Incidence and Prevalence of Type 2 Diabetes in the First Nation Community of Kahnawá:ke, Quebec, Canada, 1986-2003

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ABSTRACT

Background: Type 2 diabetes is an increasing global health concern, most notably for Aboriginal peoples living in Canada among whom prevalence rates are 3 to 5 times those of the general population. The objective of this study is to determine the incidence and prevalence of type 2 diabetes among adults living in a First Nation community from 1986 to 2003.

Methods: Kahnawá:ke is a Kanien'kehá:ka (Mohawk) community in Quebec, Canada. Numerators for incident and prevalent cases were derived from the community hospital Diabetes Registry. Denominators were derived from population distributions provided to Kahnawá:ke by Indian and Northern Affairs Canada. Rates were standardized to 2000/01 Canadian population.

Results: From 1986-88 to 2001-03, incidence rates per 1000 for those 18 years and over decreased from 8.8 to 7.0 in males, and 8.8 to 5.2 in females. Prevalence rates increased from 6.0% to 8.4% in males and 6.4% to 7.1% in females. The prevalence rate among Kahnawá:ke men aged 45-64 years was 14%, twice the corresponding rate among Canadian men. Male to female ratios for both incidence and prevalence rates were above 1.0.

Discussion: Kahnawá:ke incidence rates are much lower than those of First Nation peoples of Manitoba. Kahnawá:ke prevalence rates are midway between national Aboriginal and general Canadian populations. Kahnawá:ke incidence rates and gender ratios are closer to those of the Canadian population. The results highlight the variations of type 2 diabetes between individual communities, and may reflect Kahnawá:ke's socio-economic status, ongoing diabetes education, clinical care and diabetes primary prevention efforts.

MeSH terms: Type 2 diabetes mellitus; incidence; prevalence; Indians: North American

La traduction du résumé se trouve à la fin de l'article.

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Incidence and prevalence of type 2 diabetes are increasing and the average age of onset is decreasing worldwide.¹⁻⁵ For Aboriginal peoples* in Canada, the age- and sex-adjusted prevalence of type 2 diabetes is three to five times higher compared to the general population,^{6,7} and the only prior incidence study documented a high incidence of type 2 diabetes.⁸

Kateri Memorial Hospital Centre (KMHC) is the largest health care facility in Kahnawá:ke, a Kanien'kehá:ka (Mohawk) community (population 7,153 in 2001) located 15 kilometres southwest of Montreal. In the mid-1980s, studies documented a high prevalence of Type 2 diabetes and associated macro-vascular complications in the community.⁹⁻¹¹

Resulting increased awareness of diabetes from these studies^{12,13} prompted development and implementation of planned diabetes primary and secondary prevention efforts.^{14,15} Persons with diabetes (type 1, 2, or gestational) or pre-diabetes are routinely offered referral to the Diabetes Nurse Educator who, starting in 1985, has maintained a Diabetes Registry that includes name, gender, date of birth, type of diabetes or pre-diabetes, and date of diagnosis. Using the Diabetes Registry, this descriptive study was undertaken to document the incidence and prevalence of diabetes in Kahnawá:ke from 1986 to 2003, compare incidence in Kahnawá:ke with another Aboriginal diabetes incidence study in Canada, and to compare prevalence with previous Canadian and Kahnawá:ke studies.⁹

METHODS

Case ascertainment

The cases are patients listed on the KMHC Diabetes Registry who met inclusion criteria: Kahnawá:ke community members, aged 18 years and over, and diagnosed with type 2 diabetes according to national guidelines. The KMHC Diabetes Registry was computerized in 2004, when the hospital charts of all 694 individuals entered onto the registry were reviewed for date of birth, date of diagnosis, gender, and age of death when appropriate.

* Aboriginal people include those of First Nation, Inuit and Métis heritage.

