

# Type 2 diabetes mellitus in Canada's First Nations: status of an epidemic in progress

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## Abstract

THIS REVIEW PROVIDES A STATUS REPORT ON THE EPIDEMIC of type 2 diabetes mellitus that is affecting many of Canada's First Nations. We focus on the published literature, especially reports published in the past 2 decades, and incorporate data from the Aboriginal Peoples Survey and the First Nations and Inuit Regional Health Survey. We look at the extent and magnitude of the problem, the causes and risk factors, primary prevention and screening, clinical care and education, and cultural concepts and traditional knowledge. The epidemic of type 2 diabetes is still on the upswing, with a trend toward earlier age at onset. Genetic-environmental interactions are the likely cause. Scattered intervention projects have been implemented and evaluated, and some show promise. The current health and social repercussions of the disease are considerable, and the long-term outlook remains guarded. A national Aboriginal diabetes strategy is urgently needed.

It is widely recognized that type 2 diabetes mellitus has become a serious health problem among many Aboriginal populations in North America. In the 1970s West<sup>1</sup> provided a global survey and hinted at the emergence of an epidemic. The Pima study in Arizona contributed substantially to our understanding of the causes, pathogenesis and epidemiological features of the disease.<sup>2</sup>

In Canada a few clinical studies on carbohydrate metabolism were conducted in the 1970s among Inuit hospital patients.<sup>3,4</sup> During the 1980s prevalence studies were performed in various regions, using a variety of survey methods and diagnostic criteria.<sup>5-11</sup> Table 1 identifies recent developments that signal the increased awareness of the problem among academic researchers, service providers, and representatives of governments and Aboriginal organizations.

Diabetes can be considered to be indicative of the rapid sociocultural changes experienced by Aboriginal people in the past several decades.<sup>12</sup> In this article we update an earlier review<sup>13</sup> by including new data collected from several community studies, the 1991 Aboriginal Peoples Survey (APS)<sup>14</sup> and the 1997 First Nations and Inuit Regional Health Survey (FNIRHS).<sup>15</sup> We cover the epidemiological features and causes of the disease and issues relevant to providing health care to Aboriginal people with diabetes.

We focus on First Nations people in Canada and exclude Inuit and Metis, the 2 other constitutionally defined Aboriginal groups. Diabetes is not yet an important health problem among the Inuit,<sup>16</sup> although the situation may change.<sup>17</sup> Little data are available for the Metis, although they indicate that this group is at an increased risk relative to the overall Canadian population.<sup>18</sup> We also do not review the massive literature on American Indians in the United States.<sup>19</sup>

## Extent and magnitude of the problem

There are several ways to determine how much of a health problem diabetes is in the population, including vital statistics derived from death certificates, registries of diagnosed cases, health interview surveys and screening surveys involving measurement of plasma glucose levels (fasting or 2 hours after oral glucose challenge, or both).

Using data from the Canadian Mortality Database, Mao and colleagues<sup>20</sup> found a greater than 5-fold risk of death from diabetes among women resident on reserves compared with Canadians nationally.

## Review

## Synthèse

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Based on case registries maintained by Health Canada's Medical Services Branch, the federal agency responsible for the health care of most First Nations, the prevalence of diabetes has been found to vary according to language group, culture area, geographic location and degree of isolation, both nationally<sup>21</sup> and regionally.<sup>22</sup> Of the main language groups in Canada, the Dene (Athapaskans) have the lowest reported rate.<sup>16,21,22</sup> Substantial variation can exist even between communities of the same tribal background in close proximity.<sup>23,24</sup>

Health interview surveys provide an estimate of self-reported prevalence. Both the APS<sup>14</sup> and the FNIRHS<sup>15</sup> included questions on diabetes and its treatment. The APS was a survey of all self-identified First Nations, Inuit and Metis across Canada conducted by Statistics Canada after the 1991 census. The FNIRHS had a sample size of 9870 people aged 15 years or more; when weights derived from the age and sex strata of each regional target population were applied, it provided prevalence estimates for a national target population of 199 782 people. It covered First Nations people living on reserves in all provinces (except Newfoundland) as well as the Inuit of Labrador. The age- and sex-specific prevalence rates of self-reported diabetes from these 2 sources are shown in Fig. 1, together with all-Canadian data from the 1994 National Population Health Survey.<sup>25</sup> The crude prevalence of diabetes in the FNIRHS was 8% among men and 13% among women. When age-adjusted to the Canadian population, the prevalence was 3.6 and 5.3 times higher among First Nations men and women

respectively than among Canadian men and women.

