and percent screening by age groups are shown in Table IIa. Subject characteristics are shown in Table IIb. Thirty-seven individuals with incomplete data were excluded from the calculations, although virtually all of them had two or more abnormal parameters.

The crude prevalence of metabolic syndrome and its risk factors in those with complete data are shown in Table III. Of the 176 adults, 52.3 % and 50 % had the condition using the NCEP/ATP III new criteria, and the IDF criteria, respectively. Agreement between the two definitions in adults was almost perfect ($\kappa = 0.84$). Waist circumference was the most prevalent abnormality of the metabolic syndrome (74.4 % with the NCEP/ATP III new criteria), followed by low HDL cholesterol and elevated triglycerides.

For individuals under the age of 18, the crude prevalence of the metabolic syndrome was 40.5 % (Table IV). Similarly to adults, waist circumference was the most prevalent abnormality (65.5 % of children and adoles-

Table II a. Demographics of population and those screened.

BRAID (n= 297)	n (%) in population (2001 census data)	n (%) (of age group screened)	male:female ratio (ratio of those screened)
Age groups			
0 -14*	223 (35%)	79 (35%)	44: 64
15-24	108 (17%)	45 (42%)	43: 57
25-44	204 (32%)	106 (53%)	41: 59
45-64	83 (13%)	54 (67%)	44: 56
≥65	23 (3.6%)	13 (57%)	46: 54

*Children 0-5 years were excluded. 84 other subjects met exclusion criteria, 70 of whom had diagnosed diabetes.

Table II b. Characteristics of study population (n=260).

	Adults (n =176)	Children and adolescents (n = 84)
Age (years)	39.4 (13.3)	11.5 (3.48)
Sex (% Male)	39%	51%
BMI (kg/m2)	31.9 (7.0)	28.8 (7.1)
Weight (kg)	90.1 (21.1)	58.8 (26.3)
Waist (cm)	108.2 (17.2)	86.7 (19.1)
Fasting blood glucose	5.6 (1.1)	5.2 (0.6)
A1c (%)	5.51 (0.62)	5.25 (0.26)
LDL Cholesterol (mmol/L)	2.89 (0.86)	2.20 (0.66)
HDL Cholesterol (mmol/L)	1.04 (0.28)	1.10 (0.29)
Triglycerides (mmol/L)	1.77 (0.76)	1.19 (0.48)
Systolic BP – (mmHg)	119.4 (15.2)	110.2 (13.1)
Diastolic BP – (mmHg)	77.7 (9.8)	71.4 (9.0)

Continuous data presented as mean (SD).

Table III. Crude prevalence of the metabolic syndrome and its determinants in BRAID adults, children and adolescents.

Adults (≥18 years of age) n=176	NCEP/ ATP III	IDF	Children and adolescents (<18 years of age) n=84	NCEP/ ATP III
Abnormal waist circumference	74.4%	88.1%*	Waist (>90 th percentile)‡	65.5%
Abnormal triglycerides	44.3%	44.3%	Triglycerides (≥1.24)	38.1%
Abnormal HDL	73.3%	50.0%	HDL (≤1.03)	48.8%
Abnormal blood pressure	28.4%	28.4%	Blood pressure (>90 th percentile)	40.5%
Fasting glucose ≥ 6.1	15.3%	-	Fasting glucose ≥ 5.6	25.0%
Fasting glucose ≥ 5.6	38.1%	38.1%	Metabolic syndrome using glucose criteria ≥ 5.6§	40.5%
Metabolic syndrome	52.3%†	50.0%		

*In the absence of specific recommendations for North American Aboriginal peoples, South Asian Criteria were used.
 †Prevalence based upon NCEP/ATP III glucose criteria of 5.6. NCEP/ATP III glucose criteria of 6.1 yielded a crude prevalence metabolic syndrome of 46.6%. ‡ Criteria modified from Fernandez et al, Journal of Pediatrics 2004; 145:439-44.
 § Criteria modified from Cook S, 2003: glucose value was lowered from 6.1mmol/L to 5.6mmol/L according to recent (2005) ADA guidelines, and revision of adult criteria.

cents exceeded the 90th percentile), followed by low HDL cholesterol and elevated blood pressure.

While the crude prevalence of the metabolic syndrome in adults and children combined was 48.5 %, the age-standardized prevalence across all age groups was 49.9 % (95 % CI: 39.9 to 61.8 %). For individuals over the age of 18, and using the NCEP/ATP III criteria with a glucose cut-off of 6.1 mmol/L, the crude prevalence of metabolic syndrome was 46.6 %, while the age-standardized prevalence was 44.6 (95 % CI: 31.4 – 61.3).