TABLE I

Number of Cases, Average Age of Diagnosis, and Incidence Rates of Type 2 Diabetes in the Mohawk Community of Kahnawá:ke, Ages 18 and Over, by Three-year Intervals, per 1000 Population, 1986-2003*

Year Interval	Age Groups				Total Cases	Mean (SD) Age in Years at Diagnosis	Range in Years	Crude Incidence Rate	Standardized Incidence Rate [95% CI]	Male to Female Incidence Rate Ratio
	18-44	45-64	65-74	75+						
All										
1986-1988	14	51	19	6	90	56.9 (12.3)	27-87	4.8	8.7 [7.0,10.7]	1.0
1989-1991	23	39	17	4	83	53.8 (12.8)	22-84	3.6	7.1 [5.6,8.8]	1.1
1992-1994	17	26	8	2	53	52.3 (13.0)	27-85	1.9	4.3 [3.2,5.7]	1.8
1995-1997	13	31	8	1	53	54.0 (11.5)	25-88	1.8	4.3 [3.2,5.6]	1.5
1998-2000	17	44	12	6	79	55.4 (11.8)	26-79	2.8	5.8 [4.6,7.3]	1.6
2001-2003	22	50	9	3	84	52.0 (11.5)	27-80	2.5	5.9 [4.7,7.4]	1.3
Male										
1986-1988	7	21	12	1	41	57.6 (12.8)	27-87	5.3	8.8 [6.3,12.0]	
1989-1991	16	16	8	1	41	50.1 (13.4)	22-75	3.7	7.4 [5.3,10.1]	
1992-1994	13	16	3	0	32	47.9 (10.9)	27-74	2.1	5.8 [3.9,8.2]	
1995-1997	9	15	6	0	30	53.5 (11.3)	25-68	2.4	5.3 [3.5,7.6]	
1998-2000	9	25	8	2	44	55.5 (11.6)	26-78	3.9	7.5 [5.4,10.1]	
2001-2003	9	28	6	0	43	52.5 (9.9)	33-74	3.1	7.0 [5.0,9.4]	
Female										
1986-1988	7	30	7	5	49	56.3 (12.1)	34-85	4.4	8.8 [6.5,11.6]	
1989-1991	7	23	9	3	42	56.6 (11.6)	33-84	3.5	6.8 [4.9,9.2]	
1992-1994	4	10	5	2	21	59.1 (13.3)	40-85	1.7	3.2 [1.9,4.8]	
1995-1997	4	16	2	1	23	54.7 (11.9)	33-88	1.4	3.4 [2.2,5.1]	
1998-2000	8	19	4	4	35	55.4 (12.4)	33-79	2.1	4.6 [3.2,6.4]	
2001-2003	13	22	3	3	41	51.6 (13.0)	27-80	2.0	5.2 [3.7,7.1]	

* Standardized to 2000/01 Canada population. CI denotes confidence intervals

TABLE II

Age-specific and Standardized Prevalence of Type 2 Diabetes in the Mohawk Community of Kahnawá:ke, Ages 18 and Over, per 100 Population, 1986-2003*

Year Interval	Age Groups				Crude Prevalence Rate Age >17	Standardized Prevalence Rate [95% CI] Age >17	Male to Female Ratio
	18-44	45-64	65-74	75+			
All							
1986-1988	1.1	11.7	15.6	8.4	5.5	6.2 [5.8, 6.7]	0.9
1989-1991	1.4	12.3	18.8	7.5	6.1	6.8 [6.4, 7.3]	1.0
1992-1994	1.2	13.6	18.9	8.6	6.5	7.2 [6.8, 7.7]	1.1
1995-1997	1.2	13.0	18.4	11.3	6.7	7.1 [6.7, 7.6]	1.1
1998-2000	1.1	12.8	19.8	12.8	7.1	7.2 [6.8, 7.7]	1.2
2001-2003	1.4	12.8	22.1	13.6	7.8	7.7 [7.2, 8.1]	1.2
Male							
1986-1988	1.1	11.3	16.0	8.1	5.1	6.0 [5.4, 6.7]	
1989-1991	1.8	11.5	20.5	7.7	5.9	6.8 [6.2, 7.5]	
1992-1994	1.7	13.6	20.5	8.7	6.5	7.5 [6.8, 8.2]	
1995-1997	1.9	13.2	19.6	11.1	6.7	7.5 [6.8, 8.2]	
1998-2000	1.7	14.0	23.2	13.0	7.3	8.0 [7.4, 8.8]	
2001-2003	1.6	14.8	25.4	12.6	7.9	8.4 [7.7, 9.1]	
Female							
1986-1988	1.0	12.1	15.4	8.5	5.8	6.4 [5.8, 7.1]	
1989-1991	1.0	13.0	17.5	7.4	6.3	6.8 [6.2, 7.5]	
1992-1994	0.7	13.6	17.6	8.6	6.6	7.0 [6.4, 7.6]	
1995-1997	0.5	12.9	17.5	11.4	6.7	6.8 [6.3, 7.4]	
1998-2000	0.5	11.8	17.5	12.7	6.9	6.6 [6.1, 7.2]	
2001-2003	1.2	11.2	20.0	14.1	7.7	7.1 [6.6, 7.7]	