Oral glucose tolerance surveys have been conducted in a few localities. In 2 Algonquin reserves in northeastern Quebec<sup>23,26</sup> and among the Oji-Cree of Sandy Lake, in northwestern Ontario,<sup>27</sup> the prevalence reached as high as 25% among all adults and 80% among women aged 50–64 years. New cases detected by oral glucose tolerance screening account for 40% of all diabetes cases,<sup>27</sup> an indication that diagnosed cases do not represent the total burden of disease.

Increasingly, type 2 diabetes is observed in children and adolescents.<sup>28–30</sup> In the Island Lake region of northeastern Manitoba, new cases in children as young as 8 years have been identified through screening of fasting plasma glucose levels.<sup>31</sup> The prevalence among females aged 10–19 years has been reported to be 3.6%.<sup>31</sup>

Before the 1950s type 2 diabetes was rare in Aboriginal populations.<sup>32</sup> Within the past 2 decades, a rapid increase in prevalence has been documented in a few regions where there had been continuous surveillance. In the Sioux Lookout Zone of northwestern Ontario the prevalence increased by 45% over a 10-year period.<sup>33</sup> In Saskatchewan the rate doubled between 1980 and 1990.<sup>22</sup>

The public health significance of diabetes is manifested in the various long-term complications affecting the cardiovascular system, eyes, kidneys and nerves, resulting in premature death, disability and a compromised quality of life.

In the FNIRHS, 50% of the respondents with diabetes also reported having hypertension, and 26% reported having heart disease, prevalence rates that were 3.3 and 3.9, respectively, times those among the respondents without diabetes<sup>15</sup> (Fig. 2).

Analyses of data from the Manitoba database on use of health care services indicate that, compared with non-Aboriginal patients, Aboriginal patients with diabetes have higher rates of hospital separations and readmissions and longer stays, in both Winnipeg and nonurban areas.<sup>34</sup>

In Kahnawake, Que., over 60% of patients with diabetes were found to have at least one major complication.<sup>35</sup> As the duration of illness is a strong predictor of complications,<sup>6</sup> the rate of complications can be expected to rise as the age at onset decreases.<sup>28–31</sup> Among the James Bay Cree, factors associated with the presence of renal or retinal microvascular complications have included poor glycemic control and hypertriglyceridemia, in addition to duration of illness greater than 5 years.<sup>36</sup>

It has been shown nationally<sup>37</sup> and regionally<sup>38,39</sup> that Aboriginal people are at increased risk for end-stage renal disease, a substantial proportion of cases of which can be attributed to diabetes.

A high prevalence of microalbuminuria and macroalbuminuria, indicative of eventual renal failure, has been found among both insulin-using and non-insulin-using patients in southern Alberta First Nations.<sup>40</sup> They also have a high prevalence of serious and untreated diabetic retinopathy.<sup>40</sup>

Diabetes increases the susceptibility to infection. In Manitoba, Aboriginal women are admitted to hospital 5 to

**Table 1: Diabetes mellitus in the Canadian Aboriginal population: a chronology of significant recent developments**

1985	Canadian Diabetes Association produced videotape <i>Walking in Balance</i> and resource kit "Diabetes and Diabetes Education among the Native Population"
1986	National Workshop on Diabetes Research in the Canadian Native Population convened in Toronto, funded by the National Health Research and Development Program (NHRDP) of Health and Welfare Canada
1987	Medical Services Branch of Health and Welfare Canada established an education working group, which produced the "Duncan Declaration on Standards of Care and Education for Native Peoples with Diabetes"
1990	First International Conference on Diabetes and Indigenous Peoples held in Minneapolis, with strong Canadian participation; subsequent conferences held in Honolulu (1993), Winnipeg (1995) and San Diego (1997)
1991	NHRDP launched Special Competition on Diabetes in the Native Population and funded 6 research projects across the country
1992	Canadian Diabetes Advisory Board produced clinical practice guidelines with special section on Aboriginal people
1996	National Aboriginal Diabetes Association formed
1997	Health Canada initiated consultations with Aboriginal organizations to develop a national Aboriginal diabetes strategy
1999	Federal government allocated significant resources to the control of diabetes in Aboriginal people

20 times more frequently for acute pyelonephritis than non-Aboriginal women.<sup>41</sup> The higher rates are partially attributable to the greater frequency of pregnancy and diabetes among Aboriginal women.