Bivariate logistic regression analyses suggested that A1c, LDL cholesterol, ADA score and activity pattern were associated with the metabolic syndrome in adults, and that LDL cholesterol and ADA score were associated with the metabolic syndrome in children (Table V). Adults under the age of 65 and inactive were 4.37 (95 % CI: 2.10 – 9.11) times more likely to have the metabolic syndrome than those who were active. In children and adults, every one point increase in ADA score was associated with a 21 % to 28 % increase in the odds of having the metabolic syndrome. A one

Table IV. Numbers of abnormalities in BRAID adults, children and adolescents.

Groups of individuals	n	Number of metabolic abnormalities* (%)					
		0	1	2	3	4	5
Adults (≥age 18)	176	13 (7.4)	26 (14.8)	45 (25.6)	41 (23.9)	42 (23.9)	9 (5.1)
Male	71	11 (15.5)	12 (16.9)	12 (16.9)	16 (22.5)	18 (25.4)	2 (2.8)
Female	105	2 (1.9)	14 (13.3)	33 (31.4)	25 (23.8)	24 (22.9)	7 (6.7)
Children and adolescents (< age 18)	84	11 (13.1)	19 (22.6)	20 (23.8)	16 (19.0)	12 (14.3)	6 (7.1)
Male	43	8 (18.6)	12 (27.9)	8 (18.6)	10 (23.3)	4 (9.3)	1 (2.3)
Female	41	3 (7.3)	7 (17.1)	12 (29.3)	6 (14.6)	8 (19.5)	5 (12.2)

Bold refers to proportion of individuals meeting criteria for the metabolic syndrome.

*According NCEP/ATP III glucose criteria of 5.6.

Table V. Bivariate analysis of factors associated with metabolic syndrome.

	Adults		Children and adolescents	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Age*	1.44	(0.79 – 2.63)	1.33	(0.55 – 3.21)
A1c > 5.5%†	3.09‡	(1.67 – 5.72)	2.18	(0.79 – 6.03)
LDL§	1.69‡	(1.16 – 5.72)	2.74‡	(1.37 – 5.48)
GDM or baby > 9lbs	0.98	(0.35 – 2.78)	-	-
Sibling with DM**	1.28	(0.67 – 2.45)	4.74	(0.47 – 47.7)
Parent with DM**	1.08	(0.59 – 1.97)	2.19	(0.76 – 6.29)
Grandparent with DM**	0.57	(0.29 – 1.09)	0.72	(0.29 – 1.79)
ADA score††	1.21‡	(1.12 – 1.31)	1.28‡	(1.10 – 1.49)
Under age 65 and inactive‡‡	4.37‡	(2.10 – 9.11)	2.50	(0.54 – 11.65)

* ≥40 years for adults and ≥12 years for adolescents and children. † Dichotomous data presented. Reference category is ≤ 5.5. ‡ p < 0.01. § LDL: Low density Lipoprotein. Continuous data presented. || GDM: Gestational Diabetes Mellitus. Females ≥18 years of age only included for baby > 9 lbs. Dichotomous data presented. Reference group = no GDM or baby greater than 9 lbs. DM: Diabetes Mellitus. ** Dichotomous data presented. Reference groups (respectively) = no sibling with DM; no parent with DM; no grandparent with DM. †† ADA score: continuous data presented. ‡‡ Reference group = ≥65 years of age or active.

point increase in LDL cholesterol was associated with a 69 % to 174 % increase in the odds of having the metabolic syndrome (Table V). In adults, individuals whose A1c exceeded 5.5 were 3.09 (95 % CI: 1.67 – 5.72) times more likely to have metabolic syndrome. Furthermore, an A1c > 5.5 % had a sensitivity of 54 % in detecting the metabolic syndrome (using the NCEP/ATP III definition with a glucose cut-off of 5.6), with a specificity of 72 % and a diagnostic accuracy of 64 %. A1c cut-offs of 6.1 % and 7 % had 98 % and 100 % specificity, respectively, but very low sensitivity (8.7 % and 3 %, respectively) and low diagnostic accuracy (53 % and 52 %, respectively).

