Prevalence of gestational diabetes mellitus among James Bay Cree women in northern Quebec

Shaila Rodrigues, MS;* Elizabeth Robinson,† MD, MSc; Katherine Gray-Donald,* PhD

Abstract

Background: The prevalence of gestational diabetes mellitus has been reported to vary widely in aboriginal populations. Most of the data have come from the United States. To help determine the extent of gestational diabetes in Canada's aboriginal population, the authors assessed the prevalence in a population of Cree women in northern Quebec.

Methods: A cross-sectional study was conducted using the National Diabetes Data Group (NDDG) criteria. Information was obtained from patient charts on pregnancies between January 1995 and December 1996 among women residing in 9 Cree communities in the eastern James Bay region of northern Quebec. Women who were not Cree, had pre-existing diabetes, had spontaneous abortion or were receiving glucocorticoid treatment were excluded.

Results: Data on 654 pregnancies that met the inclusion criteria were available. Results of the screening oral glucose challenge test were available for 579 of the pregnancies; the remaining 75 were excluded. The mean gestational age at screening was 28.3 (standard deviation 2.6) weeks. The prevalence of gestational diabetes was 12.8% (74/579) (95% confidence interval [CI] 10.1%–15.5%). The prevalence in the inland communities was twice as high as that in the coastal communities (18.0% v. 9.3%, $p = 0.002$). Women with gestational diabetes or impaired glucose tolerance tended to be older, have had more pregnancies, weigh more before pregnancy and have heavier babies than those with a normal glycemic status.

Interpretation: The prevalence of gestational diabetes among James Bay Cree women in northern Quebec is twice as high as that among women in the general North American population and the second highest reported in an aboriginal group worldwide.

Gestational diabetes mellitus has been defined as "carbohydrate intolerance of variable severity with onset or first recognition during pregnancy."[1] It increases not only the risk of infant macrosomatia (birth weight greater than 4000 g), hypoglycemia, birth trauma and cesarean section[2] but also the risk of subsequent type 2 diabetes in the mother[3] and her offspring.[4] However, there is no consensus regarding universality, method, criteria or clinical utility for the screening and diagnosis of gestational diabetes.[5,6] Although the Society of Obstetricians and Gynaecologists of Canada recommends universal screening for gestational diabetes between 24 and 28 weeks' gestation,[7] the American Diabetes Association,[8] the American College of Obstetricians and Gynecologists[9] and the Canadian Task Force on the Periodic Health Examination (now the Canadian Task Force on Preventive Health Care)[10] recommend selective screening based on the presence of certain risk factors.

Studies from the United States indicate that the prevalence of gestational diabetes in aboriginal populations varies widely,[11–16] from 3.2% among Tohono O'odham Indian women in southern Arizona[11] to 14.5% among Zuni Indian women in western New Mexico.[16] Only one previously published study used standardized criteria to determine the prevalence of gestational diabetes in a native population in Canada.[17] It is important to assess accurately the prevalence of gestational diabetes

Evidence

Études

From *the School of Dietetics and Human Nutrition, McGill University, Montreal, Que., and †the Public Health Module — Cree Region, Montreal General Hospital, Montreal, Que.

This article has been peer reviewed.

CMAJ 1999;160:1293-7

See related articles pages 1299 and 1315

in Canada's aboriginal population to give a better understanding of the importance of the problem. Therefore, we decided to determine the prevalence of gestational diabetes among Cree women in the eastern James Bay region of northern Quebec

Methods

About 11 000 Cree people inhabit 5 coastal and 4 inland communities in the eastern James Bay region of northern Quebec. Primary health care is provided by physicians and nurses at local clinics (one in each community). Most pregnancies are delivered in Val-d'Or, Chibougamou or Chisasibi, Que.