Diabetes affects the psychosocial well-being of affected people. Those with diabetes are more likely to regard their health as poor and to experience some limitation in their daily activity<sup>15</sup> (Fig. 2).

### Causes and risk factors

Diabetes is a chronic disease with multifactorial causes involving the interactions of genetic susceptibility and environmental factors.

The Sandy Lake Study has yielded a wealth of new genetic data.<sup>42-44</sup> Systematic genome-wide scanning for diabetes susceptibility among affected sibling pairs revealed 4 markers suggestive of association with diabetes.<sup>45</sup> A new variant of the gene encoding the hepatic nuclear factor-1 $\alpha$ , believed to be unique to the Oji-Cree, was also discovered.<sup>46</sup> The S319 allele is present in 20% of diabetic subjects, twice the frequency among nondiabetic subjects. Diabetic subjects who are homozygous for S319 tend to have an earlier age at onset, a lower body mass index and a higher postchallenge plasma glucose level.<sup>46</sup>

Plasma insulin levels have not been studied extensively in Canadian populations. Among the Dogrib, who are at relatively low risk for diabetes, the mean plasma insulin level is comparable to that of people of European ancestry.<sup>47</sup> Fasting insulin levels vary according to the Gc genotype, the group-specific component that binds vitamin D, involved in the regulation of plasma insulin.<sup>48</sup>

Among Algonquins in Quebec, gestational diabetes is associated with higher serum triglyceride levels, measures of obesity and fasting insulin level.<sup>49</sup> Gestational diabetes is a strong predictor of high birth weight in the newborn,<sup>50-53</sup>

which predisposes to future diabetes. Surveys in northern Ontario and Quebec have shown that gestational diabetes may affect as many as 13% of pregnancies among Aboriginal women.<sup>51-53</sup> Among women over age 35, just under half of all pregnancies are associated with pre-existing type 2 diabetes or gestational diabetes;<sup>51</sup> this substantially increases the risk of diabetes in the next generation.

Cross-sectional surveys have tended to show an association between diabetes and hyperlipidemia and between diabetes and obesity.<sup>23,27,54</sup> Unlike half a century ago, obesity is now prevalent in many Aboriginal populations.<sup>55</sup> The obesity among Aboriginal people is predominantly of the central (or abdominal, upper-body) type, characterized by a high waist-to-hip ratio,<sup>5,23,27,56,57</sup> which is associ-

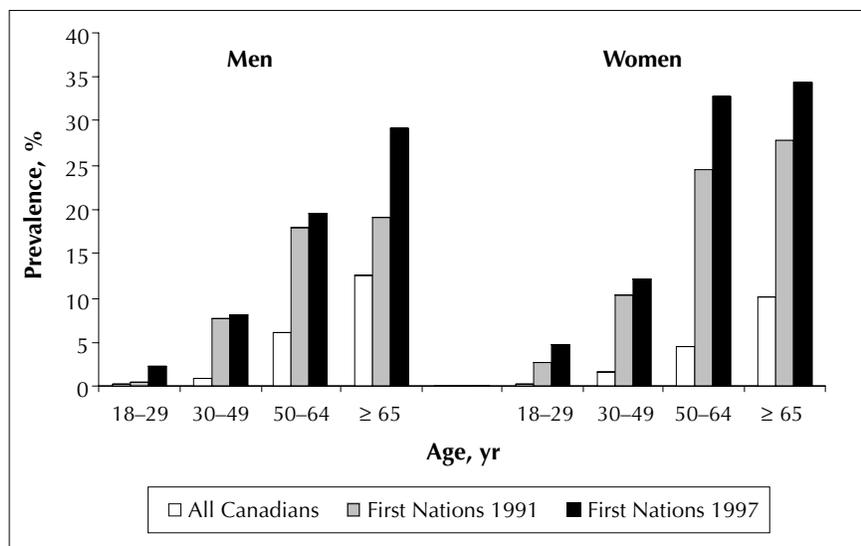


Fig. 1: Prevalence of self-reported diabetes mellitus among all Canadians (1994<sup>25</sup>) and First Nations people (1991<sup>14</sup> and 1997<sup>15</sup>).