The BRAID project identified a 4 % prevalence of undiagnosed diabetes in the Community (25), bringing the Community's overall diabetes prevalence up to 15.5 %, from a rate of ~11 % established through provincial health

data (Alberta Health and Wellness, personal communication). The rates of impaired fasting glucose – fasting plasma glucose \geq 6.1 - 6.9 mmol/L for adults according to 2003 Canadian Practice Guidelines and 1999 World Health Organization criteria, and FPG \geq 5.6 - 6.9 mmol/L for adults according to 2003 WHO criteria – identified by BRAID are shown in Table III.

DISCUSSION

Our data represent the first available information for Western Cree First Nations people, and reveal prevalence rates consistent with those found amongst the Haudenosaunee (Iroquois) of the Six Nations Reserve in Ontario, and amongst Oji-Cree populations in Manitoba and Ontario (Table VI).

Table VI. Age-adjusted prevalences of the metabolic syndrome in BRAID project compared with Aboriginal populations in other Canadian studies using same NCEP/ATP III criteria, (glucose \geq 6.1 mmol/L).

Study	Age group	Prevalence (%) (CI's)
BRAID Project: Western Cree, Alberta (n=176)	≥ 18	44.6 (31.4 – 61.3).
SHARE-AP [†] : Six Nations Reserve (Haudenosaunee), Ontario (n=301)(74)	35-75	41.6
NICDS [‡] and SLHDP [§] : Oji-Cree, Manitoba and Ontario (n=1180) ⁽¹⁶⁾	≥ 18	37.5 (33.4-41.6)*
KHAS : Canadian Inuit, Northwest Territories (Nunavut) (n=238) ⁽¹⁶⁾	≥ 18	16.0 (10.3-21.8)*

*95% CI

[†] Study of Health Assessment and Risk Evaluation in Aboriginal Peoples, 1998-2000

[‡] Northern Indians Chronic Disease Study, 1986-1987

[§] Sandy Lake Health and Diabetes Project, 1993-1995

^{||} Keewatin Health Assessment Study, 1990-1991

The prevalence for adults (aged ≥ 18) in an Inuit population reported by Liu et al. (2005) was lower than for Oji-Cree participants in the same study (16), and lower than the prevalence for the Six Nations Reserve and for BRAID participants (Table VI). Additionally, our data show a correlation between the metabolic syndrome and a lack of physical activity. These are consistent with the ethnic/socio-economic “Coca colonization” hypothesis, whereby chronic disease epidemics occur concurrently with the westernization of lifestyle in formerly traditional living groups (27), compounded by the genetic susceptibility to diabetes and its determinant factors amongst First Nations populations (28,29).

Canadian data available on the increasing rates of childhood overweight and obesity shows prevalences ranging from 29.2 % to 39.4 % for overweight, and from 13.3 % to 16.6 % for obesity (30-34), consistent with rates reported in the US (35-37) and the United Kingdom (38,39). For Aboriginal children, Canadian studies have revealed similar prevalence rates, ranging from 27.7 % to 38 % for overweight (40-42). The prevalence of metabolic syndrome in children and adolescents in the US is also increased, and the number of hospitalizations and associated costs for obesity-related diseases in children has tripled from 1979-1999 (43). Furthermore, 8 % to 45 % of all cases of diabetes diagnosed in US adolescents and children are type 2 (44). Our data is therefore particularly worrisome, as it confirms high rates of obesity, pre-diabetes and metabolic syndrome in First Nations children and adolescents, heightening the concerns engendered by Kue Young (45) and Heather

Dean (46-49) with respect to increasing obesity and diabetes in First Nations youth.

Logistic regression showed that a number of other factors predict metabolic syndrome, including LDL cholesterol, ADA risk score and A1c. This is consistent with the contention by Kahn et al. that clinical definitions of the metabolic syndrome are unnecessarily restrictive, and that the particular cluster of risk factors may not be as important as the assessment and management of each of them individually (50). Not included as often in this group of risk factors is A1c, which is emerging as a significant risk factor for diabetes, cardiovascular disease and cancer (51-55). In addition, there are suggestions that A1c should be used as a screening tool for diabetes in Aboriginal environments (56-58) and, thus, could be used as a first step in assessing the presence of diabetes and/or metabolic syndrome. A1c testing is convenient in community settings, because it does not require fasting.

Our data supports waist circumference as the primary predictor of the metabolic syndrome, as reflected in the IDF definition of the condition. Corroborating data is also found in Lemieux et al. wherein waist circumference was assessed as a variable predicting the presence of metabolic factors (hyperinsulinemia, hyperapo B, and the small, dense LDL particles) associated with increased risk of coronary heart disease in men (59).