We identified all 637 births in Quebec between January 1995 and December 1996 in the 9 Cree communities from a birth registry maintained by the Public Health Module–Cree Region. Prospective information was available for an additional 66 pregnancies delivered in 1997; these were among participants in a nutrition intervention study that ended in June 1997. We therefore had information on 703 pregnancies in 668 women. We excluded women who were not Cree, had pre-existing diabetes, had spontaneous abortion or received glucocorticoid treatment during pregnancy. The presence of pre-existing diabetes was determined on the basis of the physician's diagnosis of type 1 or type 2 diabetes recorded in the women's medical charts before the index pregnancy.

In all Cree women a 1-hour 50-g oral glucose challenge test was administered in the non-fasting state toward the end of the second trimester, as per the recommendations of the National Diabetes Data Group (NDDG) for gestational diabetes screening.[18] Women with a positive result (plasma glucose of 7.8 mmol/L or greater) are given a 3-hour 100-g oral glucose tolerance test after an overnight fast. For women at high risk for gestational diabetes, screening may be done during the first trimester; those with a negative result undergo a repeat screening test or an oral glucose tolerance test at about 24 weeks' gestation. A fasting plasma glucose test is also done during the first trimester for most women. Blood samples from women in the coastal communities are generally sent for laboratory processing to Chisasibi, Que., and those from the inland communities to Chibougamou, Que. We obtained the laboratory results from the patients' medical and laboratory records.

We determined the prevalence of gestational diabetes in the study population strictly according to the NDDG criteria.[18] For cases in which a glucose metre was used for a 50-g screen, a threshold of 7.2 mmol/L for capillary blood was used instead of 7.8 mmol/L to indicate a positive screen test result.[19] In the group of women who had a positive screen test result but no or incomplete information on the oral glucose tolerance test, we used the positive predictive value of the screen test to estimate the number cases of gestational diabetes. Impaired glucose tolerance was defined as 1 abnormal plasma glucose value on the 3-hour 100-g oral glucose tolerance test.[20]

We obtained information from the patient charts on maternal age, weight before pregnancy, height, parity, weight during pregnancy and birth weight. For the participants in the nutrition intervention study, height was measured by dietitians and weight before pregnancy was self-reported by the women. In the chart review, we used the self-reported weight before pregnancy only if it was within 5 kg of the pregnancy weight up to 10 weeks' gestation or within 7 kg of the weight at 10 to 14 weeks' gestation (if available). If the weight before pregnancy was unavailable, the weight recorded at the first prenatal visit (if held at or before 14 weeks' gestation) was used. Gestational age was determined on the basis of the woman's last normal menstrual period if it coincided within 1 week of the date determined by ultrasound done between 16 and 20 weeks' gestation;[21] otherwise we used the ultrasound estimates. We included the birth weights of the 604 term infants (delivered at 37 or more weeks).

The study was approved by the Cree Board of Health and Social Services of James Bay. Ethical approval was obtained from the Human Ethics Review Board of Macdonald Campus, McGill University. Informed consent was also obtained from participants in the intervention study.

The χ^2 test was used to determine differences in prevalence of gestational diabetes between the inland and coastal communities. Student's independent *t*-test was used to determine differences in maternal and infant characteristics between women who were and were not screened for gestational diabetes. Tukey's method was used for multiple comparisons between women with normal, abnormal and uncertain (positive screen test result but no or incomplete glucose tolerance test result) glycemic status in a one-way analysis of variance. Level of significance was set at a p value of less than 0.05.

Results

Of the 703 pregnancies during the study period 49 were excluded: 7 because the charts could not be located and 42 because they did not meet the inclusion criteria (pre-existing diabetes 12, spontaneous abortion 5, non-native status 22 and glucocorticoid treatment 3). Data for 654 eligible pregnancies were thus available.

The median age of the women was 23 (range 14 to 43) years. Of the 654 pregnancies, 202 (30.9%) were in nulliparous women, 164 (25.1%) in primiparous, 255 (39.0%) in multiparous and 33 (5.0%) in grand-multiparous women (5 or more pregnancies). The weight before pregnancy and the height were not recorded in the charts of many women. The mean weight before pregnancy was 80.9 (standard deviation [SD] 18.2) kg (n = 417). The mean body mass index (BMI) before pregnancy was 30.4 (SD 6.7) (n = 275); a BMI of more than 29 was observed in 153 (55.6%) of the pregnancies.