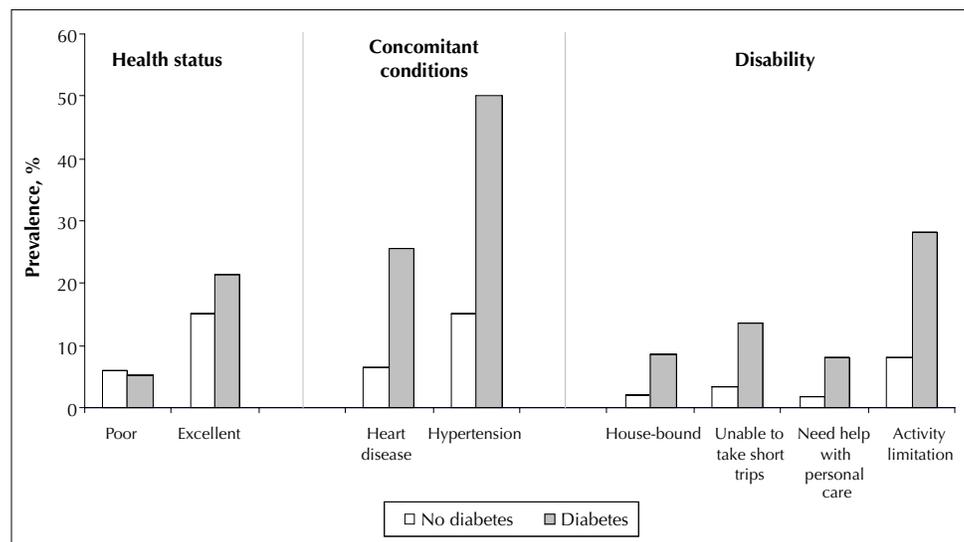


Fig. 2: Self-rated health, concomitant conditions and disability of respondents with and without diabetes in the First Nations and Inuit Regional Health Survey.<sup>15</sup>

ated with a higher risk of diabetes. Abdominal obesity among the Salishan was found to be associated with hyperinsulinemia in younger people and with elevated glycated hemoglobin concentration in older people.<sup>58</sup> The Sandy Lake Study indicated a positive association between levels of serum leptin, the genetically regulated hormone produced by adipose tissue, and measures of body fat and plasma insulin.<sup>59</sup>

An association between diabetes and dietary factors has not been demonstrated consistently. Two studies from northern Ontario and Manitoba have shown that diabetic subjects consume a higher level of proteins (adjusting for total caloric intake) than nondiabetic subjects but differ in terms of the protective effect of fibre.<sup>54,60</sup> In Sandy Lake, diabetes was found to be associated with the consumption of “junk foods” and a “fatty” method of food preparation.<sup>61</sup> Although type 1 diabetes has been reported to be associated with an impaired metabolic availability of vitamin A (retinol), a similar relation with type 2 diabetes was not found in a study among the Plains Cree of central Alberta.<sup>62</sup>

Dietary acculturation, particularly the substitution of modern for traditional food items, has been observed in many Aboriginal communities.<sup>12,63</sup> Nationally, only a minority (15%) of Aboriginal people still obtain most of their meat and fish from hunting and fishing.<sup>14</sup>

Lack of physical activity is an important risk factor.<sup>64</sup> The adoption of a more sedentary lifestyle often accompanies the transition to a modern diet. The APS showed that 54% of Aboriginal adults nationally participate in leisure-time activity.<sup>14</sup>

The “thrifty genotype” is often invoked to explain why diabetes is so prevalent today in many Aboriginal populations.<sup>65</sup> In times of food shortage, it enables the rapid production of insulin in response to rising blood glucose levels, which facilitates the storage of glucose in the form of triglycerides in fat cells. With the assurance of a continuous and ample food supply, the quick insulin trigger results in hyperinsulinemia, hyperglycemia, obesity and diabetes. Critics of the theory note that it assumes a nutritional environment in which carbohydrate intake exceeds daily energy requirements.<sup>66-68</sup> The early occupants of North America lived in an arctic or subarctic environment on a protein- and fat-based diet with little carbohydrates. Alternative pathways to provide energy (e.g., through enhanced gluconeogenesis and release of free fatty acids) may have been favoured by natural selection.