* Standardized to 2000/01 Canada population. CI denotes confidence intervals

Validation of KMHC Diabetes Registry

In 1999, to determine the completeness of the KMHC Diabetes Registry, 12% (n=648) of KMHC hospital charts for patients aged 15 years and over for 1985-1997 were systematically reviewed for Type 2 diabetes by Kanien'kehá:ka nurses blinded to the registry. The completeness of the Diabetes Registry (defined as the ratio of number of patients with diabetes identified by both this registry and chart review, to total number identified by chart

review), among men and women less than 50 years was 86% and 80% respectively, and 67% and 58% respectively among those 50 years and over.

Analyses of data, 1986-2003

Analyses were carried out separately for men and women, and both sexes combined. Data were grouped into four age categories (18-44, 45-64, 65-74, and 75+ years) and into six time intervals of three calendar years: 1986-88, 1989-91, 1992-94, 1995-97, 1998-2000, and 2001-03.

Numerators were derived from those who met inclusion criteria from the KMHC Diabetes Registry, and denominators from the population distribution in Kahnawá:ke for the base year of each time interval. For the incidence calculations, those already diagnosed with diabetes were removed from subsequent periods. The Kahnawá:ke population distributions were derived from on-reserve Indian Register data compiled annually by Indian and Native Affairs Canada (INAC) and provided to the Mohawk Council of Kahnawá:ke (MCK).

TABLE III

Incidence of Type 2 Diabetes in the Mohawk Community of Kahnawá:ke, Aged 18 and Over, per 1000: Comparison with Manitoba,^{8,23} and the Canadian Population³

	Incidence/1000					
	1986	1989	1992	1995	1998	2001
Kahnawá:ke men	8.8	7.4	5.8	5.3	7.5	7.0
Kahnawá:ke women	8.8	6.8	3.2	3.4	4.6	5.2
Manitoba FN men ⁸	—	15.3	—	—	21.1	—
Manitoba FN women*	—	21.9	—	—	21.5	—
Manitoba non-FN men ⁸	—	5.4	—	—	6.8	—
Manitoba non-FN women ⁸	—	4.7	—	—	5.7	—
Manitoba ²³	7.1	—	—	—	—	—
Canada ³	—	—	—	4.0	6.7	—

* Personal Communication, Dr. Chris Green, Public Health Branch, Manitoba Health, December 22, 2005.

TABLE IV

Prevalence of Type 2 Diabetes in the Mohawk Community of Kahnawá:ke, Age 18 and Over, per 100: Comparison with Manitoba First Nations⁸ and Non-First Nations Populations,²³ and the Canadian Population³

	Prevalence/100					
	1986	1989	1992	1995	1998	2001
Kahnawá:ke men	6.0	6.8	7.5	7.5	8.0	8.4
Kahnawá:ke women	6.4	6.8	7.0	6.8	6.6	7.1
Manitoba FN men ⁸	—	10.4	12.1	14.8	17.0	—
Manitoba FN women ⁸	—	18.6	20.7	23.1	24.9	—
Manitoba non-FN men ⁸	—	4.2	4.8	5.3	5.9	—
Manitoba non-FN women ⁸	—	3.7	4.3	4.8	5.4	—
Manitoba ²³	4.5	—	—	—	—	—
Canada ³	—	—	—	3.4	3.8	4.5

MCK then added those Kanien'kehá:ka not registered with INAC, but registered in the community. Direct standardization used the 2000/01 Canadian populations, and male to female ratios were calculated for incidence and prevalence. Confidence intervals were computed according to the method of Far and Feuer.¹⁶ All analyses were performed using SAS version 9.1 (SAS Institute Inc., Cary, NC). This study was approved by the KMHC Director of Professional Services, the Kahnawá:ke Schools Diabetes Prevention Project Community Advisory Board¹⁵ and McGill University Institutional Review Board.