The results of the screening oral glucose challenge test and the oral glucose tolerance test are summarized in Fig. 1. Screen test results after 22 weeks' gestation were available for 534 of the pregnancies. The mean gestational age at screening was 28.3 (SD 2.6) weeks. The median plasma glucose level was 7.2 (range 2.9–18.5) mmol/L. Of the 534 pregnancies 199 (37.3%) had a positive screen test result; the oral glucose tolerance test was completed for 123 (61.8%) of these pregnancies. Gestational diabetes was found in 32 (26.0%) of these 123 pregnancies, impaired glucose tolerance in 24 (19.5%) and normal glycemic status in 67 (54.5%).

For the remaining 76 pregnancies with a positive screen test result, the charts contained no (n = 71) or incomplete (n = 5) information on the oral glucose tolerance test. Reasons for no information were patient refusal or missed laboratory appointments, physician diagnosis of gestational diabetes on the basis of the positive screen value, missing glucose tolerance test results from the patient records or vomiting after the test solution was given. Using the positive predictive

value of the screen test, we estimated that 19.8 (26.0% × 76) of these 76 pregnancies would have had a positive test result for gestational diabetes had the oral glucose tolerance test been performed. Of the 335 pregnancies with a normal screen test result, an oral glucose tolerance test was conducted in 18 cases because of a clinical indication; gestational diabetes was detected in 3 of these, impaired glucose tolerance in 3 and normal glycemic status in 12.

The remaining 120 pregnancies not screened by the standard protocol included 6 for which gestational diabetes was diagnosed during the first trimester, 33 for which the oral glucose tolerance test was done directly, 3 for which screen test results were not in the woman's chart but the woman was transferred out of the community for management of the gestational diabetes, 3 with a capillary screen and 75 with no screen values (Fig. 1). The last group of 75 were excluded from our estimation of the prevalence of gestational diabetes because no assumptions could be made regarding the glycemic status. Common reasons for no screen values were patient absence at laboratory appointments or no prenatal care.

The estimated prevalence of gestational diabetes in the study population over the 2-year period was 12.8% (74/579) (95% CI 10.1%–15.5%). The prevalence was significantly higher in the inland communities than in the coastal communities (18.0% v. 9.3%, p = 0.002). The prevalence of pre-existing diabetes was 1.8% (12/674) (95% CI 0.8%–2.8%); to calculate this estimate, we ex-