Study limitations

There is disagreement about the merits of screening activities carried out in community settings, since little is known about patient compliance with referrals for

confirmatory testing after a positive screen (60,61). However, the Community partner in the BRAID project has a full-time Diabetes Educator position in its health centre. The Diabetes Educator works hand-in-hand with BRAID and with a Health Canada project ("SLICK", Screening for Limbs, I-Eyes, Cardiovascular and Kidney) that screens individuals with known diabetes for complications (18). The Diabetes Educator provides a consistent "diabetes care" presence within the community, and follows up with BRAID clients to encourage referral compliance and enrolment with SLICK. Collecting data in the communities is the only way to gather rich population-based information.

The numbers of participants in the BRAID project are small, and a percentage of the population could not be reached, or has not been reached to-date. In addition, there is a transient/seasonal population in many First Nations communities, so determining the denominator for the population is challenging. For this reason, we chose Statistics Canada figures, which may be an underestimate. It is therefore possible that we have a biased sample, including those most concerned about their health, who are likely to attend screening programs. However, it is also well known that there is an element of denial when it comes to diabetes or lifestyle-related health risks. We are comforted by almost identical figures for metabolic syndrome presence obtained when a larger sample was used in a different set of Aboriginal peoples in Alberta – see Kaler, 2005 (25).

The number of children and adolescents studied is particularly small, and awaits comparison with other population-based

data. In addition, the criteria for assessing the metabolic syndrome in children and adolescents is not well established, as few studies have been done (4,5,62-65).

Since the BRAID protocol did not include an OGTT, it is possible that some of the individuals included in our results have diabetes, or isolated IGT (impaired glucose tolerance with elevations in 2-hour post-challenge glucose). Had we included the subjects with diabetes or isolated IGT in this study, our population-based prevalence rates would have been even higher. Most studies do not exclude patients with diabetes when reporting (14,15,66,67).

Conclusions

In summary, we report an alarmingly high prevalence of the metabolic syndrome and its risk factors in a group of First Nation Cree Western Canadians of the Woodland language group. The Canadian Government has acknowledged the great disparity in health and resources of its First Nations Peoples. At the First Ministers' Meeting in November 2005, the Prime Minister committed to working with First Nations leaders to reduce health disparities in four key areas, including reducing diabetes and childhood obesity by 20 % in five years and by 50 % in 10 years (68). At the time of this writing (2006), resources continue to be directed to Communities through the Aboriginal Diabetes Initiative (69), although commitments in other areas appear less certain, because of changing government priorities (70-72). This is regrettable, because solutions must come not only from Health

Canada, but also from Canada's economic development and human resources departments, accompanied by respect for Aboriginal cultures, facilitating a return to an active and healthy way of life for the (presently) seriously disenfranchised communities (73).

We have presented our findings to the Community, which has utilized this data to obtain funding for the establishment of a full-time Diabetes Educator position for its health centre, and to implement weight loss challenges and physical activity initiatives within the Community. Since BRAID began, the Community has built a walking trail from the health centre to the school and to the Band office, and has developed a multi-purpose gym with a focus on boxing, a sport in which the community has a tradition. The Community's elementary and junior high school has instituted changes with respect to diet and physical activity. Community gardens and women's groups have been established, and a licensed practical nurse on staff at the health centre has begun offering holistic workshops incorporating teachings about indigenous plant/home remedies (to be used in conjunction with western medicine), and the "Stanford model" of self-help for individuals with chronic disease has been instituted (<http://patienteducation.stanford.edu/programs/cdsmp.html>). As this paper is being written, the Community is organizing a major conference on diabetes and prevention, targeting all First Nations Communities in the area.

BRAID is still ongoing, and the researchers are seeking funding to support human health resource development

within the Community, with the objective of completing the screening of the entire population, and to assist the Community in health promotion activities and community-based diabetes care and management programming.

Specific criteria for identifying risk and diagnosing the metabolic syndrome and diabetes in First Nations people are lacking. In particular, specific waist circumference and BMI percentiles are needed, as these are important explanatory variables for the foregoing conditions. Population-based studies in more First Nations communities are necessary to provide evidence for establishing such criteria, as well as to characterize the epidemiology of the metabolic syndrome and diabetes in this segment of the population, which appears to be at higher risk, likely resulting from the confluence of genetic factors, socio-economic pressures and the rapid westernization of lifestyles. More wide-ranging data is also essential for evidence-based health care programming in First Nations Communities.

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