RESULTS

The inclusion criteria identified the data of 631 persons (312 men and 319 women) available for analyses. The 63 persons excluded were diagnosed with type 1 diabetes, gestational or pre-diabetes. The study time interval spanned 18 years, with the diabetes diagnostic criteria lowered in 1998.¹⁷

Average age of onset

The average age of onset decreased by approximately 5 years for both men and women during the study period (Table I).

Incidence rates

Between 16 and 38 people were diagnosed with diabetes each year. Incidence rates per

1000 among women decreased from 8.8 to 3.2 from 1986-88 to 1992-94, and increased to 5.2 in 2001-03. Among men, the rates decreased from 8.8 to 5.3 from 1986-88 to 1995-97, and increased to 7.0 in 2001-03 (Table I).

Prevalence rates

From 1986-88 to 2001-03, the standardized prevalence rates in Kahnawá:ke increased from 6.4% to 7.1% among women, and increased from 6.0% to 8.4% among men (Table II). Age-specific prevalences were highest among individuals aged 65 to 74, with a steady increase throughout the study period (Table II), from 15.4% to 20.1% for women and from 16.0% to 25.4% for men. By the end of the study period, 14.8% of men and 11.2% of women aged 45 to 64 years had diabetes.

Ratio of men to women

The male to female ratio of the standardized incidence and prevalence rates increased throughout the study period and remained above 1.0 (Tables I and II).

DISCUSSION

This is the second incidence study for type 2 diabetes among Aboriginal peoples in Canada, and the first from an individual First Nation community. Our data suggest

a strong decline in type 2 diabetes incidence from 1986-88 to 1992-94, with little change after that period. This decline coincided with a period of community mobilization for diabetes treatment and primary prevention, including many community programs promoting health and wellness. Longstanding Kahnawá:ke programs include the KMHC Diabetes Education Program (1985),¹⁴ community dissemination of the results of early prevalence studies,⁹⁻¹¹ and the Kahnawá:ke Schools Diabetes Prevention Project (1994), which is a diabetes primary prevention project for local schools and the general community.¹⁵ We believe that these programs and initiatives plus the other multi-sector collaborations for youth and family physical and social activities have contributed to the decreasing incidence rates, particularly among women.

Settled in the 17th century, Kahnawá:ke is located close to Montreal and has a defined political, social and traditional infrastructure. Significantly, it has many years of community-operated systems: education (1967), health care (1970), youth recreation (1972), social and community services (1972) and a local court system (1979). It is a vibrant community with increasing levels of education and growing employment opportunities.¹⁸ Chandler and Lalonde¹⁹ showed lower rates of suicide in communities which have taken active steps

Appendix 1

Review of Published Prevalence Rates of Type 2 Diabetes in Aboriginal Populations of Canada, 1985-2006

Author, Year, Population, Age Range	Case Ascertainment	Prevalence Rate/100 All [Male, Female] Standard	
Young et al., 1985 ³¹ Cree/Ojibway NW Ontario and NE Manitoba, All ages	Registry (A)	Crude: 2.75 Age 45-64: 4.6 Age 64+: 9.6	
Montour & Macaulay, 1985 ⁹ Mohawk, Quebec, Ages 45-64	Registry (C)	Crude: 12.0	
Evers et al., 1987 ³⁵ Iroquois, SW Ontario, Age >4	Registry (L)	14.7	[13.9, 15.5] Canada, 1985
Young et al., 1990 ²⁹ Inuit/On-Reserve, Canada, All ages	Registry (A)	Atlantic: 8.7 Quebec: 4.8 Ontario: 7.6 Manitoba: 5.7	[6.9, 10.7] [3.0, 6.8] [6.1, 9.2] [3.8, 8.0] Canada, 1985
Brassard et al., 1993 ²⁴ Cree, NE Quebec, Age >19	Registry (L)	6.6	Canada, 1986
Fox et al., 1994 ²⁵ Ojibway, NW Ontario, All ages	Registry (C)	6.7	[4.1, 9.3] Canada, 1986
Delisle et al., 1995 ³⁶ Algonquin, SW Quebec, Ages 30-64	Community Screen with OGTT	Survey 1: [23.9, 48.6] Survey 2: [16.3, 16.3]	WHO 1950/1960
Pioro et al., 1996 ²⁶ On-Reserve, Saskatchewan, Age >19	Registry (L)	9.7	[7.2, 12.1] Saskatchewan, 1990
Harris et al., 1997 ³⁷ Oji-Cree, NW Ontario, Age >9	Community Screen with OGTT	26.1	[24.2, 28.0] Canada, 1991
Bobet, 1998 ⁶ Aboriginal, Canada, Age >14	Self-Report	10.0	[8.0, 11.0] Canada, 1995
Maberley et al., 2000 ³⁸ Cree, NW Ontario, Age >14	Registry (C, L)	13.1	Canada, 1991
Green et al., 2003 ⁸ Manitoba-Registered First Nations, Age >19	Registry (A)	21.0	[17.0, 24.9] Canada, 1991