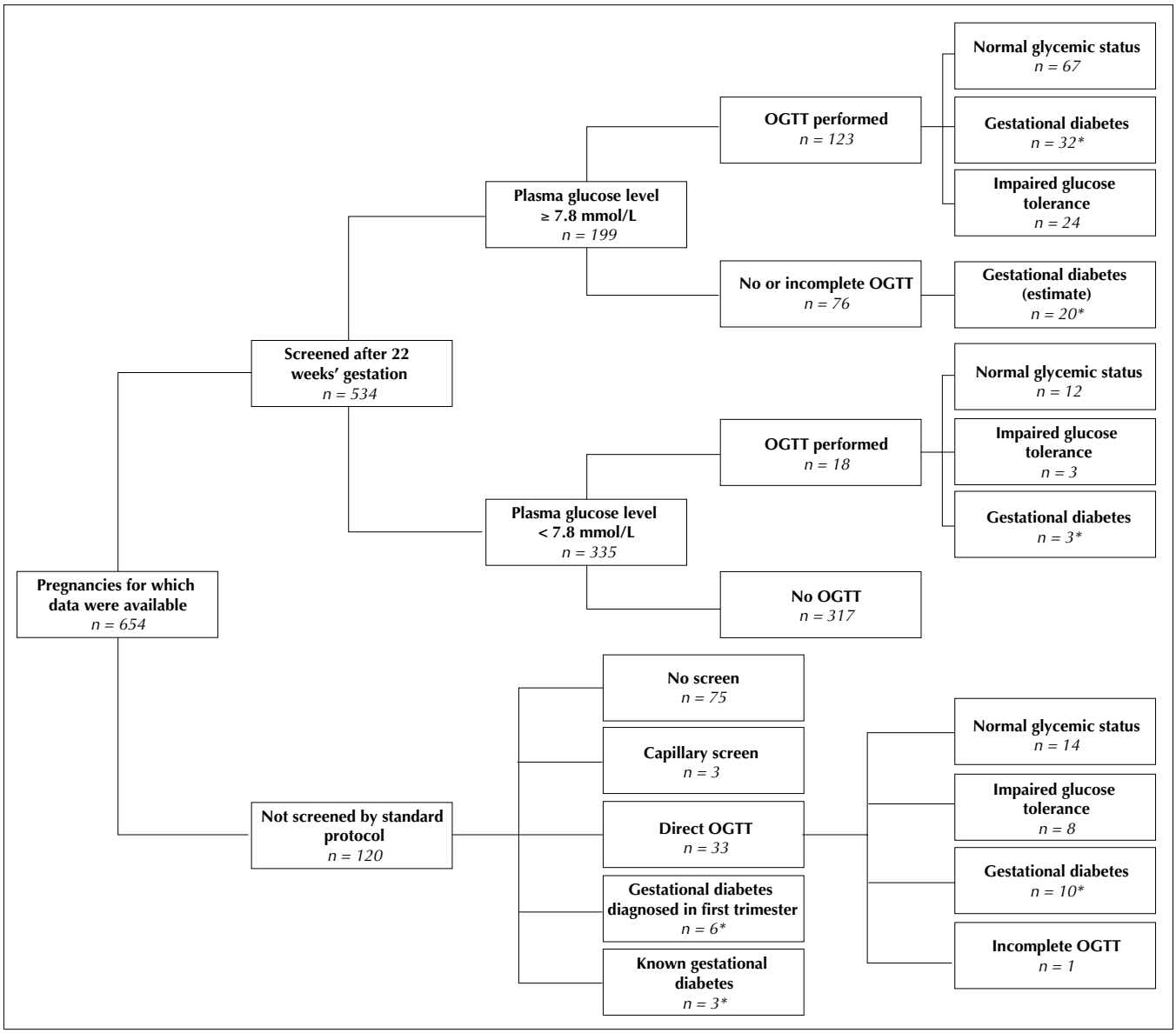

Fig. 1: Results of screening for gestational diabetes among Cree women in the eastern James Bay region of northern Quebec. *Numbers marked with an astrisk were used to calculate the prevalence of gestational diabetes in the study population: (30 + 20 + 3 + 10 + 6 + 3) ÷ 579 = 74/574 = 12.8% (95% confidence interval 10.1%–15.5%).

cluded from the denominator women without charts (n = 7) and those who were not Cree (n = 22) from the 703 pregnancies during the study period.

The mean maternal age, parity, body weight before pregnancy and infant birth weight by screen test result are presented in Table 1. The women found to have gestational diabetes or impaired glucose tolerance and those with a positive screen test result but no or incomplete information on the glucose tolerance test were older and heavier than the women with normal glycemic status. The women with gestational diabetes or impaired glucose tolerance had had more pregnancies and had heavier babies than the women with normal glycemic status; the women with a positive screen test result but no or incomplete information on the glucose tolerance test had parity and birth weight values that fell between the 2 groups. A similar trend was noted when women with impaired glucose tolerance were pooled with those who had normal glycemic status. The mean age, parity, weight before pregnancy and infant birth weight of those screened (n = 579) compared with those not screened (n = 75) for gestational diabetes were similar (Table 1); this indicated little risk of bias by not having screen test results for the 75 women.