## Primary prevention and screening

The primary prevention of diabetes involves the promotion of healthy behaviours, especially achieving and maintaining a healthy body weight through increased physical activity and a balanced diet. Equally important is a supportive environment conducive to behavioural change. A variety of community-based diabetes prevention projects have begun in a few locations across Canada, most notably in

Kahnawake,<sup>69,70</sup> Sandy Lake,<sup>71,72</sup> and Okanagan First Nation in British Columbia.<sup>73,74</sup> These participatory research projects, with intervention sites in schools, stores and the community at large, respect Aboriginal culture, traditions and learning styles, and have achieved a high degree of community support and awareness. A project focusing on physical activity and directed at gestational diabetes was initiated in Saskatoon.<sup>64</sup>

Although national expert committees such as the Canadian Task Force on the Periodic Health Examination<sup>75</sup> (now the Canadian Task Force on Preventive Health Care) do not recommend screening for diabetes in the general population, the more recent Canadian clinical practice guidelines for the management of diabetes recommend testing fasting plasma glucose levels in all Canadians over age 45 once every 3 years and more frequently in high-risk groups,<sup>76</sup> which would include Aboriginal people.

## Clinical care and education

Health care professionals who serve Aboriginal people need to adapt their treatment plans and education programs to the culture and social environment of their patients. Furthermore, many First Nations are geographically remote, with little access to needed specialized services. The cultural dimensions of diabetes care were highlighted in the submission from Alethea Kewayosh, coordinator of diabetes education with the Assembly of First Nations, to the Royal Commission on Aboriginal Peoples.<sup>77</sup>

The APS revealed a high use of health care services: over 90% of diabetic people reported having seen a health care professional in the year before the survey, as compared with 75% of those without diabetes.<sup>78</sup> Over 80% of the respondents with diabetes in the FNIRHS considered their health care to be in need of improvement, requiring more staff, chronic care facilities, home care, teaching about medications, education about prevention and mental health counselling.<sup>15</sup> Diabetic respondents were less likely than nondiabetic respondents to be current smokers (50% v. 64%).<sup>15</sup> This finding suggests some success in lifestyle modification, although a prevalence of smoking of 50% is still too high.

The 1998 Canadian clinical practice guidelines make 3 recommendations specifically directed at the Aboriginal population.<sup>76</sup> These relate to the need for community-based screening and primary prevention programs and urge respect for, and sensitivity to, language and cultural issues.

The effects of a traditional lifestyle on metabolic control in patients with diabetes was investigated among the James Bay Cree in northern Quebec.<sup>79</sup> Diabetic subjects who spent 3 months in the bush did not differ from those who stayed in the village in body weight, plasma glucose level, glycated hemoglobin concentration and blood pressure. Although bush dwellers were more active physically than those who remained in the village, they also brought along large quantities of store-bought foods for sustenance.

## Cultural concepts and traditional knowledge

It is important for non-Aboriginal health care professionals to understand how Aboriginal people interpret their illness experience and respond to treatment regimens, and to respect the logic and rationality of another system of thought.

Many Aboriginal people consider diabetes an example of "white man's illness," a new, introduced disease similar to smallpox and tuberculosis in the past. The adoption of modern foods and the decline of hunting and fishing are widely believed to be the underlying causes of the epidemic.<sup>80,81</sup>

Balance is central to the Aboriginal understanding of diabetes. The concept can be used effectively in explaining how diabetes works and suggesting means to cope with the illness. Aboriginal legends can also be incorporated into teaching materials.<sup>82</sup>

The concept of obesity is culture specific.<sup>83</sup> In Sandy Lake, researchers found that 16% of the community members were satisfied with their current body shape.<sup>84</sup> Those with a higher body mass index were less satisfied with their bodies and believed themselves to be less healthy than people with a lower body mass index.

New research on Aboriginal understanding and explanation of diabetes, using qualitative methods, has been conducted in such communities as the James Bay Cree<sup>85</sup> and the Cape Breton Mi'kmaq.<sup>86</sup>

Aboriginal peoples have a long tradition of using the healing properties of plants in the environment.<sup>87</sup> Ethnobotanical research may yet reveal effective remedies. A single-blind, placebo-controlled trial of Aboriginal herbal tea in the treatment of diabetes failed to show a significant reduction in blood glucose levels.<sup>88</sup> Traditional plant beverages, regardless of their medicinal value, may offer healthful substitutes to sweetened soft drinks. Much research needs to be done to test and document the uses of indigenous plants.

## Conclusion

The epidemic of diabetes in many First Nations communities in Canada is still on the upswing, and its causes remain to be elucidated. Scattered intervention projects have been implemented, and some show promise. The health and social repercussions of the disease are considerable, and the long-term outlook remains guarded.

Diabetes is not simply a metabolic disorder that can be adequately dealt with on an individual basis in a clinic or hospital ward. Its prevention and control require community action and collaboration among Aboriginal organizations, governments, voluntary agencies and health care professionals.

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