Registry denotes physician-diagnosed cases of diabetes; data from chart reviews (C), administrative records such as those of the Medical Services Branch, Health Canada, Department of Health and Welfare, and provincial health insurance databases (A), and chronic diseases/diabetes registry or lists (L); and OGTT denotes oral glucose tolerance test.

to preserve cultural continuity, and we hypothesize that these findings may also apply to chronic diseases. Given that the determinants of health and illness are powerfully explained by socio-economic variables,^{8,20} further interpretation of the results and their close relation with national rates within a socio-economic and cultural paradigm is needed. Continued surveillance will determine if incidence rates will continue to decrease.

In 1998, Canadian guidelines lowered the diabetes diagnostic criteria from an ante cibum (AC) blood glucose level of 7.8 mm/L in 1992²¹ to 7.0 mm/L in 1998.¹⁷ This study used the diagnostic criteria from 1992 and 1998 (2003 guidelines were published in December 2003). Given the 1998 Clinical Practice Guideline changes, we expected and demonstrated a one-third step increase in numbers of incident cases after the new guidelines, as documented by Young and Mustard.²² Similar to other studies, the average age of onset has decreased for men and women^{3,4} over the study period (Table I).

In Manitoba, incidence rates per 1000 among First Nation men increased from

15.3 to 21.1 and for First Nation women remained at 21.9 and 21.5 respectively, from 1989 to 1998. These incidence rates, derived from administrative databases, were two to three times higher than those of Kahnawá:ke men and women.⁸ Comparisons with general Canadian incidence rates, derived from self-reports at the provincial³ and national levels²² as well as rates derived using administrative data,^{8,23} show that type 2 diabetes incidence rates in Kahnawá:ke are similar to those of the general Canadian population (Table III).

In Kahnawá:ke, the average male to female incidence rate ratio is higher than the corresponding Canadian ratios.³ In other Aboriginal populations, studies have documented lower male to female ratios approximating 1:2.⁸ The Kahnawá:ke ratio may be a real difference, or perhaps a higher percentage of men are tested in Kahnawá:ke due to high community awareness, and/or some other studies included women with gestational diabetes.⁶

Diabetes prevalence rates in Kahnawá:ke are approximately one and a half to two times higher than those from the general Canadian population (Table IV),³ similar

to estimates from some regional Aboriginal populations,^{24,25} but lower than province-wide and national Aboriginal estimates which report rates 3 to 5 times higher than the general Canadian population^{6,26,27} (Appendix 1). The highest prevalence rates in Kahnawá:ke were among the 65 to 74 year olds. This contrasts with findings in other Aboriginal communities where rates are higher among women under 64 years.^{6,28} For both genders combined, the age-specific prevalence rates in Kahnawá:ke were comparable to Canadian rates, with the exception of the 45-64 year category, where the rate is unchanged since 1985⁹ and twice that of Canada.³ The slightly higher standardized prevalence rates among Kahnawá:ke men may reflect the fact that the population of women over age 40 in this community is larger, and/or that more men are diagnosed with diabetes at a younger age (Table I). However, many community interventions may not reach the men because many work in construction trades outside the community, entailing less healthy lifestyles including eating out and the stress of traveling long distances.