Interpretation

The prevalence of gestational diabetes among Cree women in the eastern James Bay region of northern Quebec (12.8%) was at least twice as high as that reported in the general North American population (3%–5%).[22,23] In a recent Canadian study the prevalence among Cree and Ojibwa women of northwestern Ontario was found to be 8.7% (110/1263) according to the NDDG criteria.[17] Earlier Canadian studies used self-reported data to determine the prevalence of gestational diabetes in some native groups and found it to range from 2% in the Pacific region to 16% in Quebec.[24,25] The accuracy of our estimate is enhanced in 2 ways. First, we had data for 88.5% (579/654) of all eligible Cree women over the study period. Second, gestational diabetes was diagnosed strictly in accordance with the NDDG criteria.[18] Our results support those from other studies showing that women with gestational diabetes were more likely to be older, to have had more pregnancies, to weigh more before pregnancy[17,26,27] and to deliver heavier babies[28] than women without gestational diabetes. Our finding that the prevalence of gestational diabetes was twice as high in the inland (southern) communities as in the coastal (northern) communities may indicate lifestyle differences based on proximity to urban centres. This is supported by reports of a north–south gradient for diabetes prevalence in the same population[29] and in other native populations.[30]

Previously reported prevalence rates of gestational diabetes in native populations in North America (3.2%–14.5%)[11–16] may be underestimated, because women who had a positive screen test result but did not have an oral glucose tolerance test appear to have been classified as having normal glycemic status. For comparison purposes, we used the positive predictive value of the screen test, where available, to estimate the number of cases of gestational diabetes in each of these studies. The proportion was available for Navajo women (20%),[12] Yup'ik Eskimo women (22%)[13] and Chippewa women (25%);[15] these figures are comparable to the 26% obtained in our study. The use of these proportions to estimate potential cases of gestational diabetes among women who did not undergo the glucose tolerance test increased the prevalence estimate from 9.3% to 12.8% among the Cree in our study, from 4.3% to 5.7% among the Navajo women, from 5.8% to 6.6% among the Yup'ik Eskimo women and from 5.8% to 7% among the Chippewa women.

The prevalence of gestational diabetes among Pima women using the NDDG criteria was determined to be only 1.6%,[14] but the prevalence of pre-existing diabetes was 6.3% (95% CI 3.0%–9.6%),[31] as compared with 1.8%

Table 1: Characteristics of James Bay Cree women of northern Quebec who were screened and those who were not screened for gestational diabetes

	Screened				
Characteristic	Normal glycemic status	Gestational diabetes or impaired glucose tolerance	Positive screen, no OGTT	Total	Not screened
Mean maternal age (and SD), yr	23.1 (5.1)* *n = 413*	27.4 (6.2)† *n = 89*	25.6 (6.1)† *n = 77*	24.0 (5.7) *n = 579*	24.1 (5.6) *n = 75*
Mean parity (and SD)	1.4 (1.4)* *n = 412*	2.0 (1.9)† *n = 89*	1.8 (1.6)*† *n = 77*	1.6 (1.6) *n = 578*	1.6 (1.6) *n = 75*
Mean weight before pregnancy (and SD), kg	78.9 (18.5)* *n = 261*	84.8 (18.6)† *n = 67*	86.4 (13.5)† *n = 47*	80.9 (18.2) *n = 375*	79.9 (18.9) *n = 42*
Mean birth weight of term infants (and SD), g	3800 (505)* *n* = 394	4012 (532)† *n = 86*	3851 (476)*† *n = 67*	3839 (510) *n = 547*	3835 (459) *n = 57*

Note: SD = standard deviation, OGTT = oral glucose tolerance test.
*For the 3 subgroups of screened women, different symbols indicate statistically significant differences in means ($p < 0.05$).

(95% CI 0.8%–2.8%) in our study. One explanation may be that screening for diabetes before pregnancy was probably more intensive among the Pima women than among the Cree women in our study, which would lead to more cases of diabetes being detected before pregnancy. Alternatively, because of the different genetic makeup and environmental and lifestyle factors of the Cree, a low prevalence of pre-existing diabetes may be a true phenomenon; a low prevalence (3.2%) was also noted among the Cree and Ojibwa women of Ontario.[18]

A limitation of our study was that no screening for gestational diabetes was done in 75 of the pregnancies. However, there is no reason to believe that these women were at higher or lower risk for gestational diabetes than those who were screened, because they were of similar age, parity and weight before pregnancy. Also, for 76 of the pregnancies with a positive screen test result, there was no or incomplete information on the oral glucose tolerance test; we instead used the positive predictive value of the screen test to estimate the number of cases of gestational diabetes in this group.

In conclusion, Cree women in the eastern James Bay region of northern Quebec are at higher risk for gestational diabetes than the general North American population. They have the second highest prevalence of gestational diabetes reported in an aboriginal group worldwide. The high rate in this Cree population is of concern, because type 2 diabetes may subsequently develop in about 60% of the women with gestational diabetes.[3] Whether this reflects a greater genetic propensity for diabetes or an elevated level of risk factors for gestational diabetes in certain native populations remains to be determined.

We thank the Cree Board of Health and Social Services of James Bay and the Cree Nation Councils in the 4 intervention communities for permission to conduct the study. We also thank all health personnel in the 9 communities of James Bay for assistance with the project. In particular, we thank Kinga David, Aileen Collier, Helen Smeja, Lucie Leclerc, Emily Bobbish-Rondeau, Pauline Langdon, Nellie Bobbish, Pauline Bobbish, Irene Mistacheesick, Lillian Stewart, Nathalie Gallant, Annie Bosum, Jane Loon, Helen Iserhoff, Beatrice Petawabano, Luce Bourassa, Mary Rabbitskin, Christine Longchap, Rita Mianscum, Paul Linton, Emily Gull and Harriet Charles. Finally, we thank the study participants, who made this project possible.

This study was supported by grant 6605–4190–76 from the National Health Research and Development Programme.

Competing interests: None declared.