Prevalence rates of type 2 diabetes in Aboriginal peoples have been shown to vary by cultural group, geographical location,⁶ degree of isolation^{6,29} and genetic mutation.³⁰ Rates have also been shown to vary within a defined geographical location by socio-economic factors such as income and level of education.⁶ Since the first prevalence study of type 2 diabetes in First Nations in 1985,³¹ several studies have documented the prevalence of type 2 diabetes (Appendix 1). Comparing the results is complicated by variation in the geographic and demographic coverage, and the method of case ascertainment that includes population screening, self-reports, registries of clinical data and, more recently, administrative data sets.

The limitations of this study are as follows. First, a diabetes registry of clinical case findings, instead of population-based screening, was used to determine the numerators. However, a recent study showed a low rate of undiagnosed diabetes in an Aboriginal community where clinical suspicions were also high.³² Second, the denominators were determined using INAC data. Though other methods were considered, such as matching medicare numbers with postal codes, a method used in remote and defined communities, this would have been less accurate as the postal code population would have included Aboriginal people from other communities and non-Aboriginal persons. Third, the completeness of the KMHC Diabetes Registry study suggests that the rates calculated are underestimated, especially among the older age groups. Although some community members seek health care outside KMHC, 92% and 94% of the population aged 45-64 years in 1989¹¹ and 2002 respectively, used KMHC for either full or partial care (A. Montour CCHRA(C), Manager Medical Records, KMHC, 29 March 2006). Fourth, the small number of cases of diabetes led to wide variability of some estimates, particularly the average age of diagnosis (Table I). Finally, increased awareness of diabetes in the early years may have resulted in increased medical contacts leading to misclassification of prevalent cases as incident cases, as documented in other studies,²³ and artificially increasing the apparent decline in diabetes incidence of the early time periods.

Undertaking this study increased awareness among community health profession-

als of the importance of diabetes surveillance and promoted research capacity building for community professionals as recommended by several national organizations.^{33,34} The results have been disseminated within Kahnawá:ke to increase diabetes awareness among community leadership and the general population, and to promote ongoing diabetes-specific programs in community health care planning.

This study highlights the wide variation of diabetes incidence and prevalence rates among First Nation communities and the results contribute to increasing the small amount of data currently available on Type 2 diabetes among Aboriginal Peoples in Canada.

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RÉSUMÉ

Contexte : Le diabète de type II est une préoccupation croissante partout dans le monde, mais surtout pour les Autochtones du Canada, qui affichent des taux de prévalence trois à cinq fois supérieurs à ceux de la population générale. Nous avons voulu déterminer l'incidence et la prévalence du diabète de type II chez les résidents adultes d'une communauté des Premières nations entre 1986 et 2003.

Méthode : Kahnawá:ke est une communauté kanien'kehá:ka (mohawk) du Québec, au Canada. Les numérateurs des taux d'incidence et de prévalence proviennent du registre des cas de diabète de l'hôpital communautaire. Les dénominateurs proviennent des chiffres sur la répartition de la population fournis à Kahnawá:ke par le ministère canadien des Affaires indiennes et du Nord. Les taux ont été normalisés selon la population canadienne de 2000-2001.

Résultats : De 1986-1988 à 2001-2003, les taux d'incidence pour 1 000 habitants chez les 18 ans et plus ont diminué (de 8,8 à 7 ‰ chez les hommes et de 8,8 à 5,2 ‰ chez les femmes). Les taux de prévalence ont augmenté (de 6 à 8,4 % chez les hommes et de 6,4 à 7,1 % chez les femmes). Le taux de prévalence chez les hommes de Kahnawá:ke âgés de 45 à 64 ans était de 14 %, soit le double du taux correspondant chez les hommes canadiens. Le rapport homme/femme était supérieur à 1, tant pour les taux d'incidence que pour les taux de prévalence.

Discussion : Les taux d'incidence du diabète de type II à Kahnawá:ke sont beaucoup plus faibles que chez les membres des Premières nations du Manitoba. Les taux de prévalence à Kahnawá:ke se situent à mi-chemin entre les taux nationaux pour les Autochtones et les taux dans l'ensemble de la population canadienne. Les taux d'incidence et le rapport homme/femme à Kahnawá:ke sont plus proches de ceux de la population canadienne. Ces résultats soulignent les écarts entre les taux de diabète de type II d'une communauté à l'autre et pourraient s'expliquer par le statut socioéconomique, la formation et l'information continues sur le diabète, les soins cliniques et les efforts de prévention primaire du diabète à Kahnawá:ke.

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