References

1. Metzger BE, and the Organizing Committee. Summary and recommendations of the Third International Workshop-Conference on Gestational Diabetes Mellitus. *Diabetes* 1991;40(2):197-201.
2. Coustan DR, Carpenter MW. Detection and treatment of gestational diabetes. *Clin Obstet Gynecol* 1985;28:507-15.
3. Mestman JH. Follow up studies in women with gestational diabetes mellitus. The experience at LAC/USC Medical Centre. In: Weiss DA, Coustan DR, editors. *Gestational diabetes*. New York: Springer-Verlag; 1987. p. 191-8.
4. Pettitt DJ, Bennett PH, Saad MF, Charles MA, Nelson RG, Knowler WC. Abnormal glucose tolerance during pregnancy in Pima Indian women. Long term effects on offspring. *Diabetes* 1991;40(Suppl 2):126-30.
5. Thompson DM. Controversies in gestational diabetes. *J Soc Obstet Gynaecol Can* 1996;18:765-71.
6. Okun N, Verma A, Demianczuk N. Gestational diabetes mellitus. Unresolved issues and future directions. *Can Fam Physician* 1997;43:88-93.
7. *Routine screening for gestational diabetes mellitus in pregnancy* [Society of Obstetricians and Gynaecologists of Canada Committee Opinions]. Available: www.sogc.medical.org/sogc_docs/public/guidelines/screen.htm
8. Report of the Expert Committee on the diagnosis and classification of diabetes mellitus. *Diabetes Care* 1997;20(7):1183-97.
9. *Diabetes and pregnancy*. Washington: American College of Obstetricians and Gynecologists; 1994. Technical bulletin no 200.
10. Canadian Task Force on the Periodic Health Examination. Periodic Health Examination 1992 update: 1. Screening for gestational diabetes mellitus. *CMAJ* 1992;147:435-43.
11. Livingston RC, Bachman-Carter K, Frank C, Mason WB. Diabetes mellitus in Tohono O'odham pregnancies. *Diabetes Care* 1993;16(1):318-21.
12. Sugarman JR. Prevalence of gestational diabetes in a Navajo Indian community. *West J Med* 1989;150:548-51.
13. Murphy NJ, Bulkow LR, Schraer CD, Lanier AP. Prevalence of diabetes mellitus in pregnancy among Yup'ik Eskimos, 1987-1988. *Diabetes Care* 1993;16(1):315-7.
14. Pettitt DJ, Bennett PH, Hanson RL, Narayan KM, Knowler WC. Comparison of World Health Organization and National Diabetes Data Group procedures to detect abnormalities of glucose tolerance during pregnancy. *Diabetes Care* 1994;17(11):1264-8.
15. Rith-Najaran SJ, Ness FK, Faulhaber T, Gohdes DM. Screening and diagnosis for gestational diabetes mellitus among Chippewa women in northern Minnesota. *Minn Med* 1996;79:21-5.
16. Benjamin E, Winters D, Mayfield J, Gohdes D. Diabetes in pregnancy in Zuni Indian women. Prevalence and subsequent development of clinical diabetes after gestational diabetes. *Diabetes Care* 1993;16(9):1231-5.
17. Harris SB, Caulfield LE, Sugamori ME, Whalen EA, Henning B. The epidemiology of diabetes in pregnant native Canadians. *Diabetes Care* 1997; 20(9):1422-5.
18. National Diabetes Data Group. Classification and diagnosis of diabetes mellitus and other categories of glucose intolerance. *Diabetes* 1979;28:1039-57.
19. Carr SR, Slocum J, Tefft L, Haydon B, Carpenter M. Precision of office-based blood glucose meters in screening for gestational diabetes. *Am J Obstet Gynecol* 1995;173:1267-72.
20. Lindsay M, Graves W, Klein L. The relationship of one abnormal glucose tolerance test value and pregnancy complications. *Obstet Gynecol* 1989;73:103-6.
21. Kramer MS, McLean FH, Boyd ME, Usher RH. The validity of gestational age estimation by menstrual dating in term, preterm and postterm gestations. *JAMA* 1989;261:2329-30.
22. Sermer M, Naylor S, Gare DJ, Kenshole AB, Ritchie JWK, Farine D, et al. Impact of increasing carbohydrate intolerance on maternal-fetal outcomes in 3637 women without gestational diabetes. *Am J Obstet Gynecol* 1995;173:146-56.
23. Magee S, Walden CE, Benedetti TJ, Knopp RH. Influence of diagnostic criteria on the incidence of gestational diabetes and perinatal morbidity. *JAMA* 1993;269:609-15.
24. Langner NR, Steckle JM. National database on breastfeeding among Indian and Inuit women: Canada 1988. *Circumpolar Health* 1990;563-5.
25. Dyck RF, Tan L, Hoeppner VH. Body mass index, gestational diabetes and diabetes mellitus in three northern Saskatchewan aboriginal communities. *Chronic Dis Can* 1995;16(1):24-6.
26. Berkowitz GS, Lapinski RH, Wein R, Lee D. Race/ethnicity and other risk factors for gestational diabetes. *Am J Epidemiol* 1992;135:965-73.
27. Dooley SL, Metzger BE, Cho NH. Gestational diabetes mellitus. Influence of race on disease prevalence and perinatal outcome in a U.S population. *Diabetes* 1991;40(Suppl 2):25-9.
28. Caulfield LE, Harris SB, Whalen EA, Sugamori ME. Maternal nutritional status, diabetes and risk of macrosomia among native Canadian women. *Early Hum Dev* 1998;50:293-303.
29. Brassard P, Robinson E, Lavallee C. Prevalence of diabetes mellitus among the James Bay Cree of northern Quebec. *CMAJ* 1993;149(3):303-7.
30. Young TK, Szathmary EJE, Evers S, Wheatley B. Geographical distribution of diabetes among the native population of Canada: a national survey. *Soc Sci Med* 1990;31(2):129-9.
31. Pettitt DJ, Knowler WC, Baird HR, Bennett PH. Gestational diabetes: infant and maternal complications of pregnancy in relation to third-trimester glucose tolerance in the Pima Indians. *Diabetes Care* 1980;3(3):458-64.

Reprint requests to: *Dr. Katherine Gray-Donald, School of Dietetics and Human Nutrition, Macdonald Campus, McGill University, 21–111 Lakeshore Rd., Ste-Anne-de-Bellevue QC H9X 3V9; fax 514 398-7739; gray@agradm.lan.mcgill.ca*